Analyzing the Ventral View During Prey-Capture in Molly Fish, *Cyprinodontiformes*

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Introduction

Cyprinodontiformes fishes, such as, killifishes, mollies, guppies, and other live-bearers capture prey by “picking” miniature pieces from the surface of the water. This “picking” mode of feeding requires premaxillary protrusion as a mechanism for placing the jaws close to, and around, the food item. Premaxillary protrusion confers multiple advantages for feeding and is considered a key morphological innovation in the evolution of fishes. In Cyprinodontiformes, premaxillary protrusion is used differently than most other fishes. Most fish use protrusion to help generate suction production for drawing in prey. Cyprinodontiformes, on the other hand, use the protrusion to shape the mouth into a beak-like shape, aiding in grabbing the prey in a pincer like motion (aka ‘picking’) instead of drawing the prey into the mouth. Prey capture is typically studied in the two-dimensional, lateral aspect. We know that the head and jaws expand three-dimensionally, but the ventral aspect has not been studied during picking prey capture. The purpose of this study is to examine how the ventral view looks during feeding and compare the protrusion rate with the width expansion rate.

Methodology

- Mollies (*Poecilia sphenops*) were housed in 10-gallon tanks and were trained to eat thawed bloodworms and brine shrimps from forceps.
- In order to obtain ventral view of the fish during feeding, a mirror set at a 45-degree angle was used in recording the fish in the water.
- A Fastec imaging high-speed camera was used to capture the prey capture event at 250 frames per second (4 Hz) .
- ImageJ software was used to measure the amount of jaw protrusion as well as the lateral expansion at the jaw joint starting from when the mouth opens (time zero) until it completely closes.
- Cleared and stained specimens were used in order to understand the underlying anatomy of the jaw.

Results

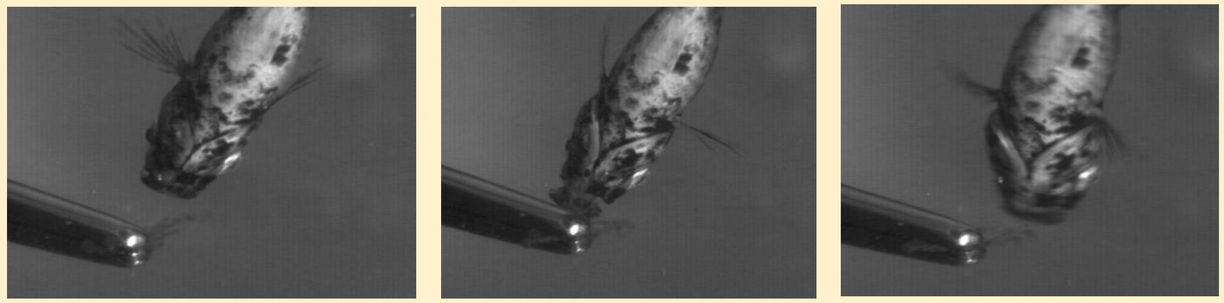


Figure 1. Pictures captured at each phase of prey capture from a white spotted molly. Frame begins at time zero with mouth closed and in resting position and then moves onto the highest peak in prey capture. The last frame is when prey capture has finished, and the mouth is back to time zero.

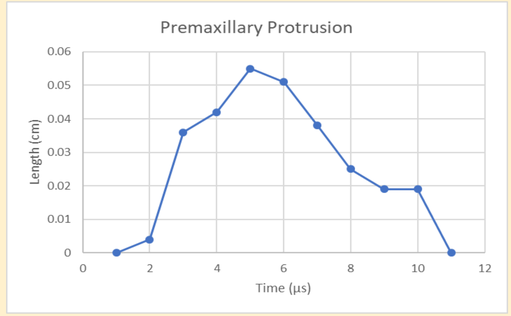


Figure 2. Shown is the graph of the premaxillary protrusion length against time at t=0. As shown in figure 1, the mouth is at the beginning of prey capture, signifying zero protrusion. The maximum level of protrusion was observed in T=5. At this point as shown in figure 1.2, the prey is captured. Protrusion levels begin decreasing once prey is in mouth and returns to time zero (Figure 1.3). The data collected was taken from a white spotted molly.

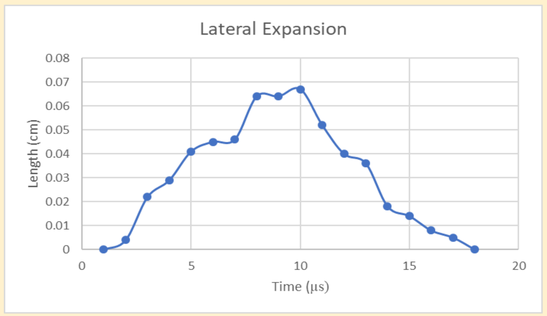
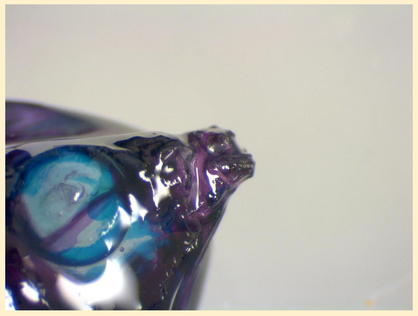
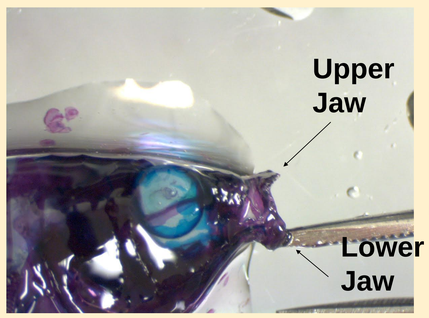


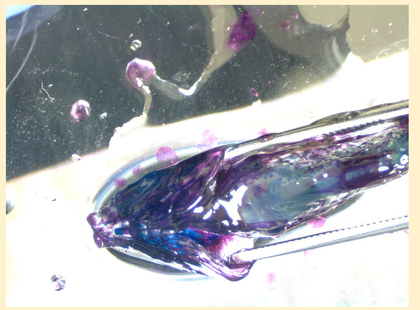
Figure 3. The graph of lateral expansion against time is shown. Just as the premaxillary protrusion graph, its noticed that the graph begins at time zero, reaches a maximum height, then back down to time zero. Lateral expansion of the bottom jaw just takes place a few seconds after the fish takes a bite. At t=5 when premaxillary protrusion is at 0.055cm, lateral expansion is at 0.040 cm. Data collected for this graph was taken from a white spotted molly.



Stained and cleared molly fish in the lateral view showing jaw at time zero.



Shown is the cleared and stained jaw of a molly fish while being held opened to show the jaw protrusion when open.



Ventral view of stained and cleared molly fish. Forceps used to show maximum lateral expansion..

Conclusion

Over the course of 8 weeks, different types of data, qualitative and quantitative, were collected. These collected data represent the relationship between premaxillary protrusion and lateral expansion. As observed (ventral view) on figure 2 and 3, premaxillary protrusion and lateral expansion are directly proportional. During the initial phase of prey capture, premaxillary protrusion and lateral expansion were observed to be smallest in length, respectively. When prey is captured, protrusion and expansion were observed to be the highest in length. The study has helped understand how protrusion and expansion look in the ventral view. Premaxillary protrusion occurs first, followed by the lateral expansion of the jaw .

Reference

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