Implications of Pathogens for Recovery of Bull Trout in the Upper Willamette

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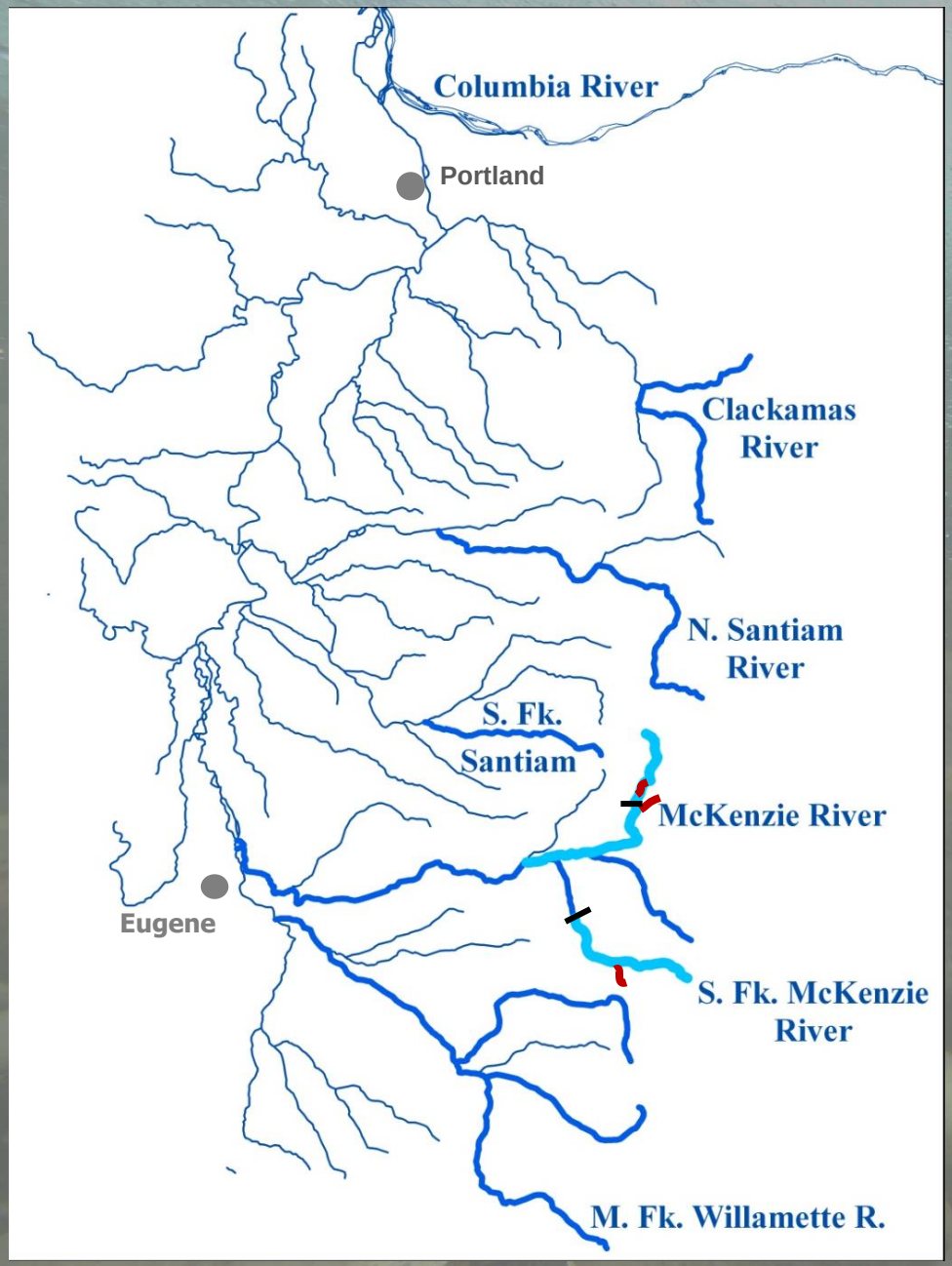
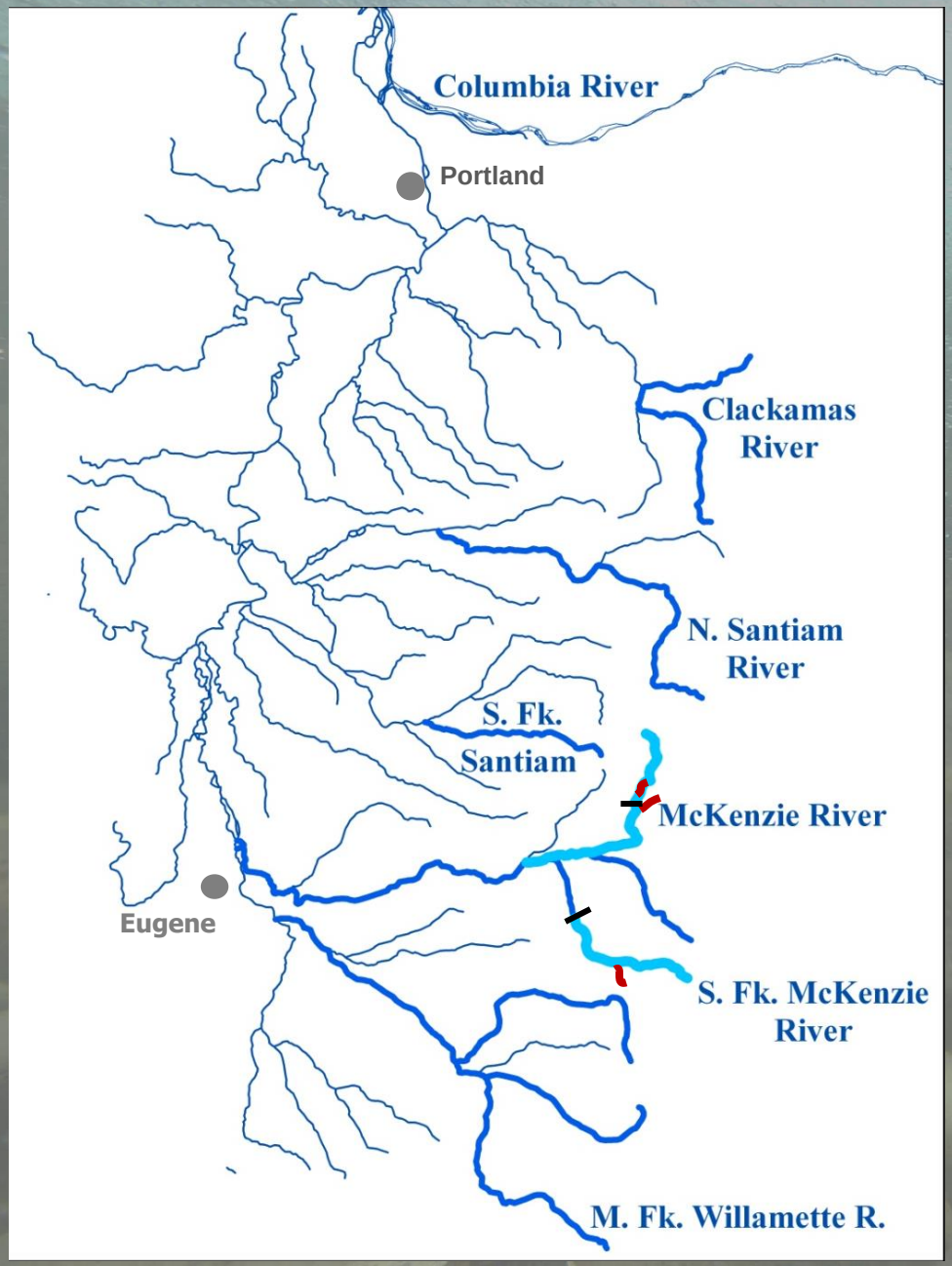
Salvelinus confluentus

Distribution in Willamette

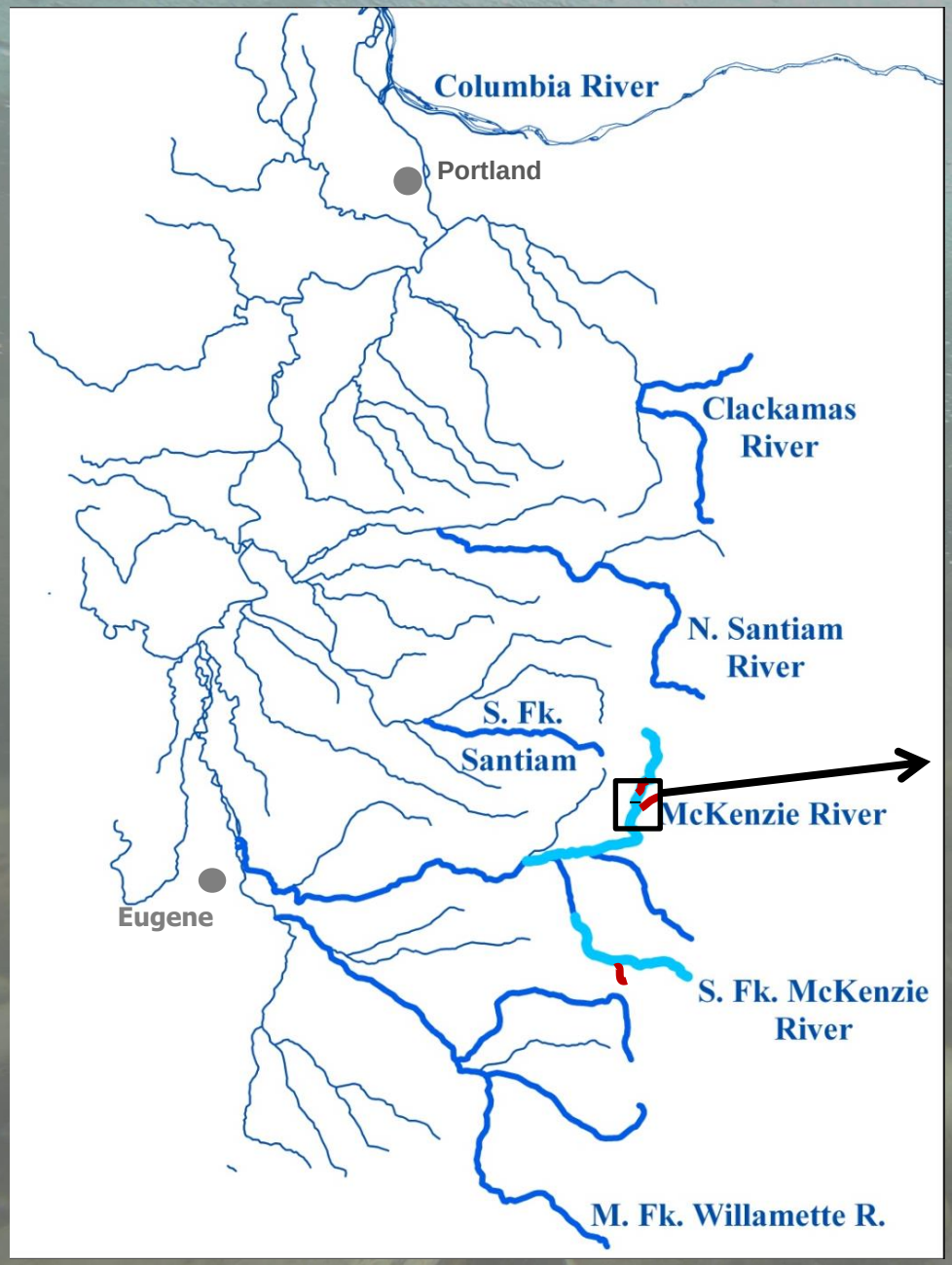


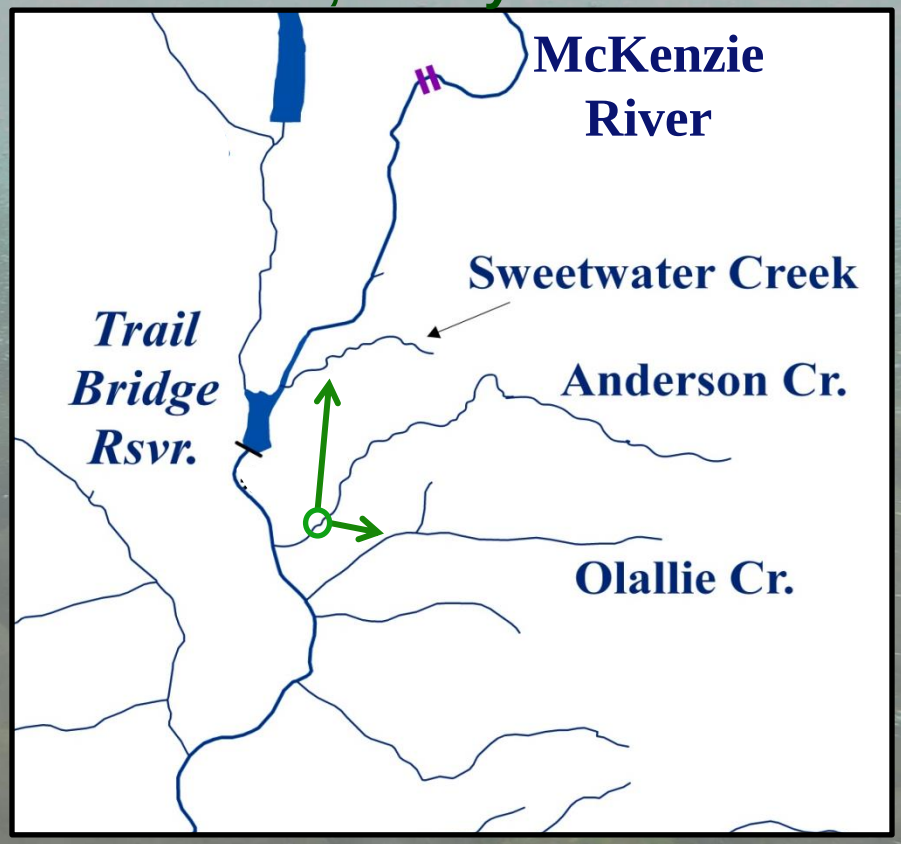
Distribution in Willamette



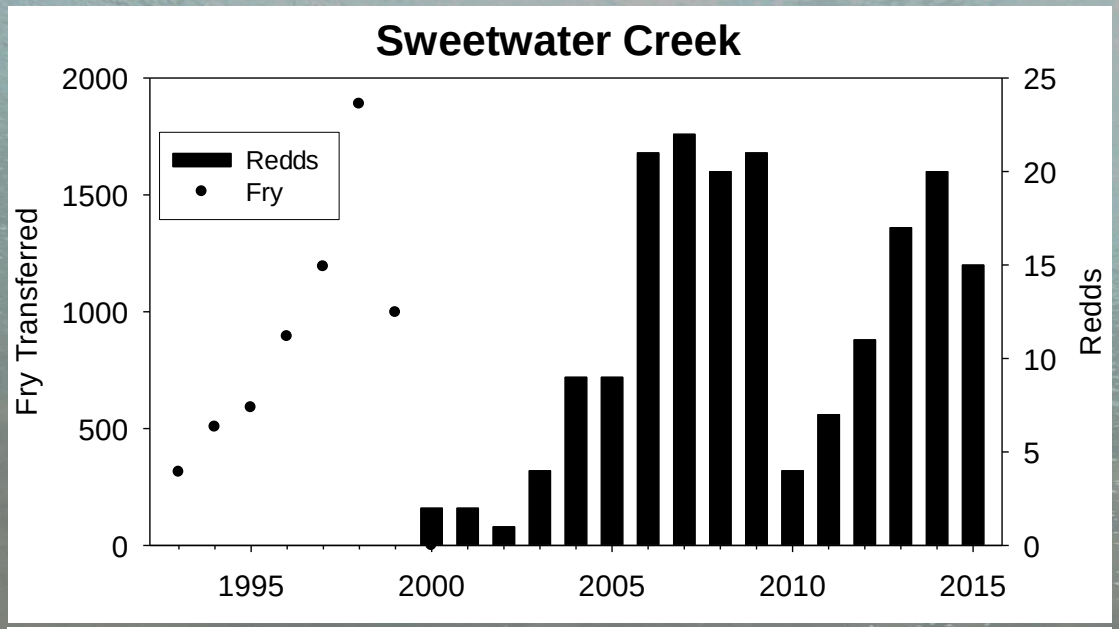
Reintroductions (1993 - 1999)

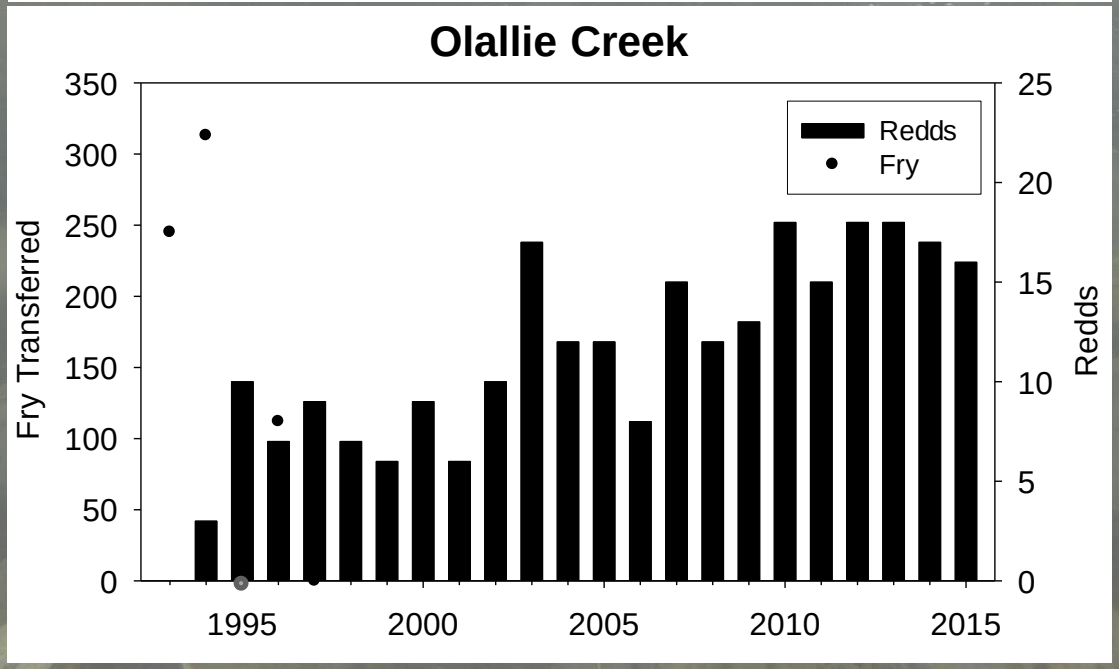
~ 7,000 fry



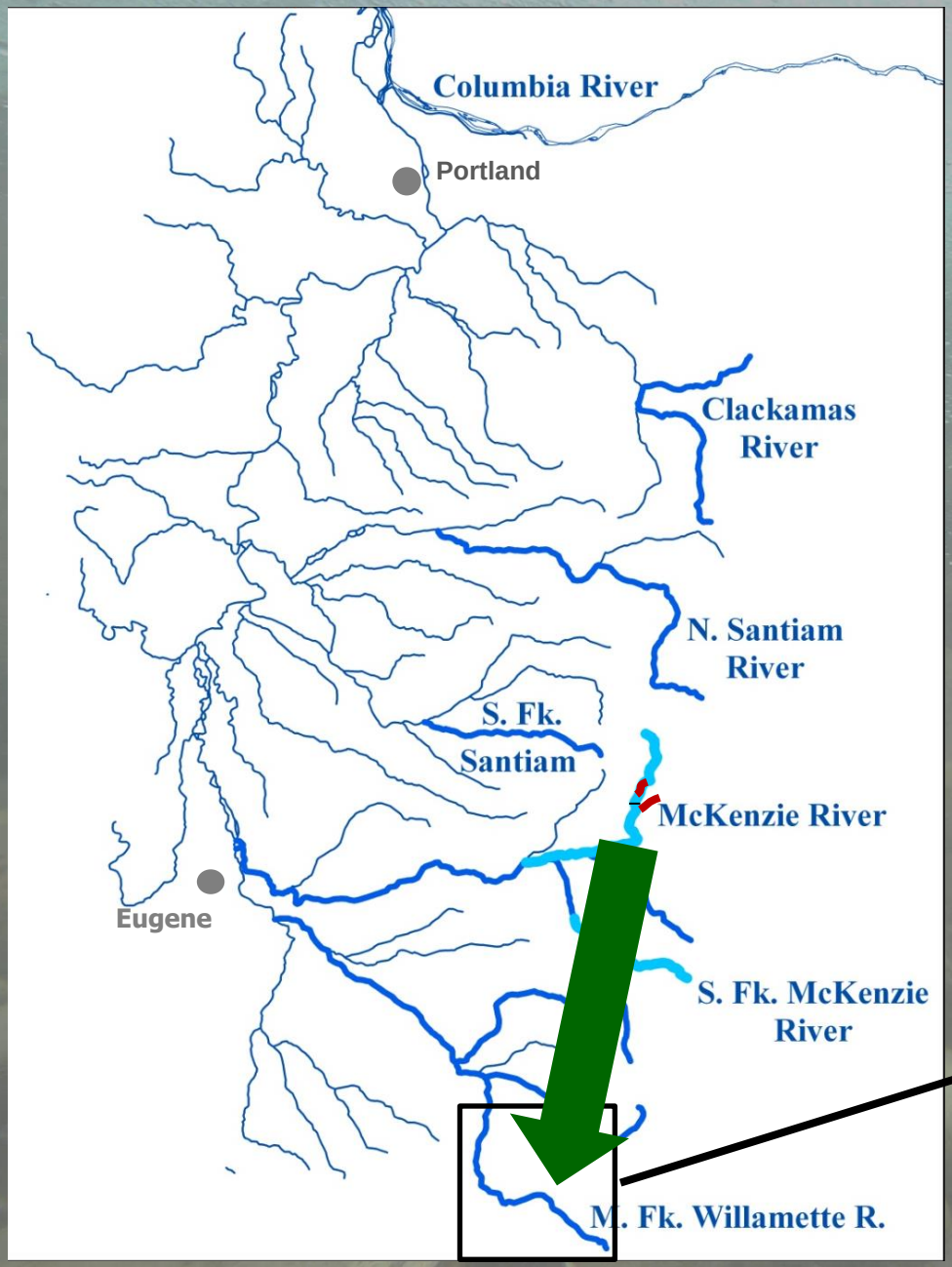


Reintroductions (1993 - 1999)

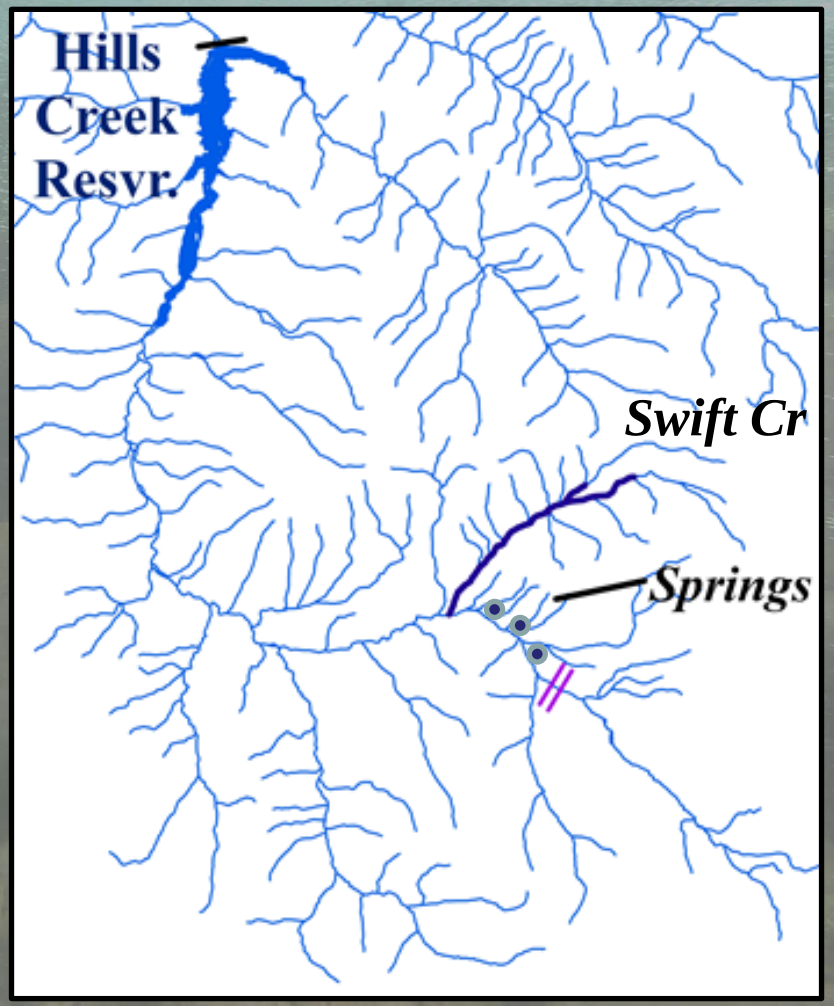




Reintroductions (1997 - 2005)

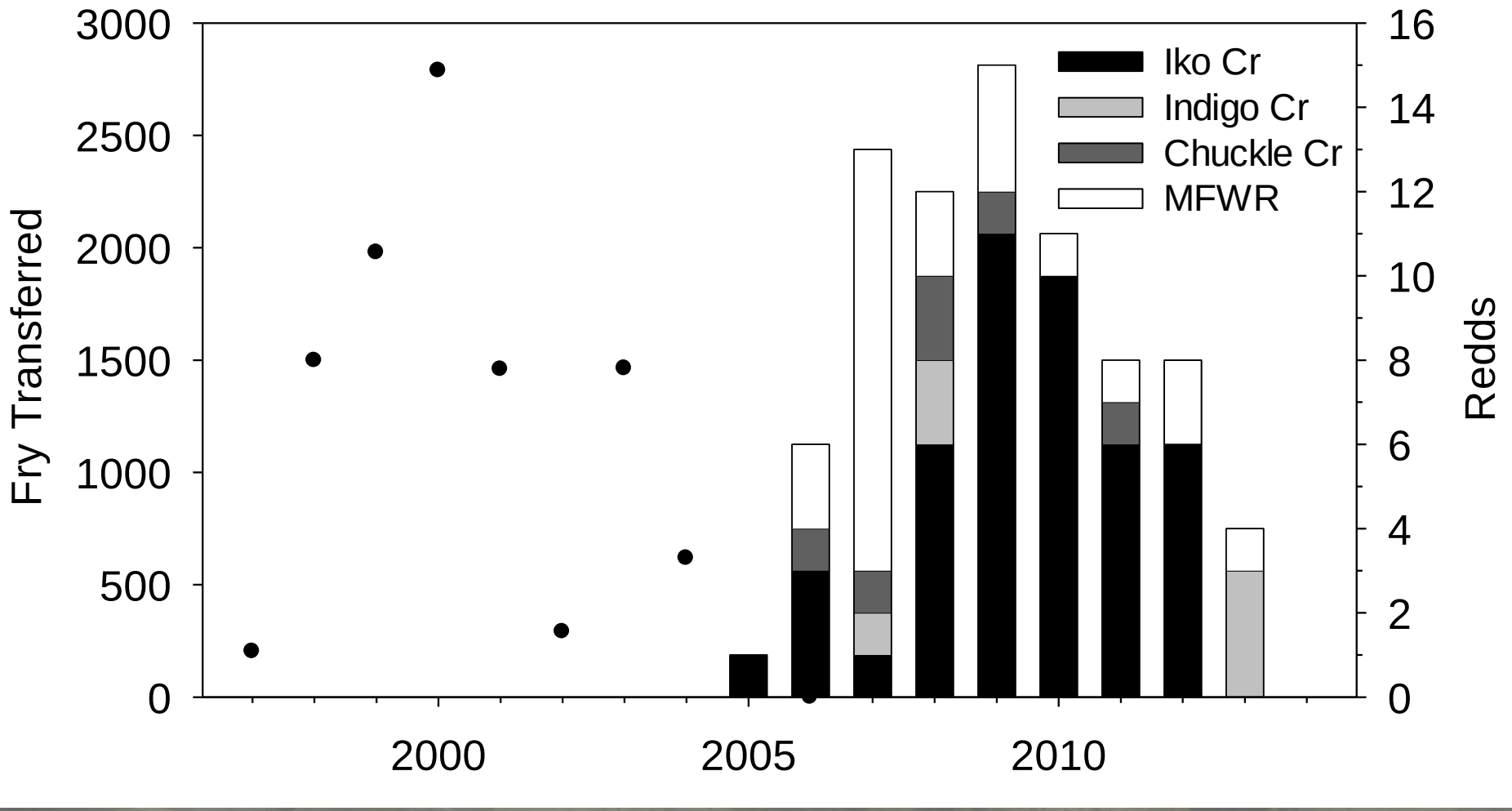


> 10,000 fry



Fry → Spawning Adults

1997–2005: Directly transferred 10,408 fry to M Fk Willam.



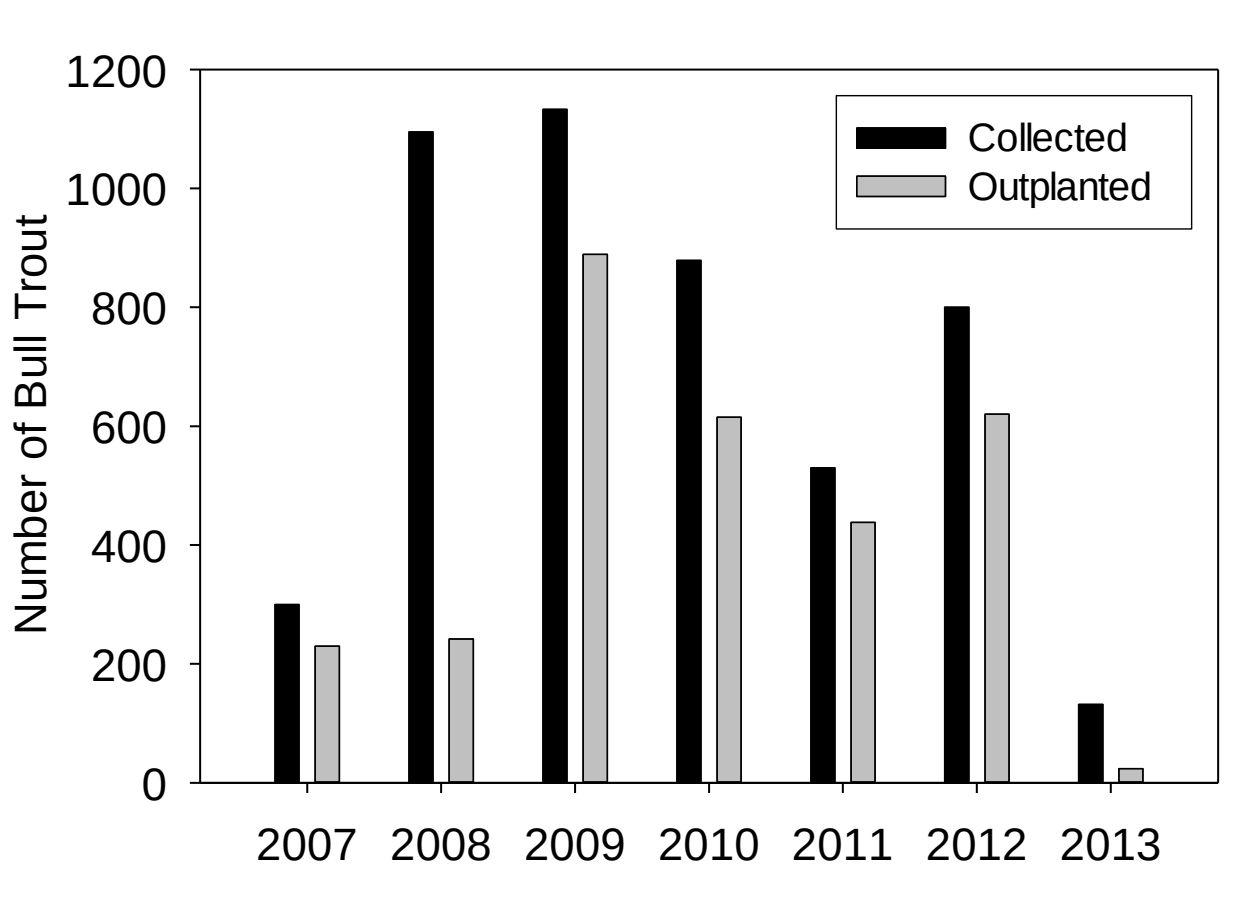
***Swift Cr: 2,773 fry → No Spawning Detected**

Captive Rearing (Headstart) 2007-2013

Circumvent predation, minimize take from donor pop.

- Fry → Leaburg Hatchery (~30 km dnstrm)
- Feed = #0 form crumbles, then smaller fish
- Size-sort in June
- Release in Aug – Nov or following April

Captive Rearing (Headstart) 2007-2013



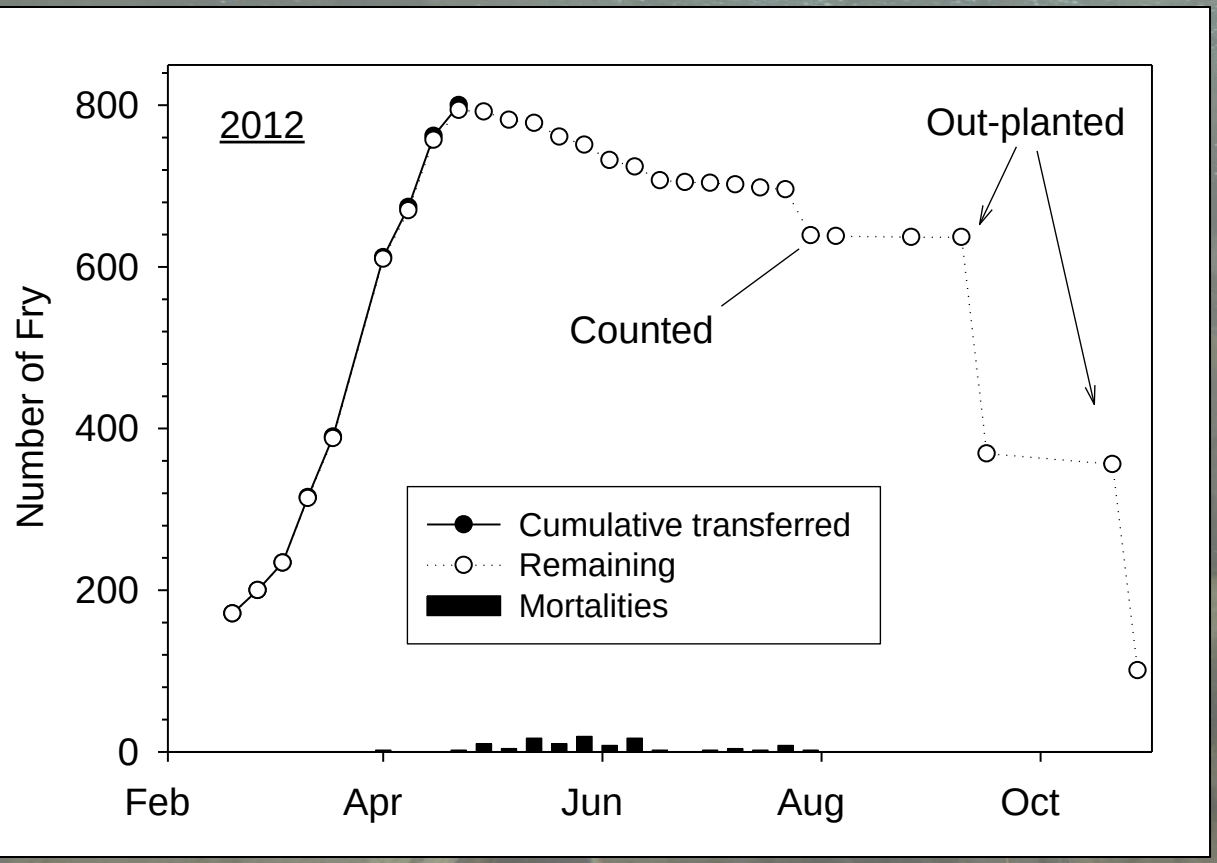
Captive Rearing Program

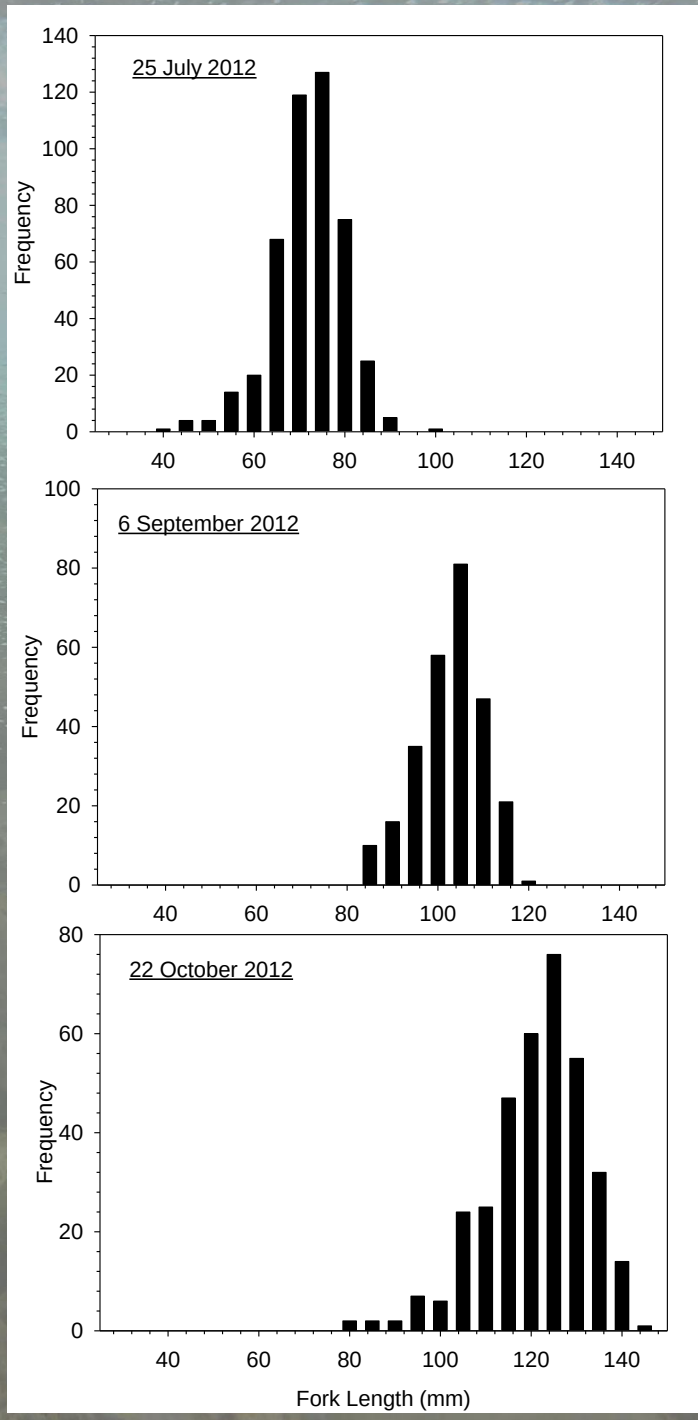
2012 Cohort:

N **= 800 to Leaburg**

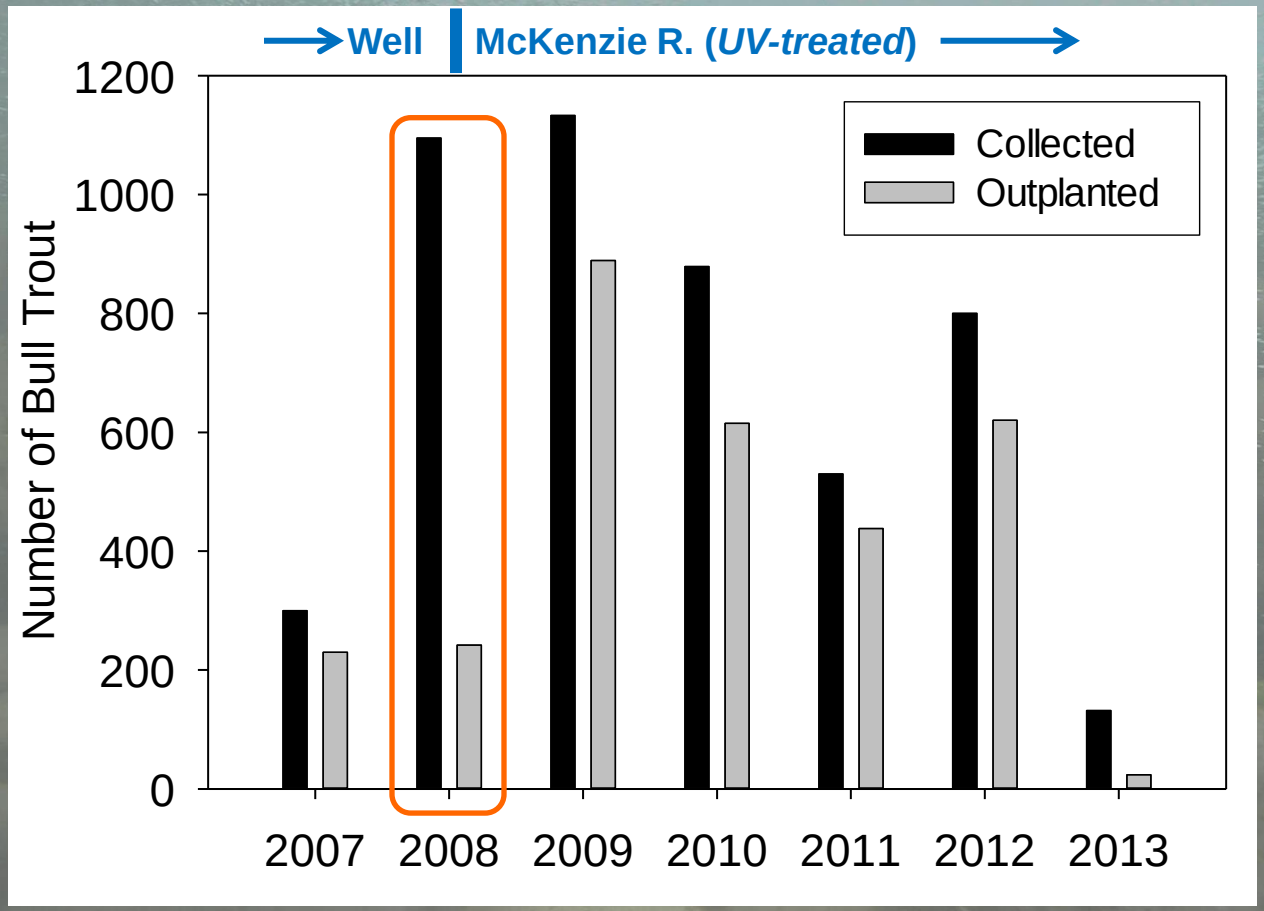
N **= 639 remaining on July 25**

(80% survival; 49 morts 'missing')

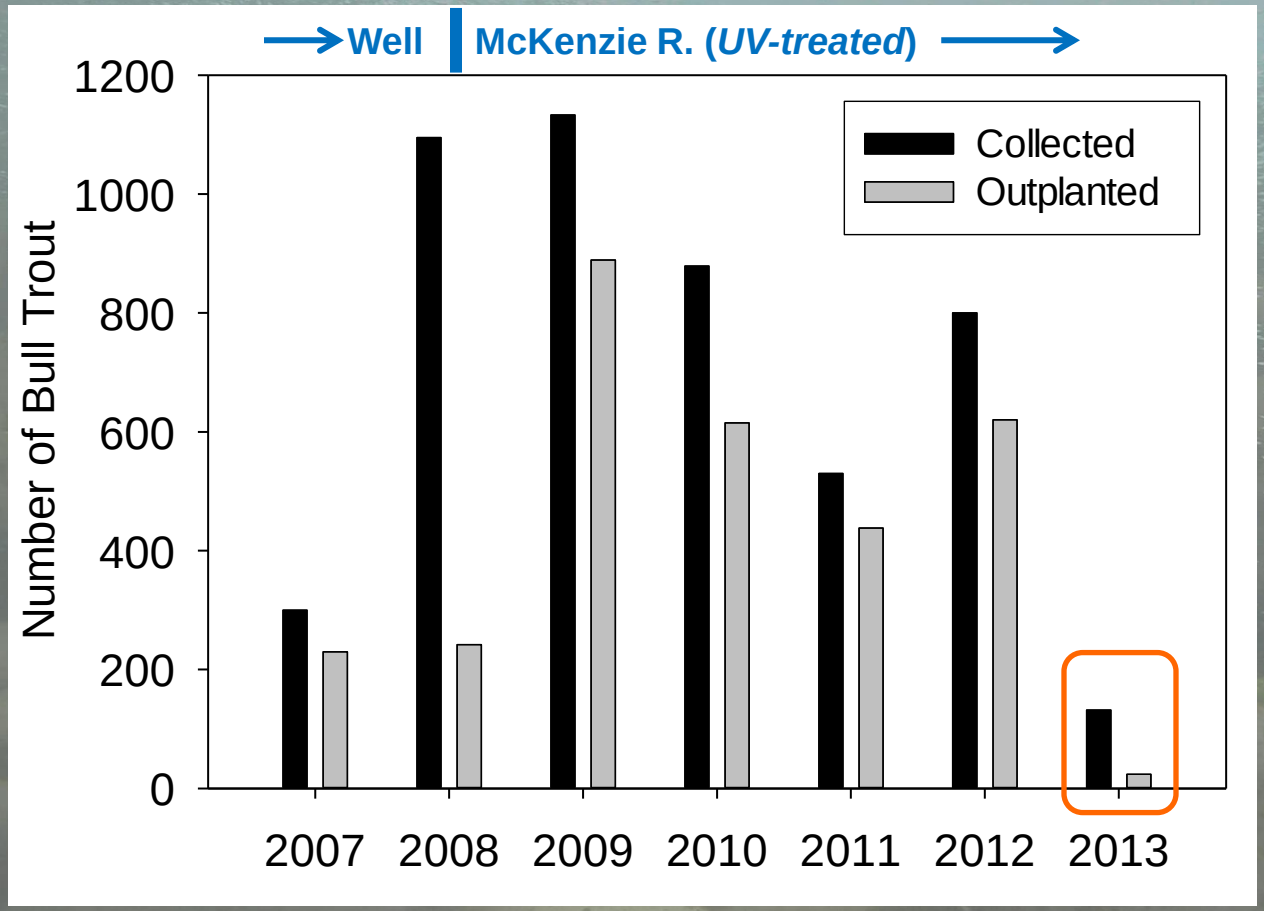




Captive Rearing (Headstart) 2007-2013



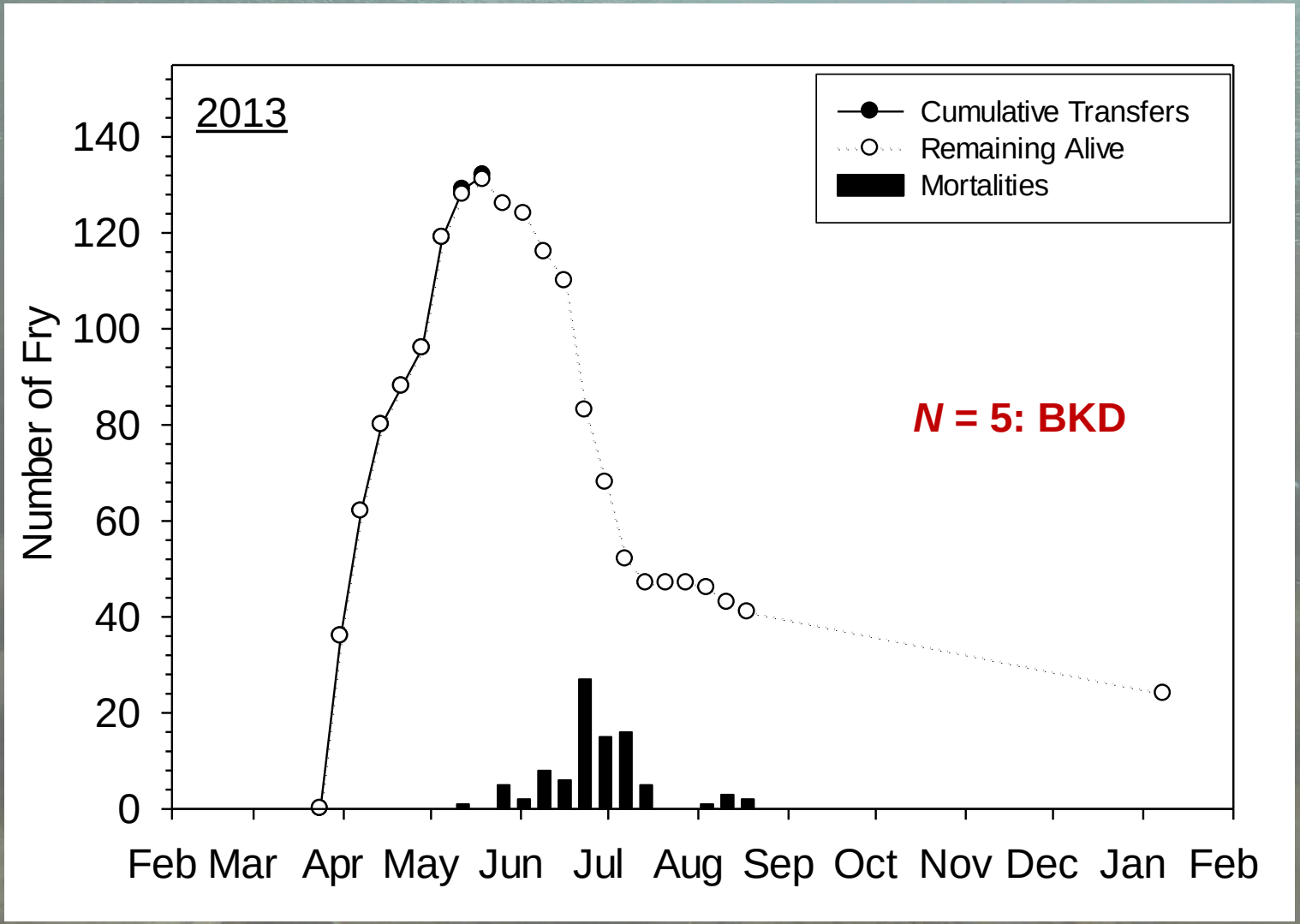
Captive Rearing (Headstart) 2007-2013



Captive Rearing Mortality - 2013

N = 132 transferred to Leaburg in spring 2013

N = 24 remaining Jan 2014 (18% survival)

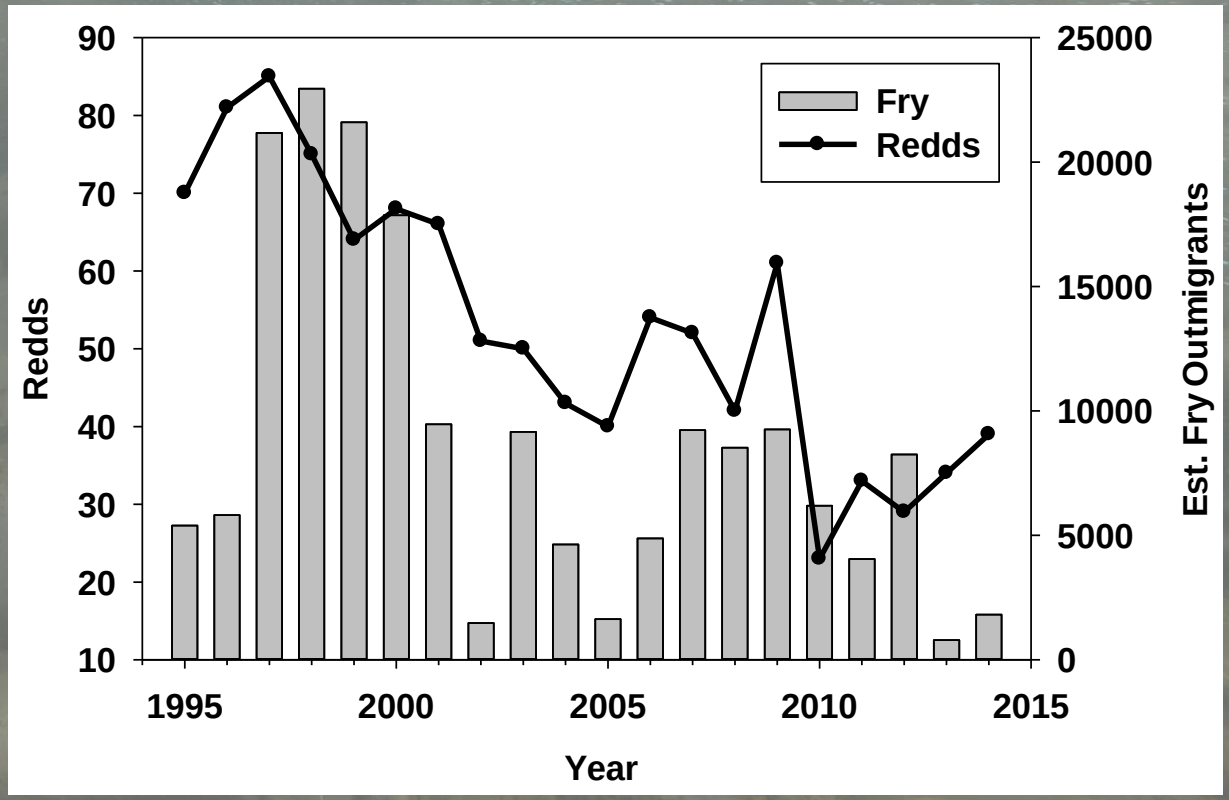


Survivors

Low Survival & High Deformity – Potential Factors

In the wild:

- Trap selectivity
- Inbreeding
- Toxicants
- Pathogens



Low Survival & High Deformity in 2013 – Potential Factors

At Leaburg Hatchery:

- **Physiochemical**
- **Diet**
- **Pathogens**

Low Survival & High Deformity in 2013 – Potential Factors

At Leaburg Hatchery:

- Physiochemical
- Diet
- Pathogens

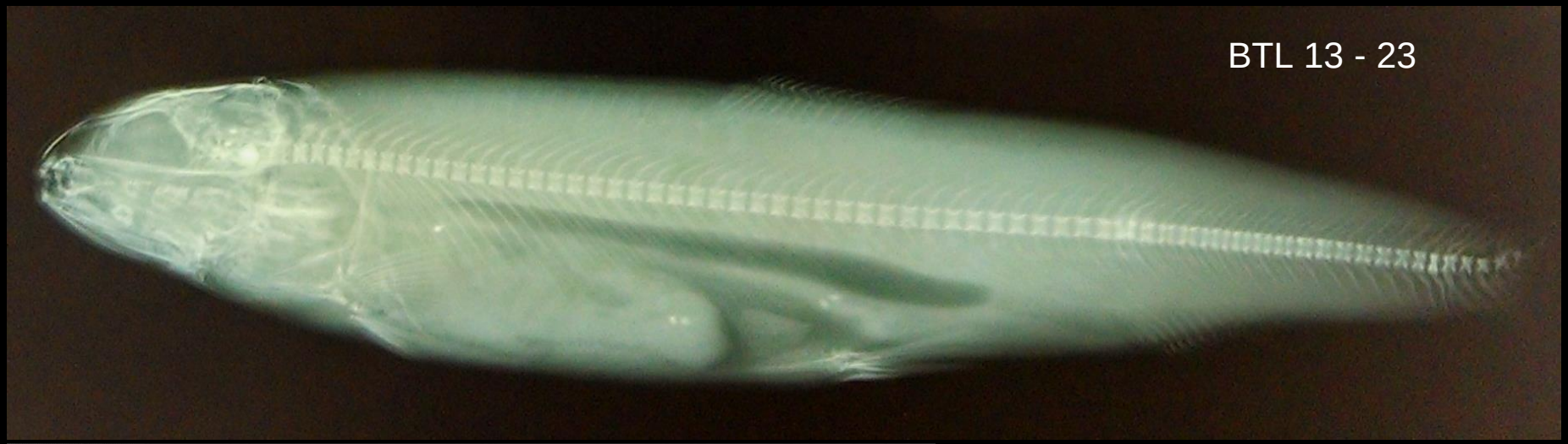
Objectives

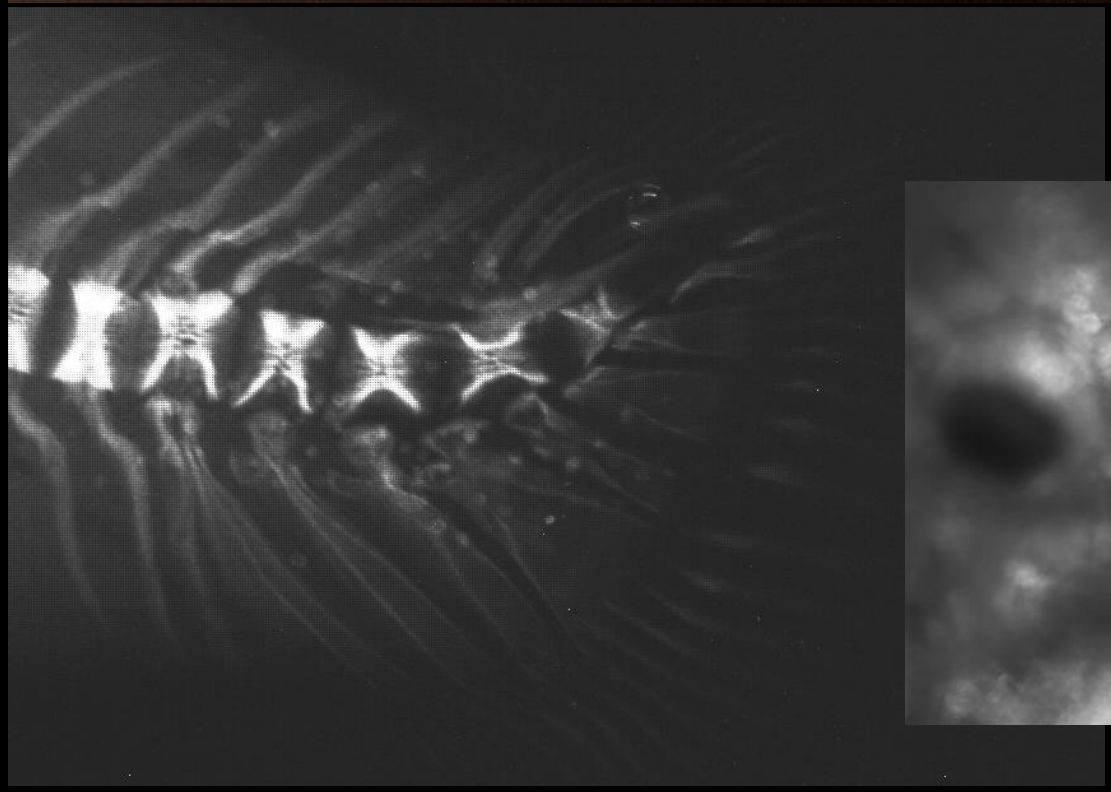
1) Determine factors causing high mortality and deformities in captive-reared bull trout.

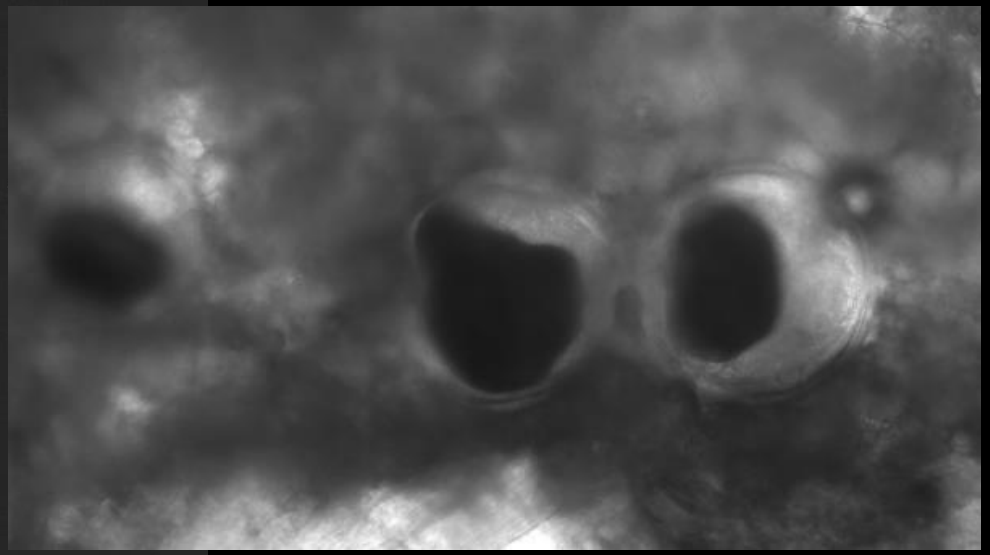
Methods

Radiography & Histology:

1) Surviving bull trout
   from 2013 (*N* = 22)
2) Presrvd. morts 2013 (*N* = 6)
   2012 (*N* = 20)
3) Wild bull trout (*no hatchery*)
   (*N* = 40)
4) Chinook salmon YOY (*N* = 25)

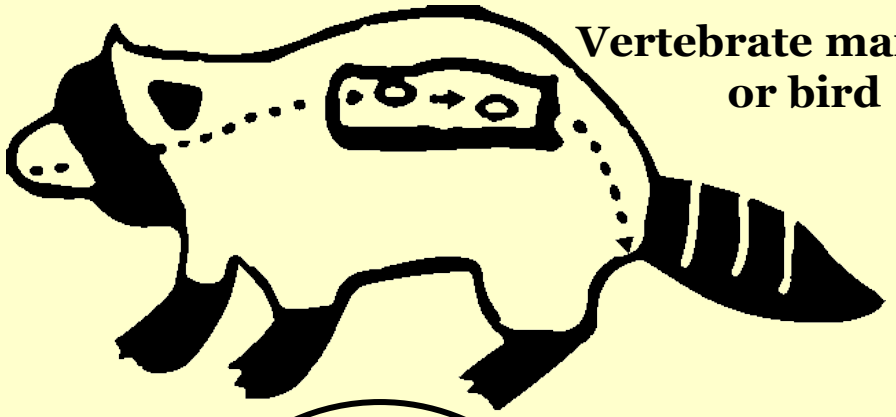






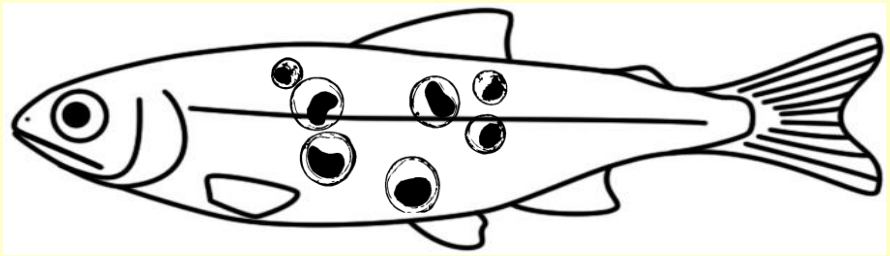
Metacercariae of *Nanophyetus salmincola*

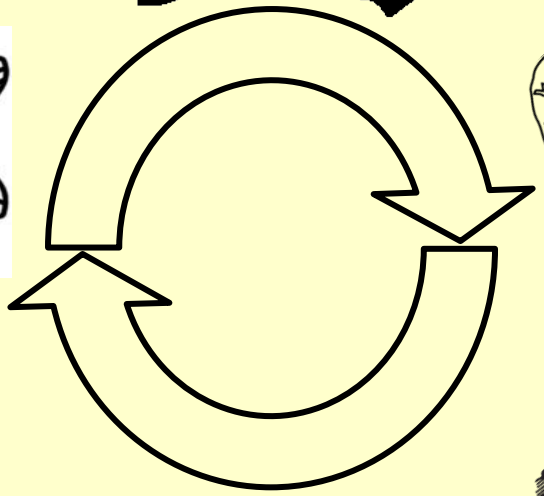
Nanophyetus salmincola



Vertebrate mammal or bird

Metacercariae





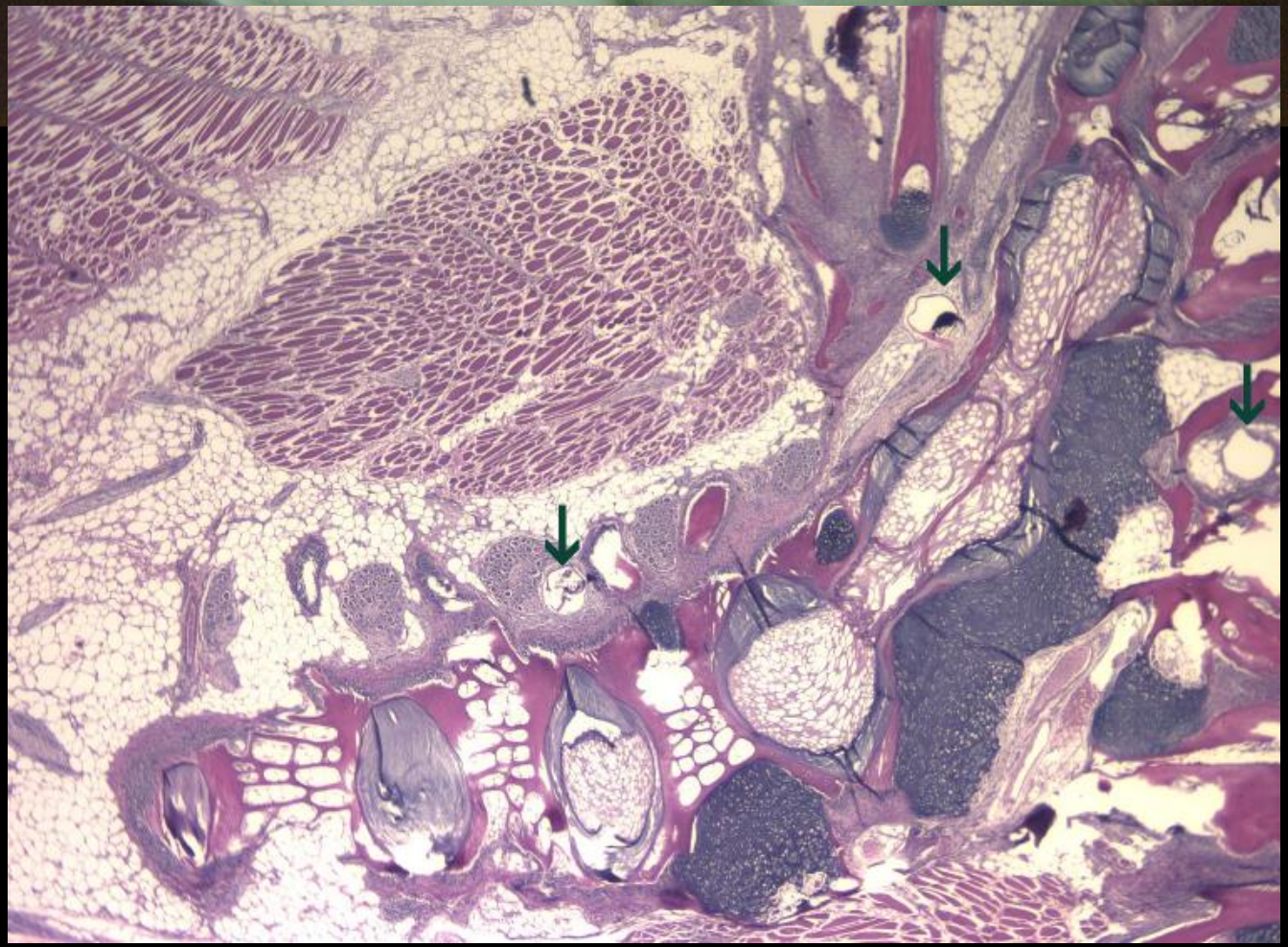
Egg

Cercaria

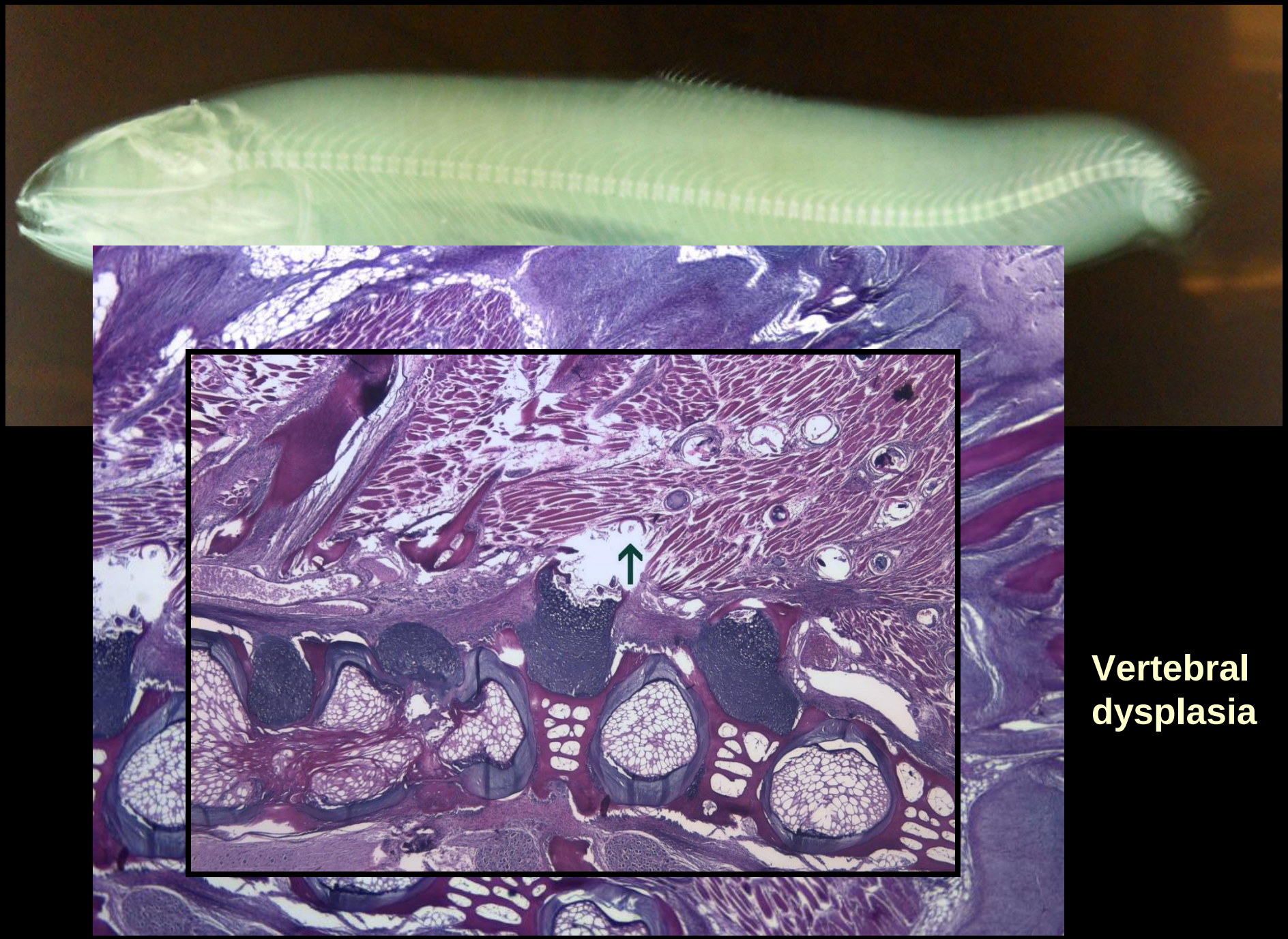
Miracidium

***Juga sp.* snail**

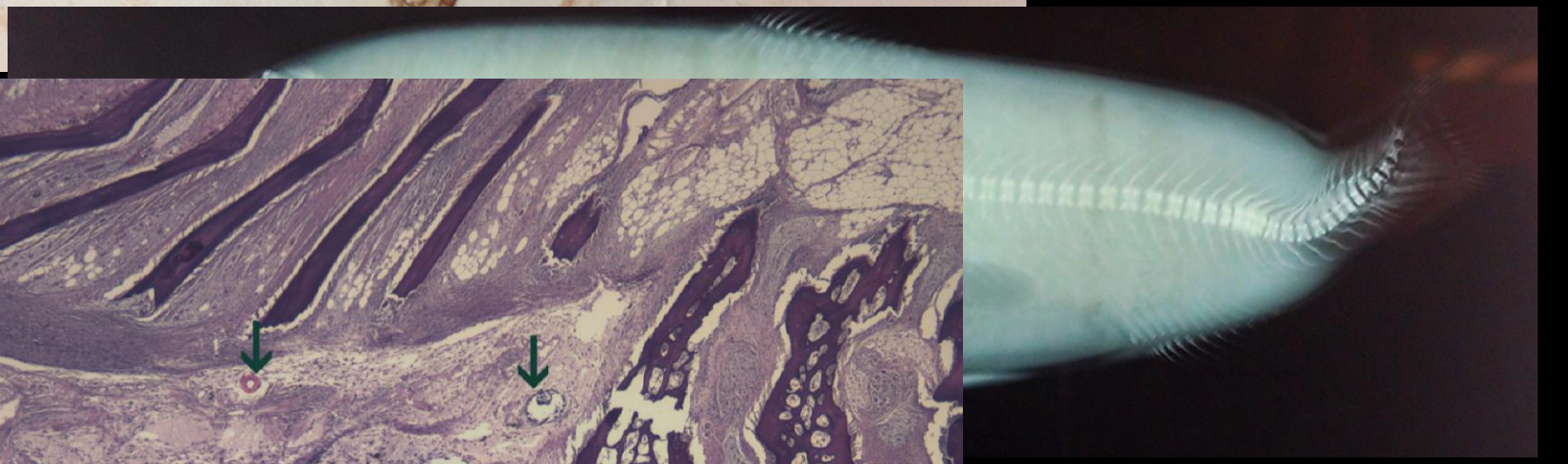
Courtesy of Sean Roon



Cartilage



Vertebral dysplasia

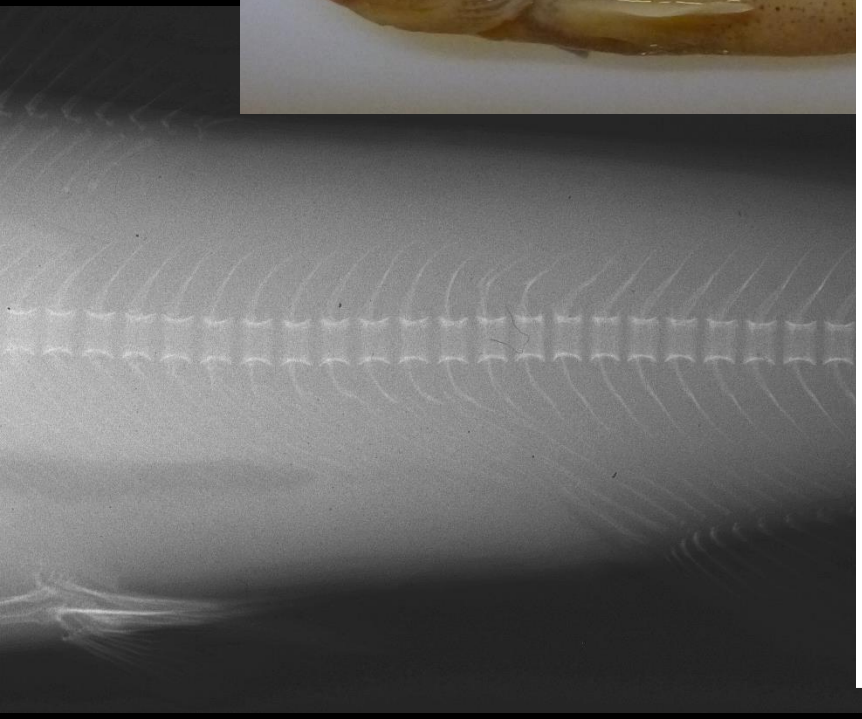


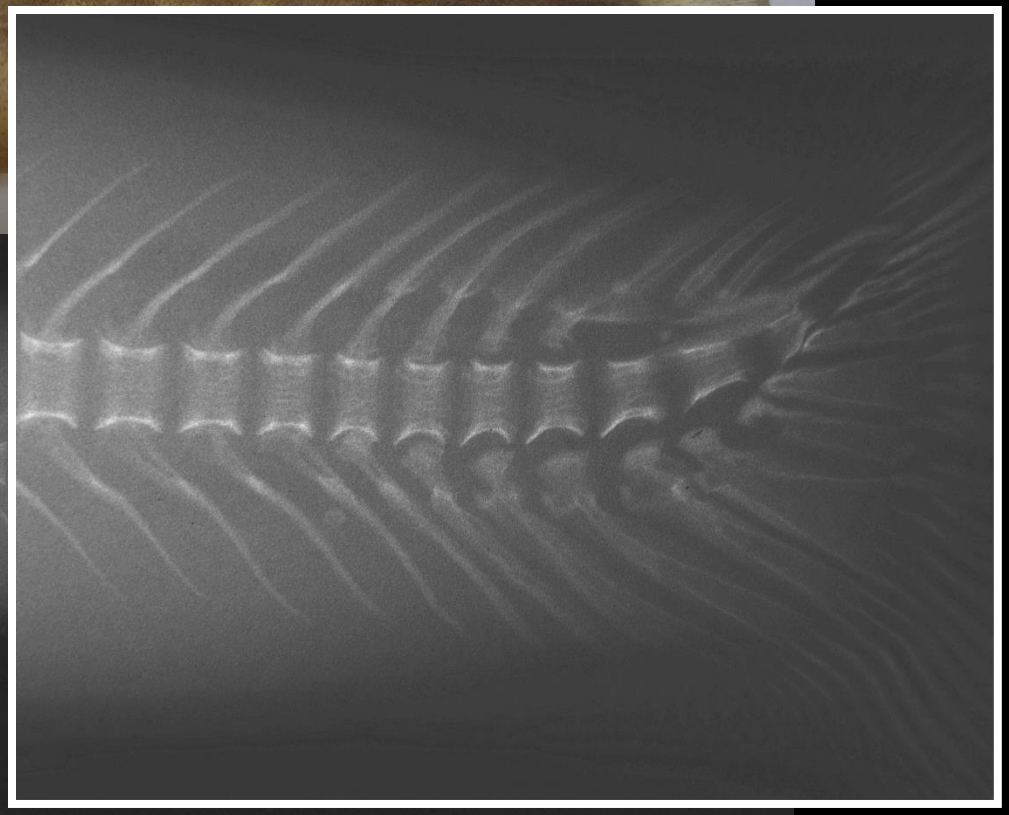
Spinal cord

Previous Mortalities – 2012 (*N* = 20)

Skeletal deform: 0%

Nanophyetus: Yes (Low)





Anderson Creek (*no hatchery*) $N = 40$

Skeletal deform: 0%

Nanophyetus: 0%

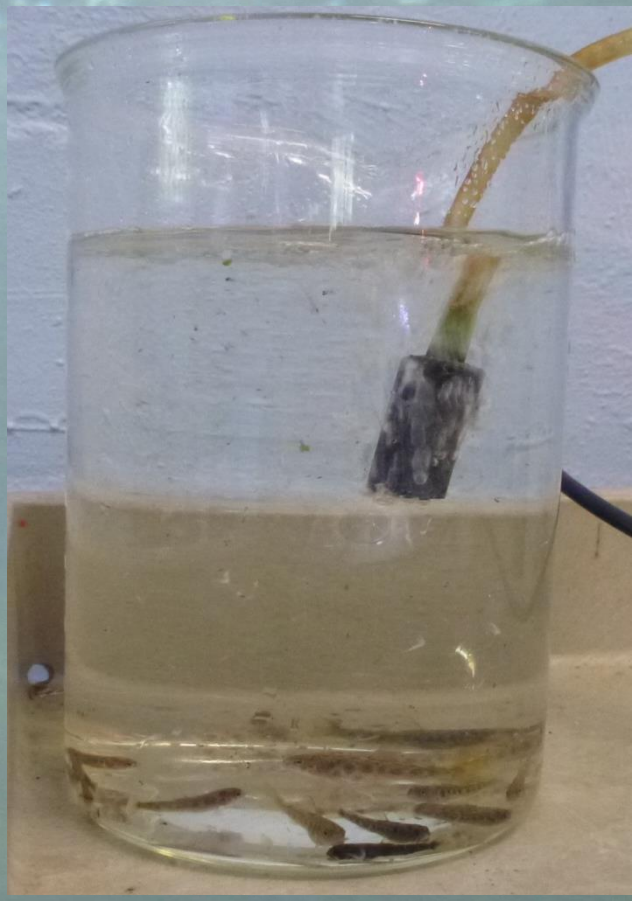
Chinook Salmon

- March – 4 mos. (*N = 20*):
  - **Skeletal deform: 0%**
  - ***Nanophyetus*: 15%**
- September (*N = 5*):
  - **Skeletal deform: 0%**
  - ***Nanophyetus*: 100%**

Methods

Radiography & Histology:

1) Surviving fish from 2013 (*N* = 22)
2) Preserved morts from 2013 (*N* = 6)
   2012 (*N* = 23)
3) Fish directly from wild
4) Chinook salmon YOY



5) Experimental Infection Study (May – Sep):

- **Control-UV (*N* = 23)**
- **Low-dose (*N* = 20)**
- **Hi-dose (*N* = 20)**

Results

Radiography & Histology :

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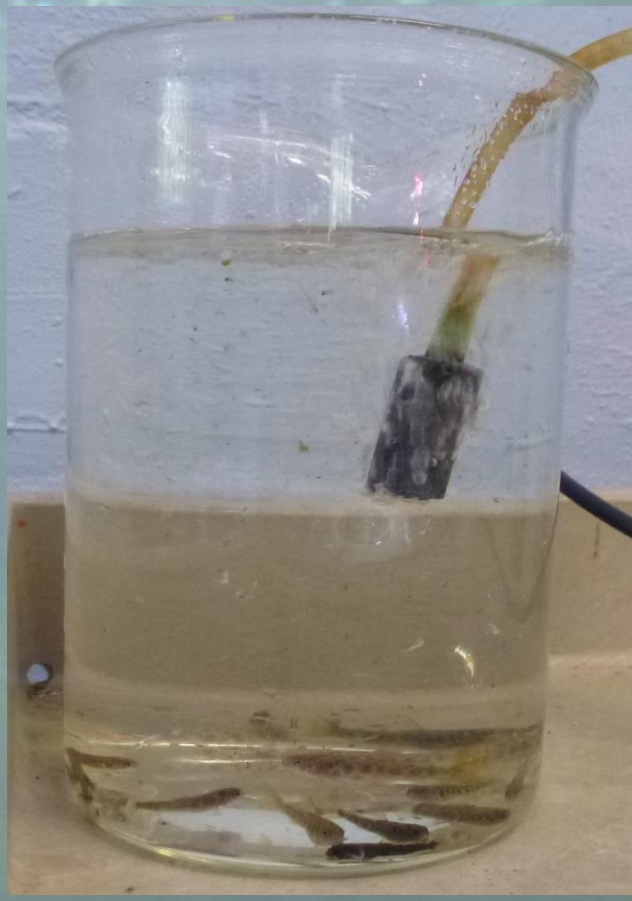
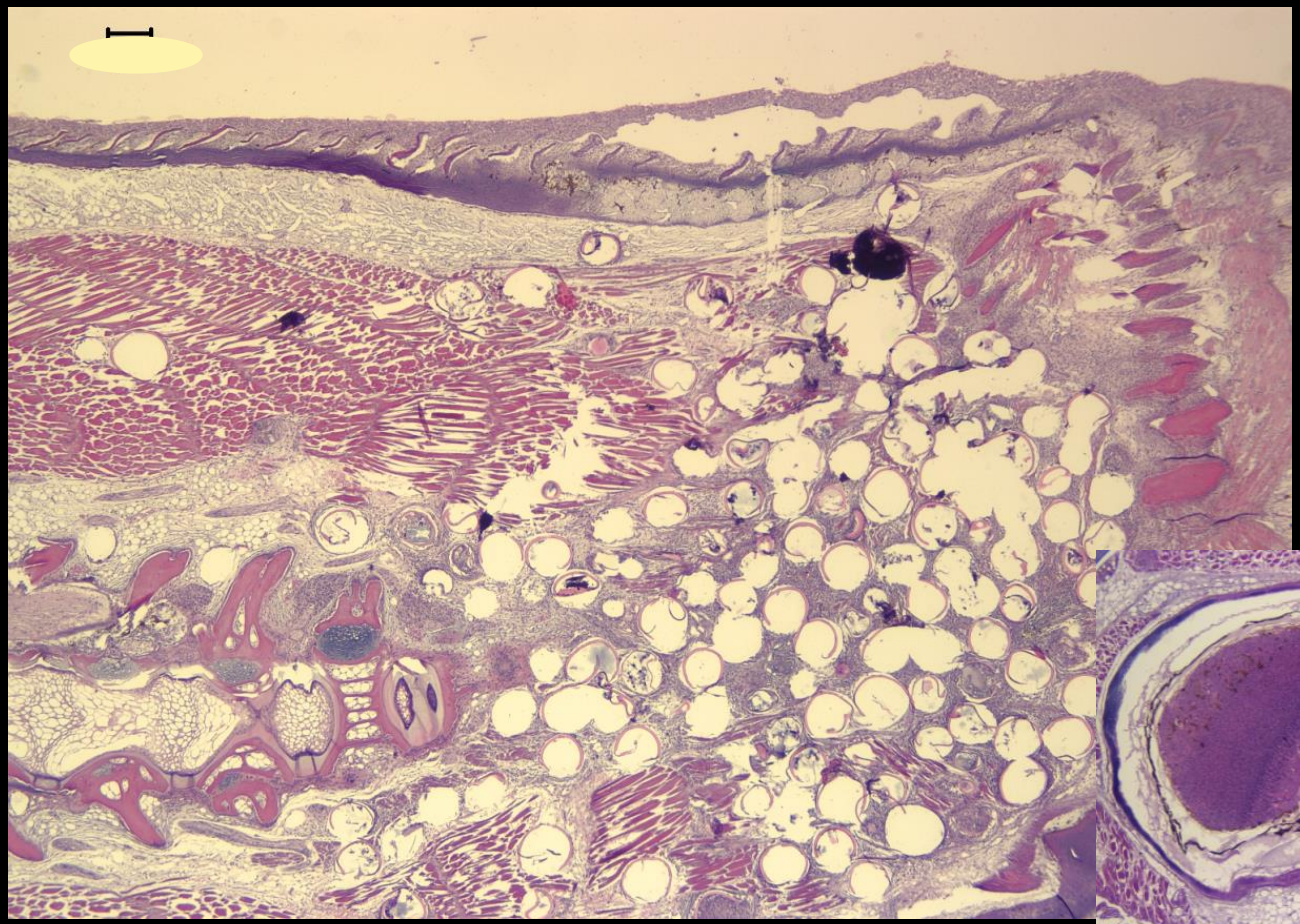
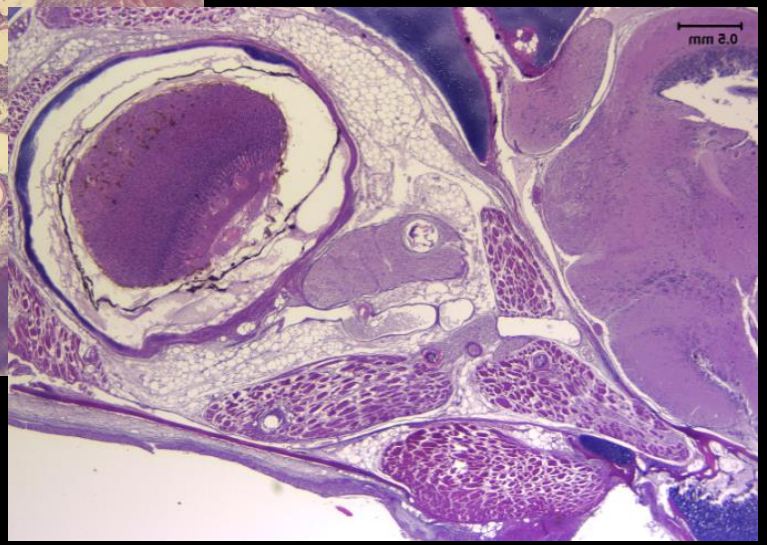


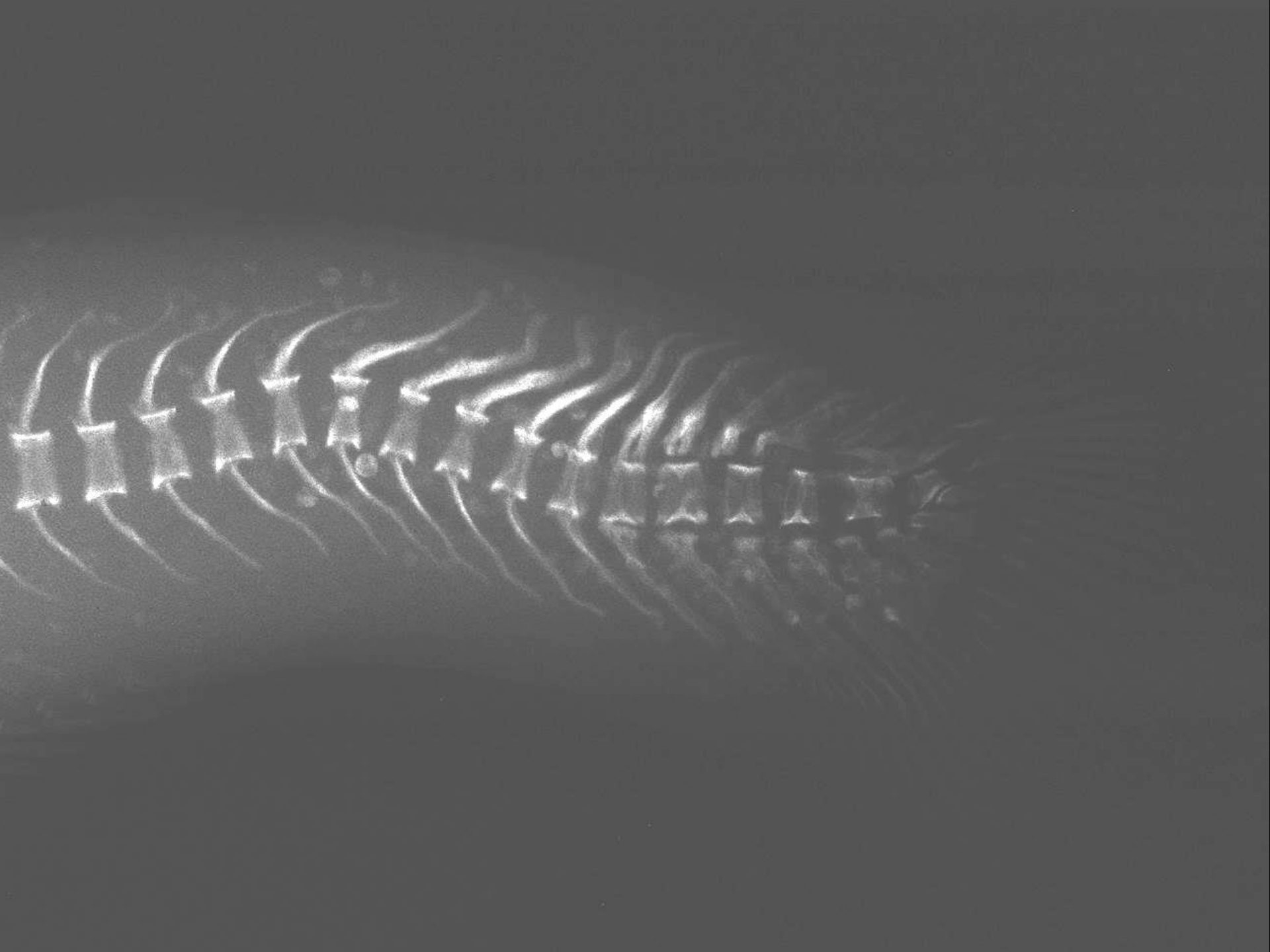
5) Experimental Infection Study (May – Sep):

- **Control-UV (*N* = 23) – 53% survival**
- **Low-dose (*N* = 20) – 45% survival**
- **Hi-dose (*N* = 20) – 38% survival**

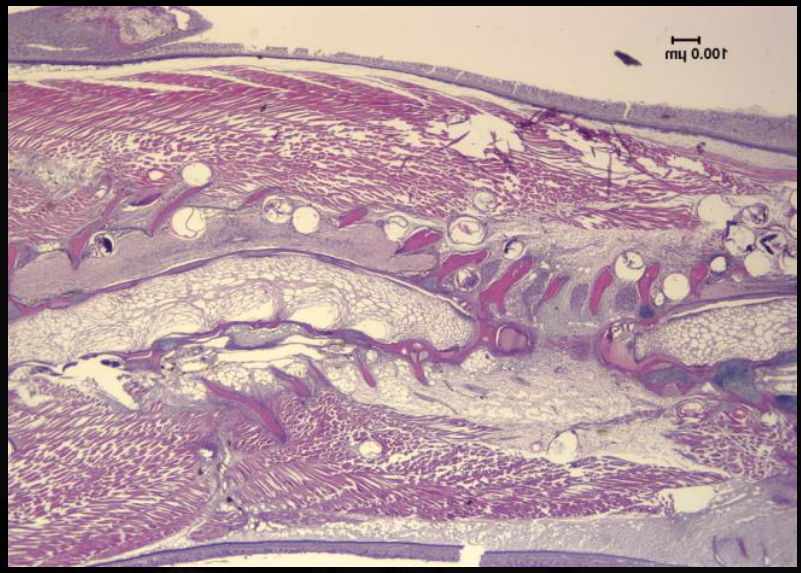

BTL14-31

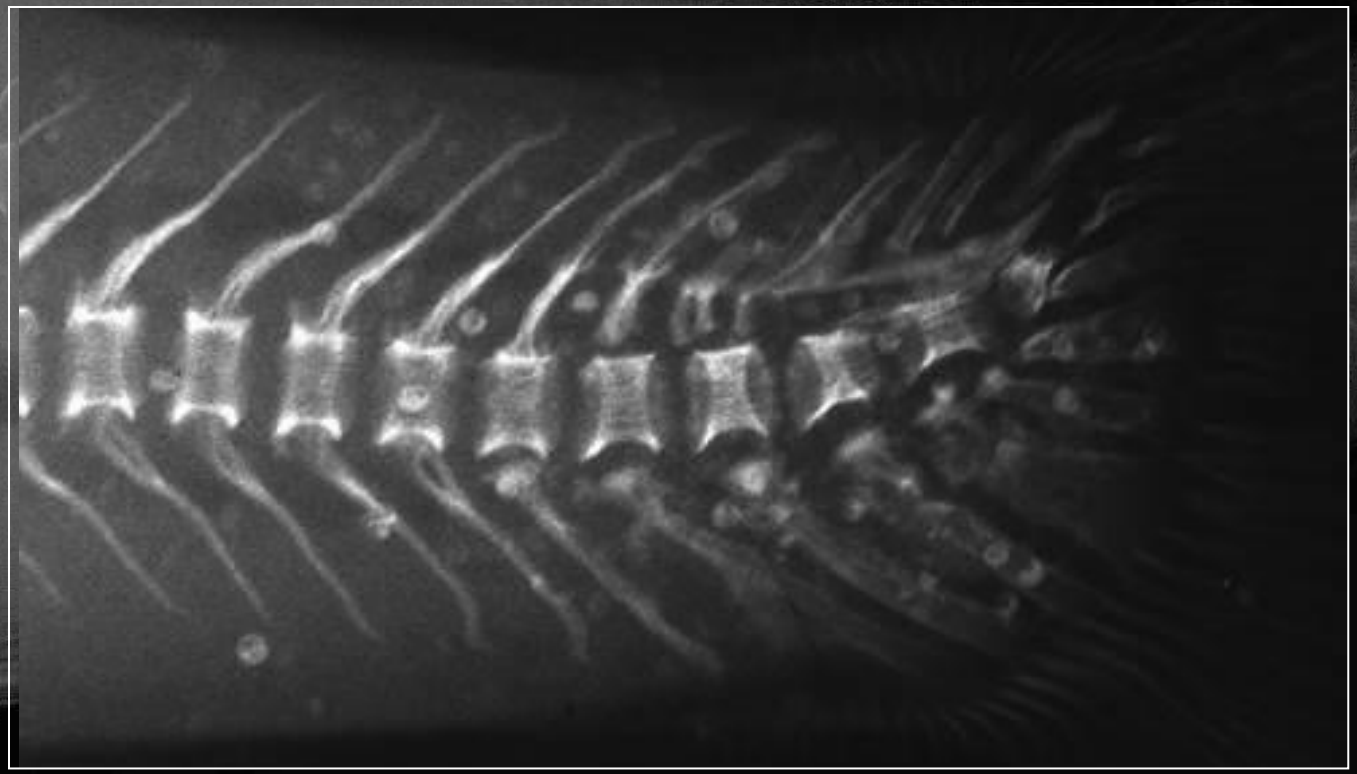






Putative Control Group (UV-Treated River Water)





Results

5) Experimental Infection (May – Sep):

- Control (*N* = 23) – 53% survival
- Low-dose (*N* = 20) – 45% survival
- Hi-dose (*N* = 20) – 38% survival

→ ***All 3 groups heavily infected & affected***

→ **Early juv. bull trout = highly susceptible**

→ **UV sterilization ineffective for macroparasites**


R
MAX

Results

6) Experimental Infection II (May-Aug 2015):

- Well-water source, static system
- McKenzie Hatchery (5 km farther downstream)

  - Control (*N* = 23)

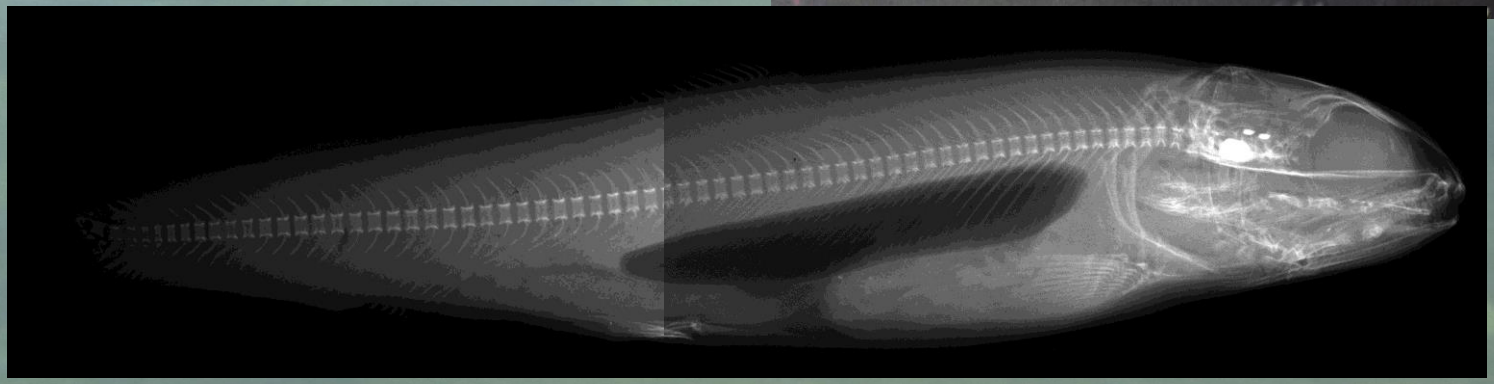
  - Exposed (*N* = 43)

Results

6) Experimental Infection II (May-Aug 2015):

- **Well-water source, static system**
- **Hatchery 5 km farther downstream**

- Control (*N* = 23)



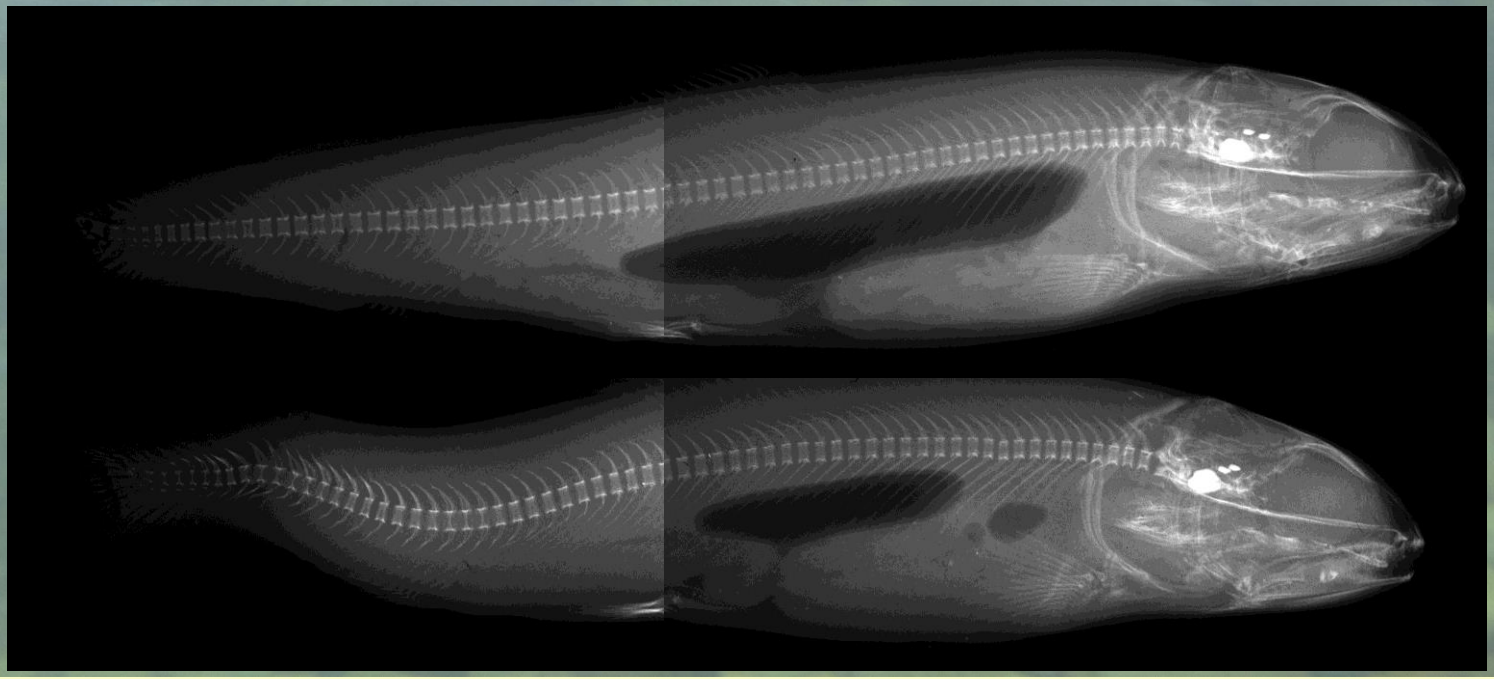
Results

6) Experimental Infection II (May-Aug 2015):

- **Well-water source, static system**
- **Hatchery 5 km farther downstream**

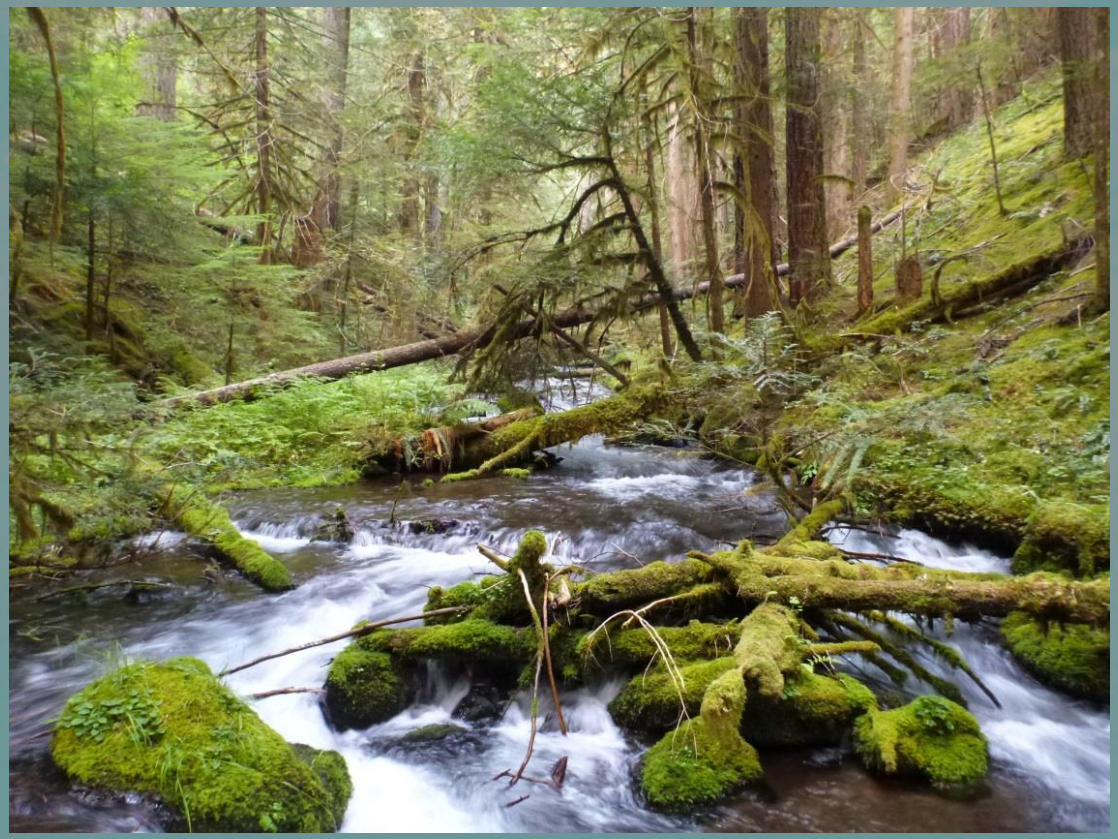
- Control (*N* = 23)

- Exposed (*N* = 43)



Objectives

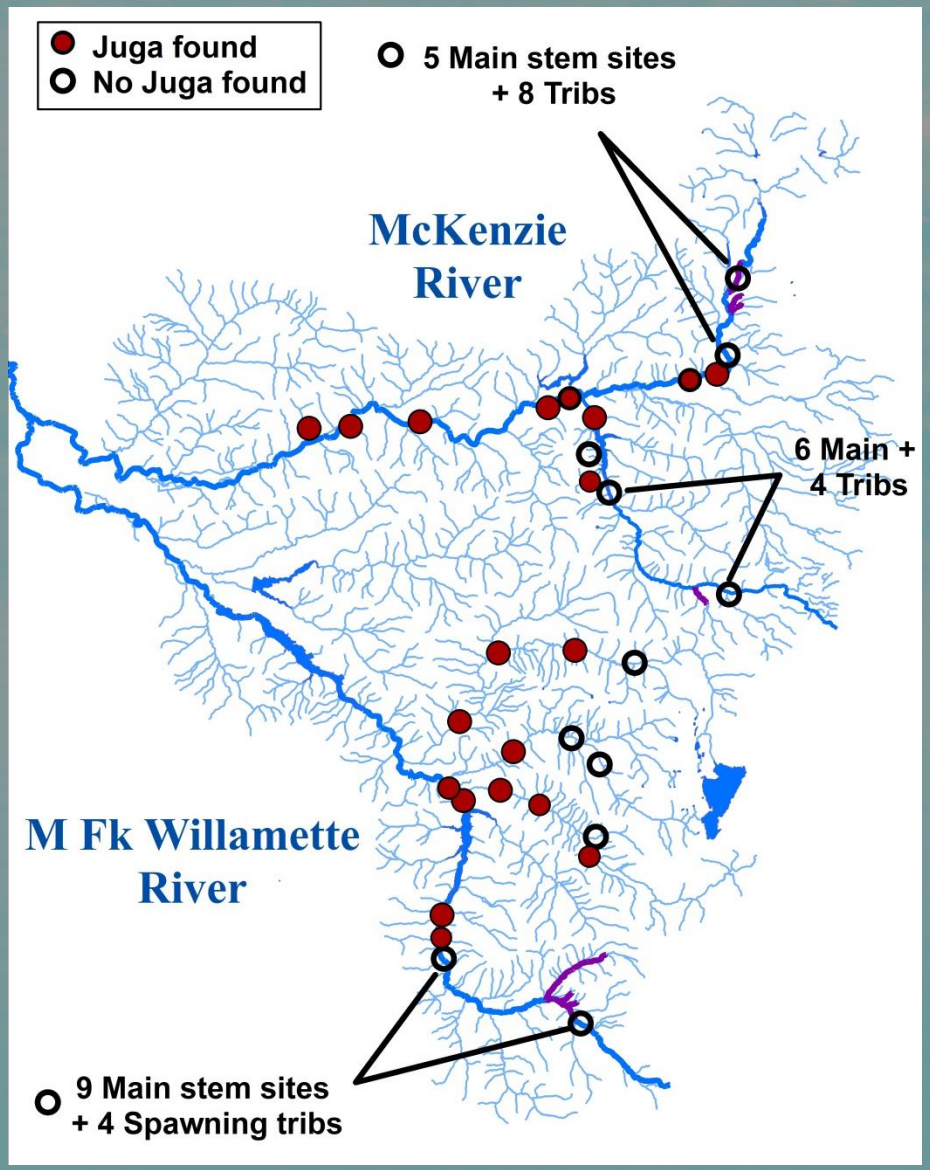
1) Determine factors causing high mortality and deformities in captive-reared bull trout.
2) **Pathogen risk to wild bull trout in the upper Willamette River basin *(4 components)***



Pathogen Risk Assessment

1) Distribution overlap of *Juga sp.* snails & bull trout

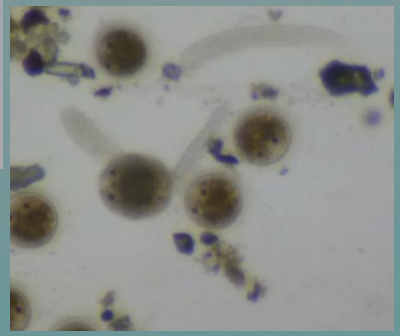
- Snorkeling >20 min / site
- Collect >100 *Juga* / site
- Spawning tribs
- Main stem bull trout reaches
- Potential reintroduction sites



Pathogen Risk Assessment

2) Assess prevalence of parasites shed from snails

~ 40 Collections (>3,000 snails) from 14 waterbodies



Pathogen Risk Assessment

3) Pathogen/parasites in various fishes

- **ODFW – Oregon Wild Fish Health Survey**

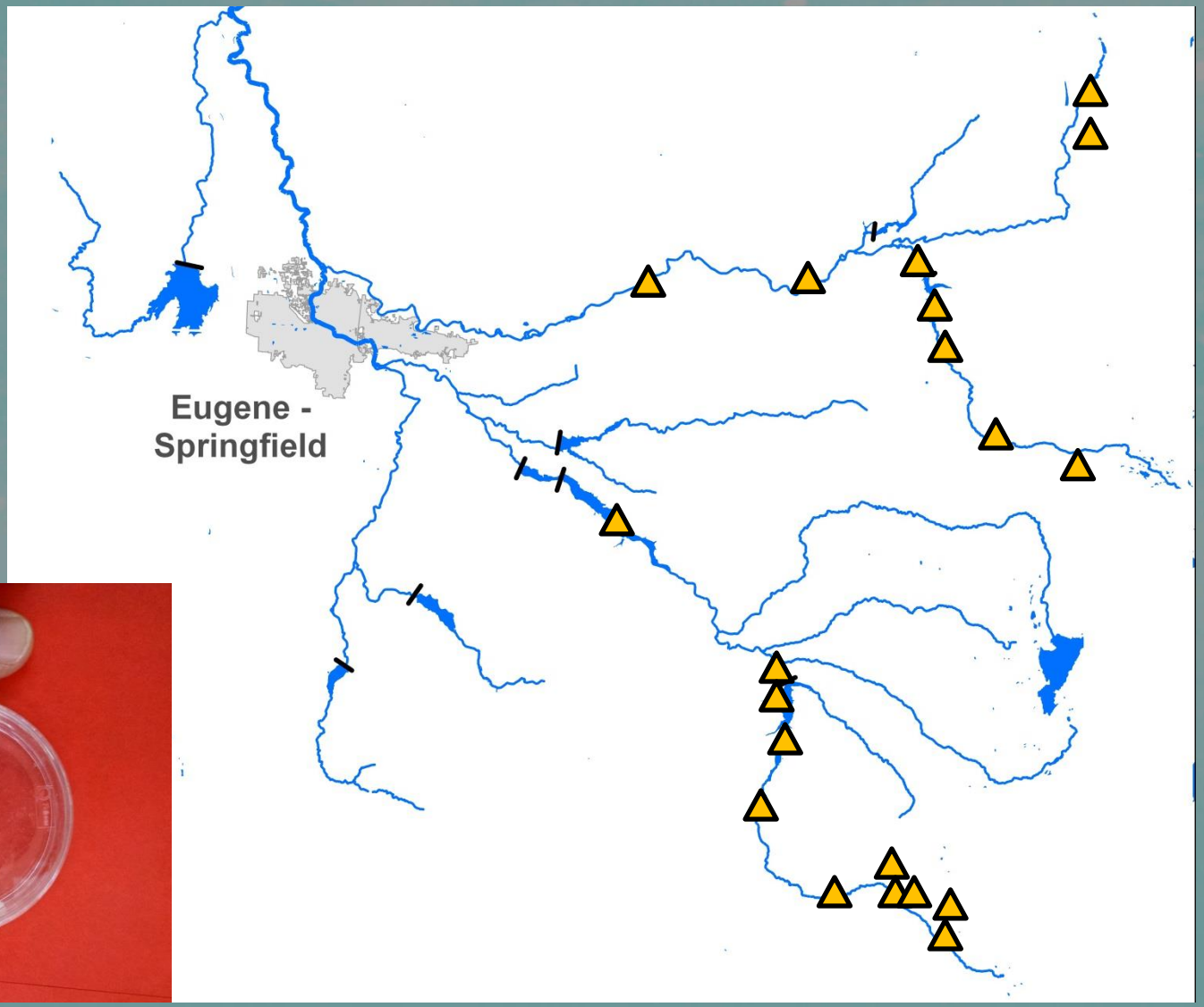
<u>To date:</u>

220 fish

18 fish spp.

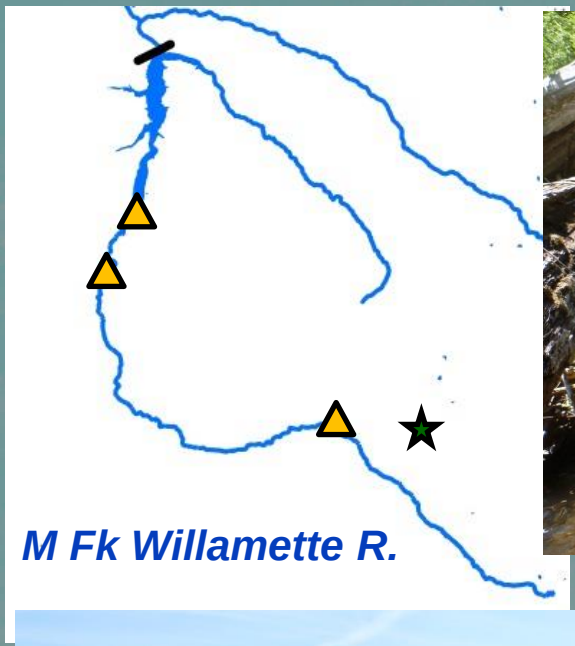
22 sites

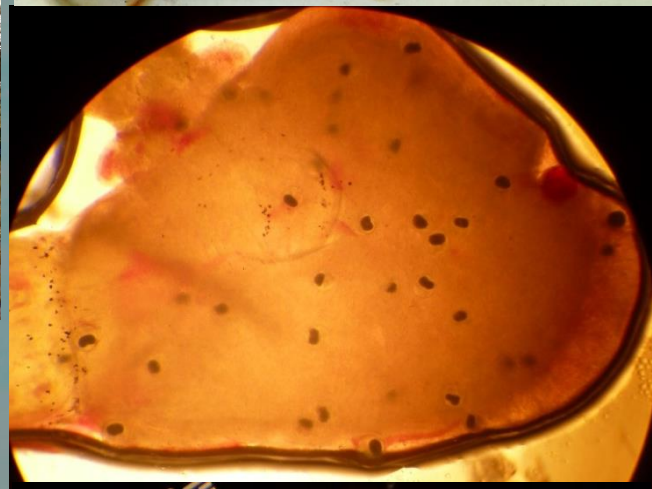
6 bull trout



Pathogen Risk Assessment

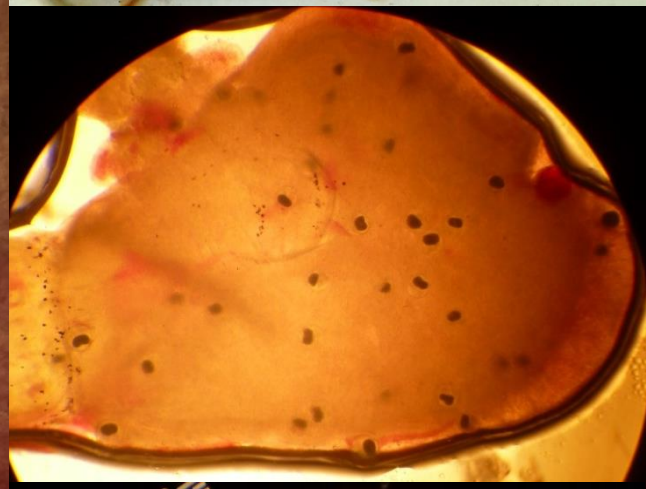
4) Sentinel fish (brook trout) – pilot study – 20 fish/site

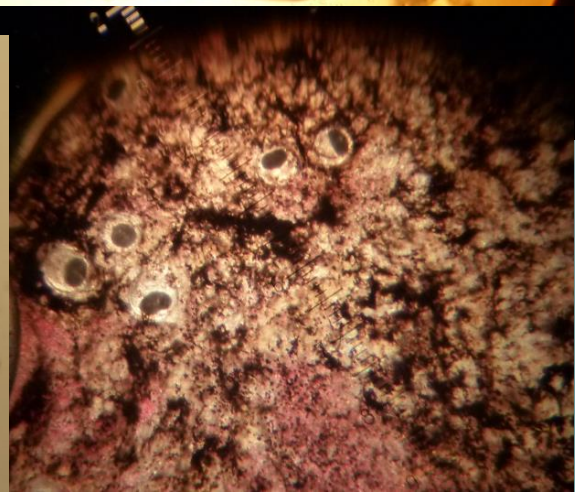




Pathogen Risk Assessment

4) Sentinel fish (brook trout) – pilot study





Implications

- ***N. salmincola*** **= threat to captive-rearing**
  - **Bull trout fry = naïve host**

    <u>Aquatic parasites → skeletal deformities:</u>

    Myxobolus cerebralis in salmonids
    Apophallus sp. in cyprinids in Willamette R.
    Riberoria ondatrae in amphibians
  - **Water supply/treatment**

Implications

- *N. salmincola* = threat to captive-rearing
  - Bull trout fry = naïve host
  - Water supply/treatment
- **Threat to wild populations?**
  - **Spatiotemporal (fish & parasite)**

Implications

- *N. salmincola* = threat to captive-rearing
  - Bull trout fry = naïve host
  - Water supply/treatment
- **Threat to wild populations?**
  - **Spatiotemporal (fish & parasite)**
  - **Reintroduction suitability**

Implications

- Changes in parasite spp./distrib./prevalence
  - Altered habitat
  - Non-natives
  - Climate change
  - Hatchery effect (amplification?)

Acknowledgements

Upper Willamette Bull Trout Working Group (EWEB, ODFW, USACE, USFS, USFWS)

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Michelle Steinauer – OSU/WUHS
Leaburg Hatchery staff
McKenzie Hatchery staff

Lab:

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Jerry Heidel – OSU Veterinary School
Brian Sidlauskas – OSU Icthyology Lab
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Sean Spagnoli – OSU
Amelia Thornhill – ODFW Fish Health

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Kate Meyer – USFS
Ray Rivera – USFS
Vince Tranquilli – ODFW
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