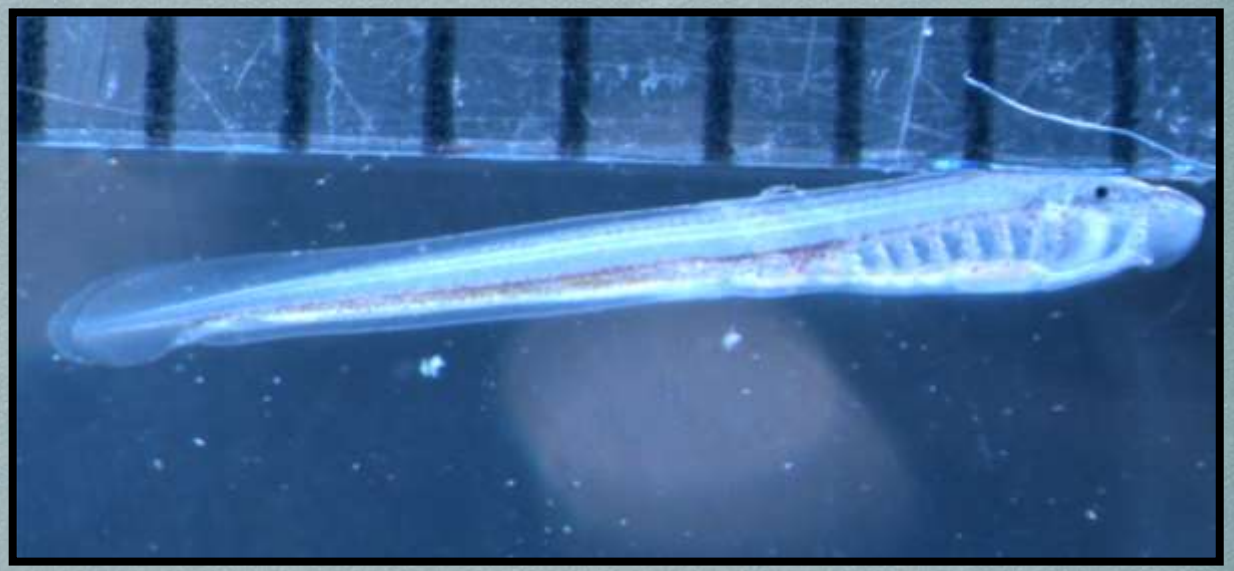
Development of diets for the intensive culture of Pacific Lamprey



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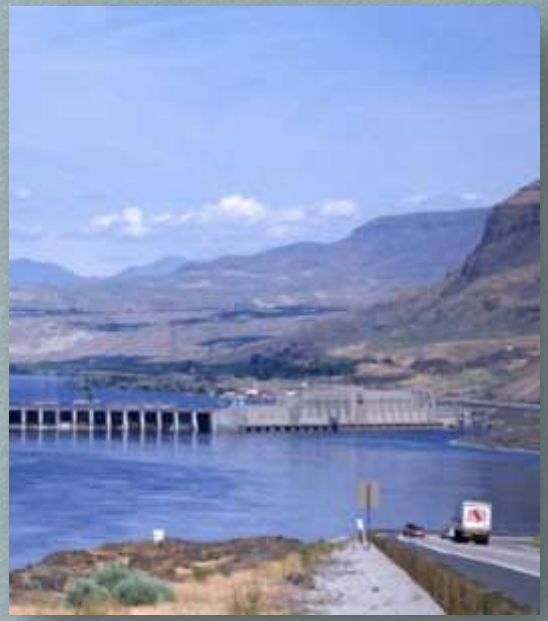
Pacific Lamprey-History

- 350+ million year old Agnathan



- Interesting species traits:
  - Jawless
  - Cartilaginous
  - Filter feeder
  - External parasite
  - Burrowing
  - Anadromous
- Populations decline in Northwest streams

- Great cultural significance for Northwest tribes
- Importance to the ecosystem
- Due to their uncertain future, development of culture methods is needed

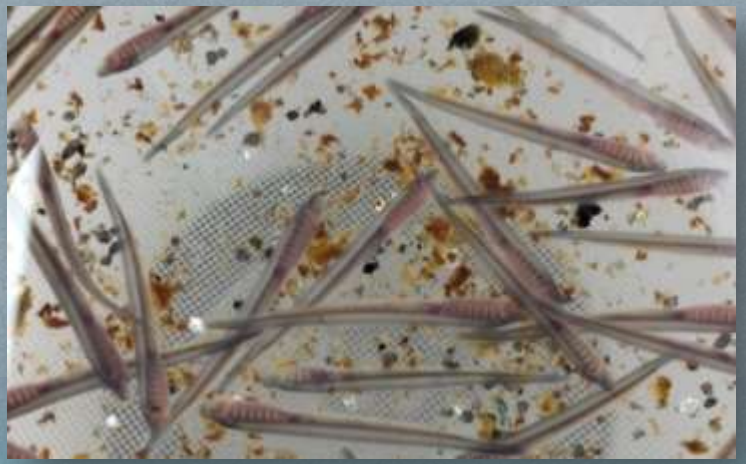
Pacific Lamprey-Life Cycle

Adult

Embryo

Macropthalmia

Ammocoete



Objectives

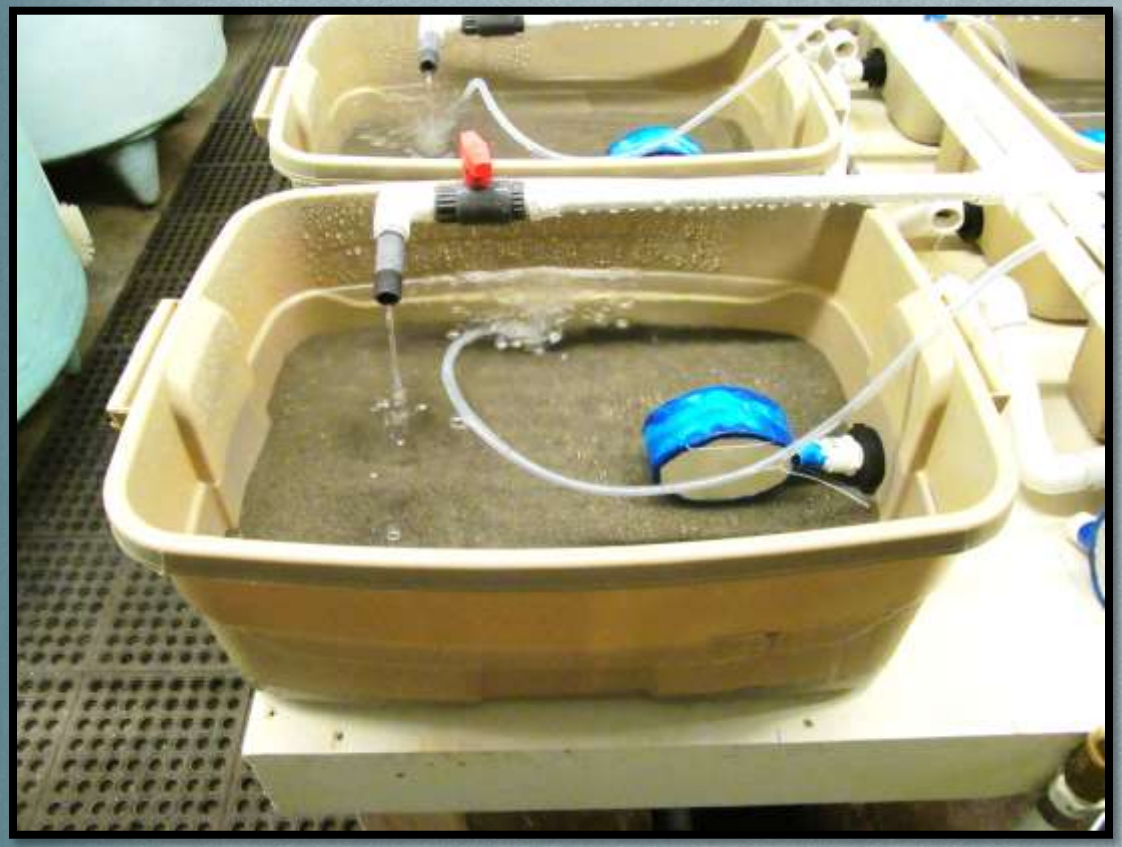
- Develop a range of diets and evaluate their effects on growth and survival of Pacific lamprey ammocoetes.

- Determine how lamprey partition consumed nutrients by measuring whole body lipid content and fatty acid profiles.

Lamprey System

- 38 liter tanks
- 14^{o}C flow through well water
- Flow rate: 1.3 L/min
- Controlled aeration in each tank

System Details



- Play sand substrate,
- ≤ 500 microns
- 500 micron effluent screen
- External standpipe

Diet Study

- 7 Dietary Treatments −5 Replicates each (35 experimental units)
  - Yeast
  - Liquid micro-Algae blend(Algae)
    - *Isochrysis* 40%
    - *Pavlova* 15%
    - *Tetraselmis* 25%
    - *Thalassiosira weissflogii* 20%
  - 50% Yeast / 50% Algae
  - Fish Oil Emulsion-Paired with the 3 former diets
  - 80% Yeast / 20% Larval fish diet(LD)-250 µm

http://dartmed.dartmouth.edu/fall12/images/back_to_basics_09.jpg

http://rsif.royalsocietypublishing.org/content/7/46/703/F1.large.jpg

Diet Study

- 16 Week trial

- 20 Ammocoetes per tank (720 fish total)
  - 51 DPH
  - Mean Weight: 0.01 g
  - Mean Length: 14 mm
- Fed 2x weekly
  - Water shut off for 6 hours during feeding
  - Tanks cleaned weekly via flushing

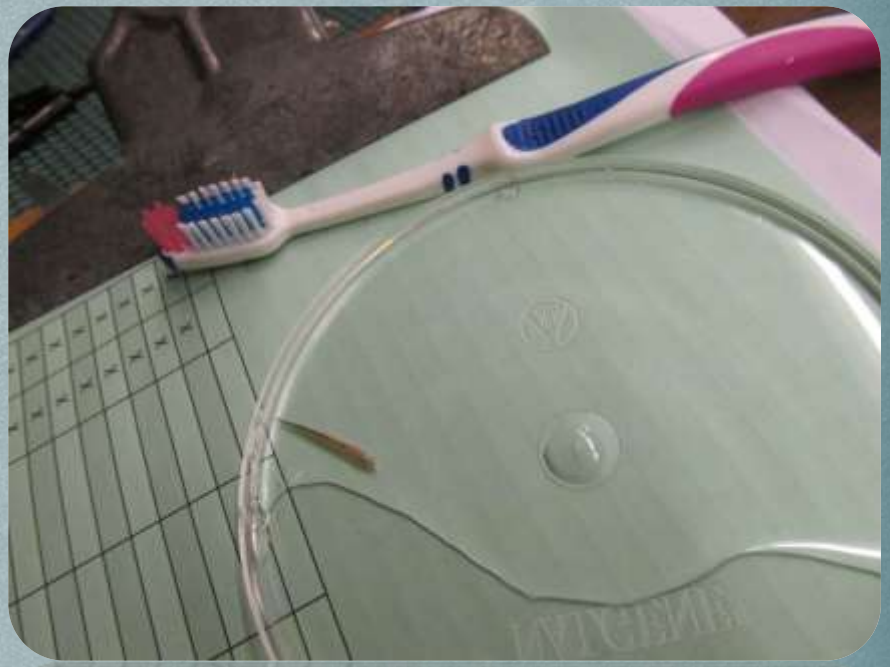
Data Analysis

- Parameters of interest:
  - Survival
  - Length and Weight
  - Whole body lipid content
  - Whole body-Fatty acid profile
  - Lipid Retention
  - Feed Conversion Ratio

- ANOVA with $\alpha=0.05$
- SNK for pairwise comparisons

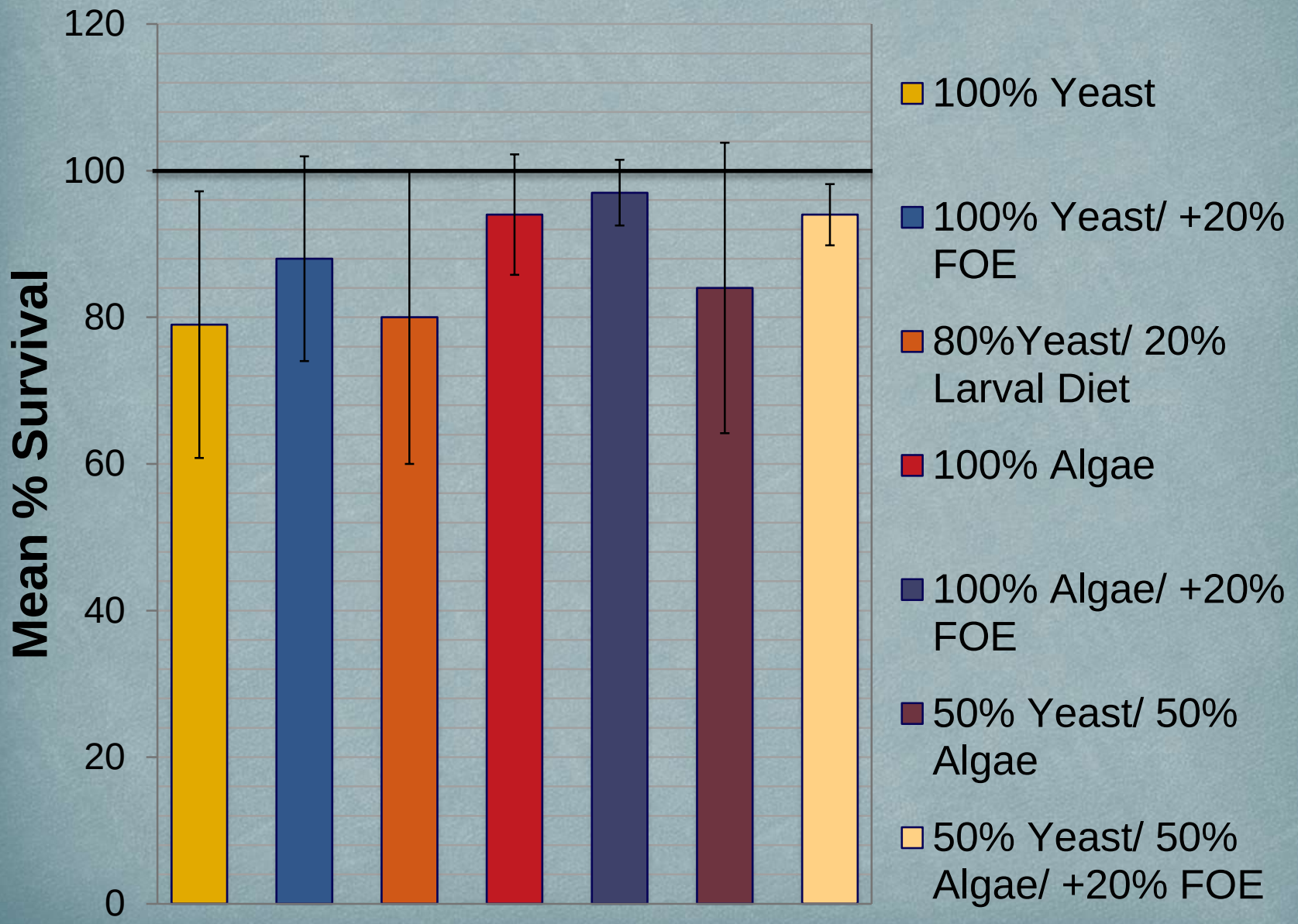
Results-Overview

- No difference in:
  - Survival
  - Whole body lipid

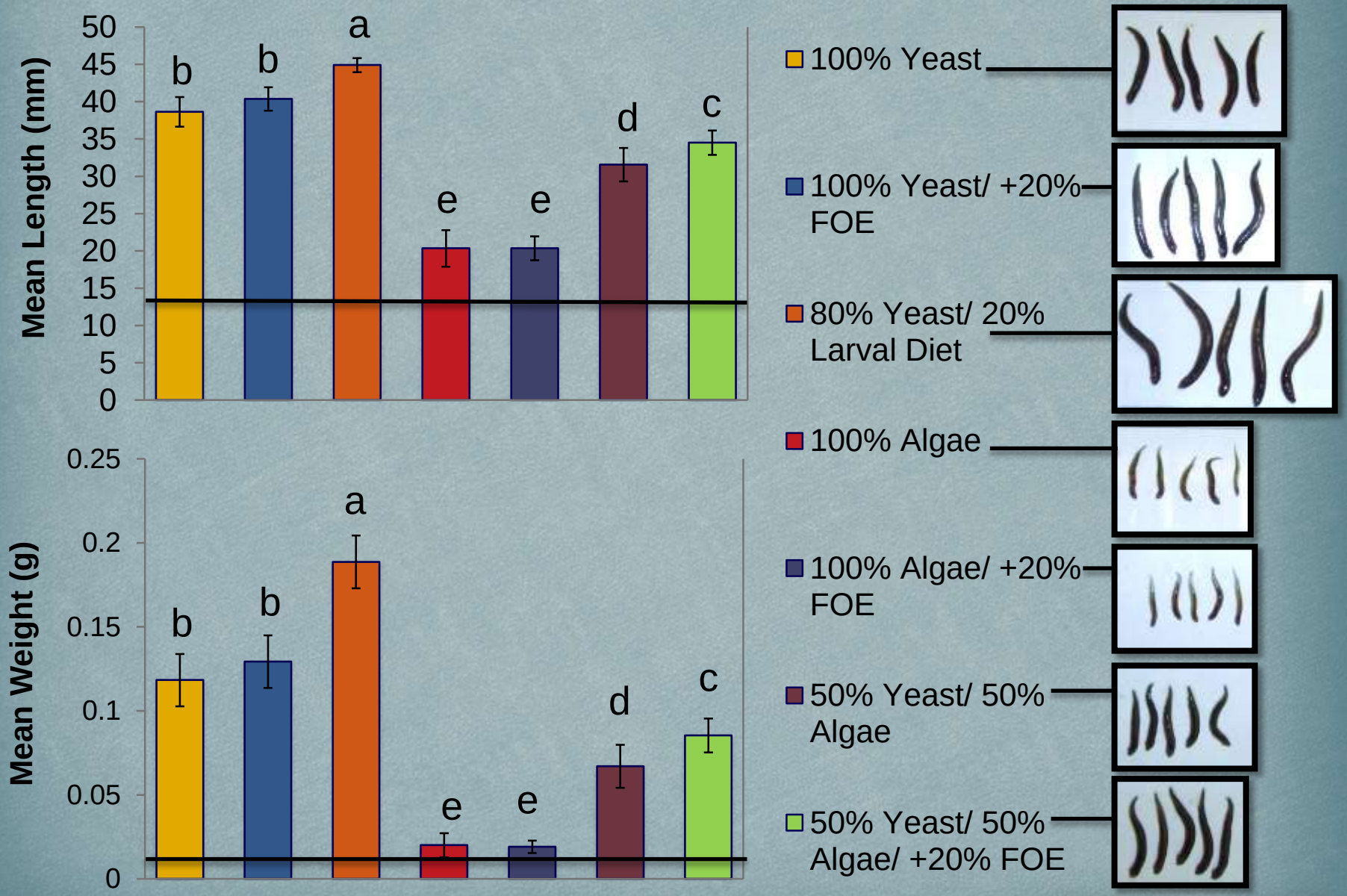


- Significant differences in:
  - Total length
  - Weight
  - Lipid retention
  - Feed conversion ratio
  - Numerous essential fatty acids including EPA, DHA, ARA

Survival (%)


120
100
80
60
40
20
0
Mean % Survival
100% Yeast
100% Yeast/ +20% FOE
80%Yeast/ 20% Larval Diet
100% Algae
100% Algae/ +20% FOE
50% Yeast/ 50% Algae
50% Yeast/ 50% Algae/ +20% FOE

Final Length and Weight



Lets Discuss: Yeast

- Generally supported the highest growth.
  - Benefited from pairing with larval fish diet.
  - Hindered by pairing with algae.
- Best lipid retention in Yeast paired with larval fish diet.
  - Greatest diversity of ingredients
- Best Feed conversion ratios in diets containing yeast.
- Generally low in essential fatty acids, and lamprey whole body reflects diet.
  - Adding larval diet, fish oil emulsion, or Algae corrected this.

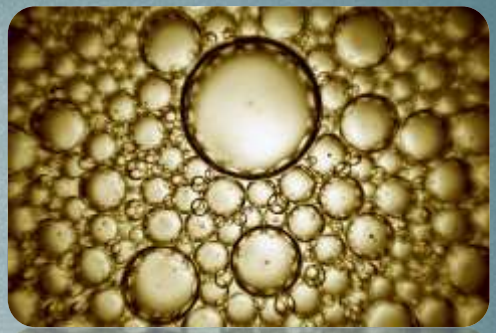
Lets Discuss: Algae

http://interestingengineering.com/wp-content/uploads/2013/09/blue-green-algae1.jpg

- Generally supported the poorest growth.
  - 71% increase in weight compared to 1,512% in yeast with larval diet
- Poorest lipid retention
- Poorest feed conversion ratios
- High in essential fatty acids, and lamprey whole body reflects diet
  - Effective supplement to provide essential fatty acids

Lets Discuss:
Fish Oil Emulsion (FOE)

http://news.harvard.edu/gazette/story/2011/12/slow-road-to-stability-for-emulsions/



- Fed as a 20% calorie bonus
- Only improved growth by adding it to the yeast/algae combo
  - Compensation for the algae component
- No effect on lipid retention or feed conversion
- High in essential fatty acids
  - Increased levels in the lamprey
- Effective delivery method for essential fatty acids
  - Holds potential for further development in the future

Thank You!

- AFTC for funding this project

- USGS Columbia River Research Laboratory for providing ammocoetes to work with:
  - Matt Mesa
  - Helena Christiansen

- For their invaluable assistance:
  - Nathan Hyde
  - Jeff Poole
  - Chris Taylor
  - Richard Glenn
  - Jim Lowell