Artificial Propagation & Lamprey Culture – Where to Go from Here?

Lamprey Summit 12-6-17

Yakama Nation Fisheries

Ralph Lampman, Bob Rose, Tyler Beals, Dave'y Lumley, Sean Goudy, Leona Wapato, Shekinah Saluskin

Outline

1. Background
2. Density Studies
3. Space Requirements by Life Stage
4. Outplanting Strategies (YNF)
   & Future Plans

Shout-Out for Everyone Helping

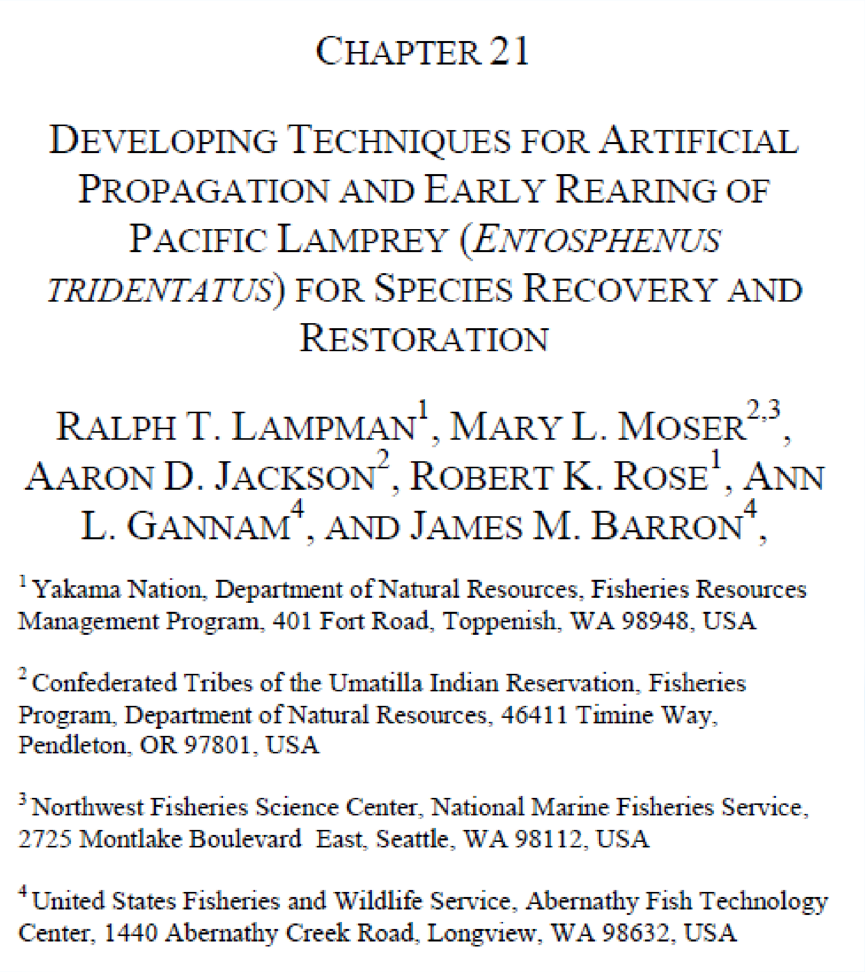
FISHERIES
YKFP
YAKAMA NATION

YAKAMA INDIAN NATION
TREATY OF 1855

CAYUSE - WALLA WALLA - UMATILLA
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION
Treaty of 1855

Art. Prop. & Rearing Protocols

AFS Book “Jawless Fishes of the World”


CHAPTER 21

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

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

[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

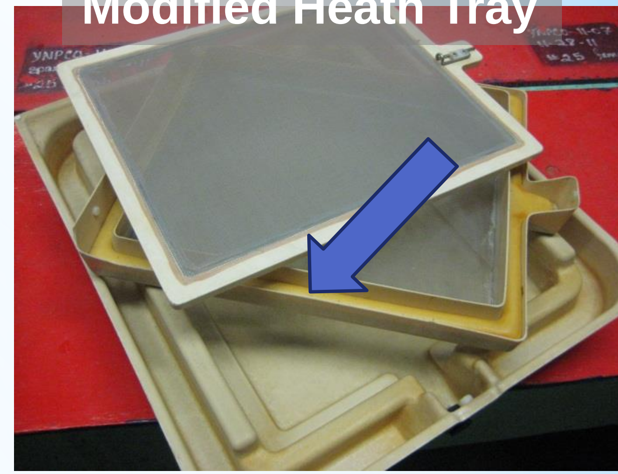
[4] United States Fisheries and Wildlife Service, Abernathy Fish Technology Center, 1440 Abernathy Creek Road, Longview, WA 98632, USA

Egg Incubation Tests

McDonald Jars

Tuperware Method

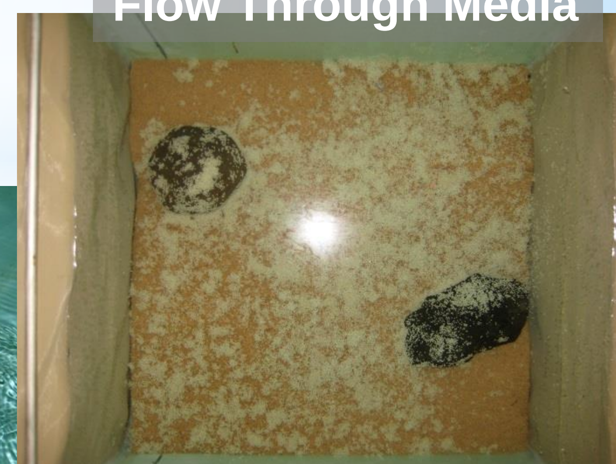
Modified Heath Tray



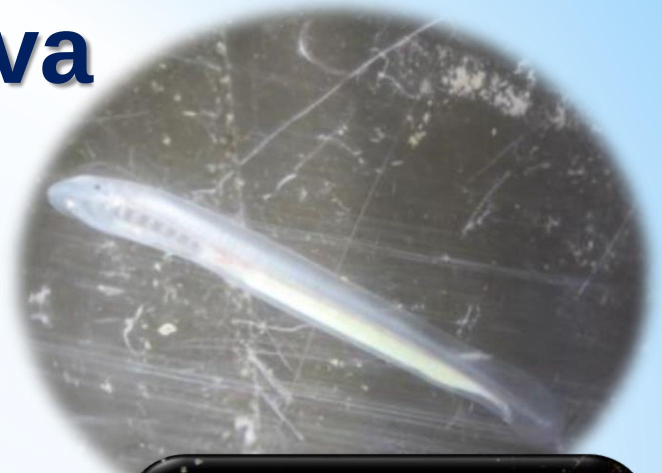
Eager Upwelling Jars

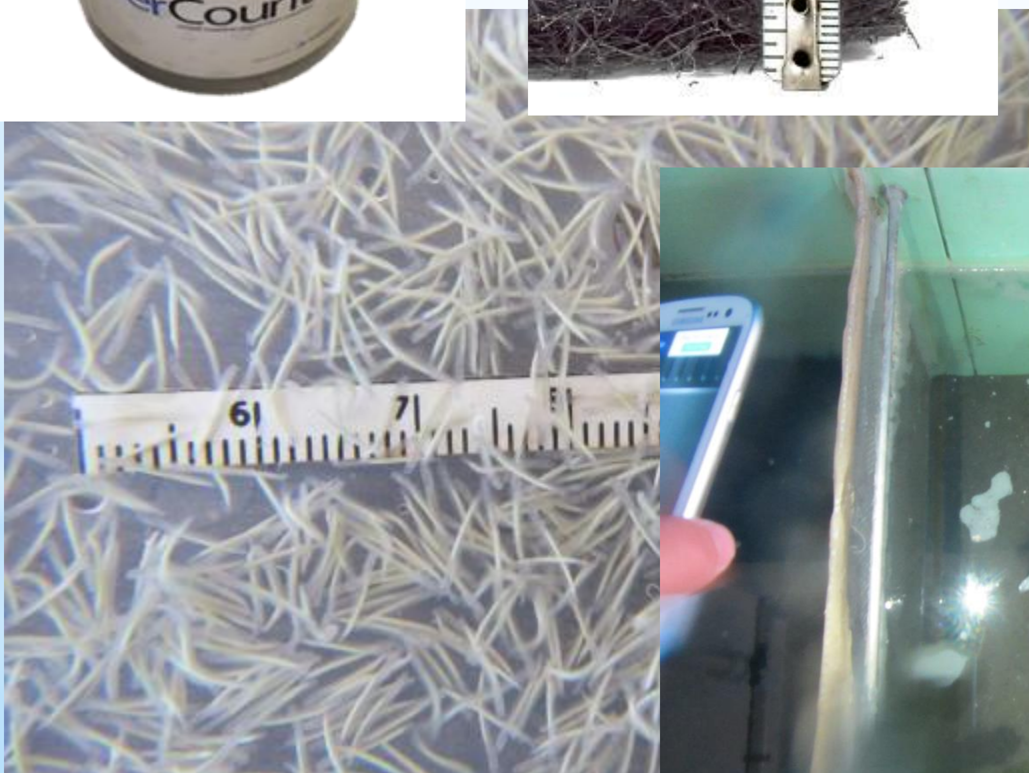
Downwelling Buckets

Flow Through Media



Prolarva->Larva

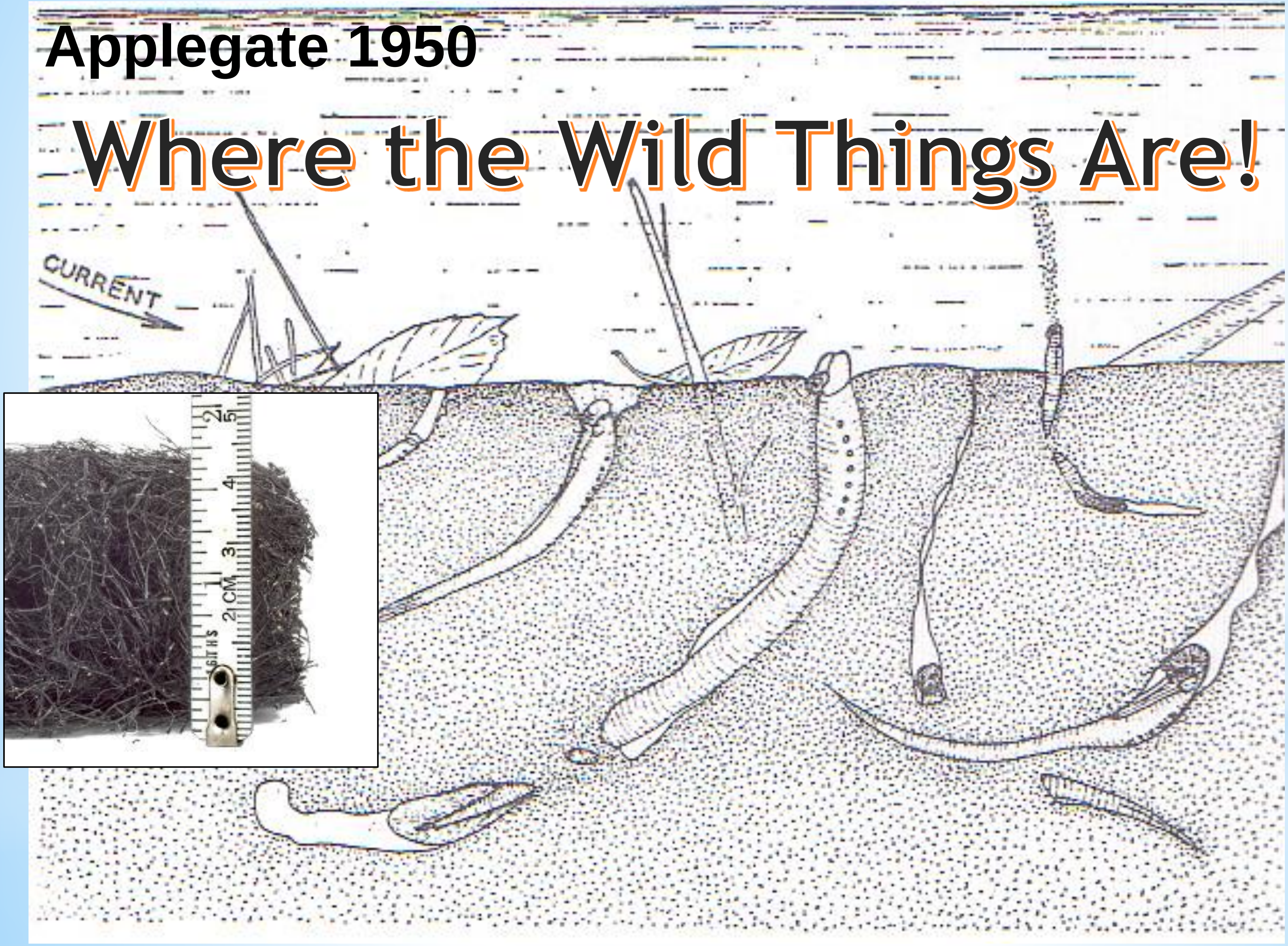




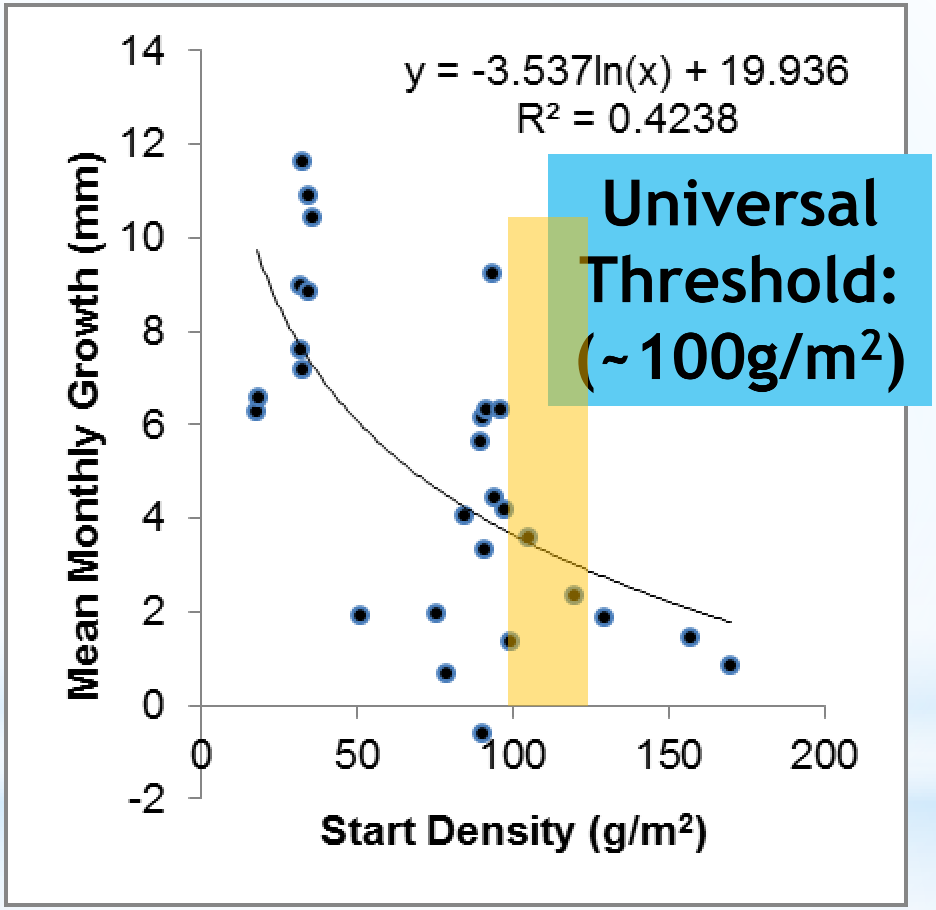
Larvae

Applegate 1950

Where the Wild Things Are!



Density, Season & Growth Rates (2012-2014)

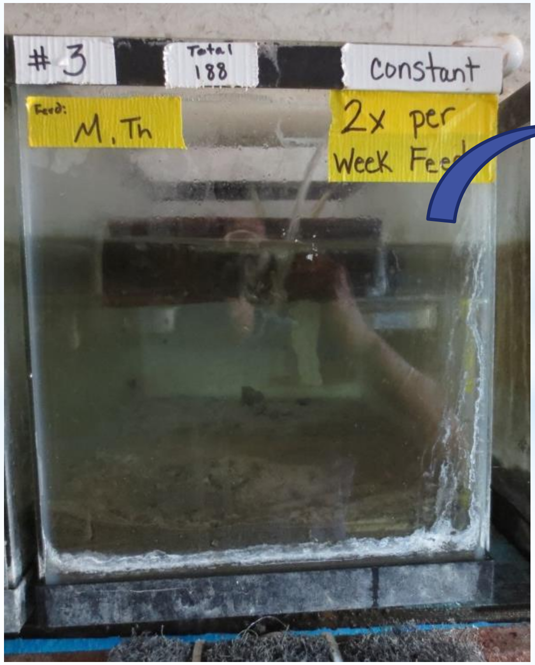


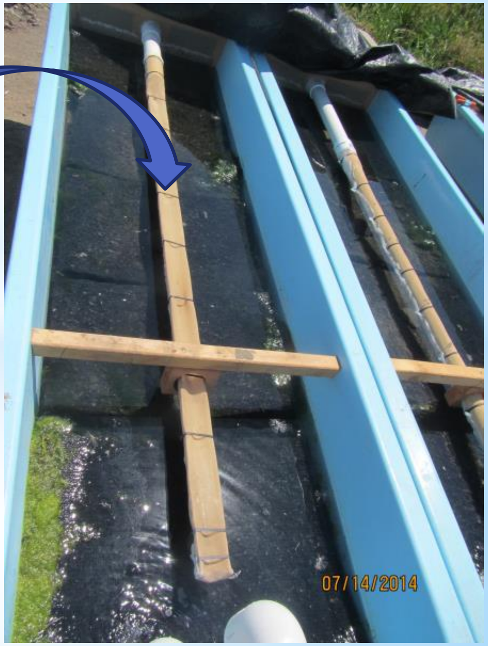
Density

(<100 g/m²)

Early Larva Feeding Study (2015~)

- **20 aquariums (25 L, 0.125 m^2, 1 L/min)**
- **Research focused on:**
  density
  amount of feed
  alternative feeds
  methods of feeding





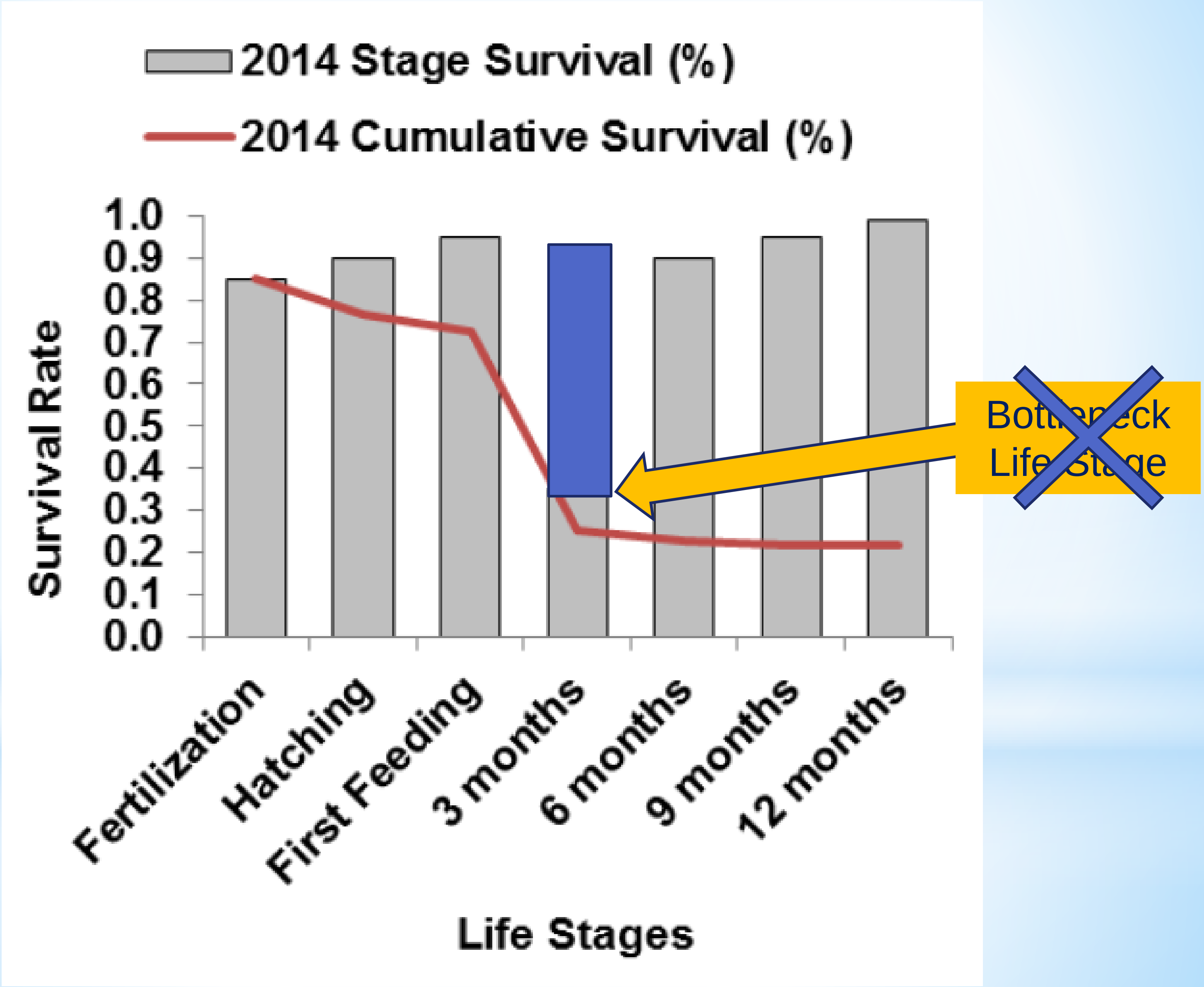
General Conclusions on Density

- Density levels (per m^2): High=3000, Med=1500, Low=750
- High & Med density groups had reduced growth rates (**7.7** & **9.6** mm/month) compared to low density (**11.6** mm/month), but no diff. on survival rates
- With increase in feed, growth rate increased for High & Med density groups (**9.2** & **11.2** mm/month) compared to low density (**11.8** mm/month)
  - End Mass density **180-217 g/m^2** (vs.104 g/m^2)

General Conclusions (Others)

- Mortality highest in early period (**first 4 weeks**)
- **Turning off water** during feeding has some risks
- Feeding **3 times** was better than **2 times** / week*
- No benefit in having **less feed at the beginning**
- **Flour** (Wheat, Dark Rye, Brown Rice) showed similar survival & growth compared to Otohime A1
- Additional benefits observed from **alfalfa pellet**, **salmon carcass**, and **chicken egg + leaves**
- Survival rates (0-3 months stage) increasing each year: **10-30%** (2012-2013), **72%** (2015), **85%** (2016), **93%** (2017)

Life Stage Survival Rates

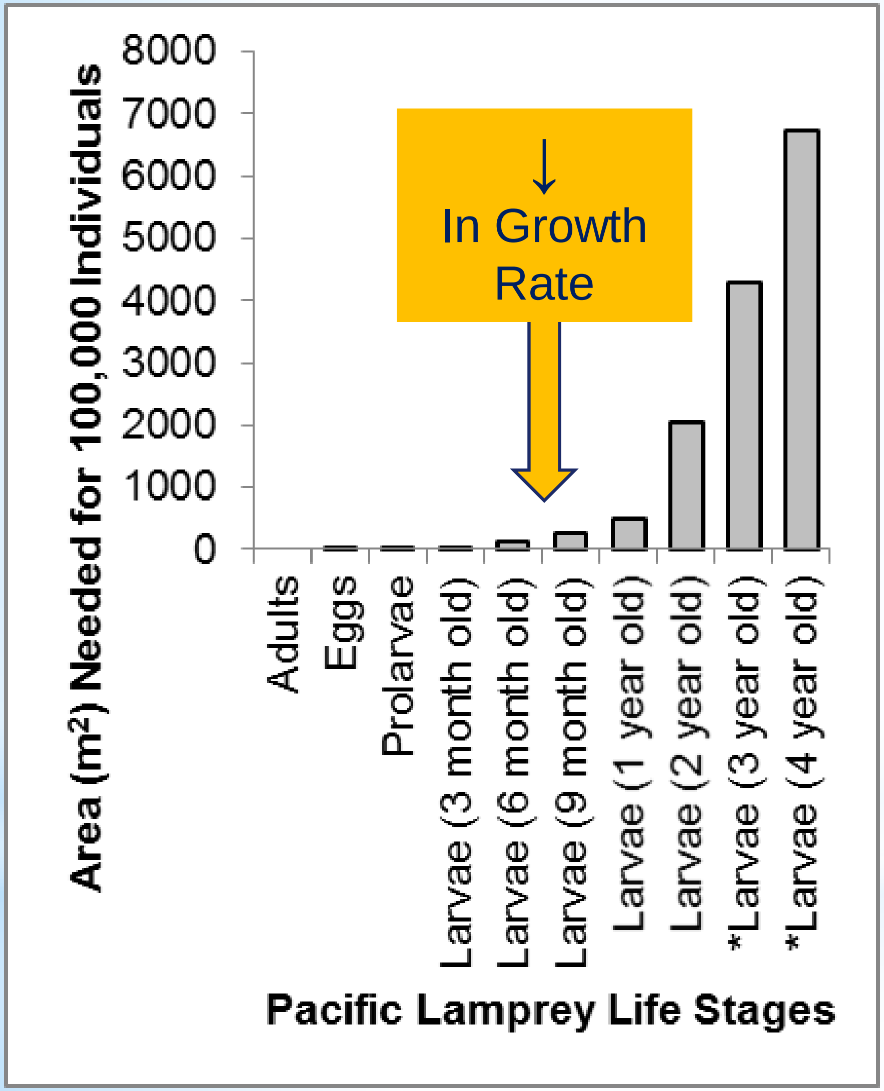


Alternative Feeds ($/lb)

- Active Dry Yeast ($**4.19**)
- Early Life Stage Feeds (<100 microns)
  - Otohime A1 ($**27.38**)
  - Hatchfry Encapsulon ($**61.69**)
  - Gemma Micro ($**107.06**)

- Leaves ($**0**)
- Salmon & Lamprey Carcasses ($**?**)
- Flour (Wheat, Soy, Rice, Rye, etc.) ($**0.89-1.72**)
- Alfalfa Pellet ($**0.20**)
- Chicken Egg ($**1.06**)

Space Requirement

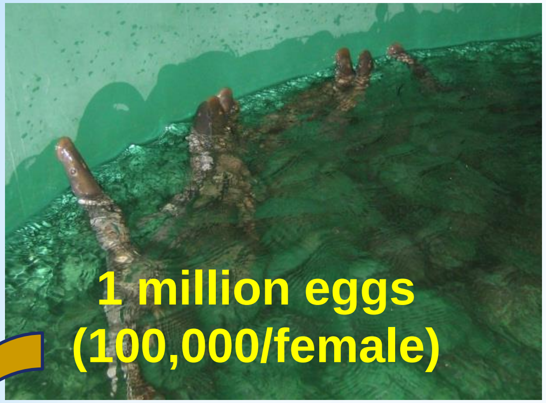


Space (m^2) Needed for 100,000 individuals

- Eggs = 0.1
- Prolarvae = 2.4
- 3 month old = 28
- 6 month old = 117
- 9 month old = 268
- 1 year old = 502
- 2 year old = 2037
- 3 year old = 4303
- 4 year old = 6727

Lamprey Production Scenario

10 females



100,000 prolarvae / trough
= 5 troughs (16’ x 1.5’)

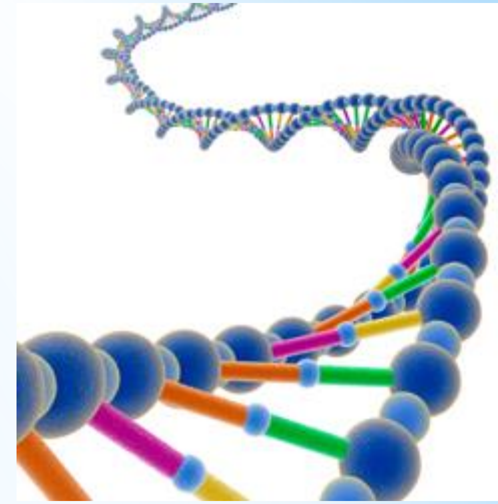
800 larvae / tank
= 156 tanks (14’ x 3.1’ trough)

14,400 larvae / tank
= 17 tanks (14’ x 3.1’ trough)

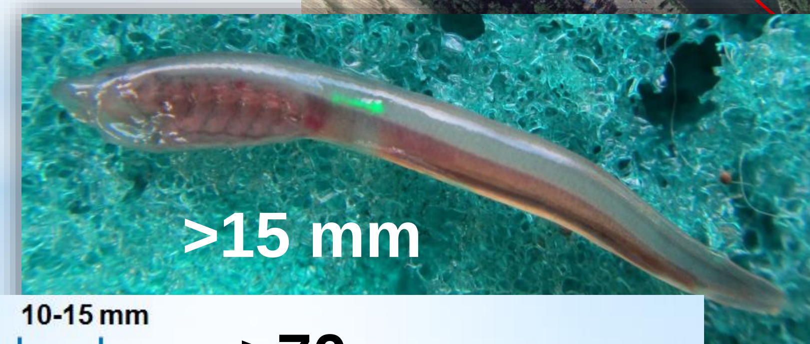
Optimal Release Sites

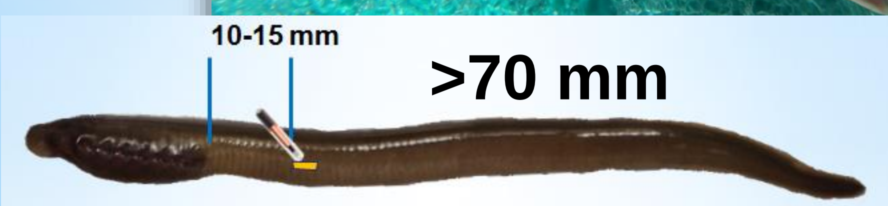
Side Channels

Acclimation
Ponds



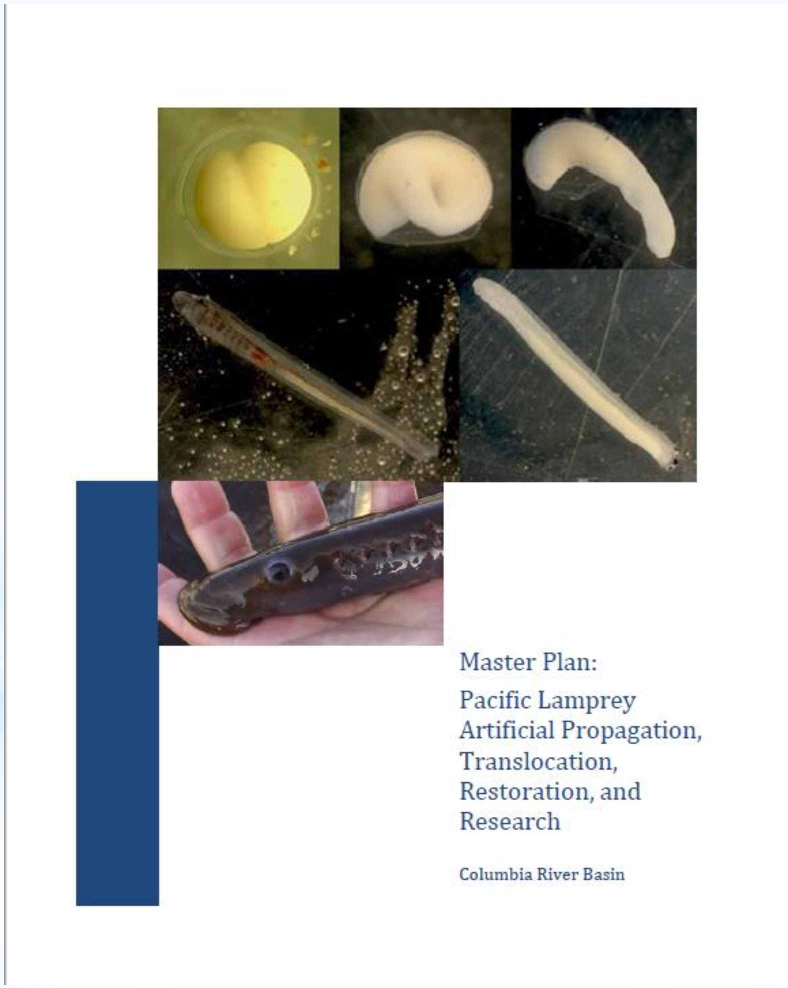
Canals



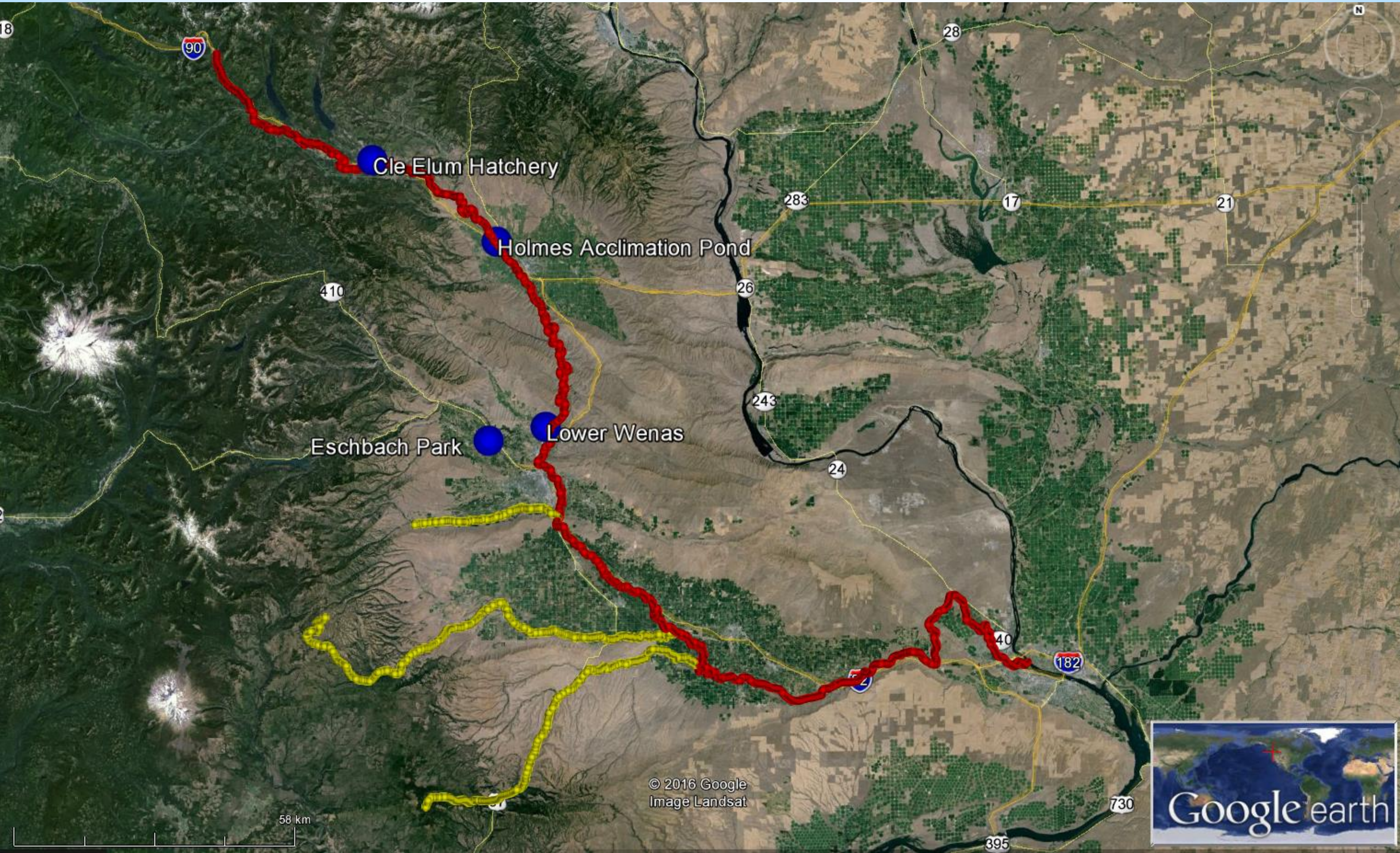


Master Plan

By CRITFC, YNF, CTUIR & NPT
(BPA NPCC Step 1 & 2)



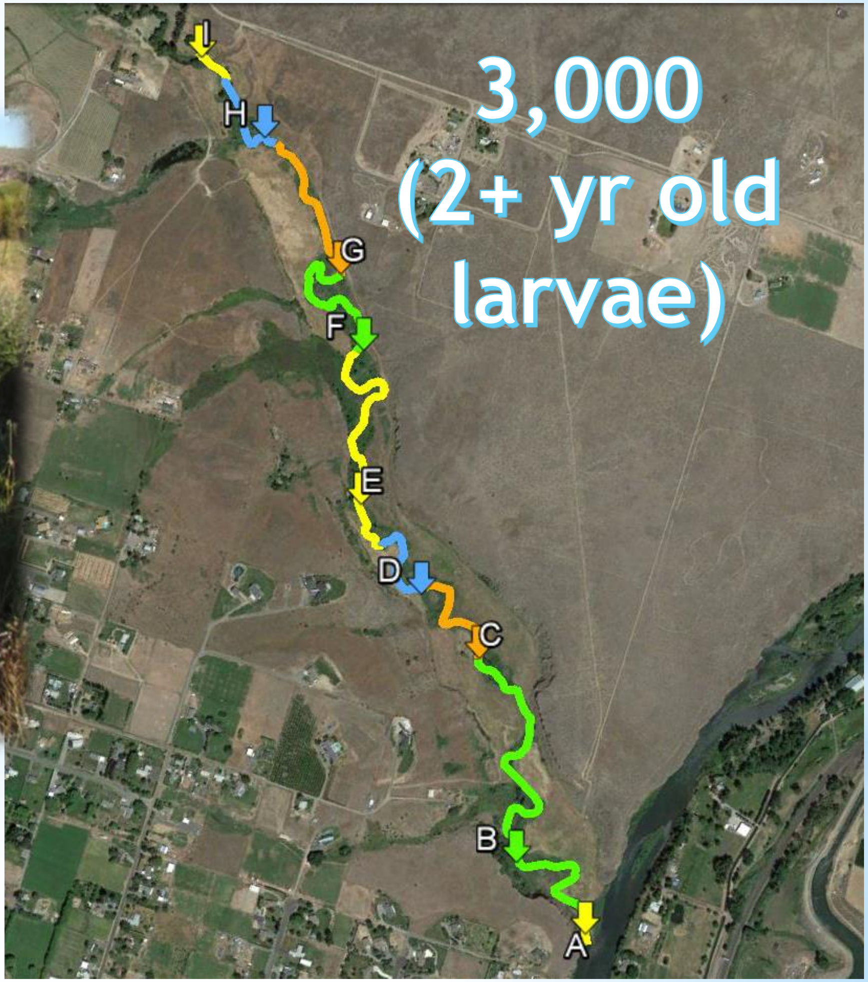
Larval Outplanting Sites



Lower Wenas Site (Yakima, WA)

Year 1 Only

Habitat Area = 8101 m^2



Carry Capacity = 49,475 larvae

***Type I = 10g/m^2**
Type II = 1g/m^2

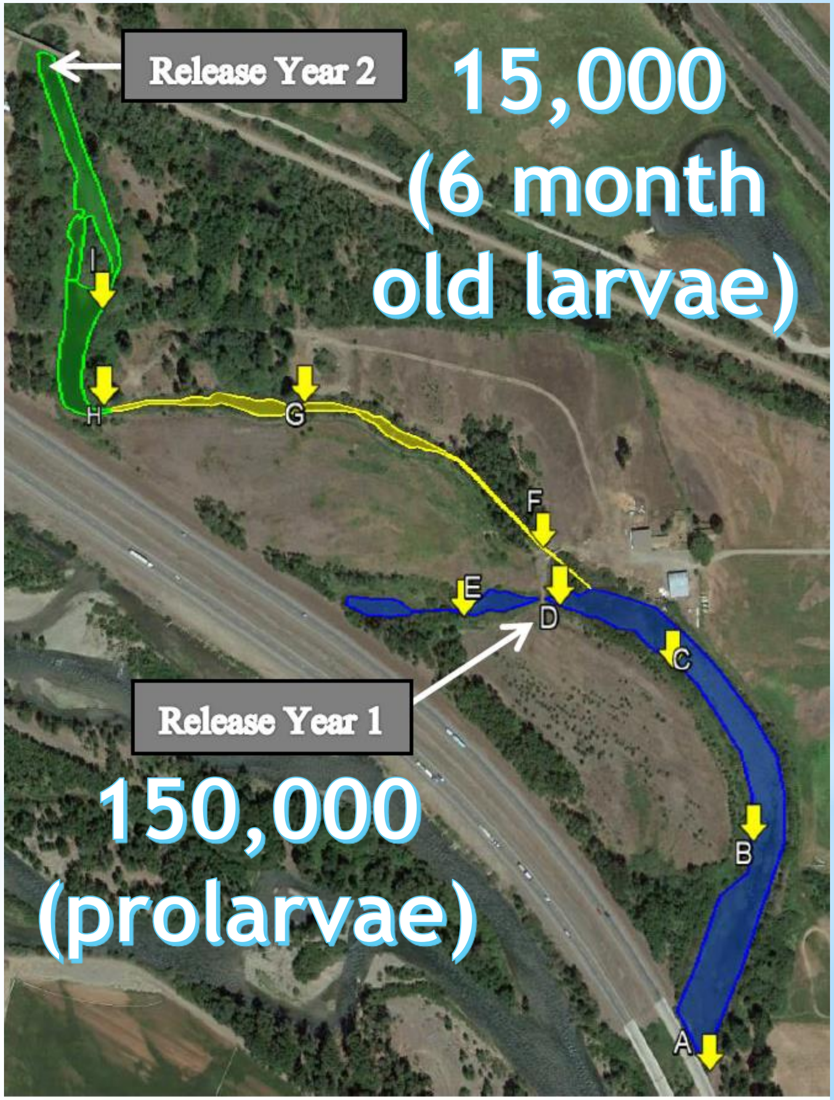
****Larva = 80mm, 1g (2-3 yr old)**

Holmes Acclimation Site (Ellensburg, WA)

Year 2-3

Habitat Area = 17,414 m^2

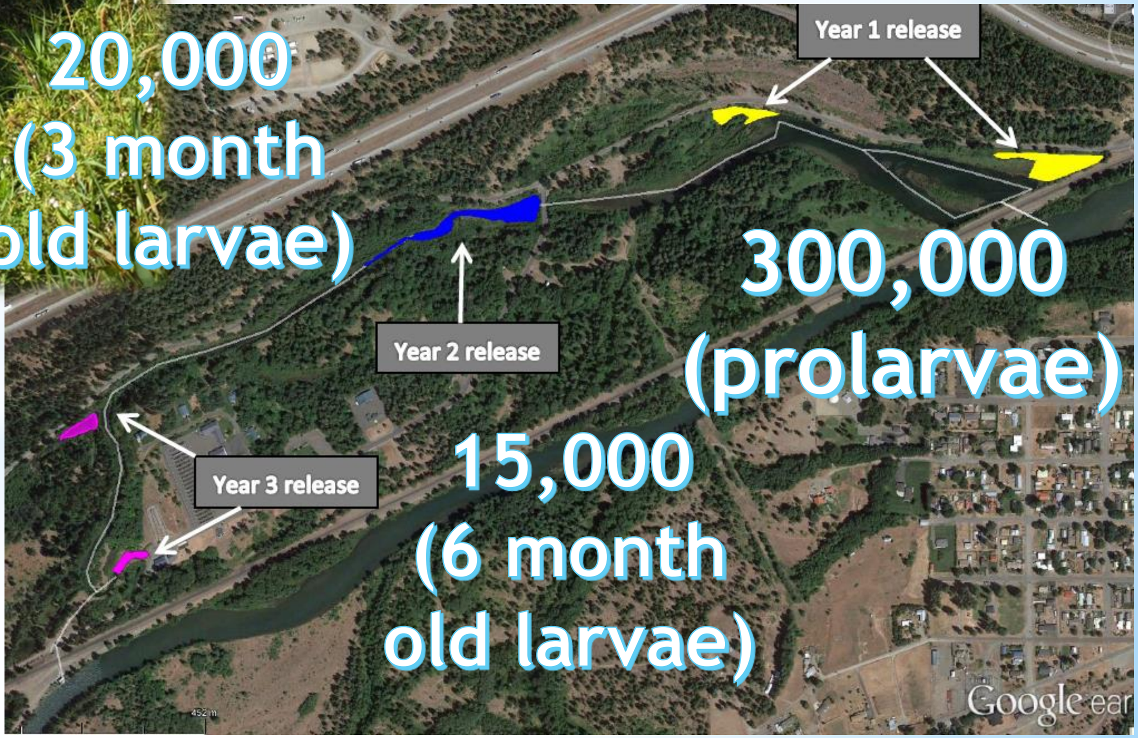
Carry Capacity = 149,600 larvae



Cle Elum Hatchery Site (Cle Elum, WA)

Year 1-3

Habitat Area = 45,896 m^2

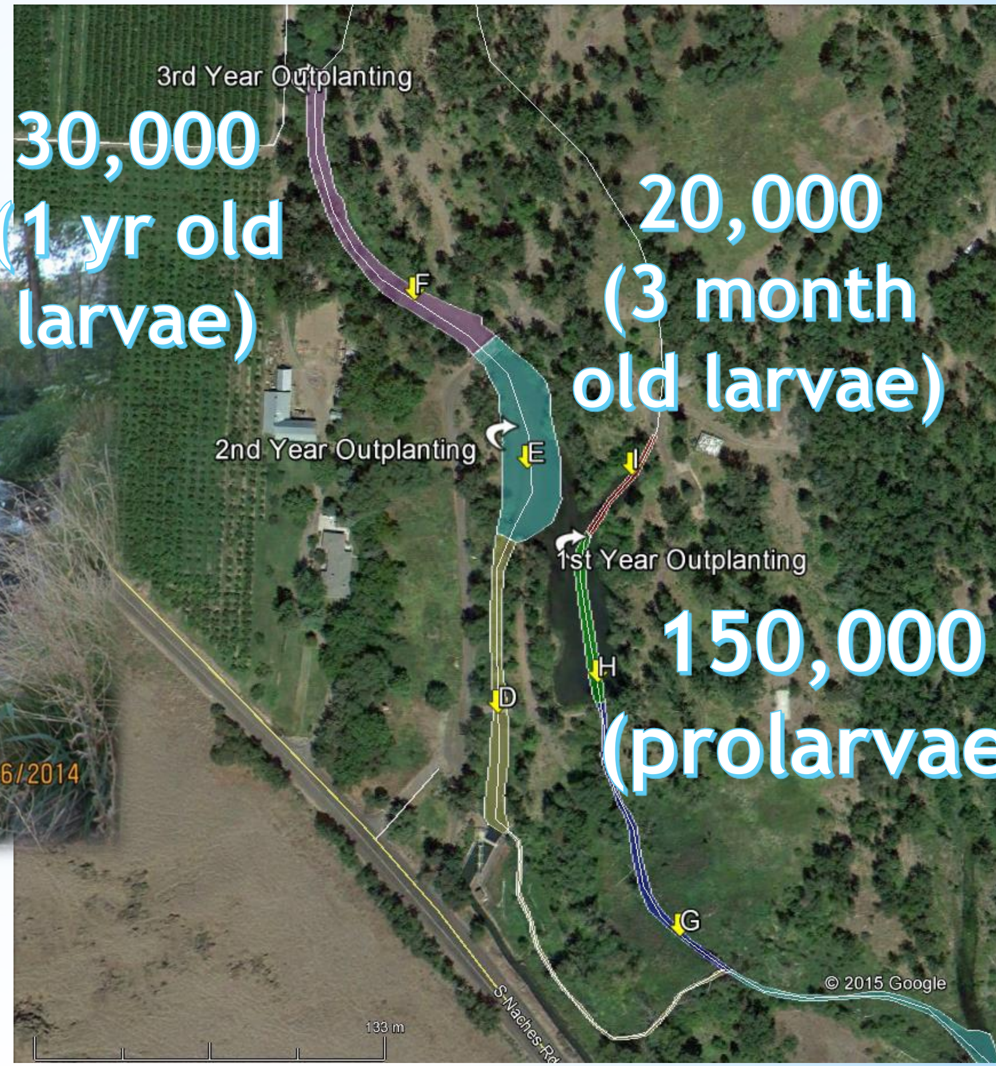


Carry Capacity = 291,530 larvae

Eschbach Park Site (Naches, WA)

Year 1-3

Habitat Area = 23,425 m^2

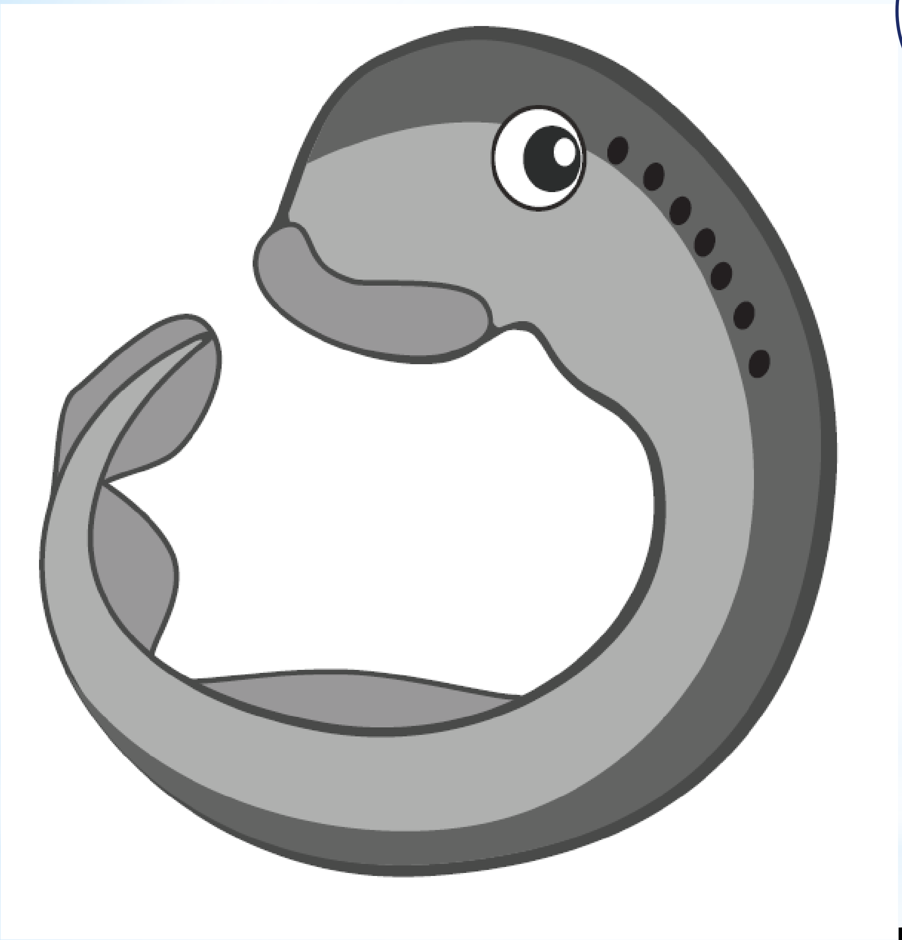


Carry Capacity = 197,636 larvae

Future Objectives…

- Refining art. prop., incubation & larval rearing methods – **conservation hatchery** techniques
- Use larvae for entrainment, passage, & other **survival studies** (BPA 3-Step Process)
- Monitor survival, growth, & behavior from small scale outplanting projects (**early life history biology**)
- In the long term, learn more about life history & survival based on **parentage assignment** (Hess et al. 2014) & other genetic tools

Partnership is Vital!!!



Ralph Lamp-rey-man
509-388-3871 (Lamprey Hotline)
lamr@yakamafish-nsn.gov

"Supplementation" Research

Salmon Definition = management strategy that uses artificial production for the purpose of attempting to rebuild depressed natural salmon & steelhead populations (ISAB 2003-03)

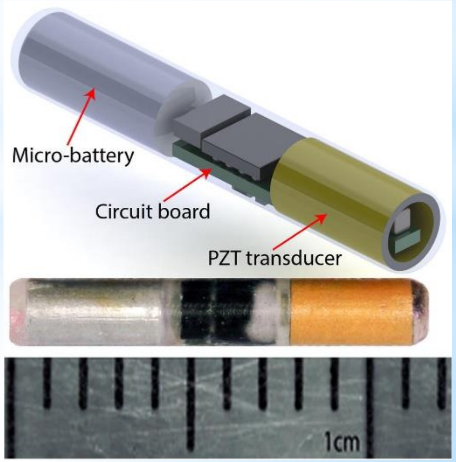
Lamprey Definition = an interim production facilitation strategy through adult translocation and artificial propagation that supports region-wide efforts to reduce known threats to self-sustaining natural productivity

Why "Supplement"?

- Many areas extinct or functionally extinct – (**cultural & ecological loss**)
- Too many threats exist to expect recovery of natural production **in a timely manner**
- With severely depressed #s, difficult to assess **existing "threats"**
- Tool to understand **biology** & **limiting factors** (vs. mining limited wild population)
- Develop techniques in **conservation hatchery** (in case we need it)
- Outplanting is **"experimental"** in nature (focus on adaptive mgmt)

Why Supplement? (Part 2)

- To rear lamprey needed for **survival studies** (juvenile passage = black box)
- To better understand **population dynamics** & life stage specific survival rates in nature



~~~~~~~~~Discussion~~~~~~~~~

Genetics

- What are the primary genetic concerns when it comes to Art. Prop. Of lamprey? What further genetic work/planning needs to be done?

Pheromones

- What are the potential positive and negative impacts of pheromones released by Art. Prop. Lamprey? Are there potential interactions with other species of lamprey?

Application

- Are there cases where our findings or abilities with cultured lamprey could be of used to help with our understanding and management of wild lamprey?
- Where would this info not be applicable?
- Are there areas of focus we should look at in the future?

~~~~~~~~~~Discussion (2)~~~~~~~~~~

Outplanting

- If art prop lamprey were to be released into the wild, where specifically would you like to see them, and where would you not? Are there pertinent questions that could be answered from an out planting project?

Surrogacy

- In what situations would art prop fish be a good surrogate for wild fish, and when wouldn’t they be?

Others???

Risks?

Genetic risks

- Diff. from salmon genetic model (natal homing)
- Source population & hatchery protocols

Reduced fitness from captive-breeding

- Focus on extinct or functionally extinct areas

Decrease in abundance from donor areas

- Set limits on degree of extraction (e.g. <4%)

Moving fish to areas w/ substantial limiting factors

- If it improves understanding of how to resolve these threats, may be worth it

Introduction of pathogens and diseases

- Lamprey appear to be naturally resistant to many of the problem pathogens & diseases (Jackson et al. in press)

Ralls et al. 2017 Highlights:

- Outcrossing was beneficial to inbred populations in 93% of cases (N=156) (Frankham 2015)
- Despite large successes (e.g. Florida panthers) even when genetically divergent populations were used, only ~30 “genetic rescue” projects are being carried out
- **Outbreeding depression** is uncommon, often transient, usually of smaller effect than inbreeding depression
- **Local adaptation** is often already compromised by random drift of alleles and human altered local conditions
- **Genetic uniqueness** and **taxonomic integrity** often overemphasized: many consider species as “fixed entities” rather than constantly evolving lineages
- Due to fears, “inaction” (falsely) regarded as the “safe” choice

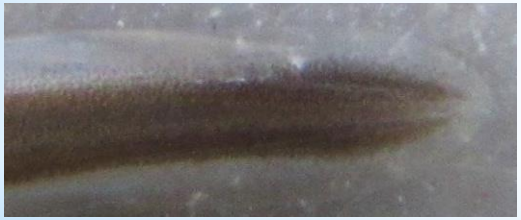
Larval Lamprey Identification

***Caudal Fin* = X**

Caudal Ridge

39 mm

40 mm



44 mm

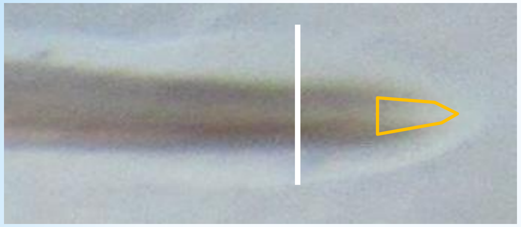
51 mm

52 mm

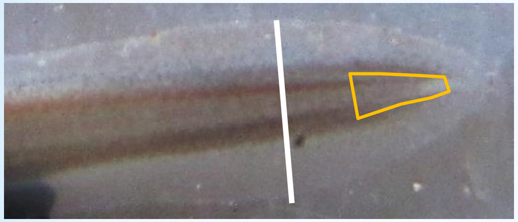
Larval Lamprey Identification

***Caudal Fin* = X**

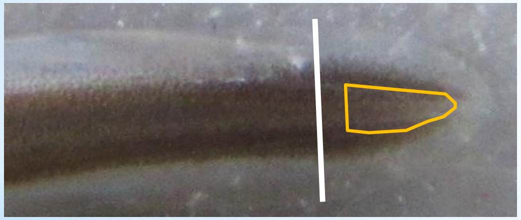
Caudal Ridge



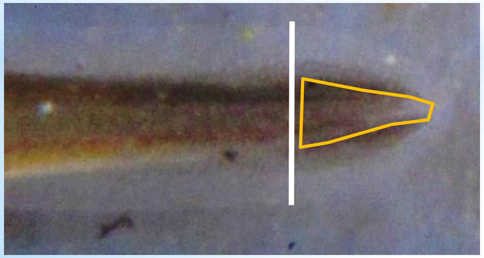
39 mm



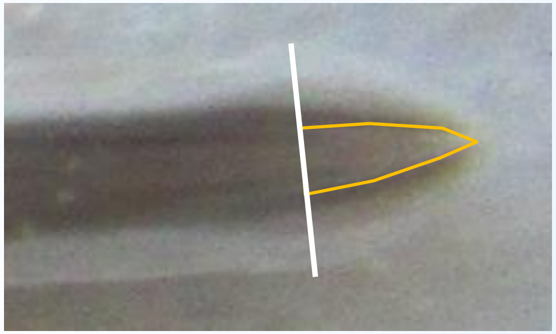
40 mm



44 mm



51 mm

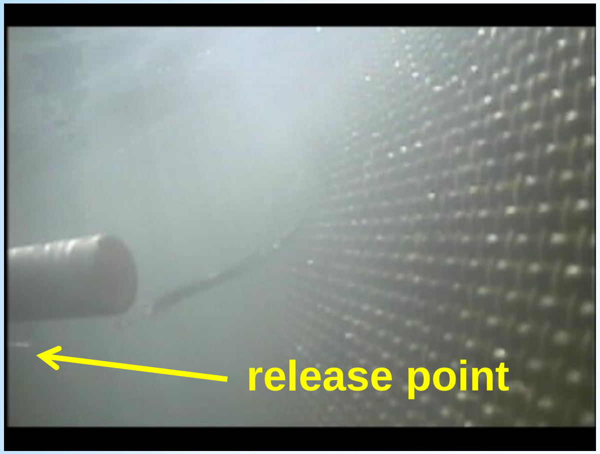


52 mm

Conclusion:
larval Pacific lamprey identifiable around 45 ~ 50 mm

Entrainment in Irrigation Diversions

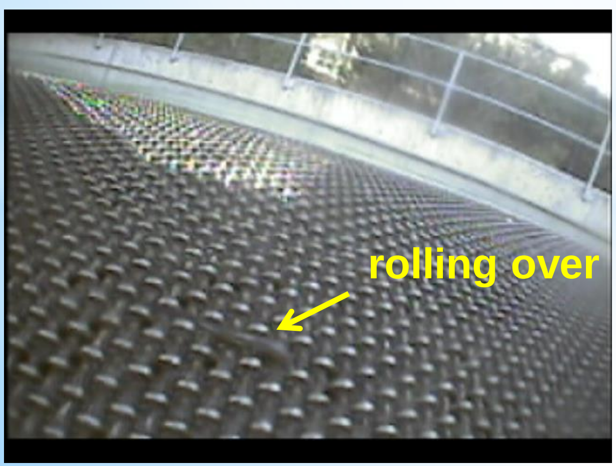
Release



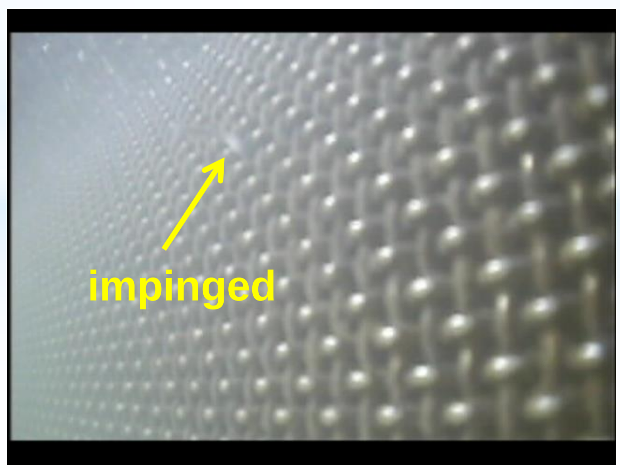
1. Escaped

2. Averted

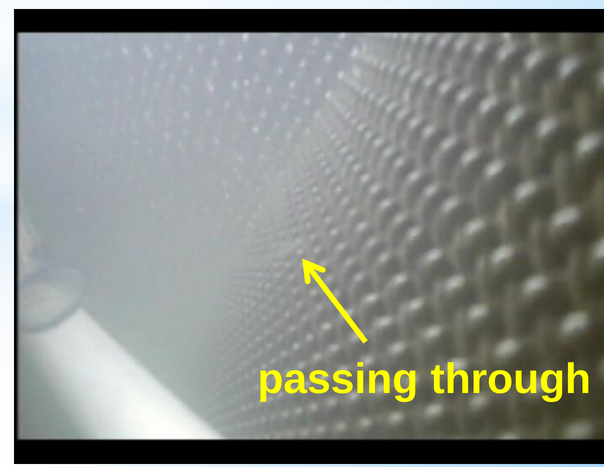
3. Rolled



4. Impinged



5. Passed



Entrainment in Irrigation Diversions