



Functional response of protected larval delta smelt

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Background

Delta smelt (*Hypomesus transpacificus*) is a small (<10 cm) fish that is endemic to the San Francisco Estuary. Historically they were one of the most abundant fish in the estuary, but recently delta smelt populations have steeply declined. In 2010, delta smelt were listed as endangered under the California Endangered Species Act. Many factors have contributed to their low numbers, such as alterations to their habitat, predation, water diversions, and prey abundance. This study aims to better understand the feeding rate of delta smelt when given specific prey concentrations of the copepod, *Limnoithona tetraspina*. This study is part of a larger study that also used the copepod, *Pseudodiaptomus forbesi* as a prey item, in order to compare feeding rates among copepod species.

Objective

- Study the functional response of lab raised, larval delta smelt (132 dph) to determine their maximum feeding rate.



Larval stage delta smelt 132 dph
Total length: 5.0 cm

Methods

- Larval delta smelt were placed in buckets for 2 hours and given different prey densities of *L. tetraspina*.
- When feeding was terminated, fish and uneaten copepods were placed in small vials in 10% formalin.
- Uneaten copepods were counted.
- Fish stomachs and intestines were dissected to determine how many copepods each fish ingested.
- All data was then put into an excel spreadsheet to graph the feeding rate.

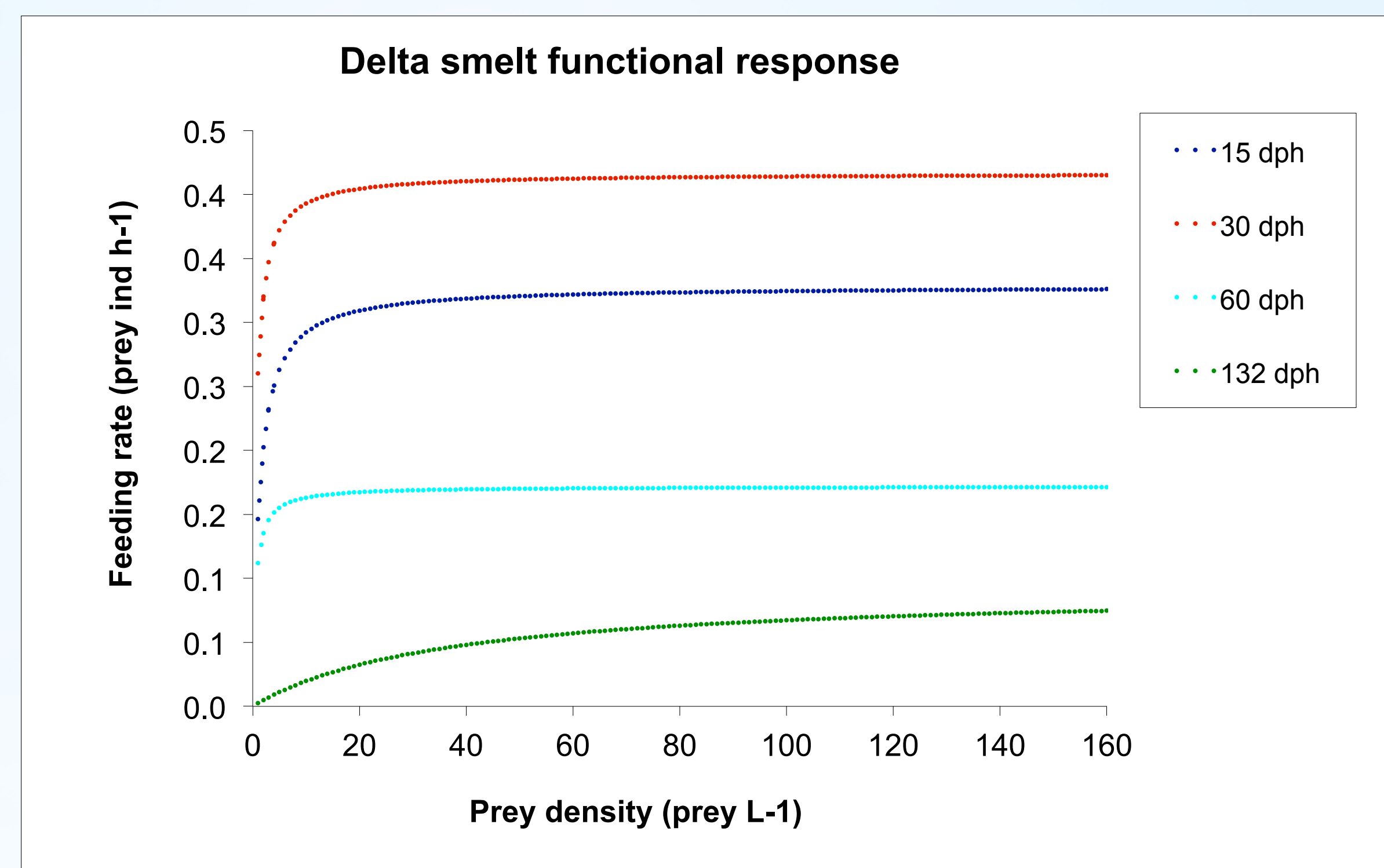


Figure 1. Feeding rates of larval delta smelt at 15 dph, 30 dph, 60 dph, and 132 dph. Prey: *L. tetraspina*

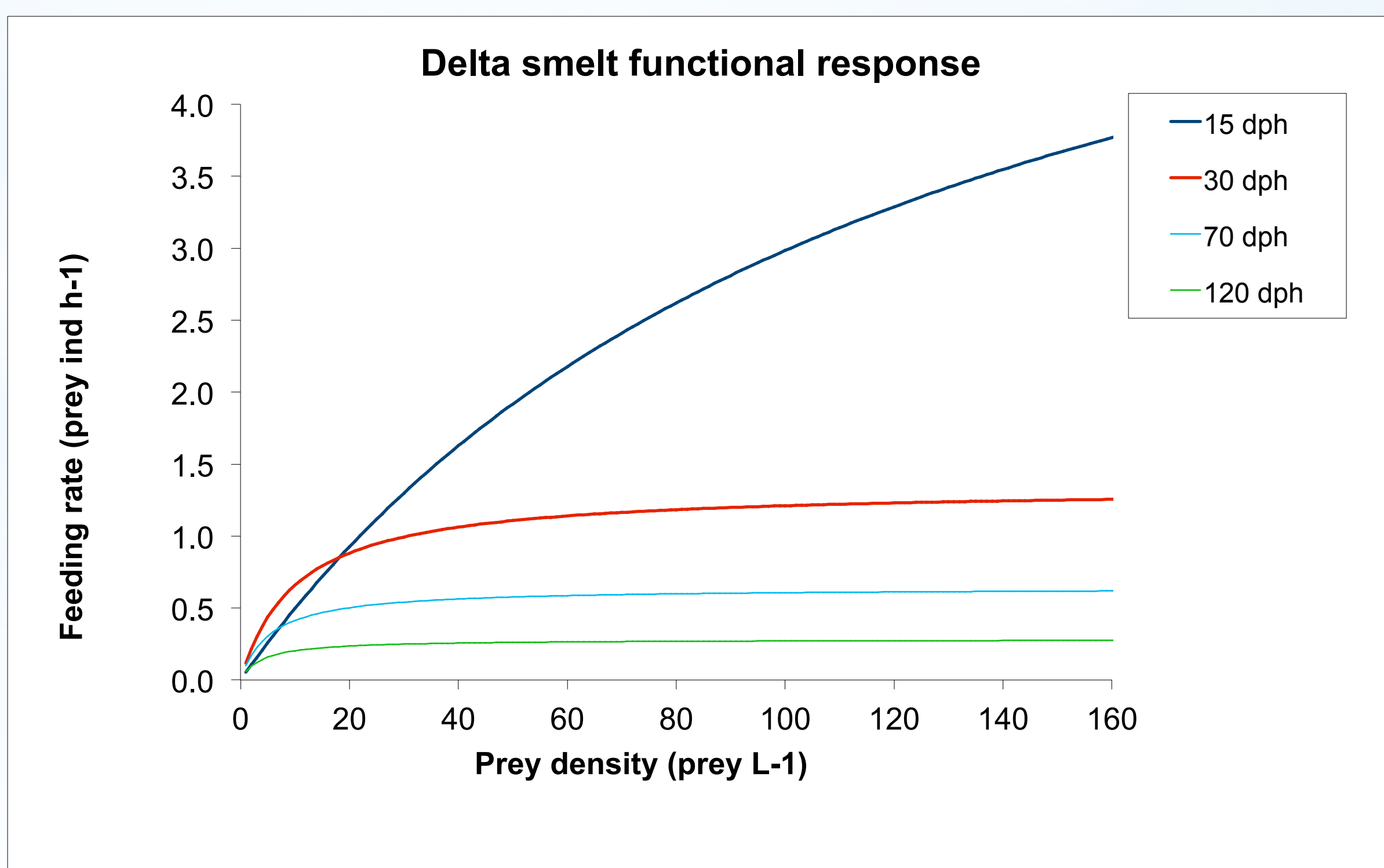


Figure 2. Feeding rates of larval stage delta smelt at 15 dph, 30 dph, 70 dph, and 120 dph. Prey: *P. forbesi*

Results

- The feeding rate of delta smelt decreases with age.
- The max feeding rate at 132 dph is less than 1 copepod per hour.
- Delta smelt had a higher feeding rate when given *P. forbesi*.

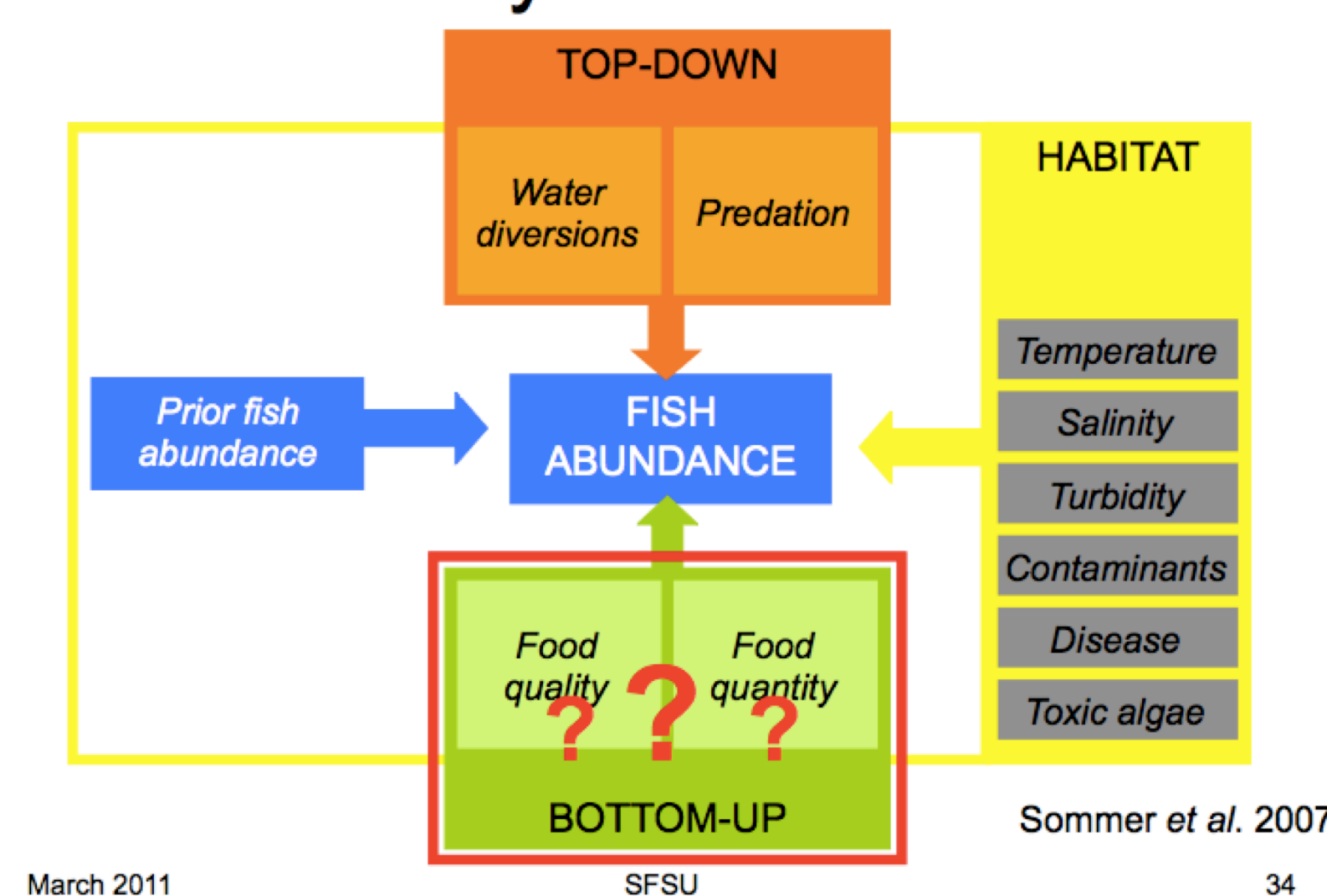
Acknowledgments

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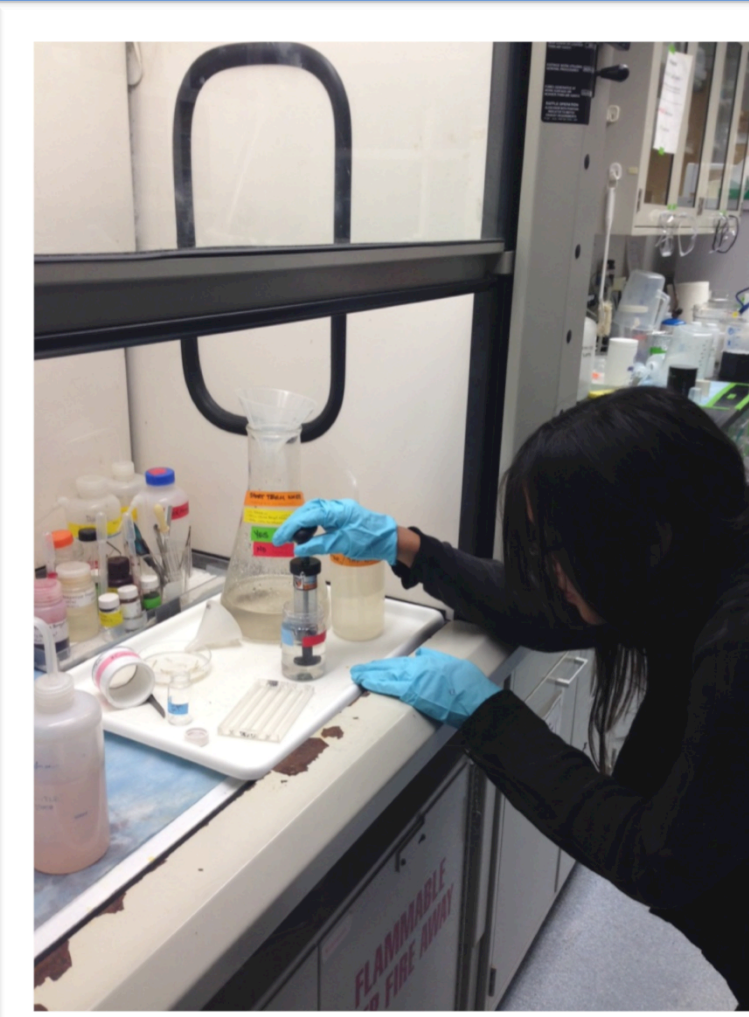
Conclusion

Delta smelt are prey limited in the wild. In these experiments the maximum feeding rate of delta smelt was at a prey density that is higher than what is found in the the San Francisco Estuary (Figure 3). This suggests that reintroducing delta smelt as a recovery method may not work because there are not enough copepods to support them. It is possible that the lab raised delta smelt may prefer different food sources than *L. tetraspina* and *P. forbesi*. Future research should further investigate the feeding relationships of delta smelt to better understand their life histories and find ways for conservation.

Recovery/Reintroduction



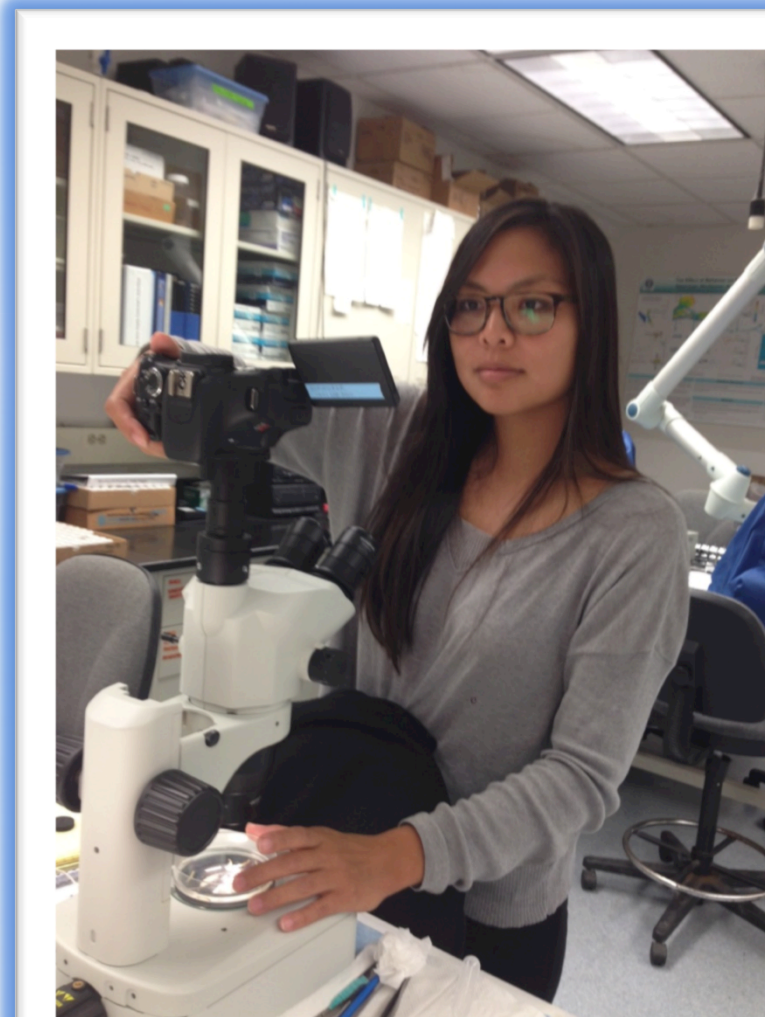
Sample preserved in formalin



Subsampled copepods at the fume hood



Dissected a fish using tweezers and a scalpel



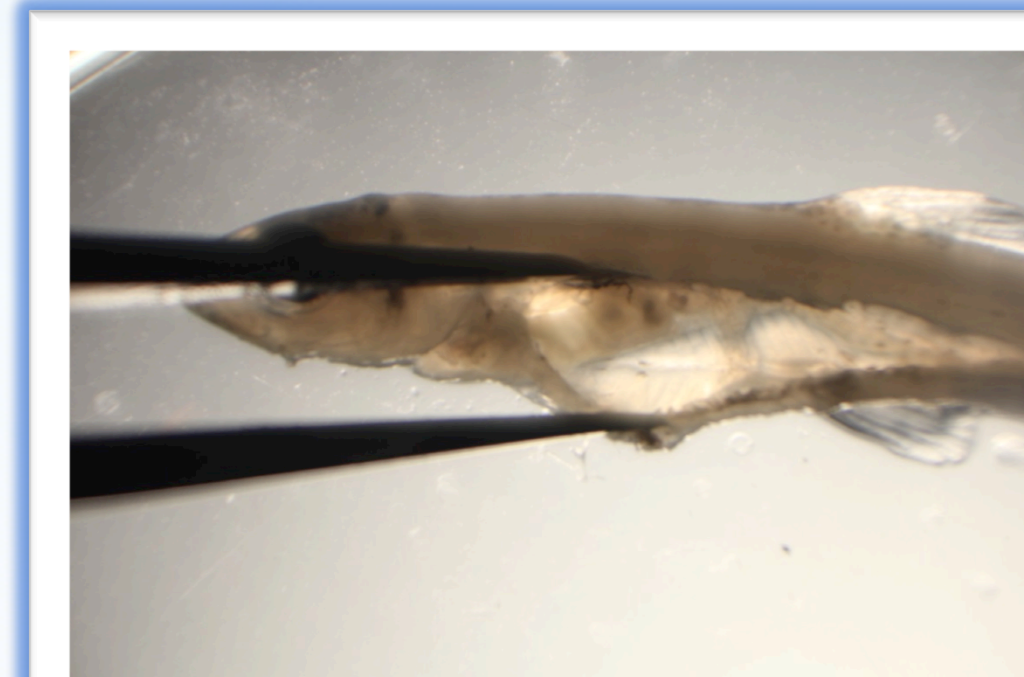
Took pictures of copepods



Made an incision behind the gill cover



Completed my cut along the side of the fish



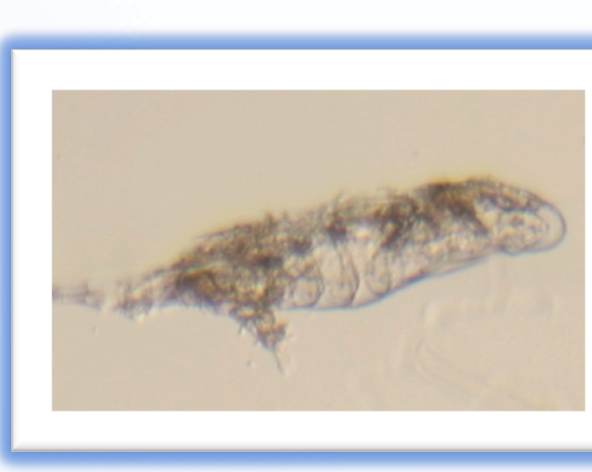
Opened up the fish using tweezers



L. tetraspina found in the stomach is more intact



Removed the stomach and intestine



L. tetraspina found in the digestive tract is more digested

Frequency Distribution of *L. tetraspina*

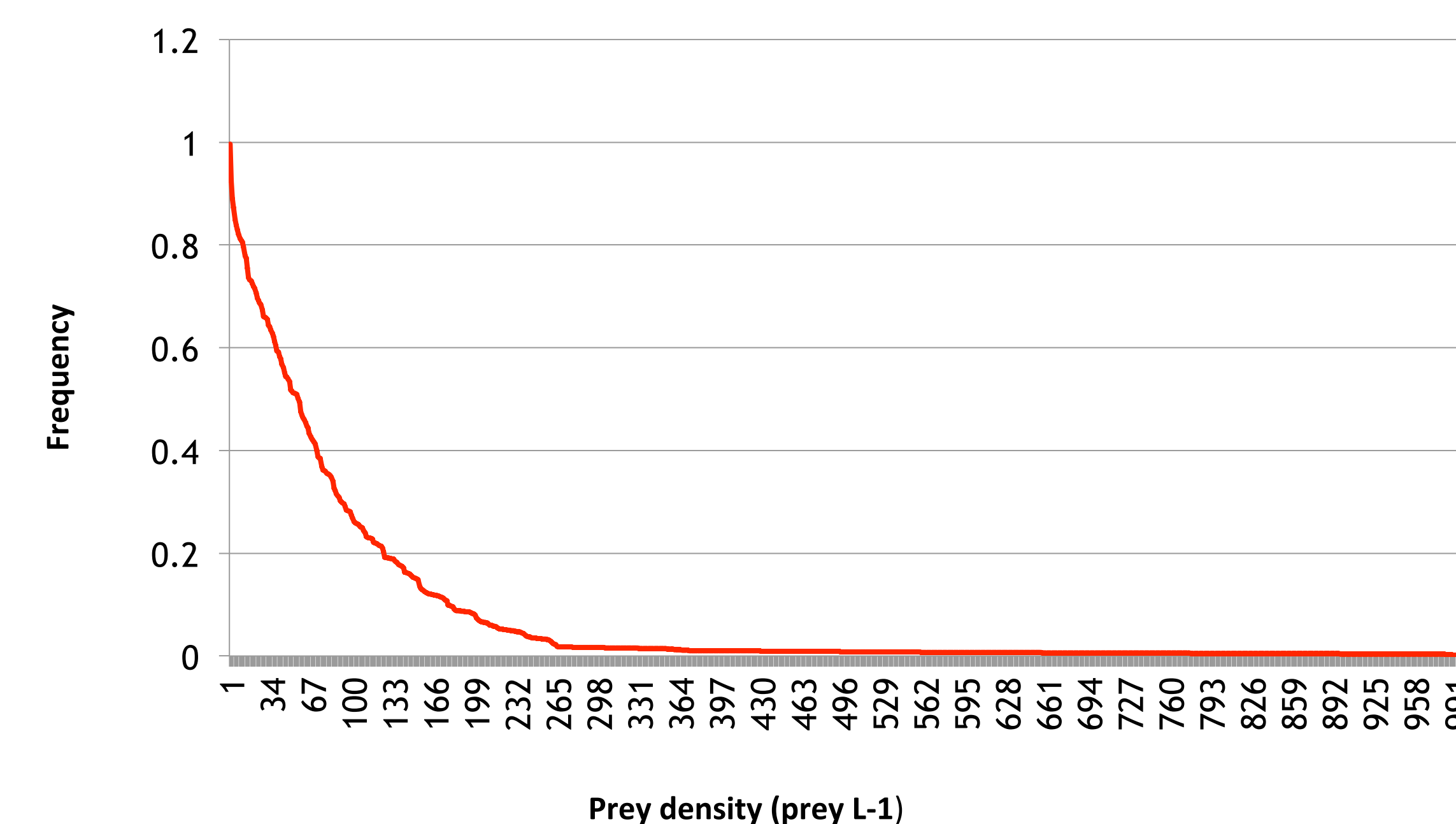


Figure 3. Frequency distribution of densities of *L. tetraspina* in the San Francisco Estuary.

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