



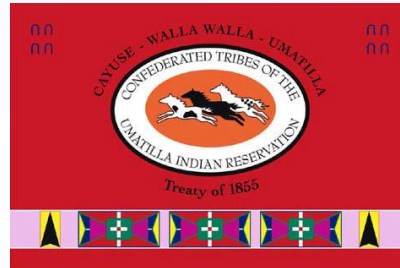
***Pacific Lamprey Supplementation:  
“Look out, propagated lamprey  
coming near YOU!”***



**Yakama Nation**

**Ralph Lampman, Bob Rose, Patrick Luke, Dave’y Lumley, Tyler Beals, and Frank Spillar**

# Shout-Out for Everyone Helping



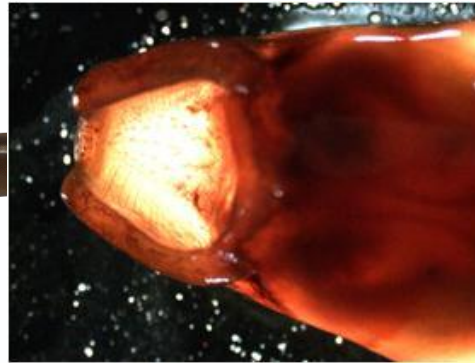
# ***Outline***

- 1. Background**
- 2. Outplanting Plans**
- 3. Updates on Art. Prop. & Rearing**



# Pacific Lamprey (*Entosphenus tridentatus*)

10 – 200 mm



**Ammocoete**

**(larva)**

*Freshwater*

100 – 190 mm



**Macrophthalmia**

**(lamprey smolt)**

*Heading to Ocean*

330 – 800 mm



**Adult**

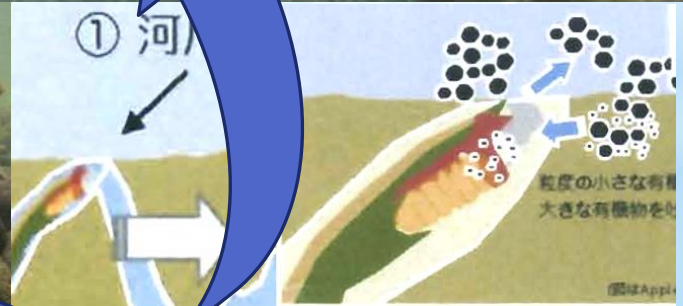
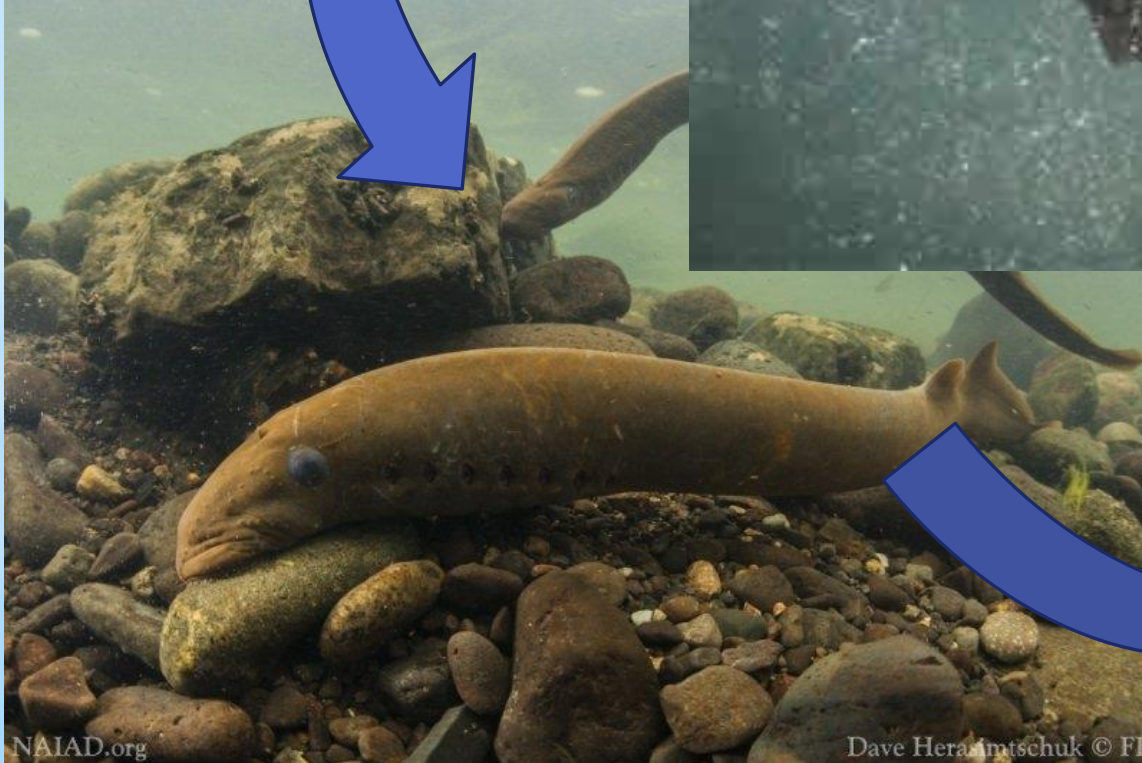
**(spawning)**

*Return to Freshwater*

# Why Should We Care?

Tribal Culture & Food Source

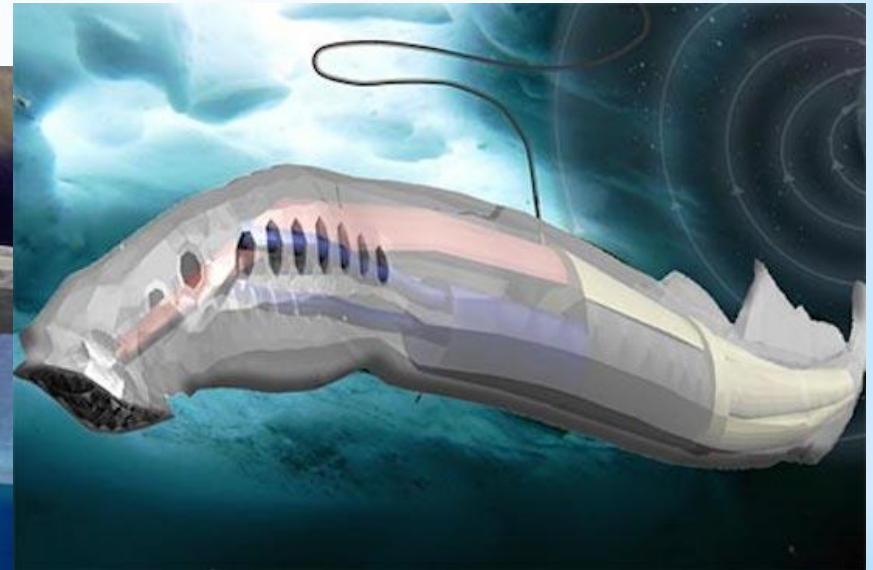
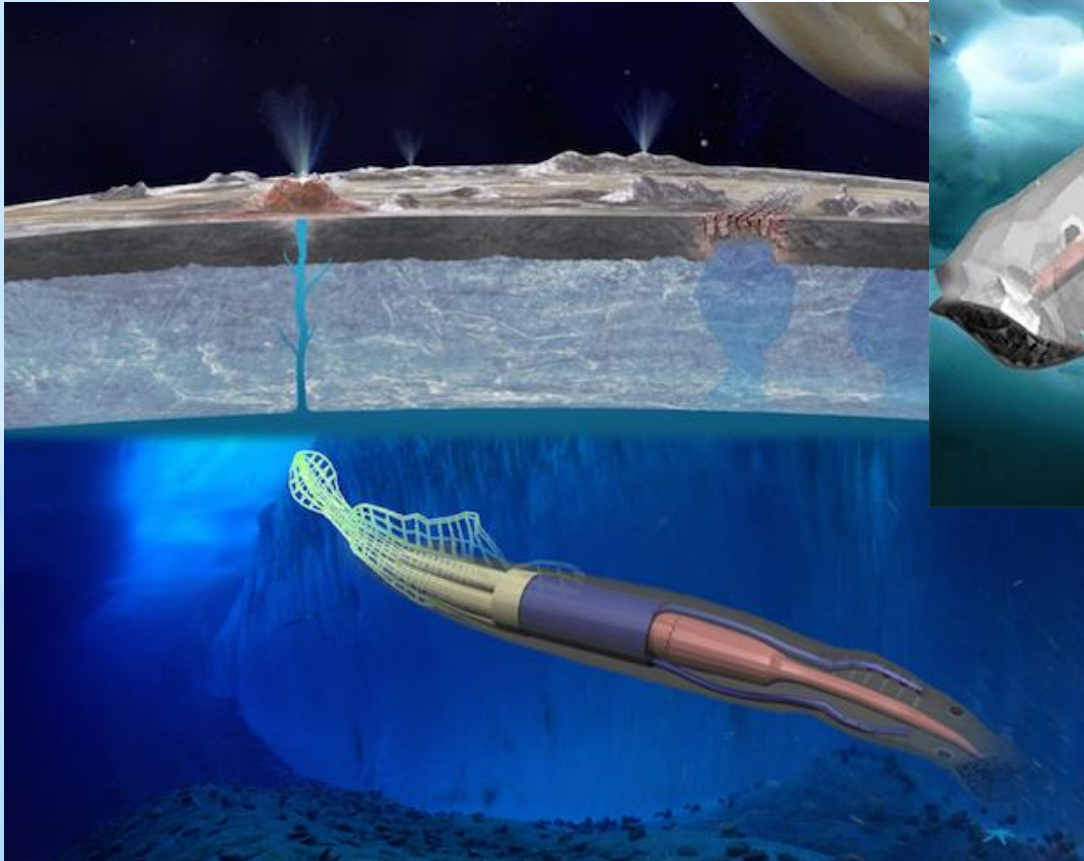
Willamette Falls



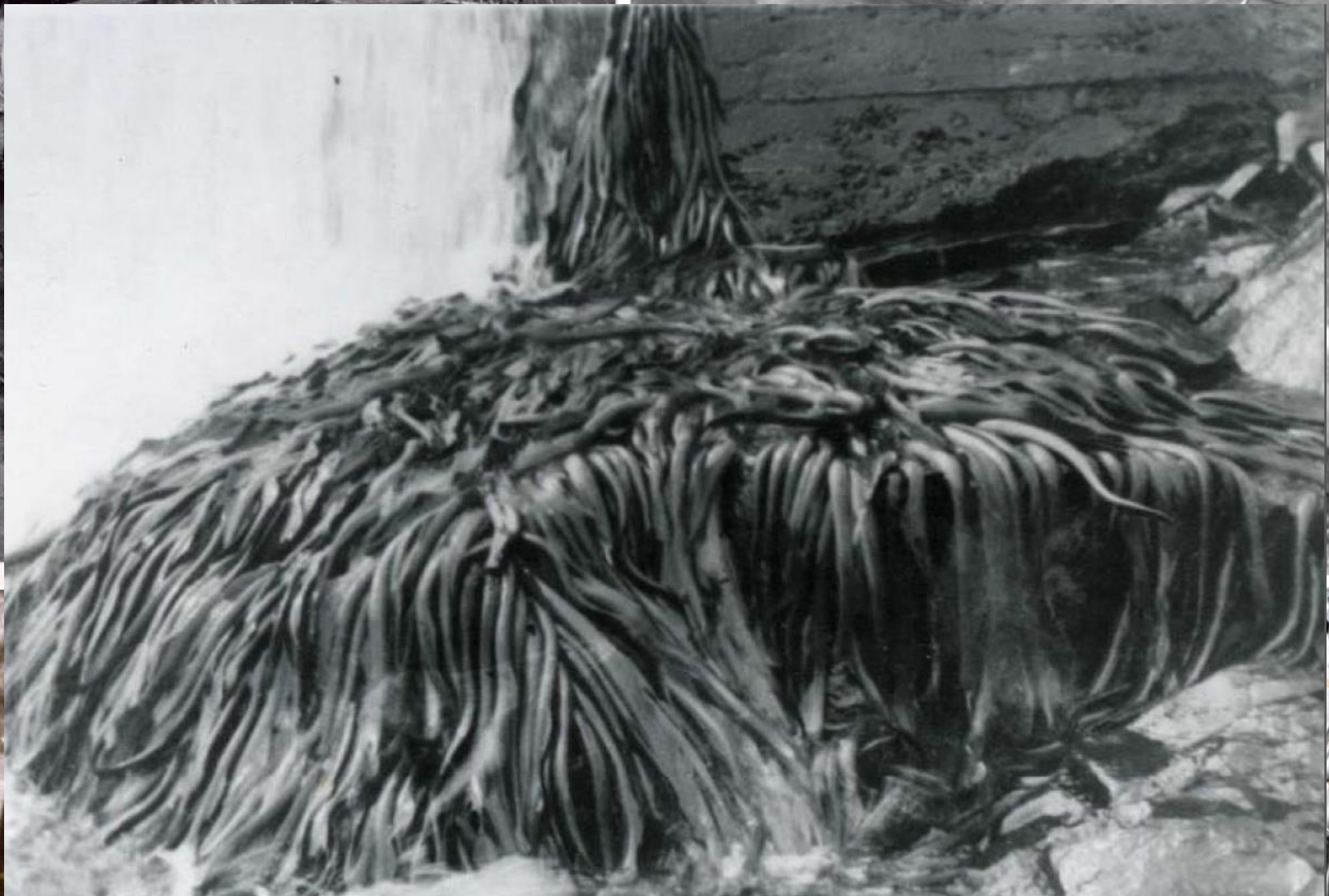
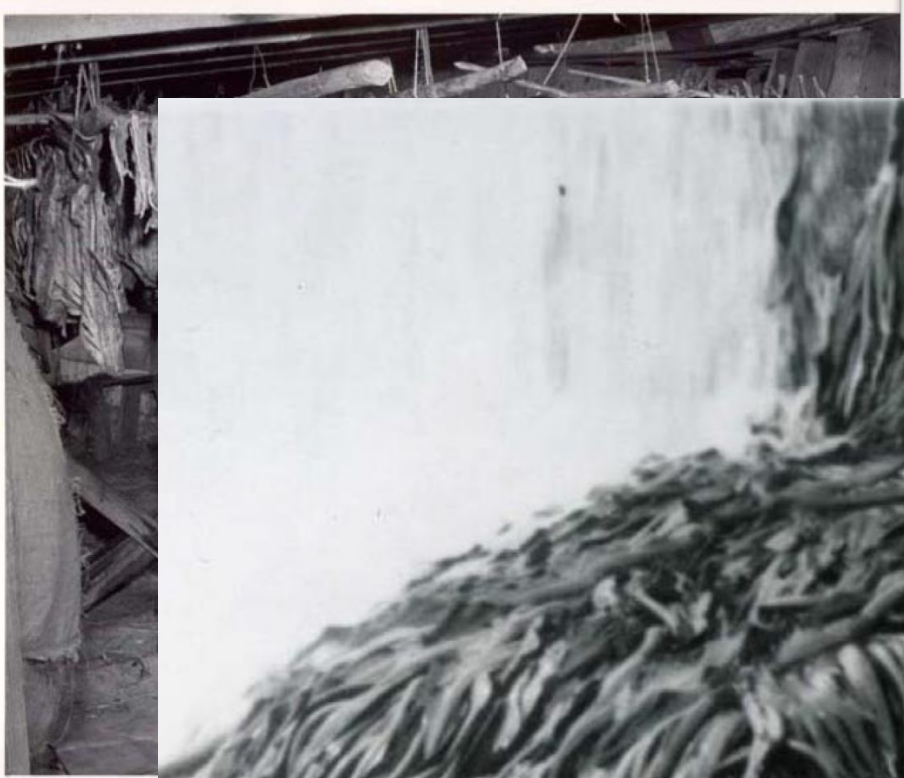
awa ② 移動による耕耘  
(2の結果より)

# “Eel-like robot could explore extraterrestrial oceans” (CBS News)

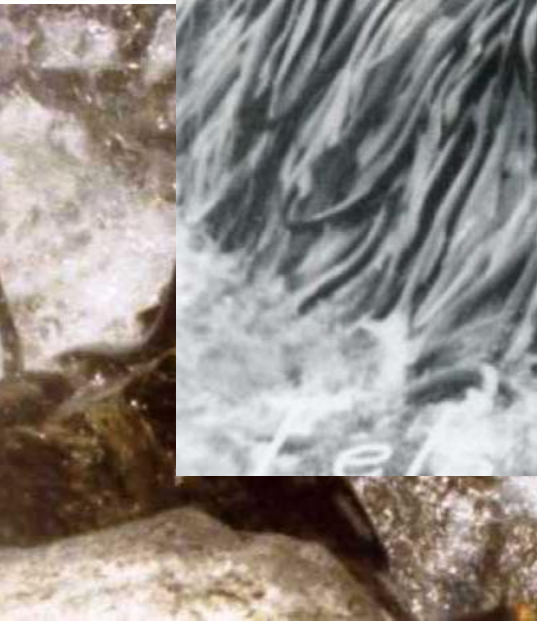
Cornell Uni. (\$100,000 grant) to develop a lamprey-like autonomous robot that could explore Europa (Jupiter’s moon)’s subsurface ocean.



**Harvest powers from locally changing magnetic fields!**



Felt of Willamette Falls. 7/15



# *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**





# Optimal Release Sites

Side Channels



Acclimation Ponds



Canals



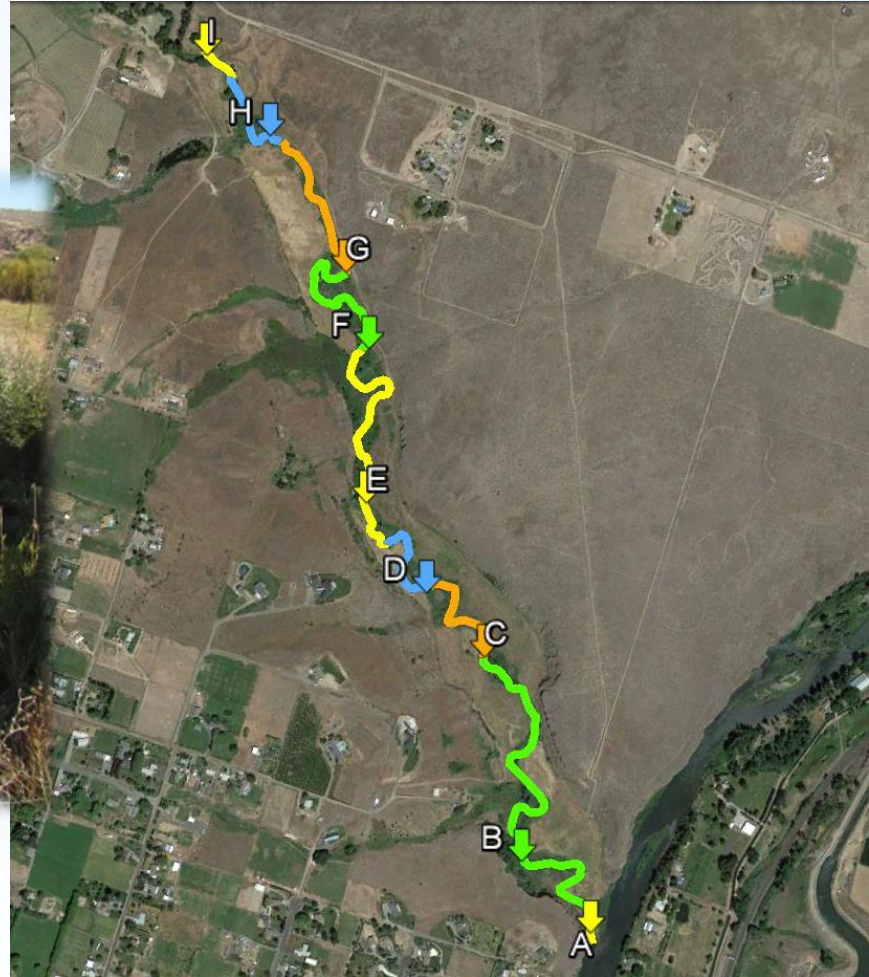
# *Lower Wenas Site (Yakima, WA)*

## *Year 1 Only*

Habitat Area =  
8101 m<sup>2</sup>



Carry Capacity =  
49,475 larvae



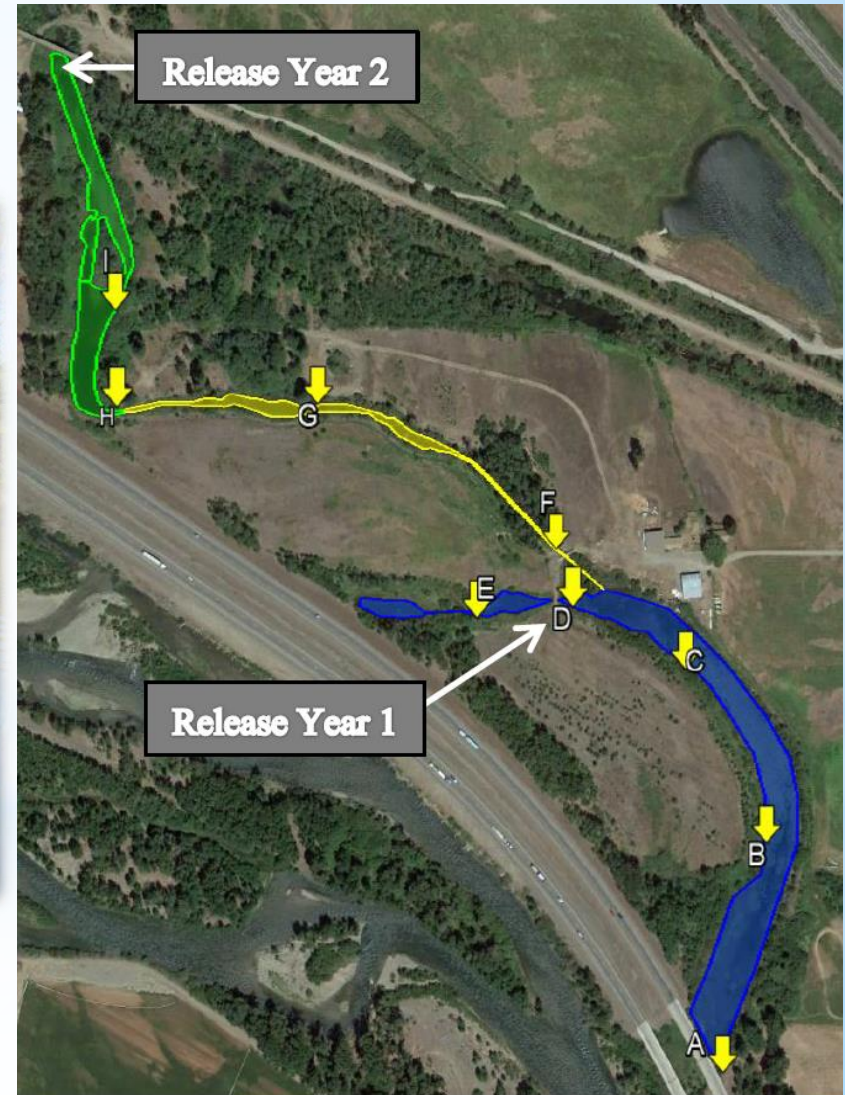
# Holmes Acclimation Site (Ellensburg, WA)

## Year 2-3

Habitat Area =  
17,414 m<sup>2</sup>



Carry Capacity =  
149,600 larvae



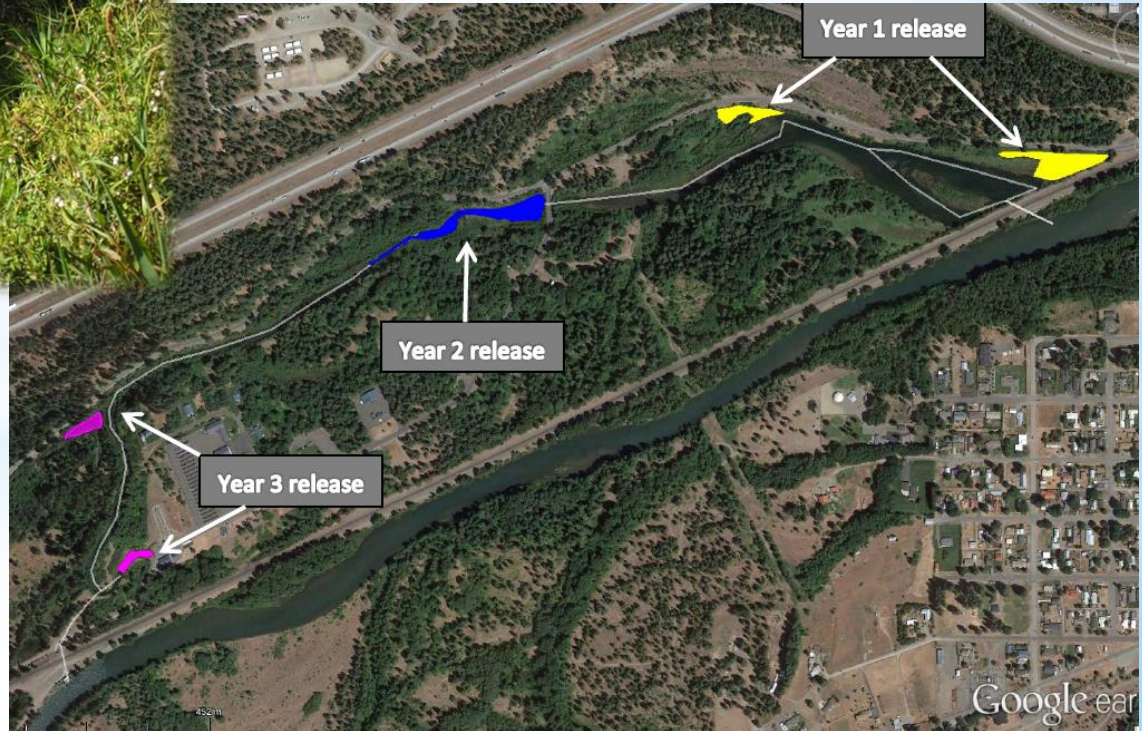
# Cle Elum Hatchery Site (Cle Elum, WA)

## Year 1-3



Habitat Area =  
45,896 m<sup>2</sup>

Carry Capacity =  
291,530 larvae



# ***Eschbach Park Site (Naches, WA)***

## ***Year 1-3***

**Habitat Area =  
23,425 m<sup>2</sup>**



**Carry Capacity =  
197,636 larvae**



# *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 (*ENTOSPHEMUS*  
*TRIDENTATUS*) FOR SPECIES RECOVERY AND  
RESTORATION

RALPH T. LAMPMAN<sup>1</sup>, MARY L. MOSER<sup>2,3</sup>,  
AARON D. JACKSON<sup>2</sup>, ROBERT K. ROSE<sup>1</sup>, ANN  
L. GANNAM<sup>4</sup>, AND JAMES M. BARRON<sup>4</sup>,

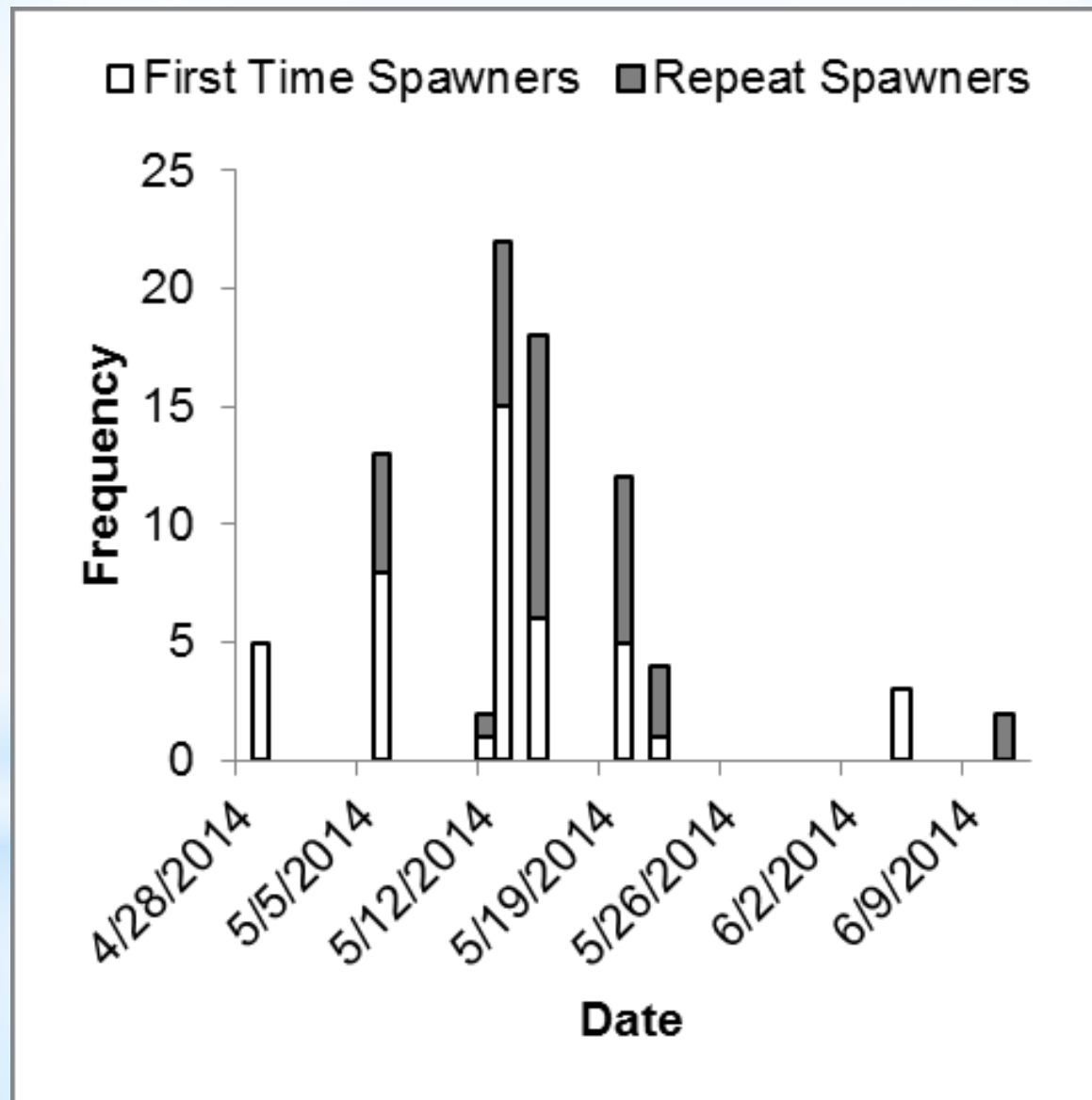
<sup>1</sup> Yakama Nation, Department of Natural Resources, Fisheries Resources Management Program, 401 Fort Road, Toppenish, WA 98948, USA

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

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

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

# Propagation



# Propagation

Eggs (70~190 g)

\*Ave. 33% of body weight

\*Ave. 90,000 eggs

Milt (0.1~9.0 g)

\*Ave. 2.0 ml

\*repeat spawn in 2 days



**Egg stickiness & buoyancy**



# Egg Fertilization

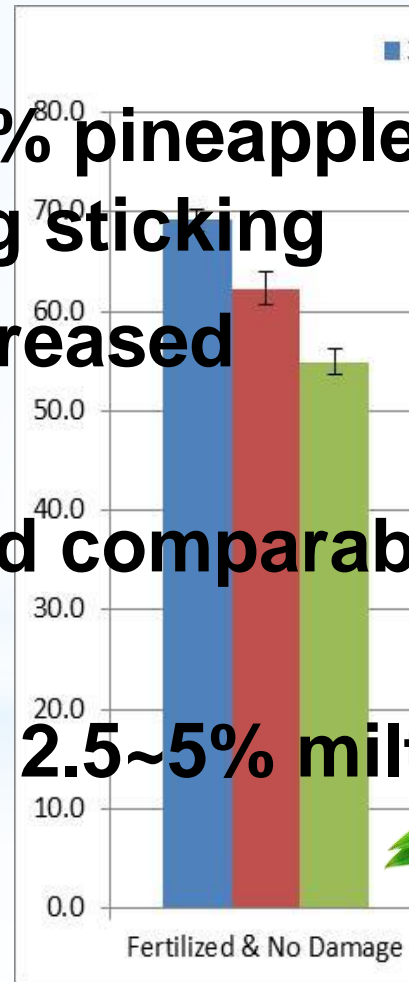
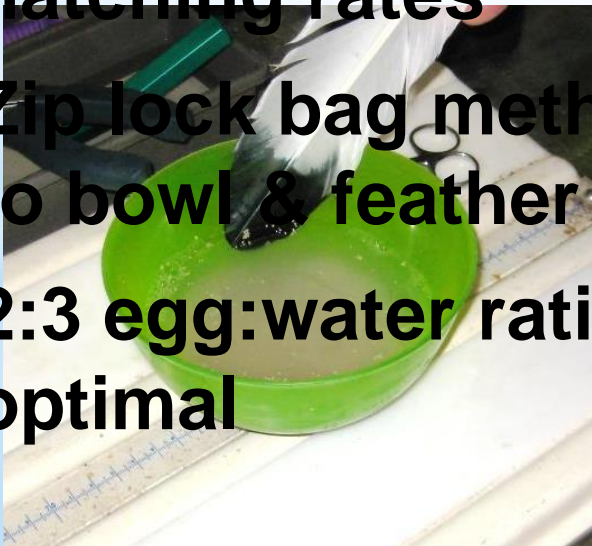
- Reduced wait time works better (3 vs. 6 vs. 12 min)

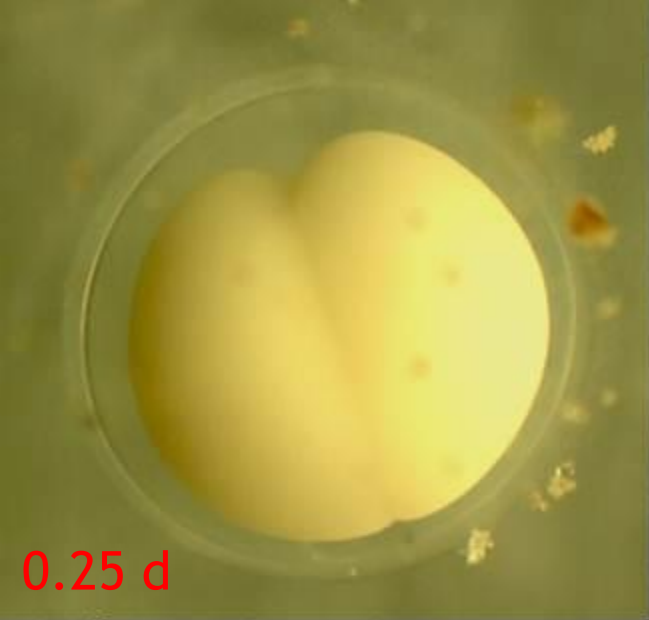
- 1-2 min mixing in 1% pineapple juice eliminates egg sticking

- Rinsing 3 times increased hatching rates

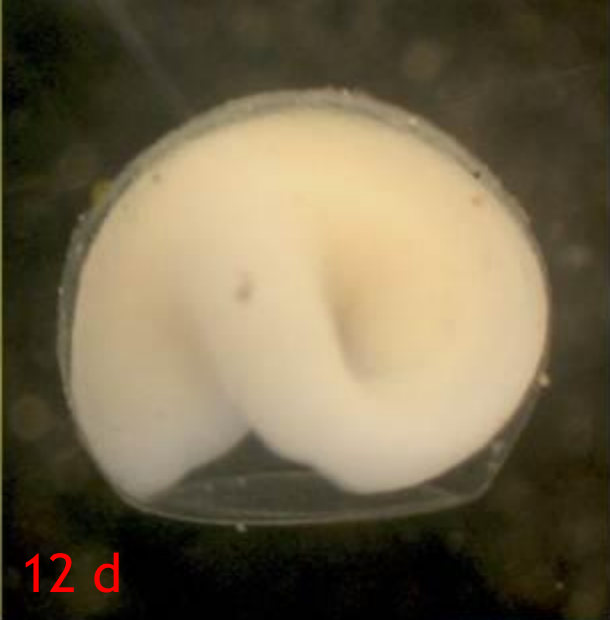
- Zip lock bag method comparable to bowl & feather

- 2:3 egg:water ratio, 2.5~5% milt optimal





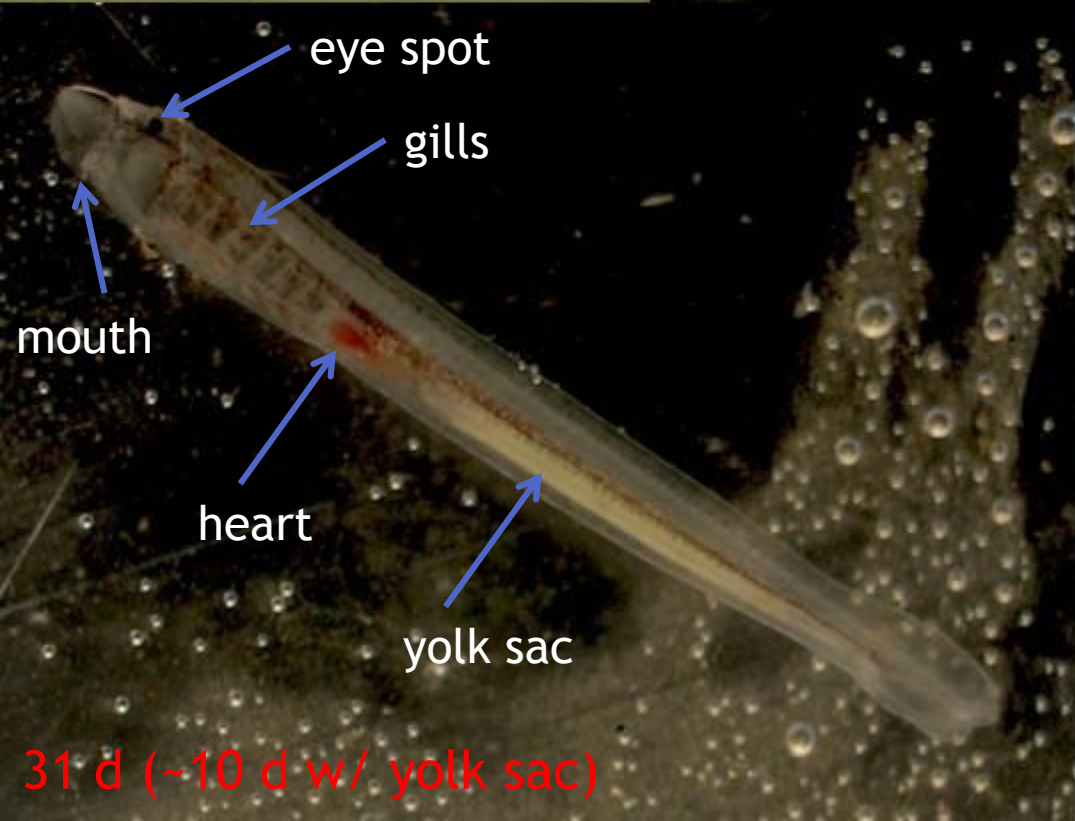
0.25 d



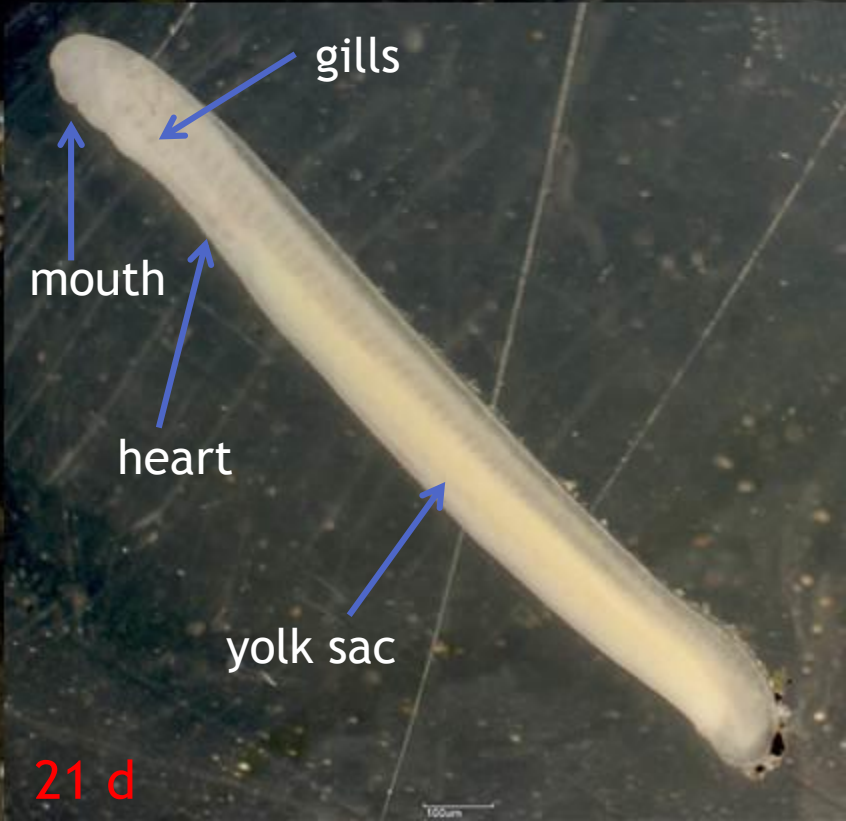
12 d



14 d (~200 dd)



31 d (~10 d w/ yolk sac)



21 d

# *Prolarvae*



# Prolarvae



## Simple

1. Add organisms into the bucket



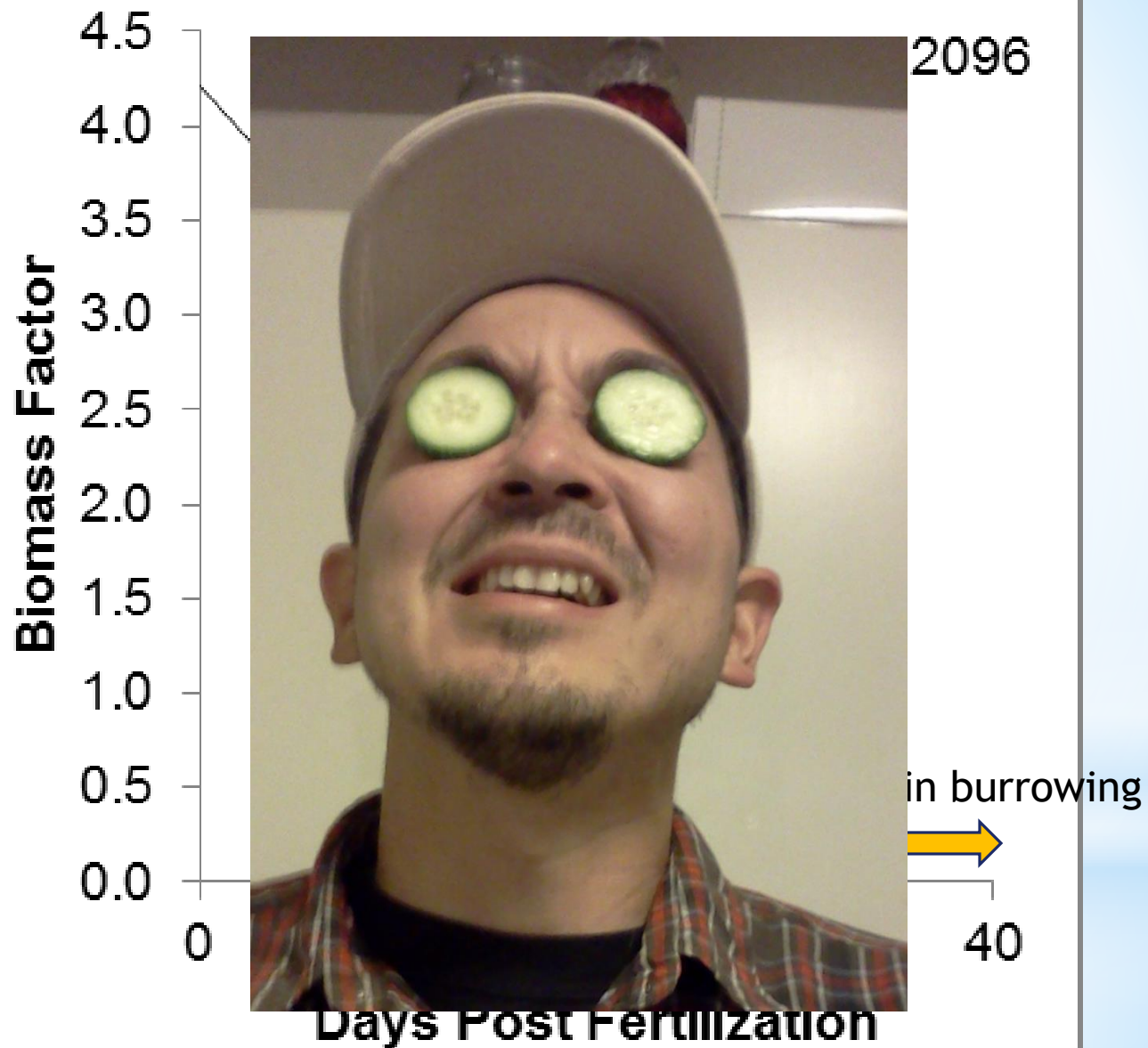
## Accurate

2. Press COUNT



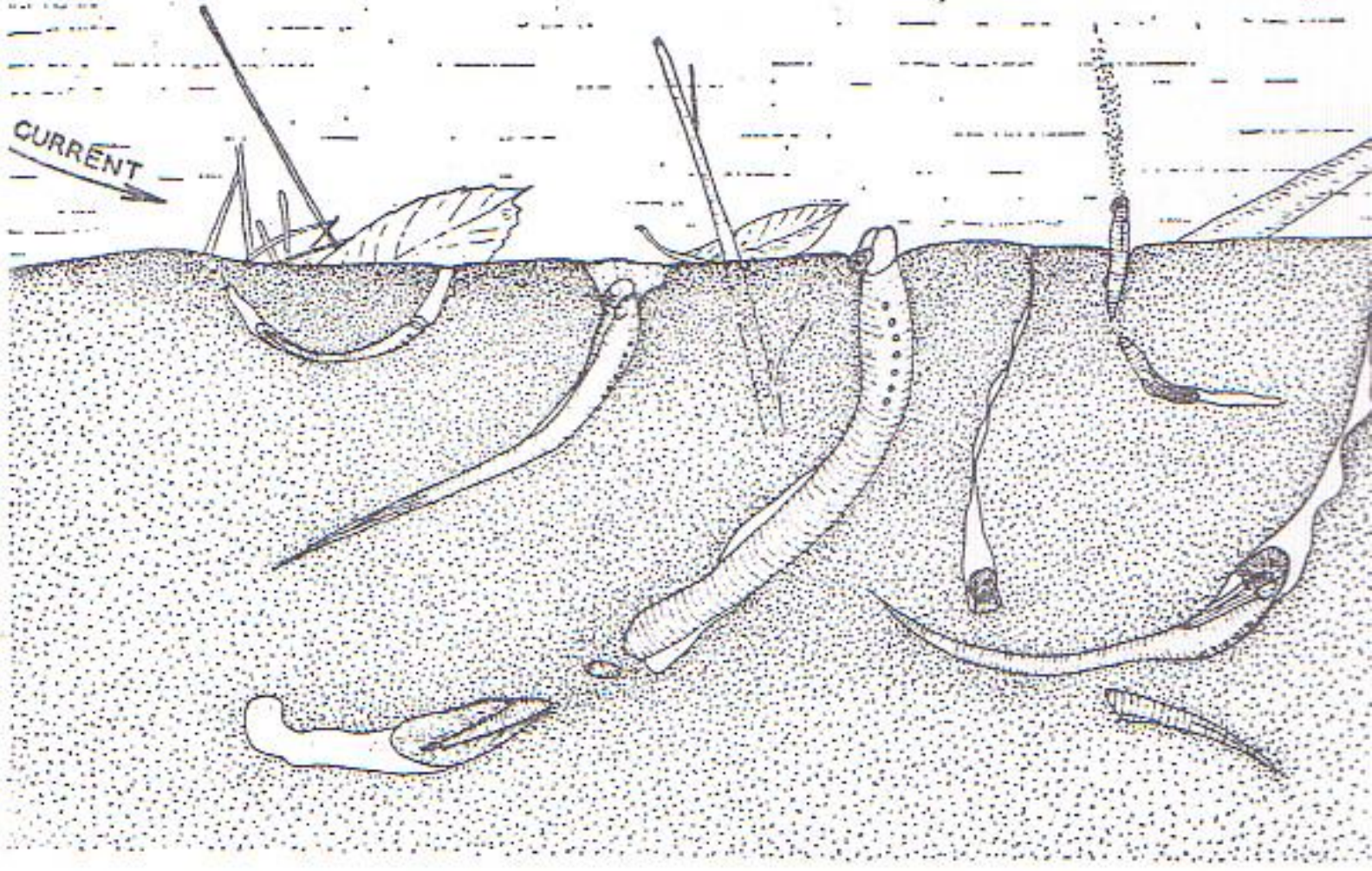
## Versatile

3. Witness accurate results in seconds



# Larvae

**Applegate 1950**



# Types of Food Source

**Organic Matter**



**Salmon Carcass**



**Algae**

**Alfalfa Pellets**



**Whole Wheat Flour**

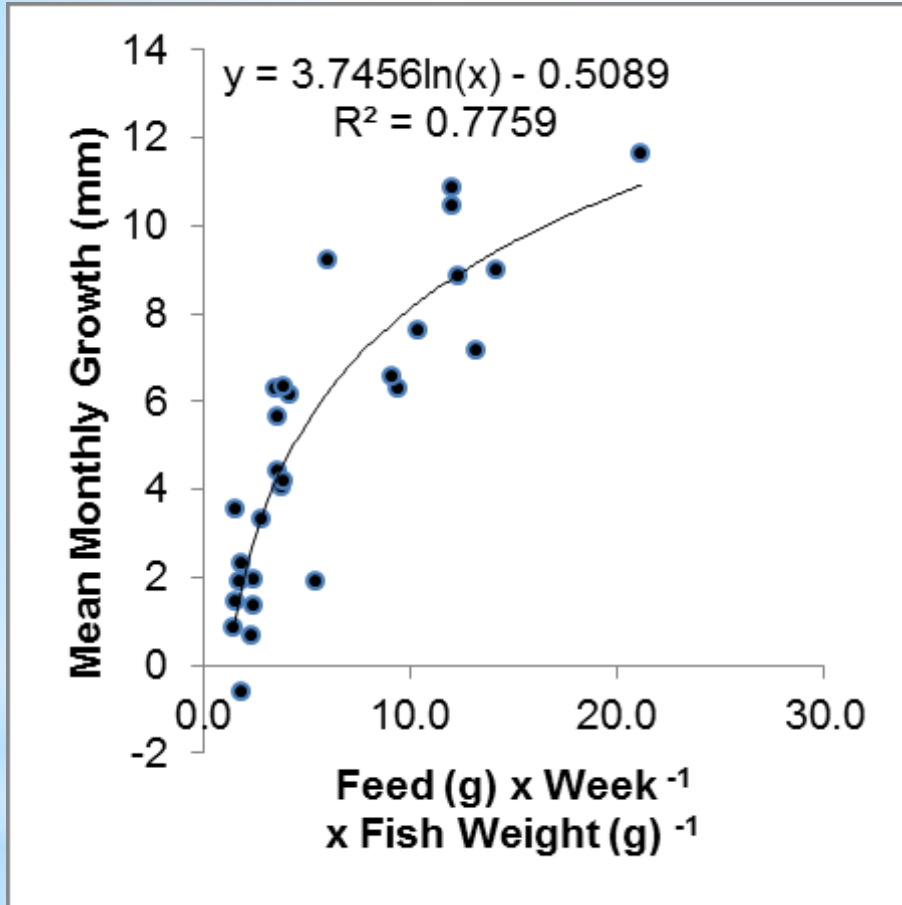


**ACTIVE DRY YEAST**

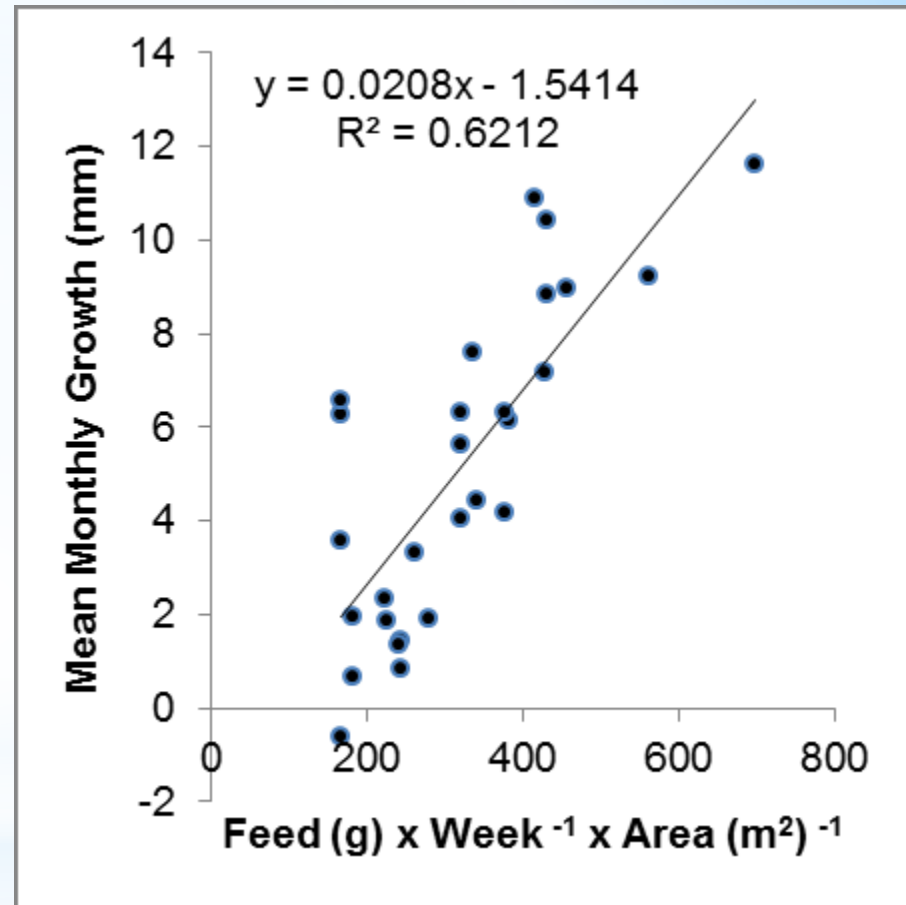
**Aquatic V**



# Feed & Growth Rates



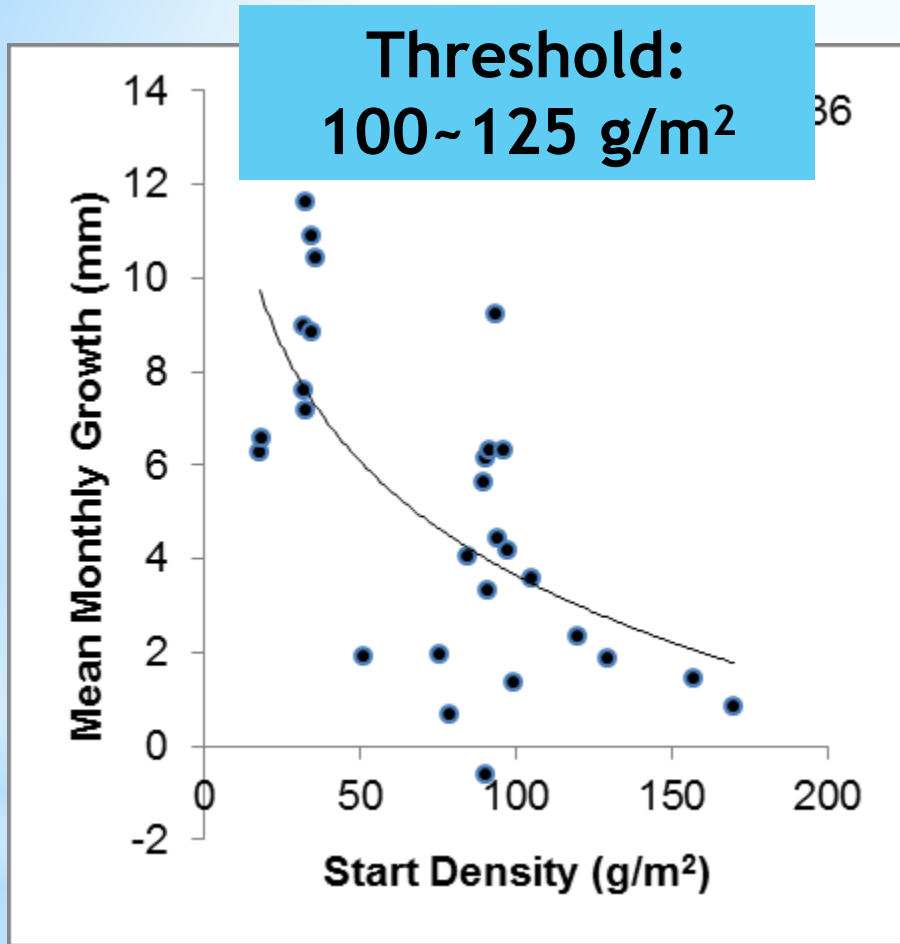
**Feed per Fish  
Weight**



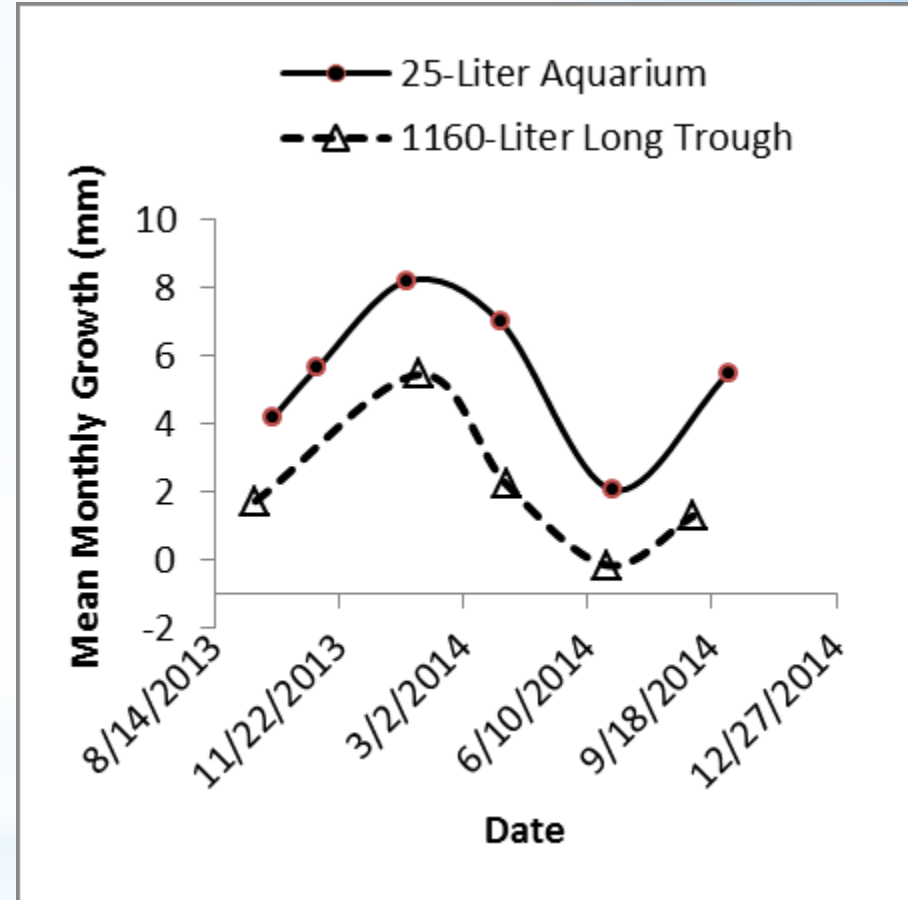
**Feed per Area**



# Density, Season & Growth Rates

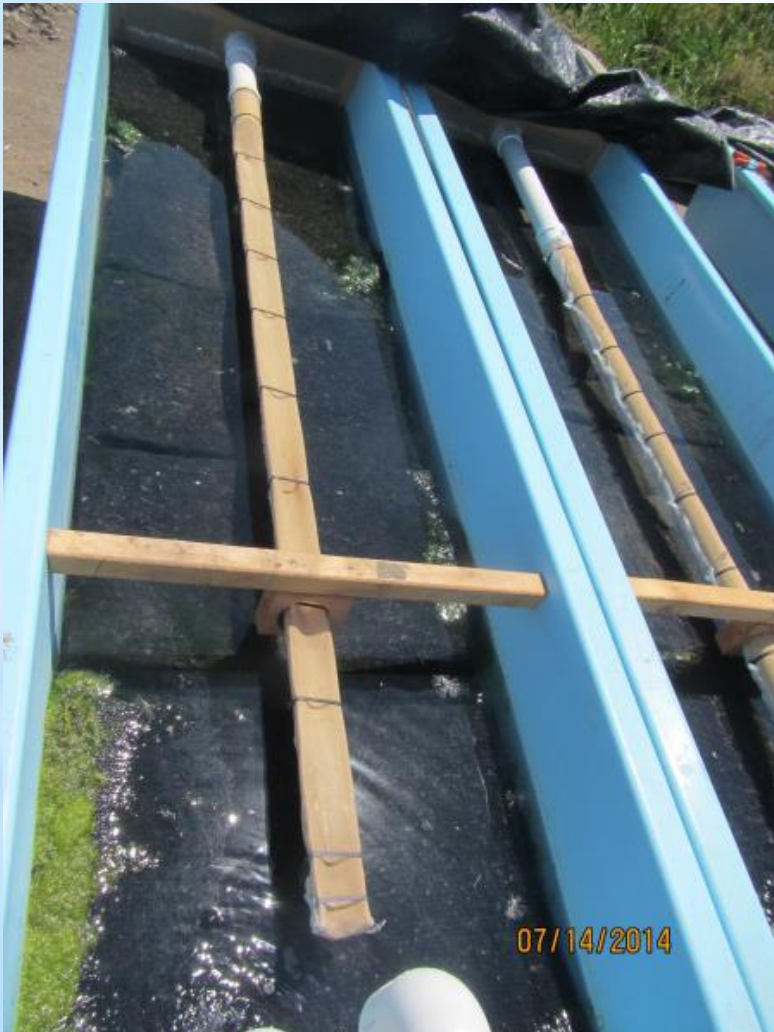


Start Density  
( $<125 \text{ g/m}^2$ )

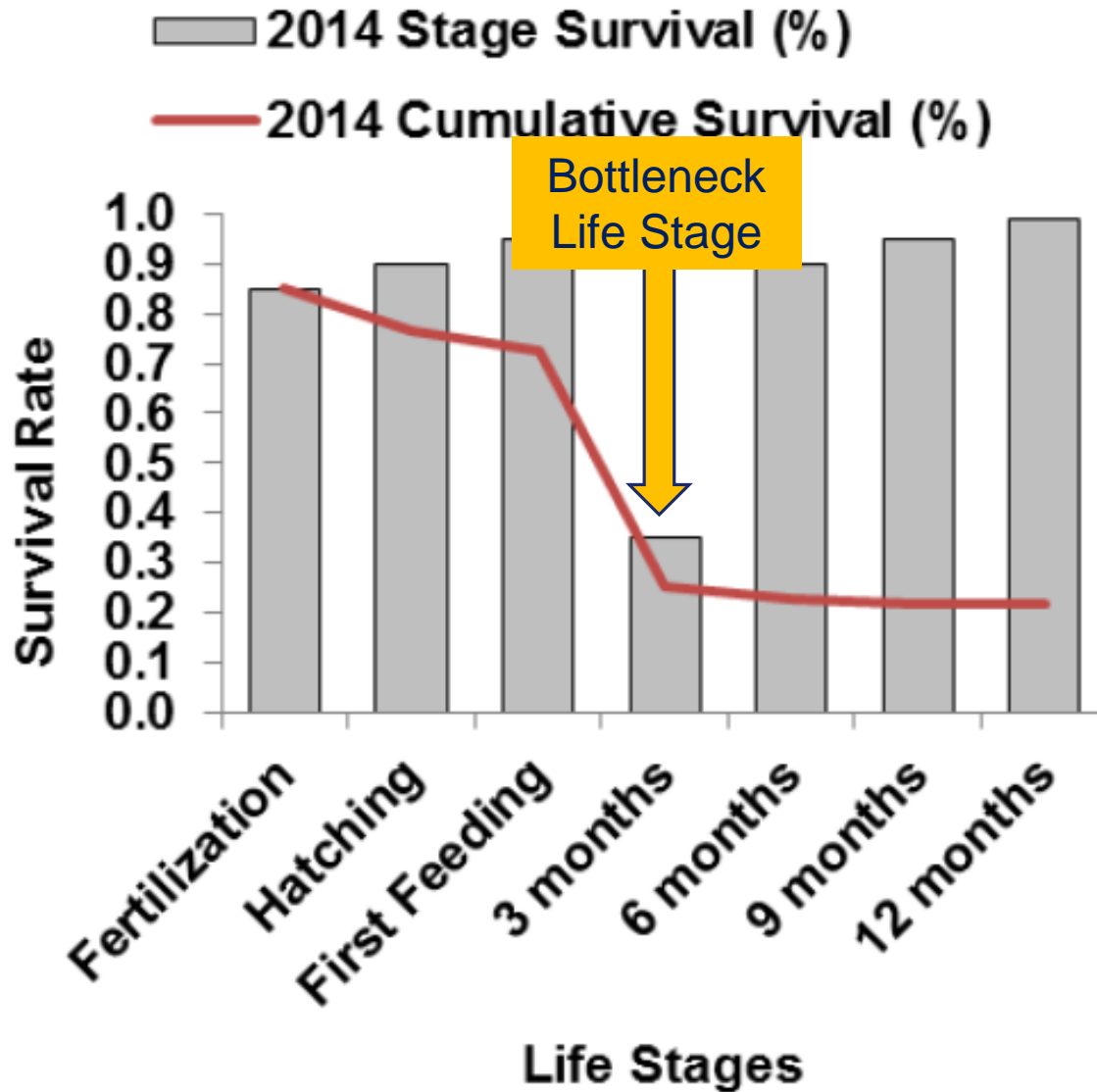


Season  
(winter = high,  
summer = low)

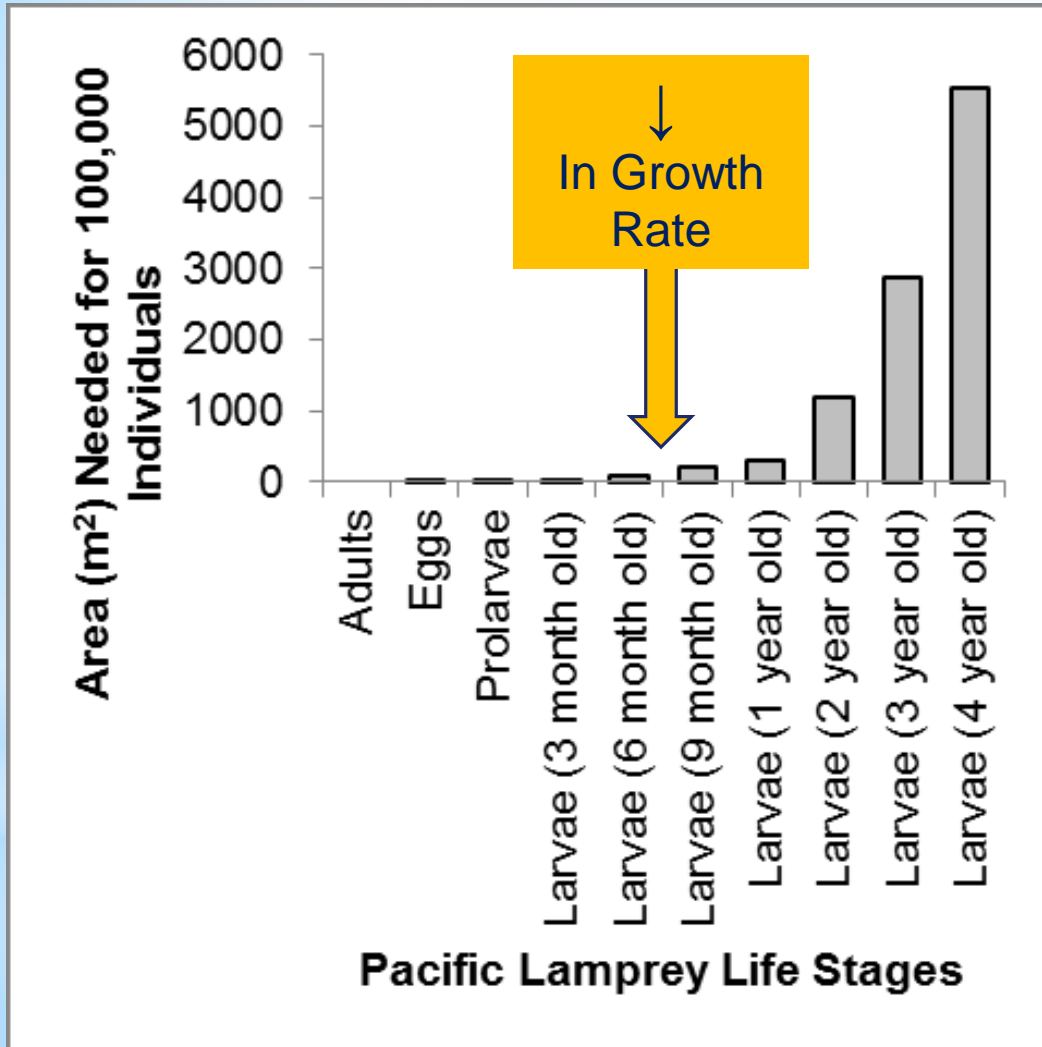
# Tank Settings and Gear



# Life Stage Survival Rates



# Space Requirement



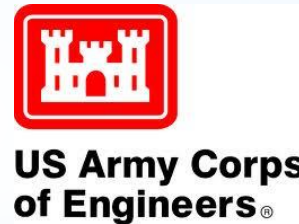
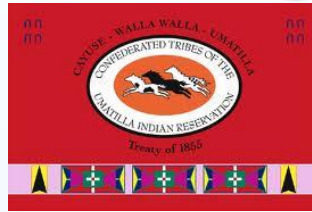
Space (m<sup>2</sup>) Needed for 100,000 individuals

- 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 = 1205
- 3 year old = 2889
- 4 year old = 5553

# Back to the Wild!



# Acknowledgement



**Partnership is key to our success!**