



Refining Best Management Practices for Rearing Newly Hatched Larval Pacific Lamprey (*Entosphenus tridentatus*)

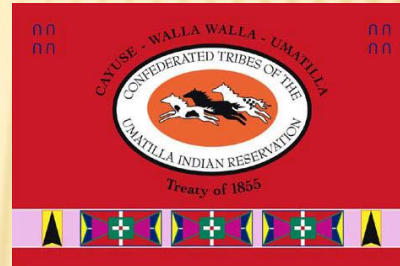


CHELAN COUNTY

Yakama Nation Fisheries

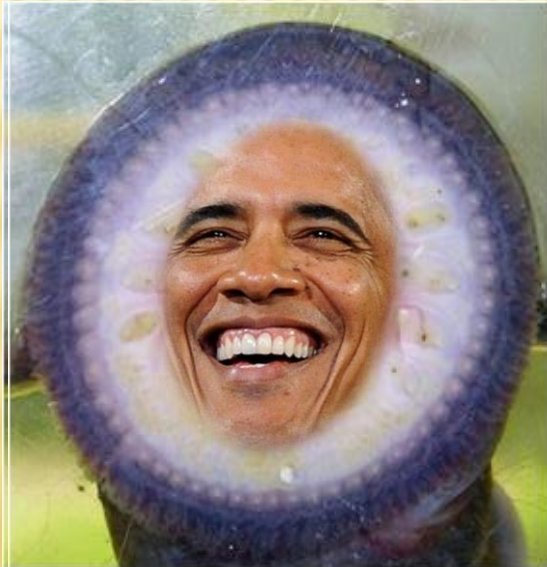
Ralph Lampman, Bob Rose, Tyler Beals, Sean Goudy,
Dave'y Lumley, Frank Spillar, Leona Wapato, April Hull,
and Hiroaki Arakawa

Shout-Out for Everyone Helping!



Outline

- 1. Background**
- 2. Larval Rearing Experiment (2015)**
- 3. Larval Rearing Experiment (2016)**
- 4. Future Plans**



Why Should We Care?

Tribal Culture & Food Source

Willamette Falls



Food for Numerous Species

Paddy Halpin

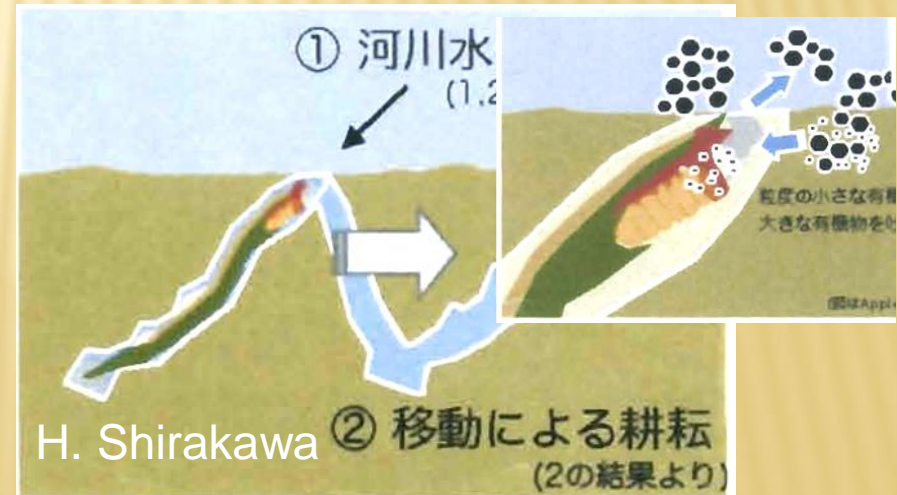


Buffer for Salmon Predation

Janet Jenson / AP



“Farmer of the Underwater World”



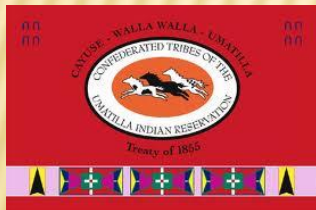
Why Supplement?

- To prevent extinction (reintroduction) & supplement low populations
 - Allow lamprey to serve their ecological roles
- To rear lamprey needed for survival studies (juvenile passage = black box)
- To better understand population dynamics & life stage specific survival rates in nature



Art. Prop. & Rearing Protocols

New AFS Book “Jawless Fishes of the World”



CHAPTER 21

DEVELOPING TECHNIQUES FOR ARTIFICIAL PROPAGATION AND EARLY REARING OF PACIFIC LAMPREY (*ENTOSPHEUS TRIDENTATUS*) FOR SPECIES RECOVERY AND RESTORATION

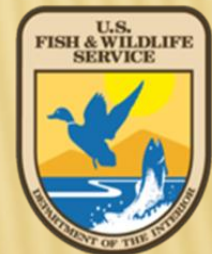
RALPH T. LAMPMAN¹, MARY L. MOSER^{2,3},
AARON D. JACKSON², ROBERT K. ROSE¹, ANN
L. GANNAM⁴, AND JAMES M. BARRON⁴,

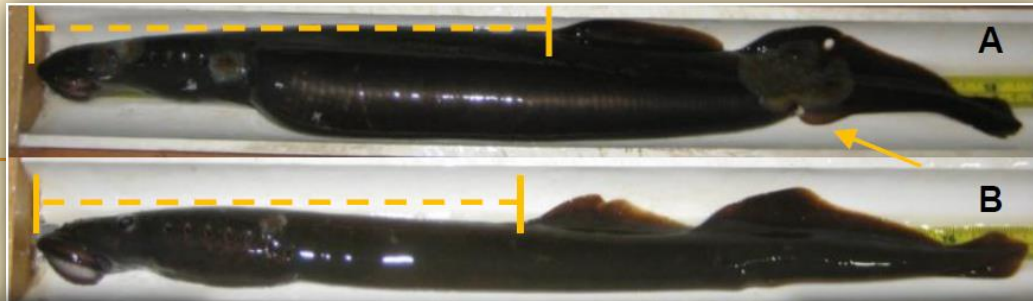
¹ Yakama Nation, Department of Natural Resources, Fisheries Resources
Management Program, 401 Fort Road, Toppenish, WA 98948, USA

² Confederated Tribes of the Umatilla Indian Reservation, Fisheries
Program, Department of Natural Resources, 46411 Timine Way,
Pendleton, OR 97801, USA

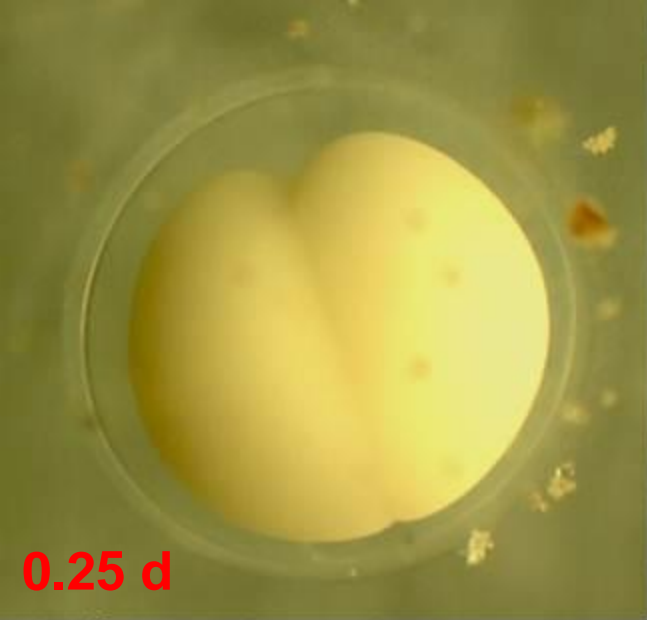
³ Northwest Fisheries Science Center, National Marine Fisheries Service,
2725 Montlake Boulevard East, Seattle, WA 98112, USA

⁴ United States Fisheries and Wildlife Service, Abernathy Fish Technology
Center, 1440 Abernathy Creek Road, Longview, WA 98632, USA

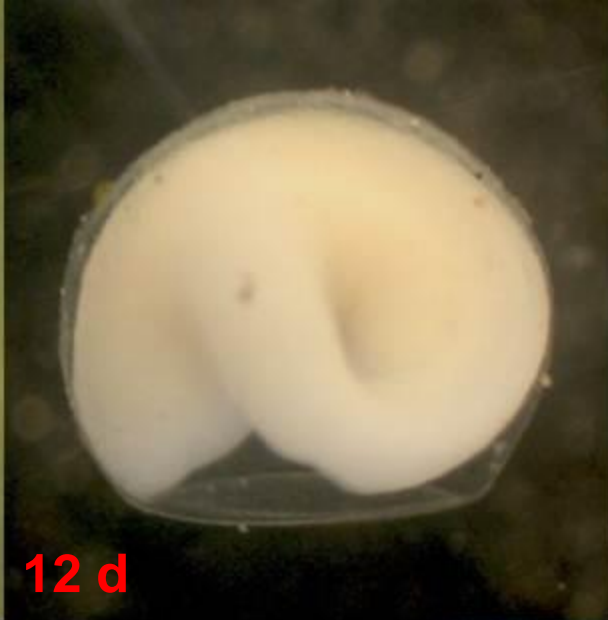




- Prolonged spawning season (April – July)
- Fecund species (>100,000 eggs)
- Eggs are sticky (stick to substrate)



0.25 d



12 d



14 d (~200 dd)

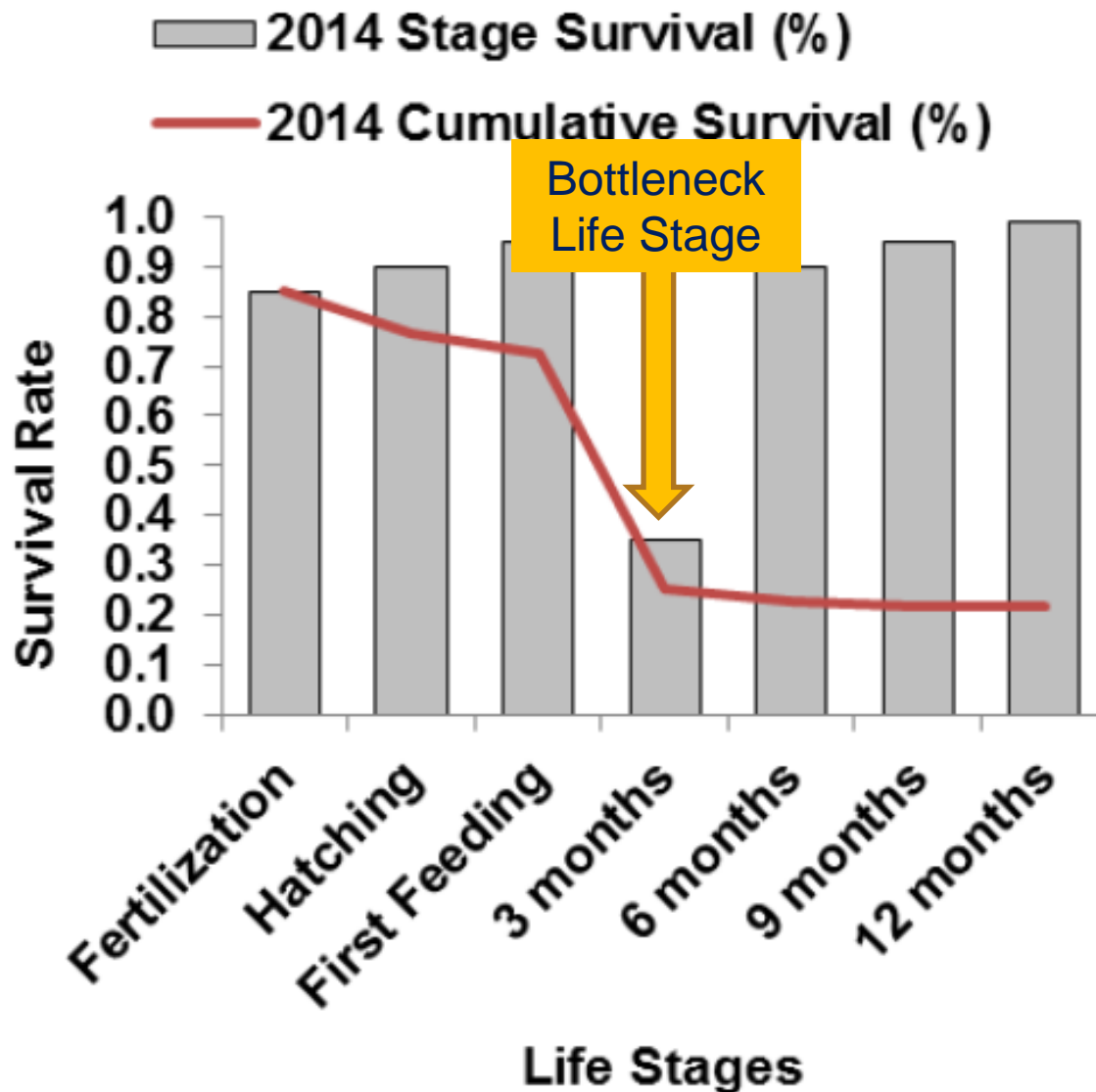


31 d (~10 d w/ yolk sac)



21 d

Life Stage Survival Rates



Types of Food Source

Organic Matter



Salmon Carcass



Whole Wheat Flour



Algae

Alfalfa Pellets



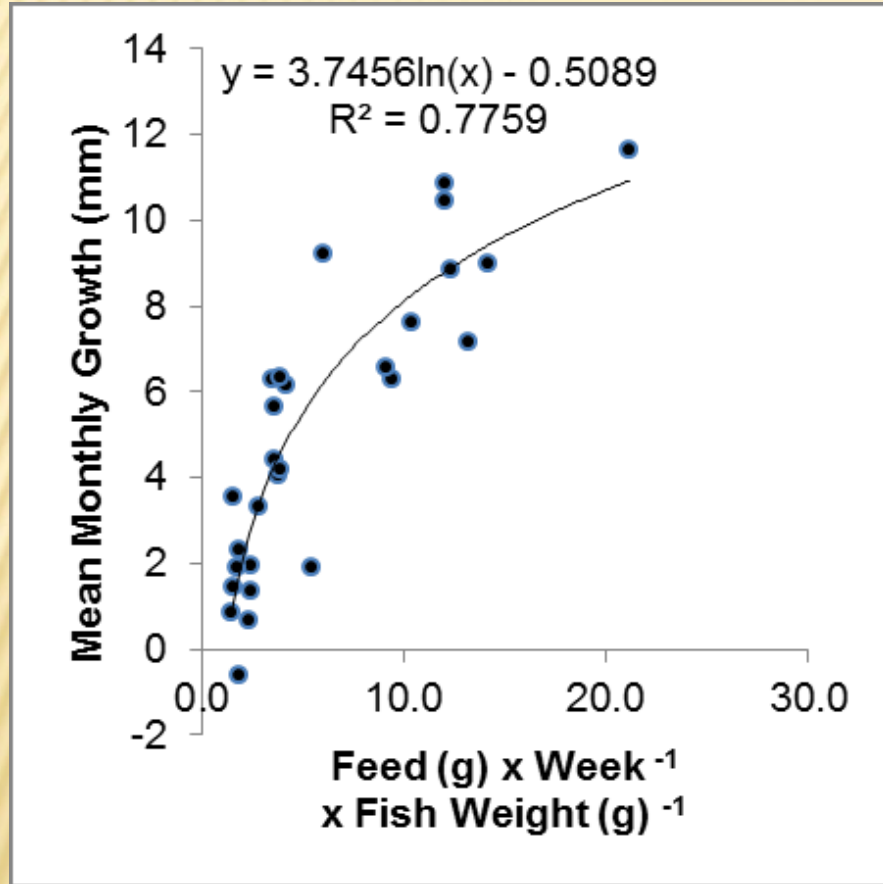
Aquatic V



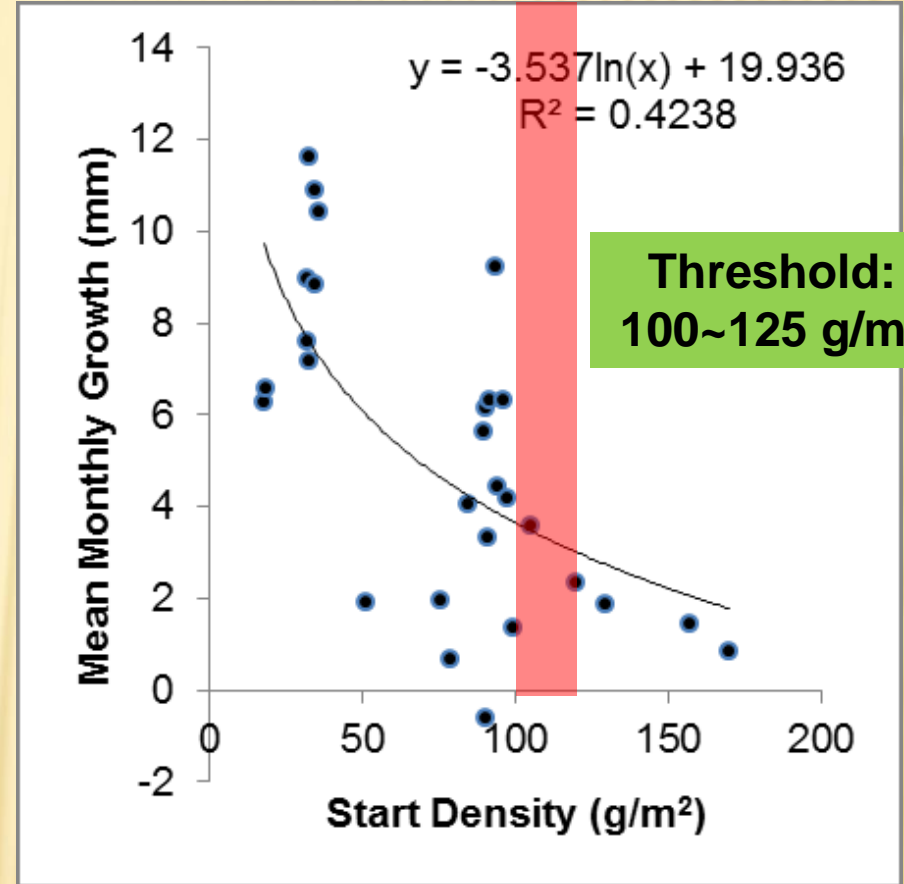
Active Dry Yeast



Growth Rates & Density



**Feed per Fish
Weight**



**Start Density
(<125 g/m²)**

Collaborative Experiment on Bottleneck Life Stage (YN, CTUIR, USFWS)

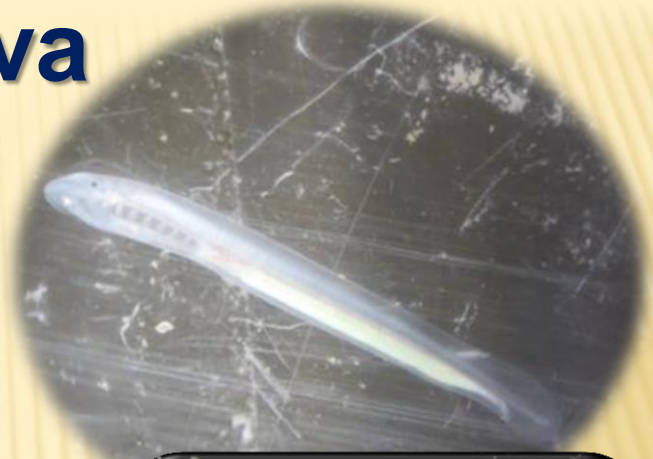
- **Feed Particle Size / Amount (CTUIR/NOAA)**
(150, 100, 50, <50 micron)
- **Timing of Initial Feeding (USFWS)**
(25, 30, 35 days post fertilization)
- **Density of Fish (YN)**
(300, 150, 75 g/m²)

Prolarva->Larva



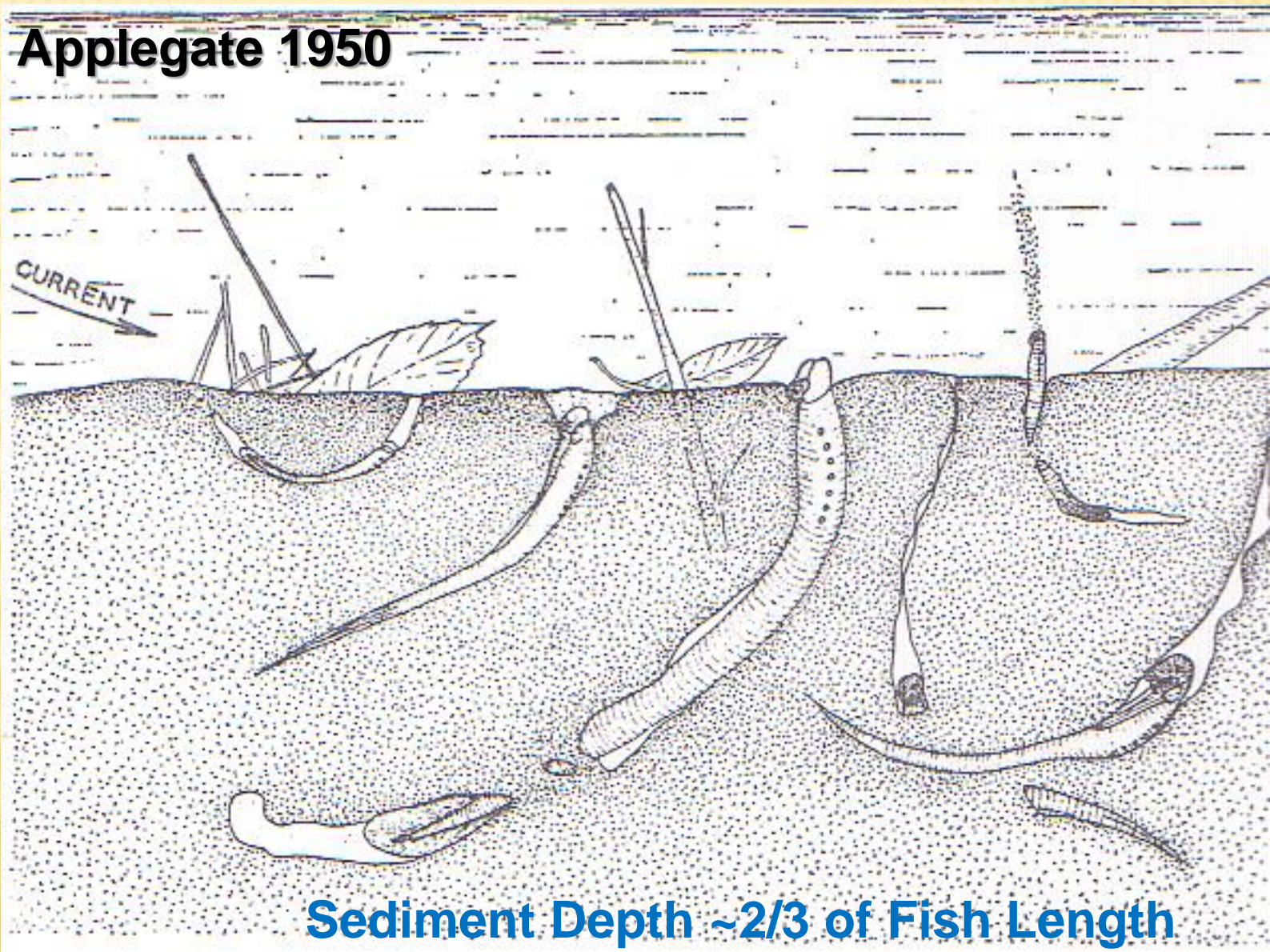
Accurate

et 2. Press COUNT



Larvae

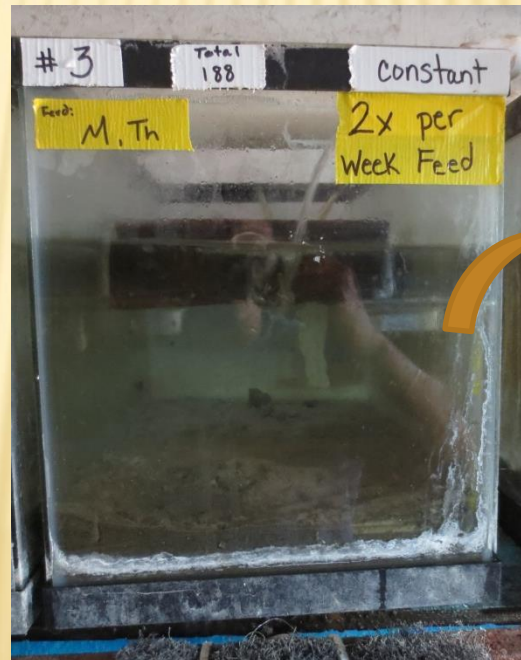
Applegate 1950



Sediment Depth $\sim 2/3$ of Fish Length

Early Larva Feeding Study

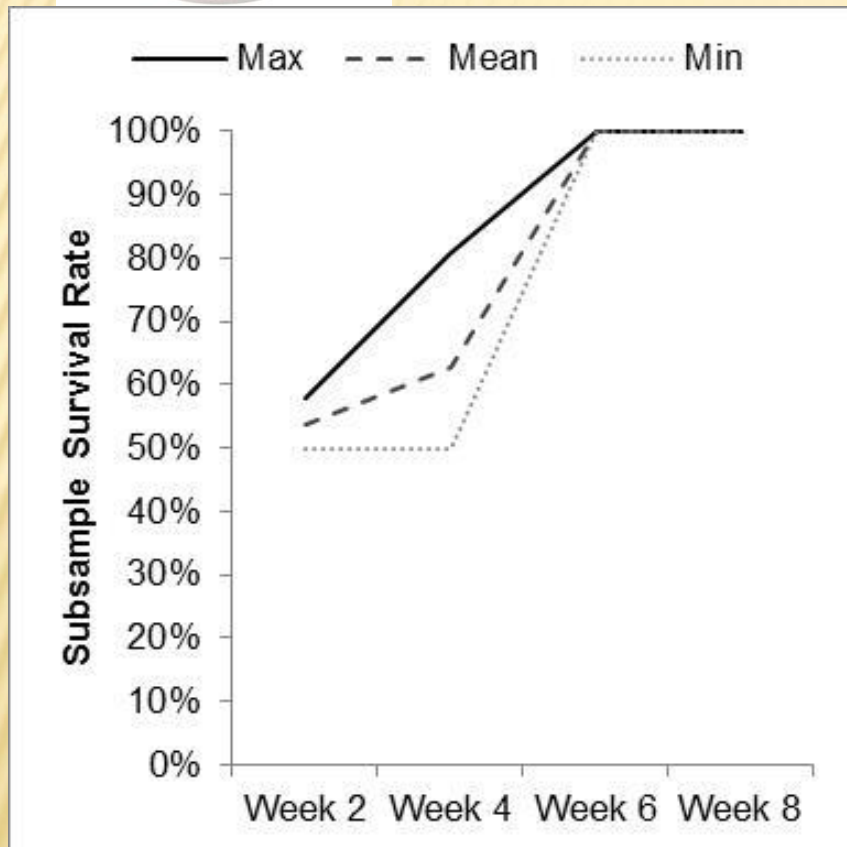
- 20 aquariums (25 L, 0.125 m², 1 L/min)
- 2015 study questions
 - Timing of die offs
 - Effects of density
 - Effects of larval & alternative feeds
 - Variation in growth rates



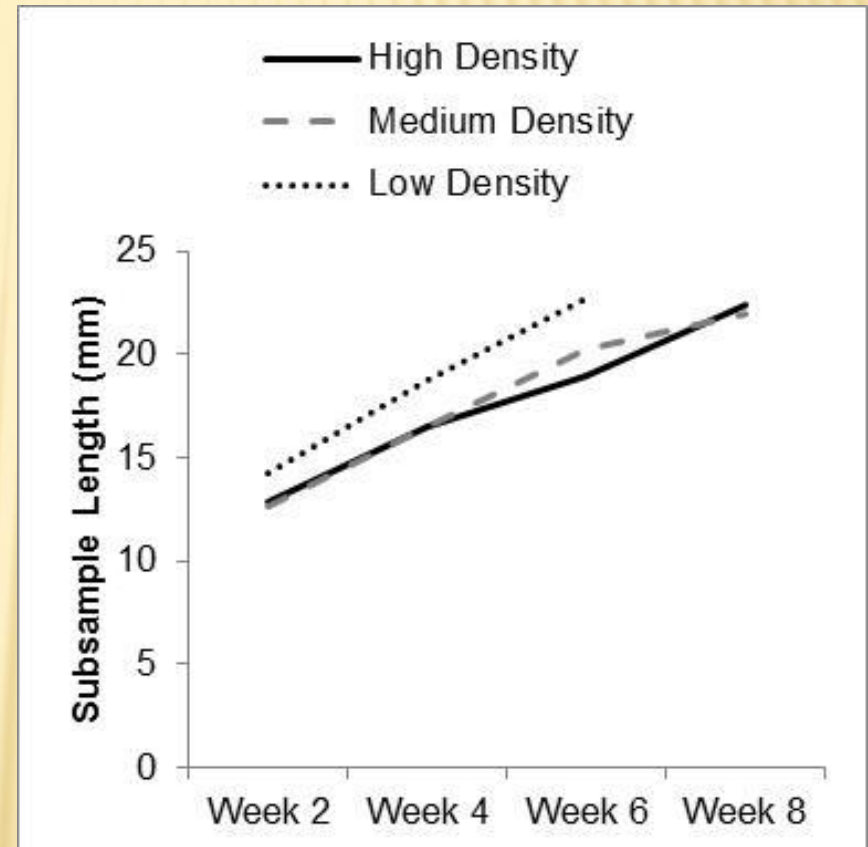


2015 Results:

Timing of Die-Offs & Growth



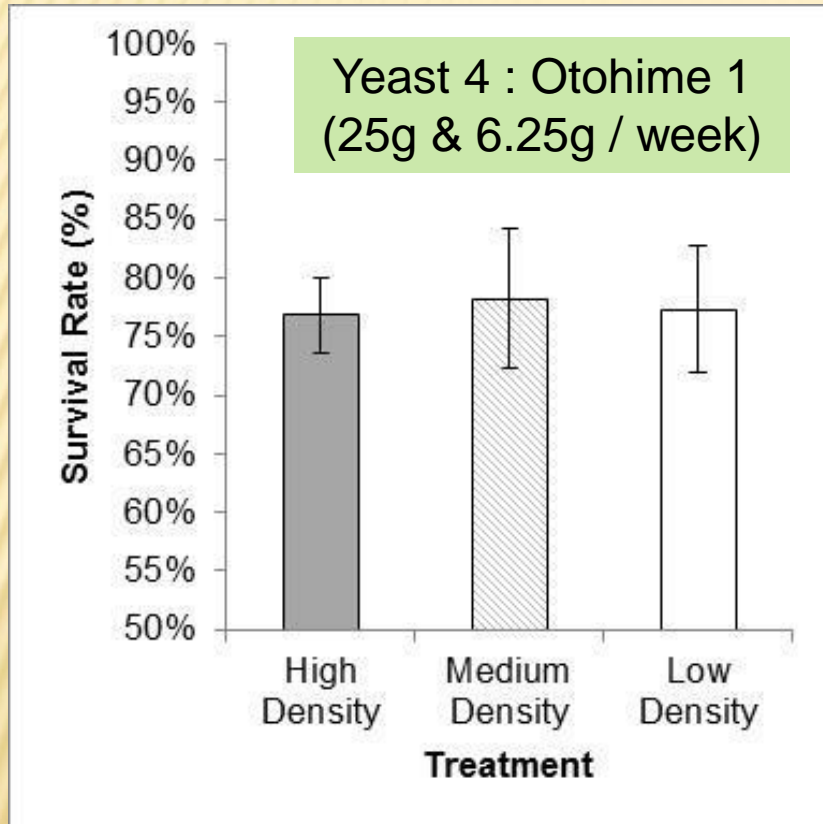
**mortality in
1st month**



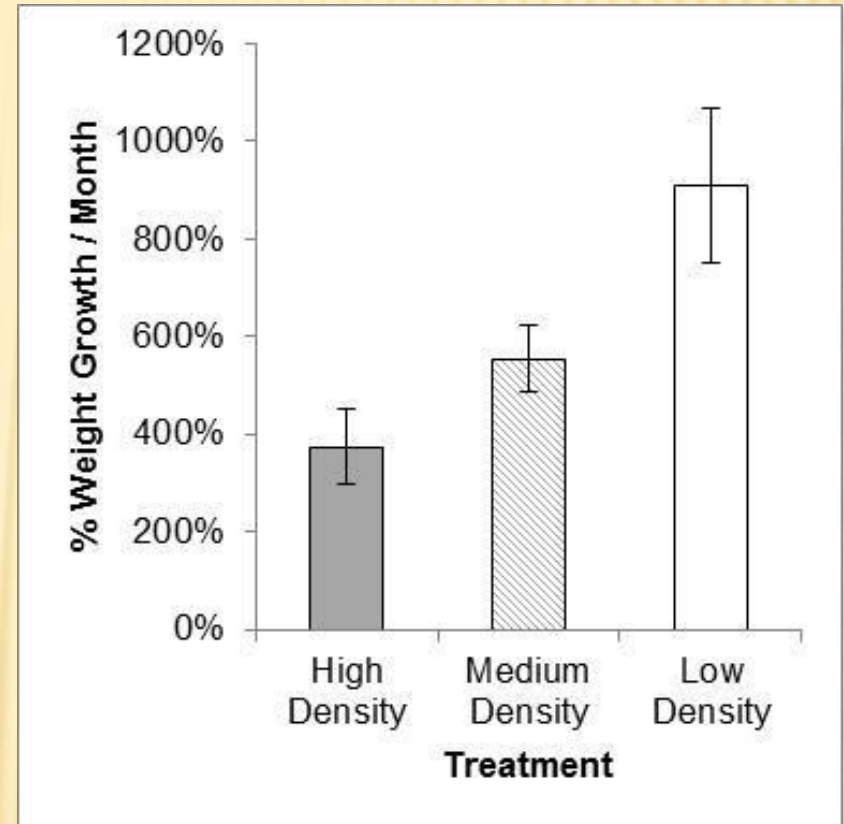
**growth rates
fairly constant**

2015 Results: Density

High = 3000/m², Medium = 1500/m², Low = 750/m²

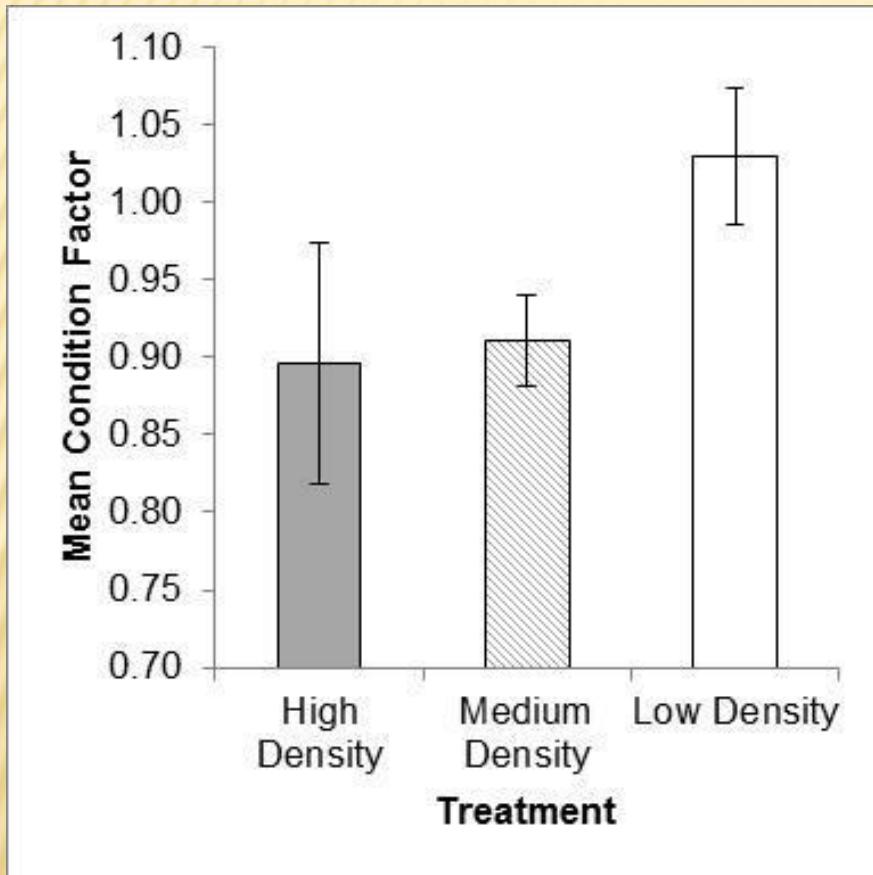


**no effect on
survival rates**

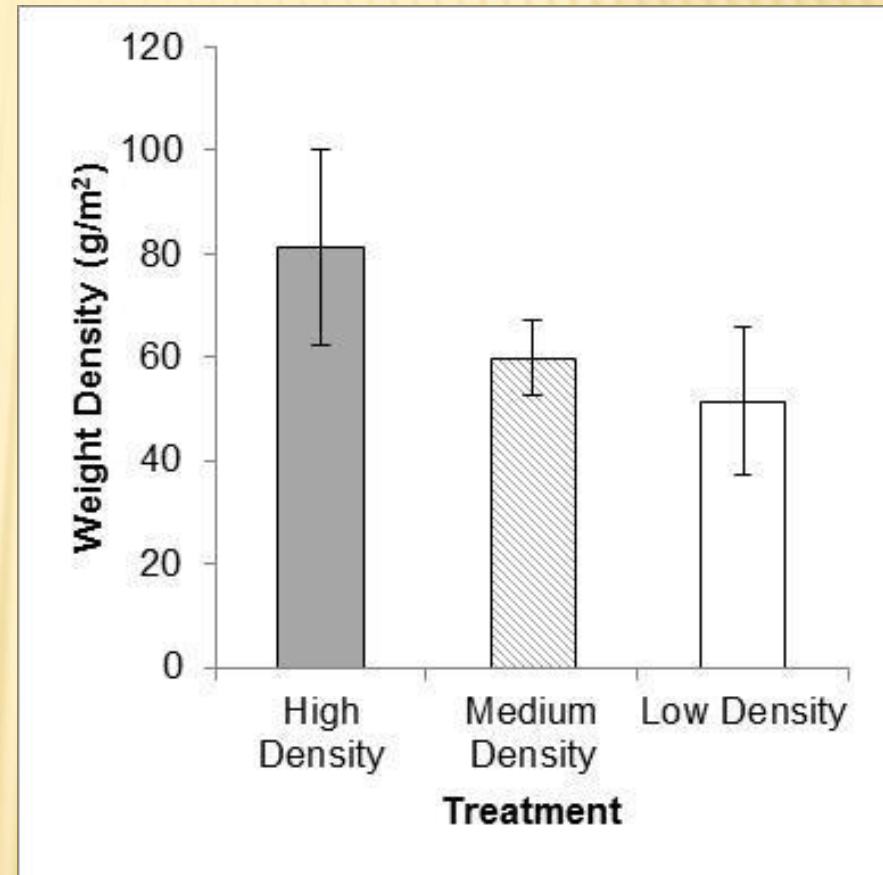


**Lower Density =
Higher Growth**

2015 Results – Density



**“Low Density”
had best K**



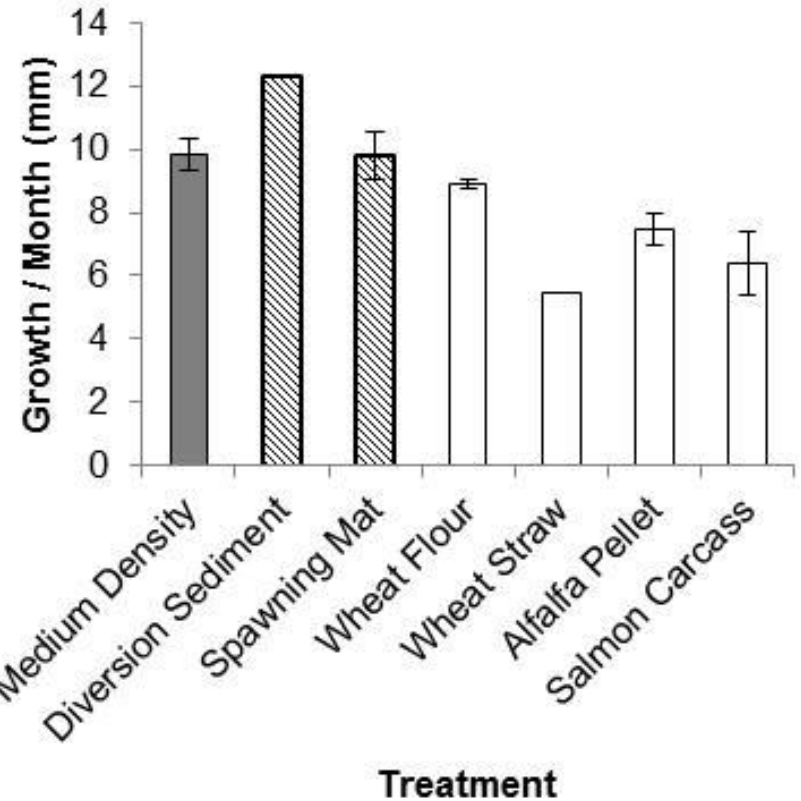
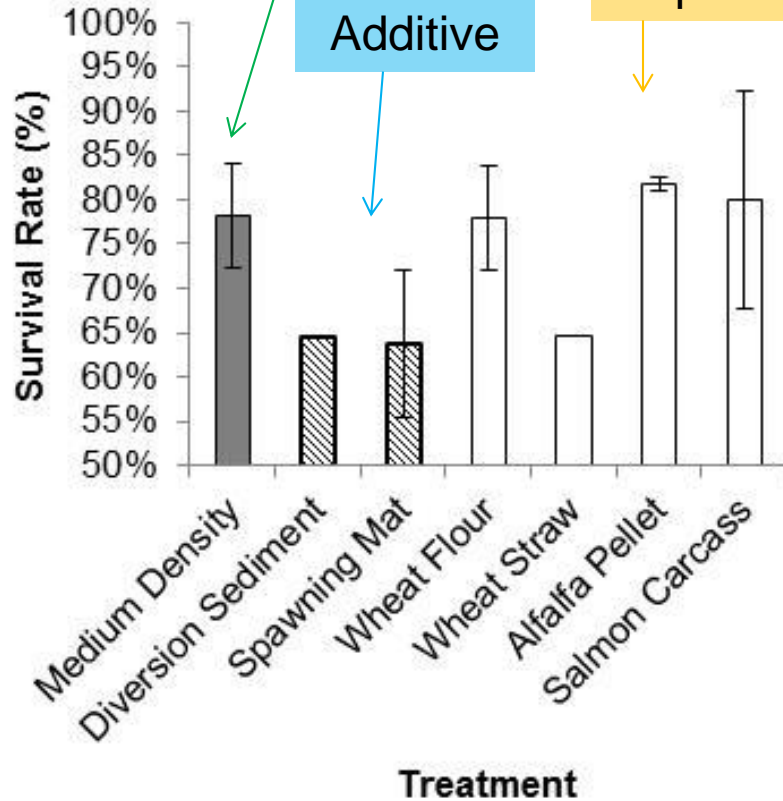
**“High Density” had
the most mass**

2015 Results: Alternate Feed

Yeast/Otohime

Replacement

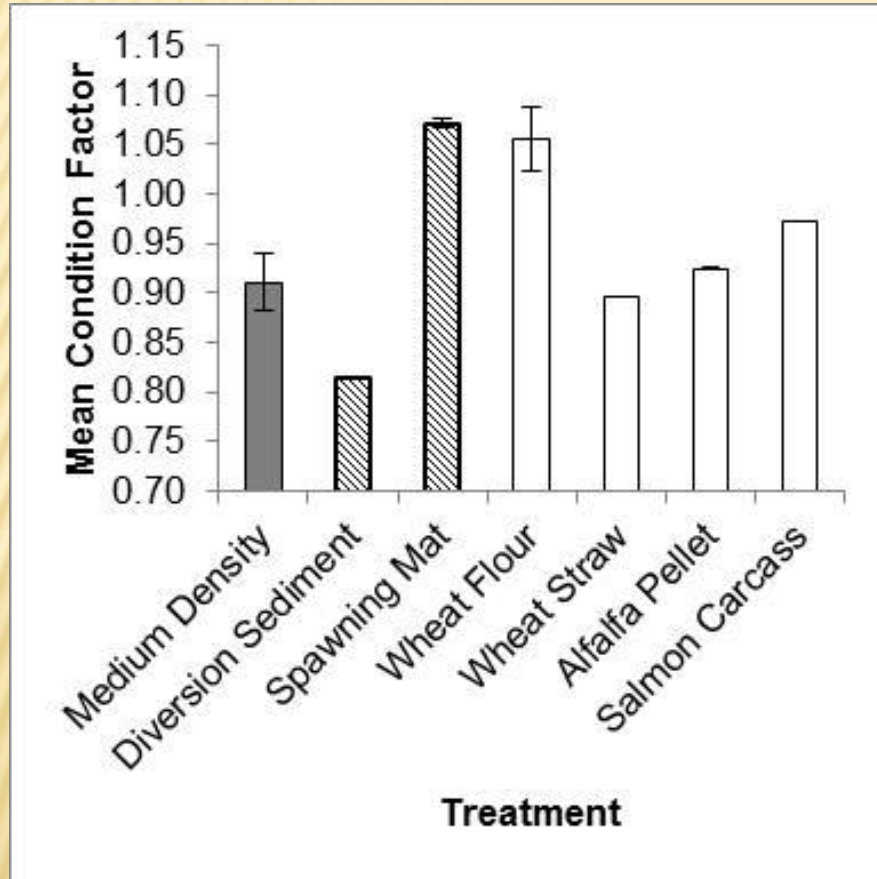
Additive



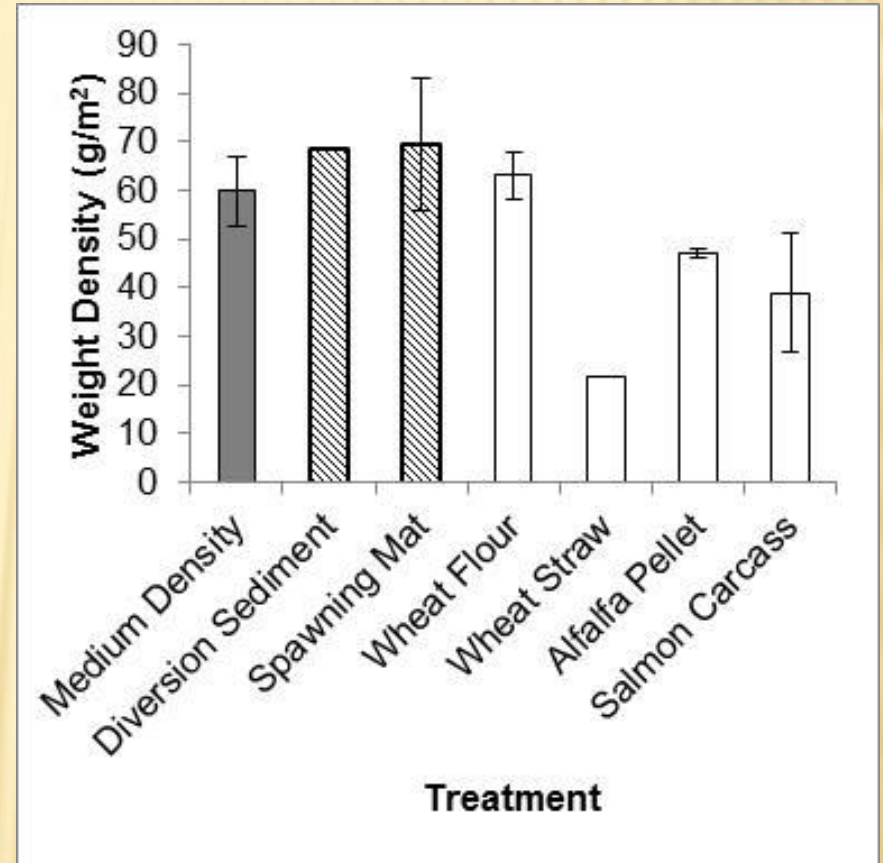
3 alternates w/ similar survival rates

3 alternates w/ similar growth rates

2015 Results: Alternate Feeds

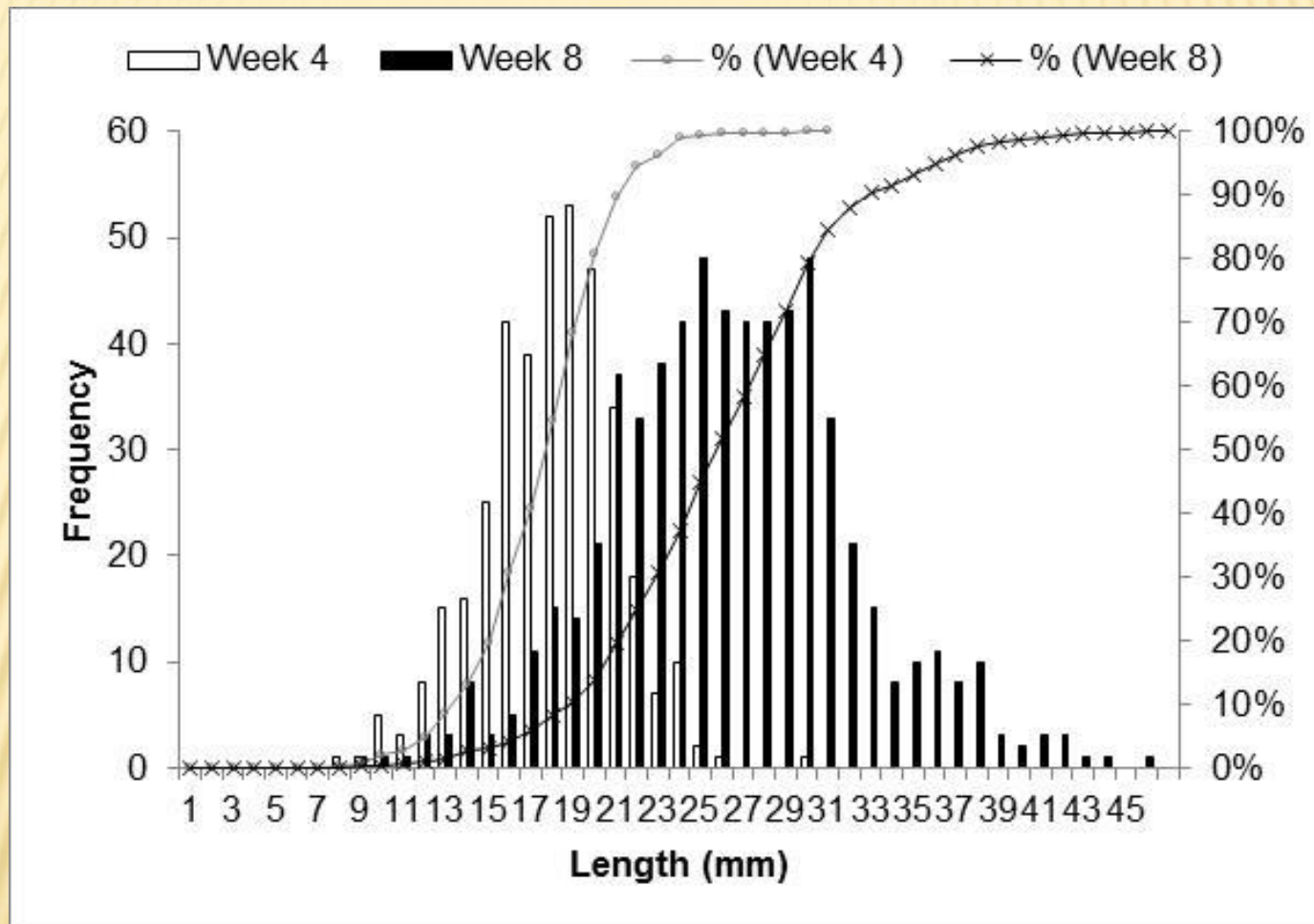


**Comparable or better
in most alternate feeds**



**Wheat Flour is a good
alternative feed**

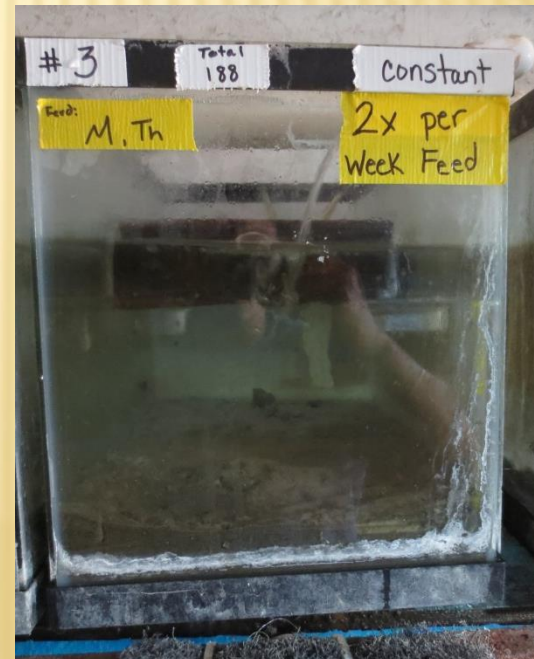
2015 Results: Variation in Growth



Highly Diverse!!!

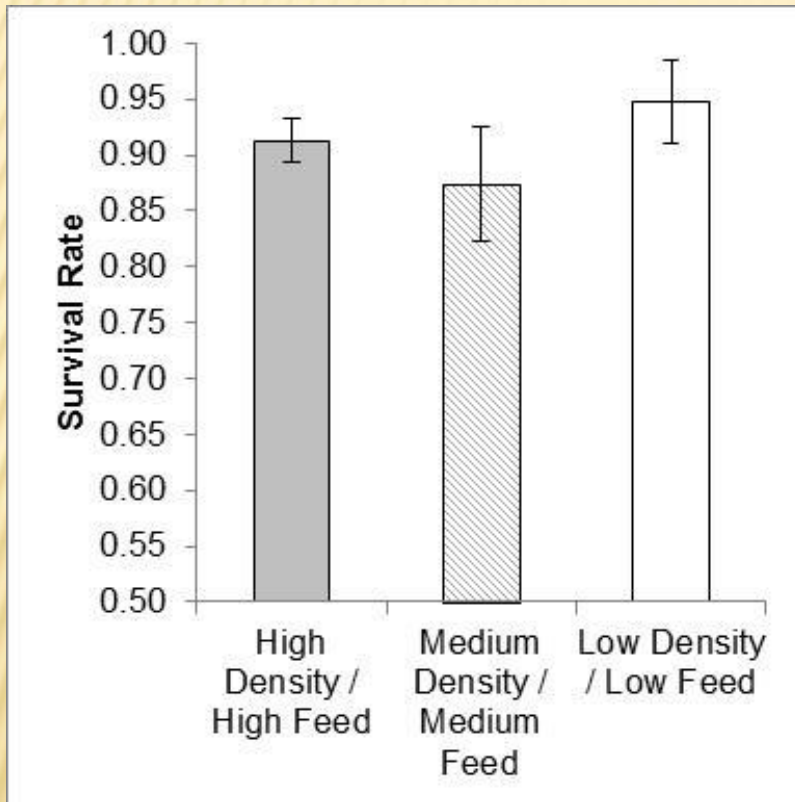
Early Larva Feeding Study

- 20 aquariums (25 L, 0.125 m², 1 L/min)
- 2016 study questions
 - Density / Feed combinations
 - Frequency & Ramping in Feeding
 - Water Off during Feeding
 - Effects of larval & alternative feeds

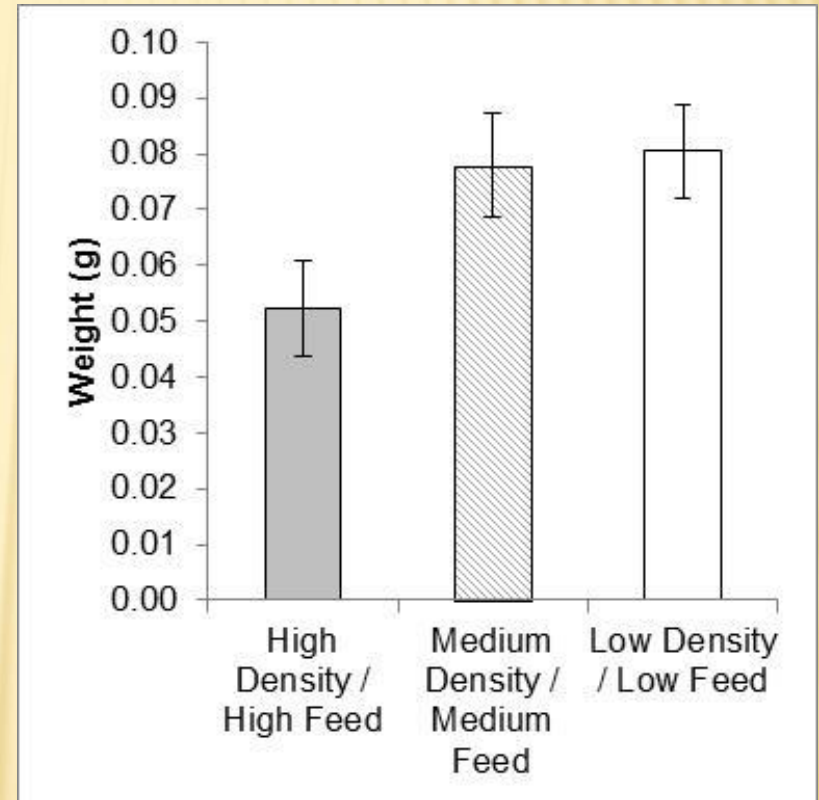


2016 Results: Density / Feed Combination

High = 3000/m², Medium = 1500/m², Low = 750/m²

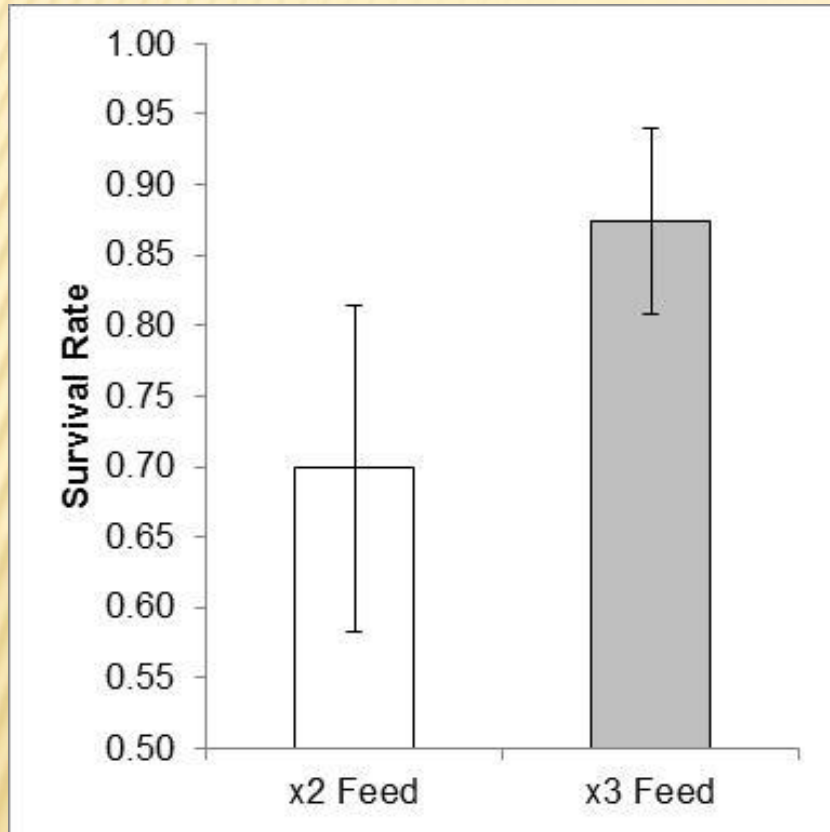


**no effect on
survival rates**

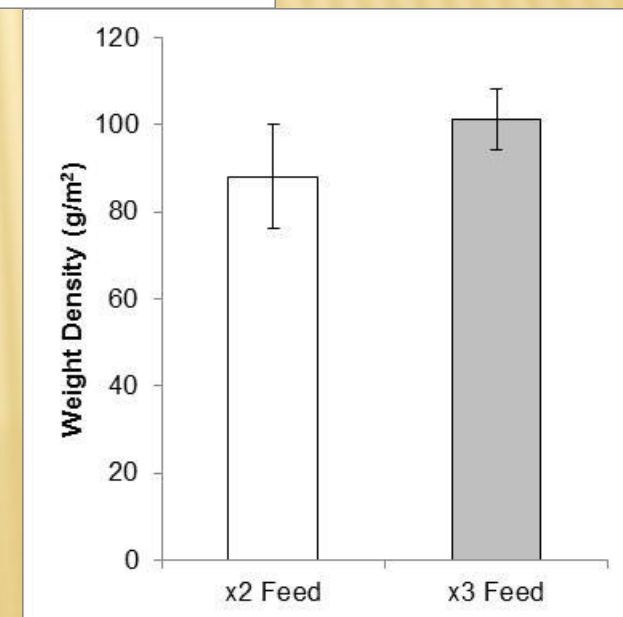
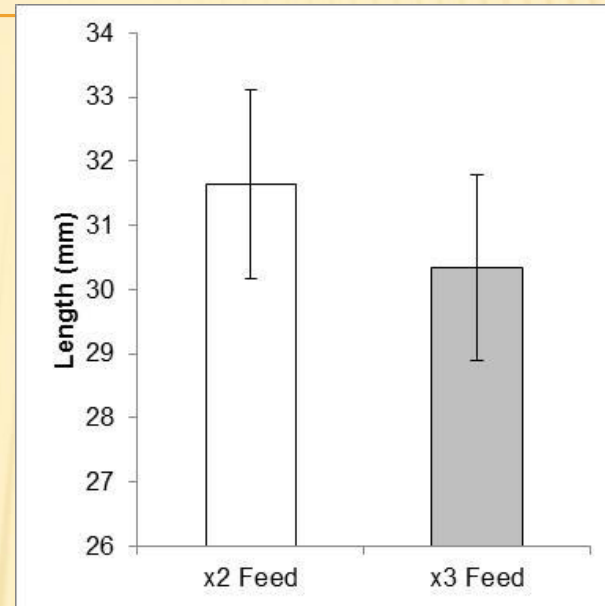


**Same weight
gain from “Low”
& “Medium”**

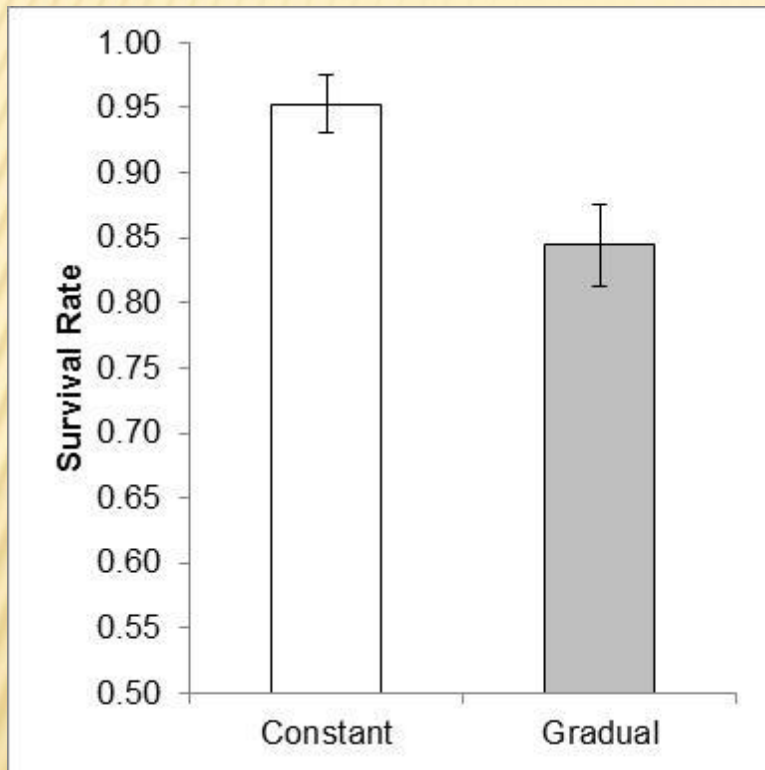
2016 Results: Frequency of Feeding



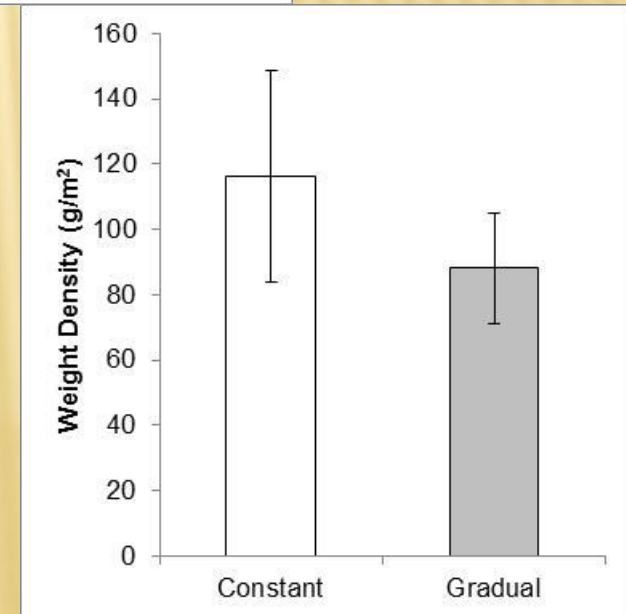
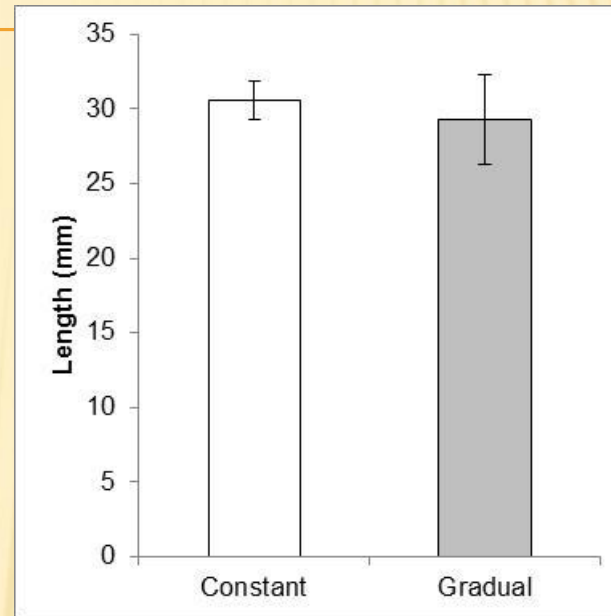
**X3 Better
Survival**



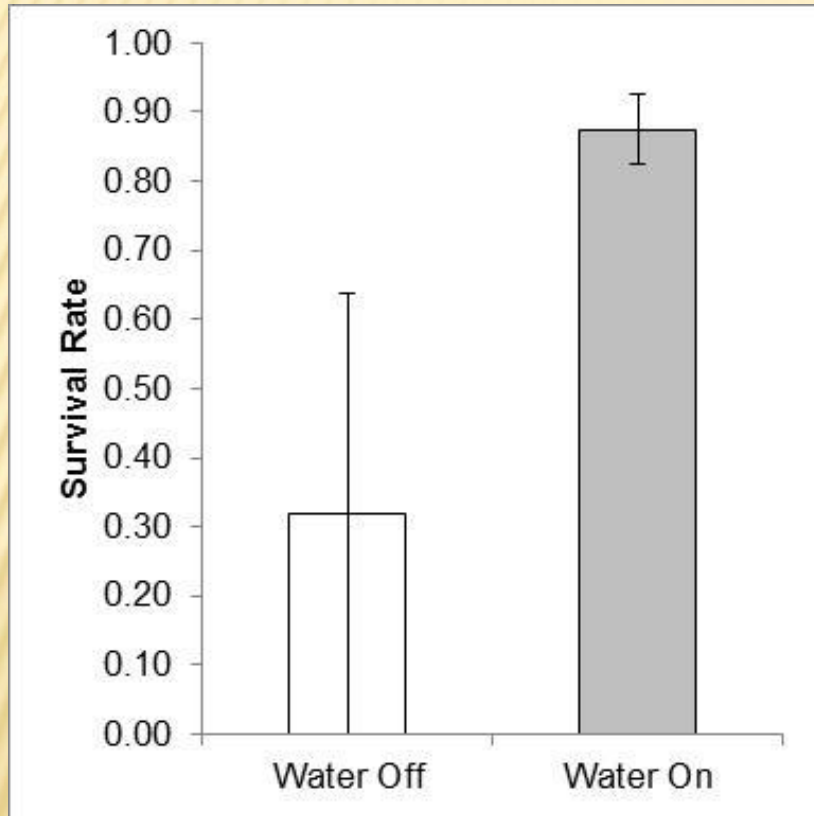
2016 Results: Ramping of Feeding



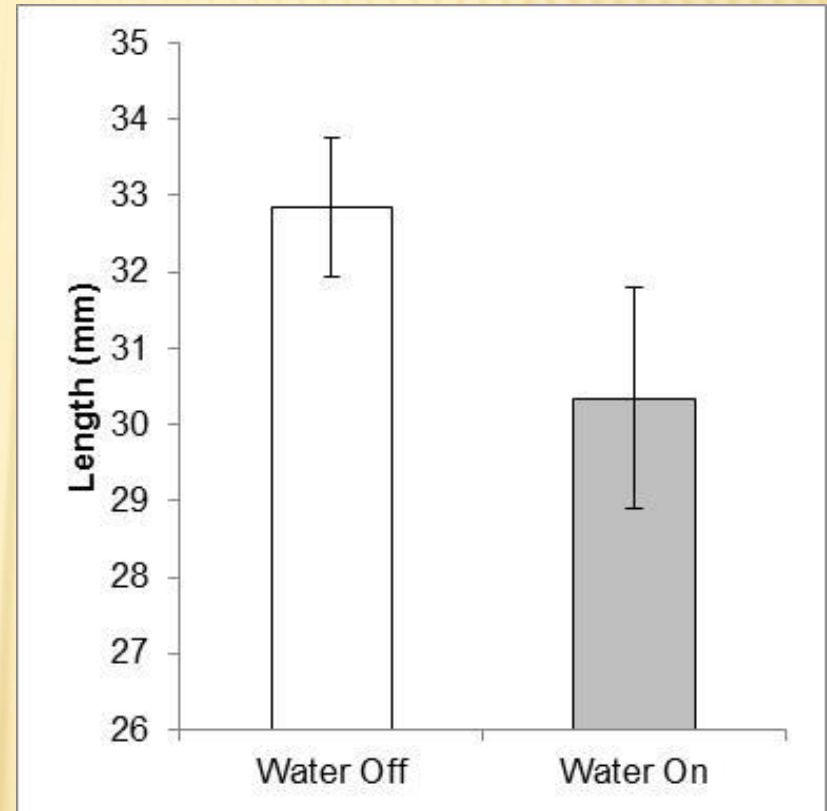
**Constant had
better survival**



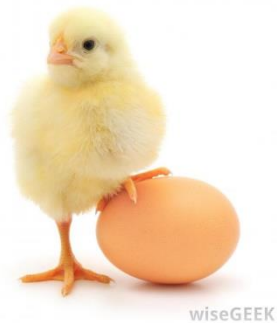
2016 Results: Water Off During Feeding



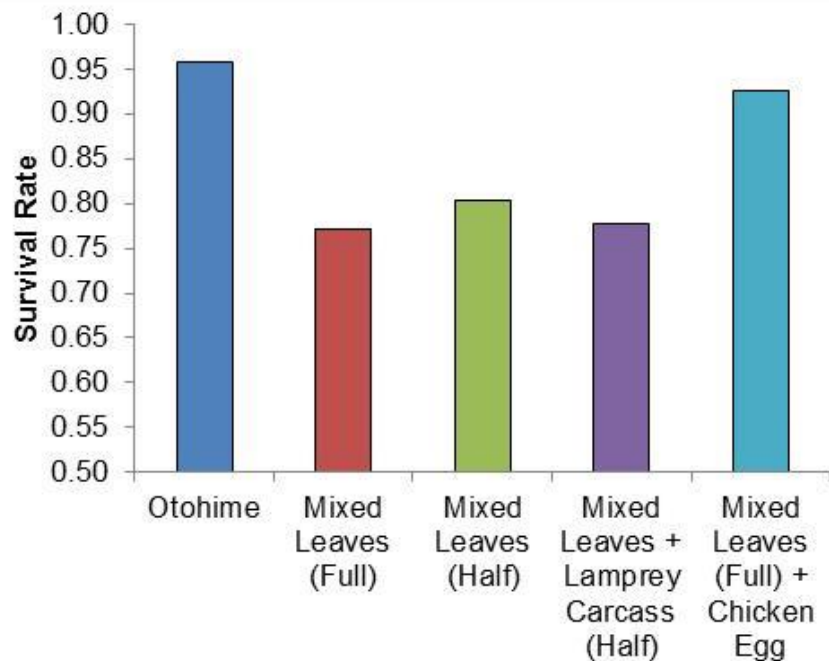
Water Off:
0% Survival in 2
tanks; 96% in 1



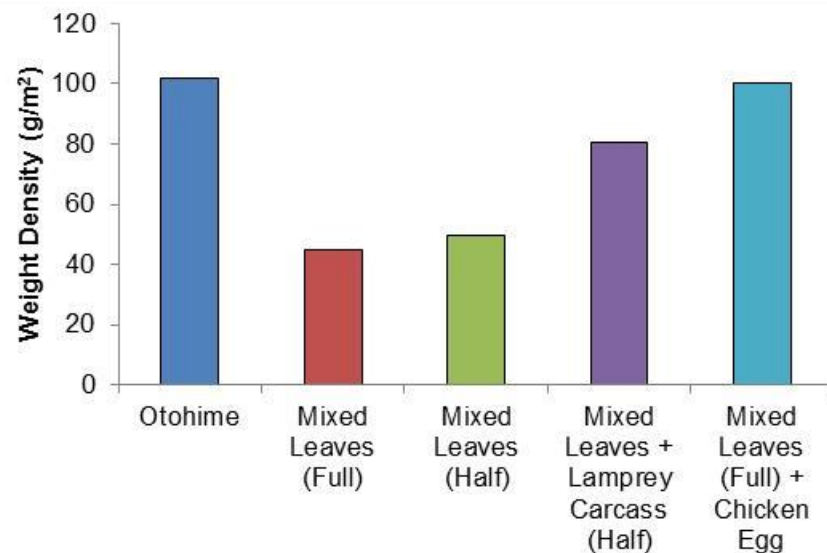
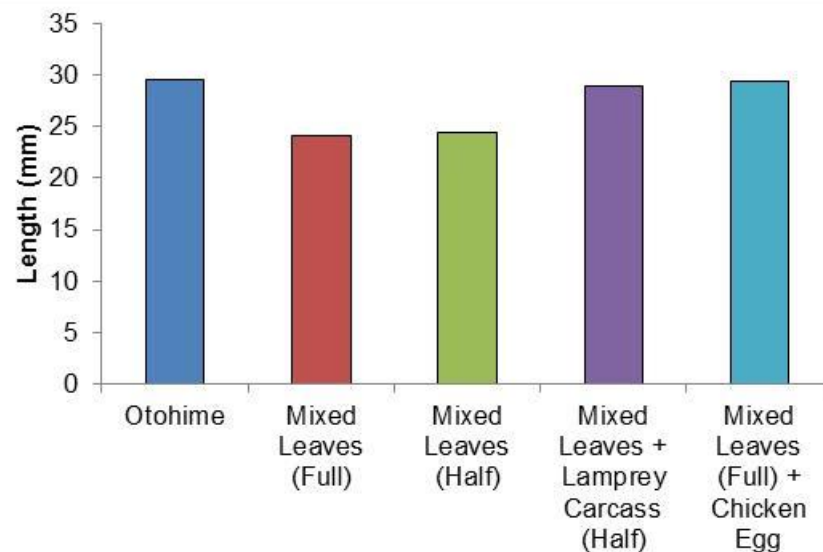
Growth Rate
Promising



2016 Results: Alternate Feeds



**“Chicken Egg /
Mixed Leaves”
had comparable
survival**

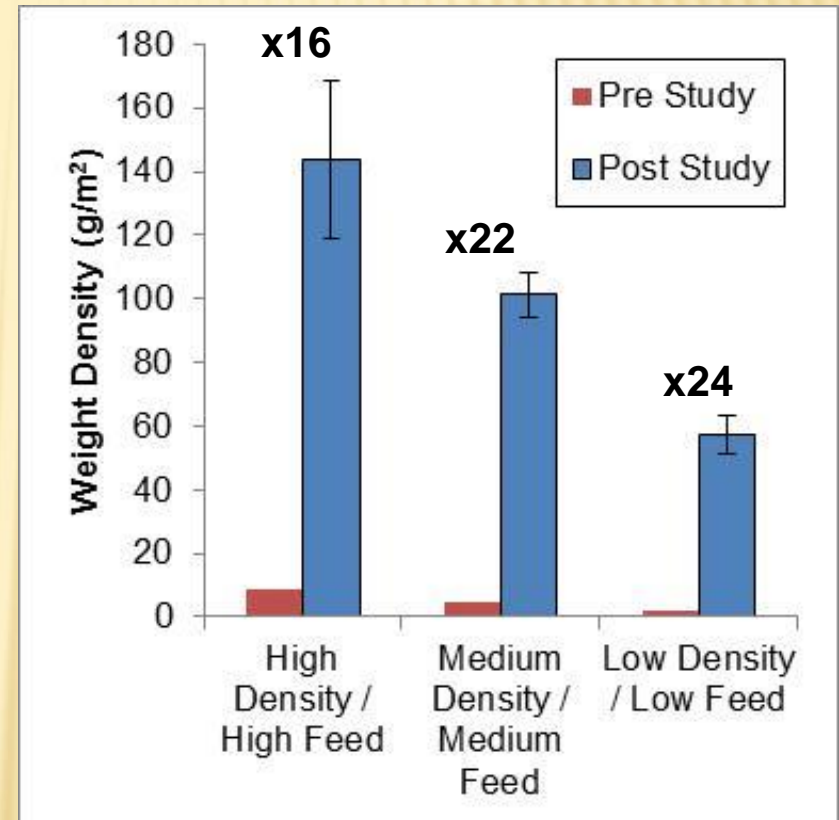


Results: Summary

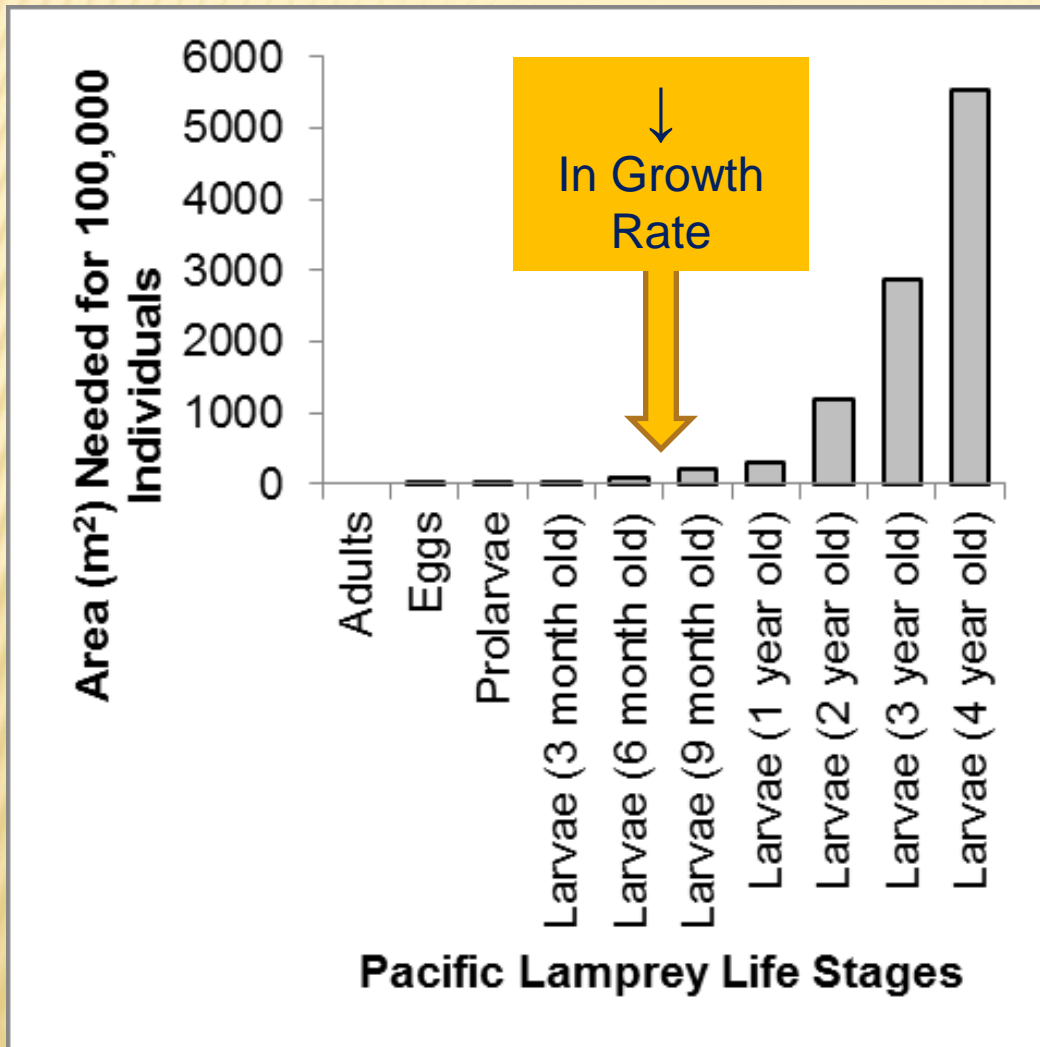
2015 = 72% Ave. Survival
2016 = 85% Ave. Survival
(2012-2013 = 10-30%)

11 mm Ave. Growth/Month
52 mm in early November
(Wild YOY 15-40mm)

0.3 g Ave. Growth/Month



Space Requirement



Space (m²) Needed for 100,000 individuals

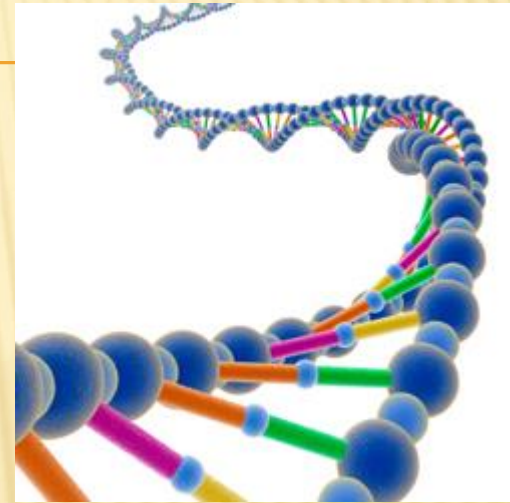
- Eggs = 0.13
- Prolarvae = 2.0
- 3 month old = 14
- 6 month old = 97
- 9 month old = 199
- 1 year old = 319
- 2 year old = 1,205
- 3 year old = 2,889
- 4 year old = 5,553

Optimal Release Sites

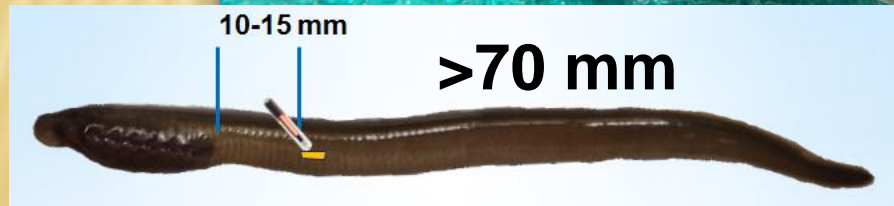
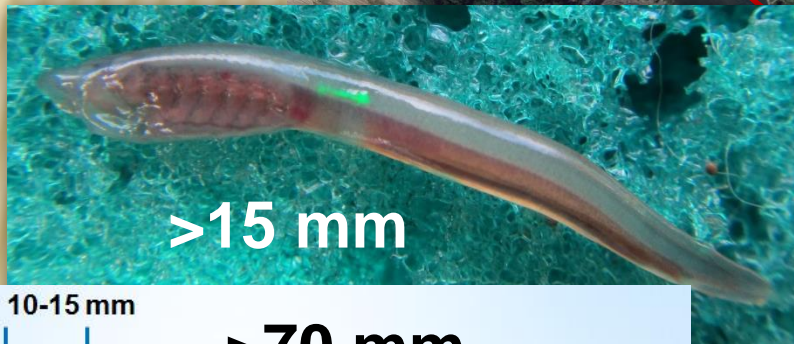
Side Channels



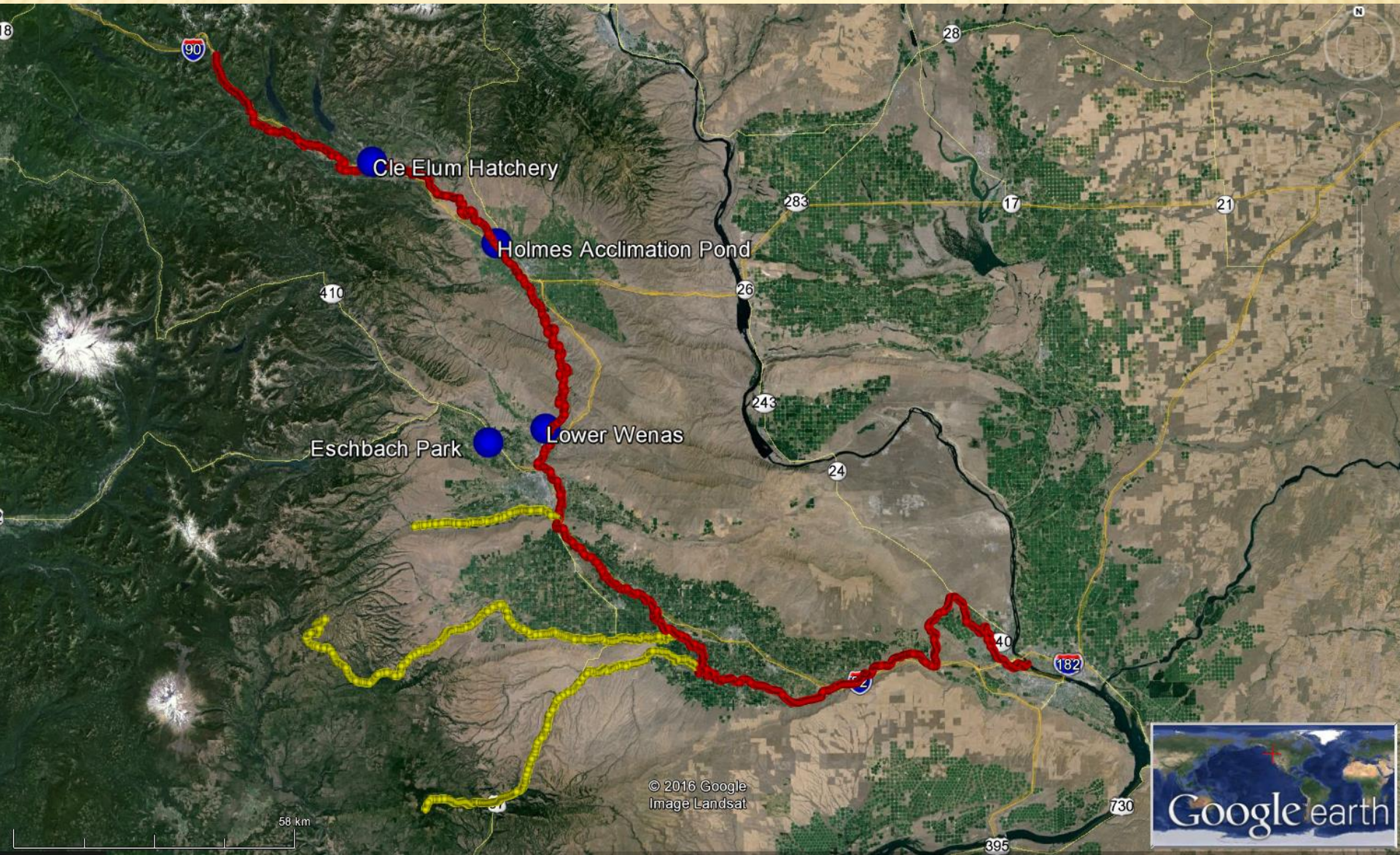
Acclimation
Ponds



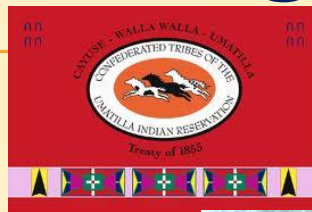
Canals



Larval Outplanting Sites



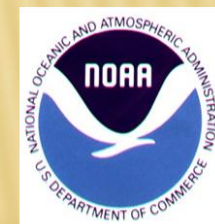
Acknowledgement



Ralph Lampman

509-388-3871

lamr@yakamafish-nsn.gov



Partnership is key to our success!