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Evaluation of the Response of American Eels to Rapid Decompression

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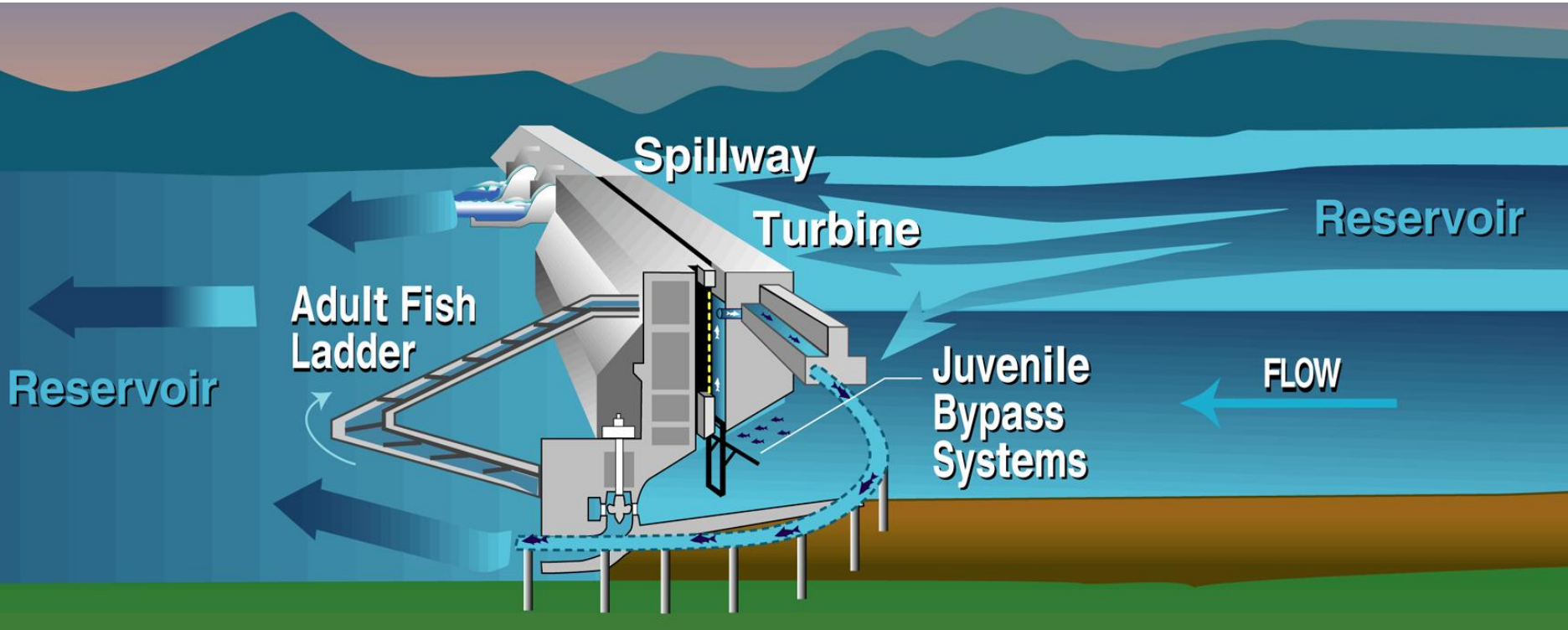
STAR Closing Conference; October 15th, 2016

PNNL-SA-121144



Background

- ▶ Hydropower dams
 - Generate electricity
 - Most common renewable energy in the world
 - Can negatively affect fish





Barotrauma

- ▶ Injuries from the changes in barometric pressures
- ▶ Caused by gases expanding internally (e.g., swim bladder)
 - E.g. emphysema, hemorrhaging, embolism, ruptured organs, bruising or hematomas



Forebay

Penstock

Turbine

Draft tube

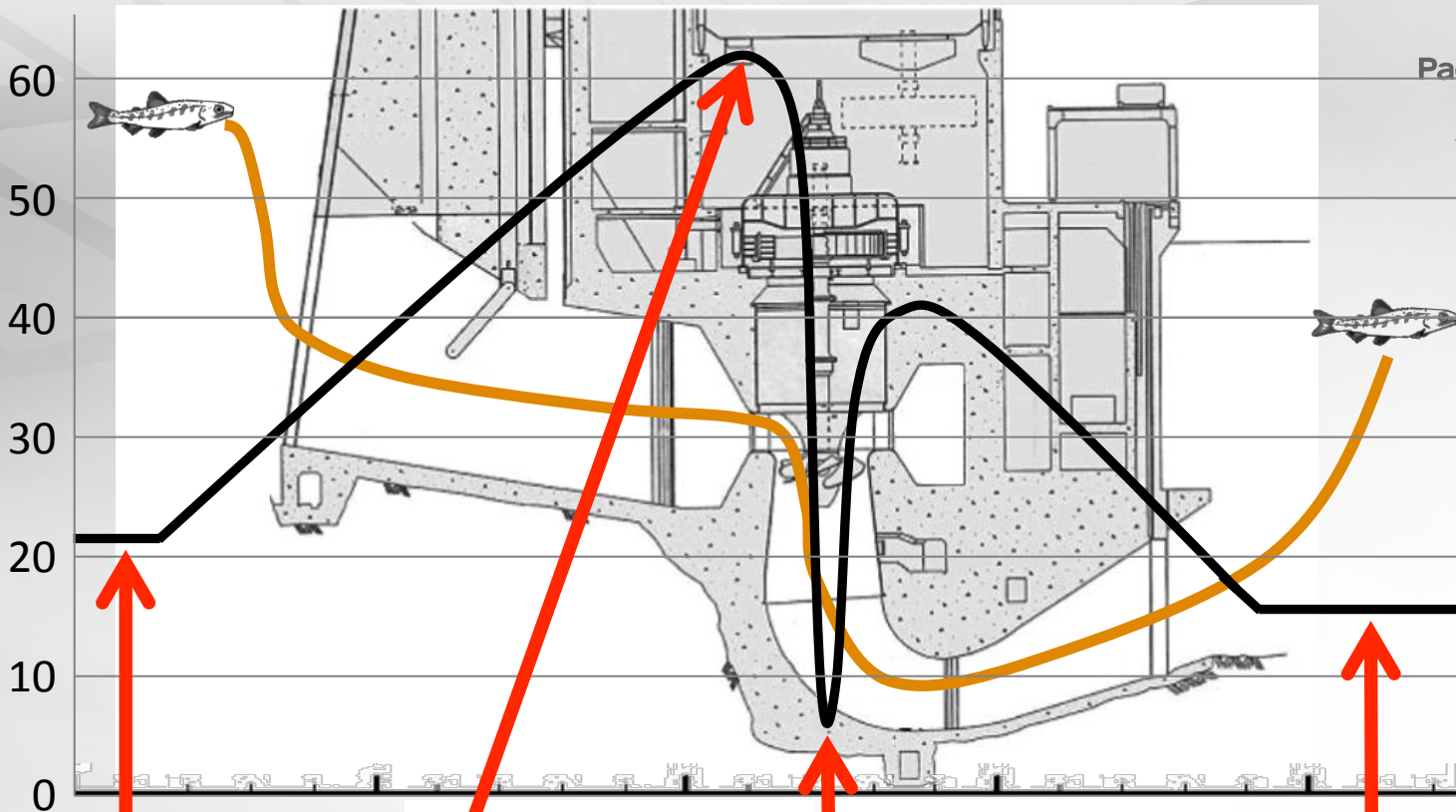
Tailrace



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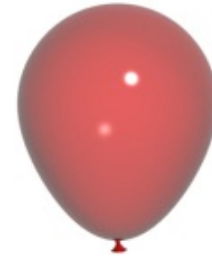
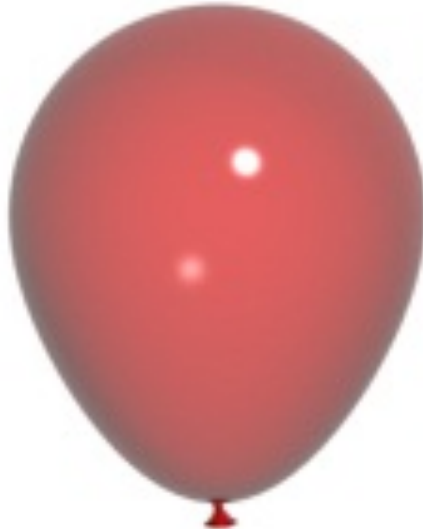
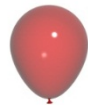
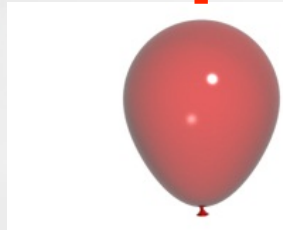
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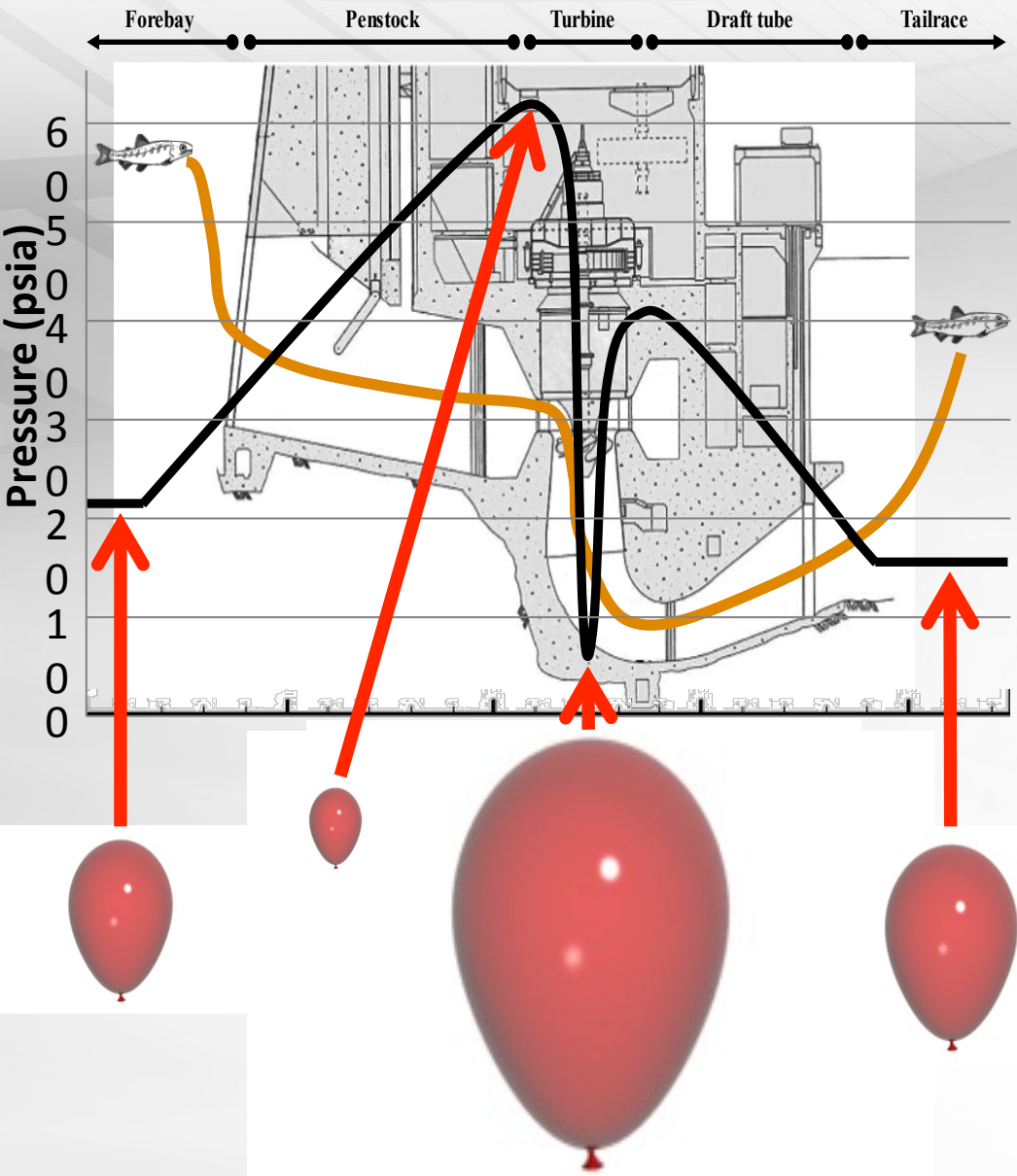
Pressure (psia)



Spike data

Path of fish





Objectives

To determine the response of American eels, *Anguilla rostrata*, to rapid decompression.

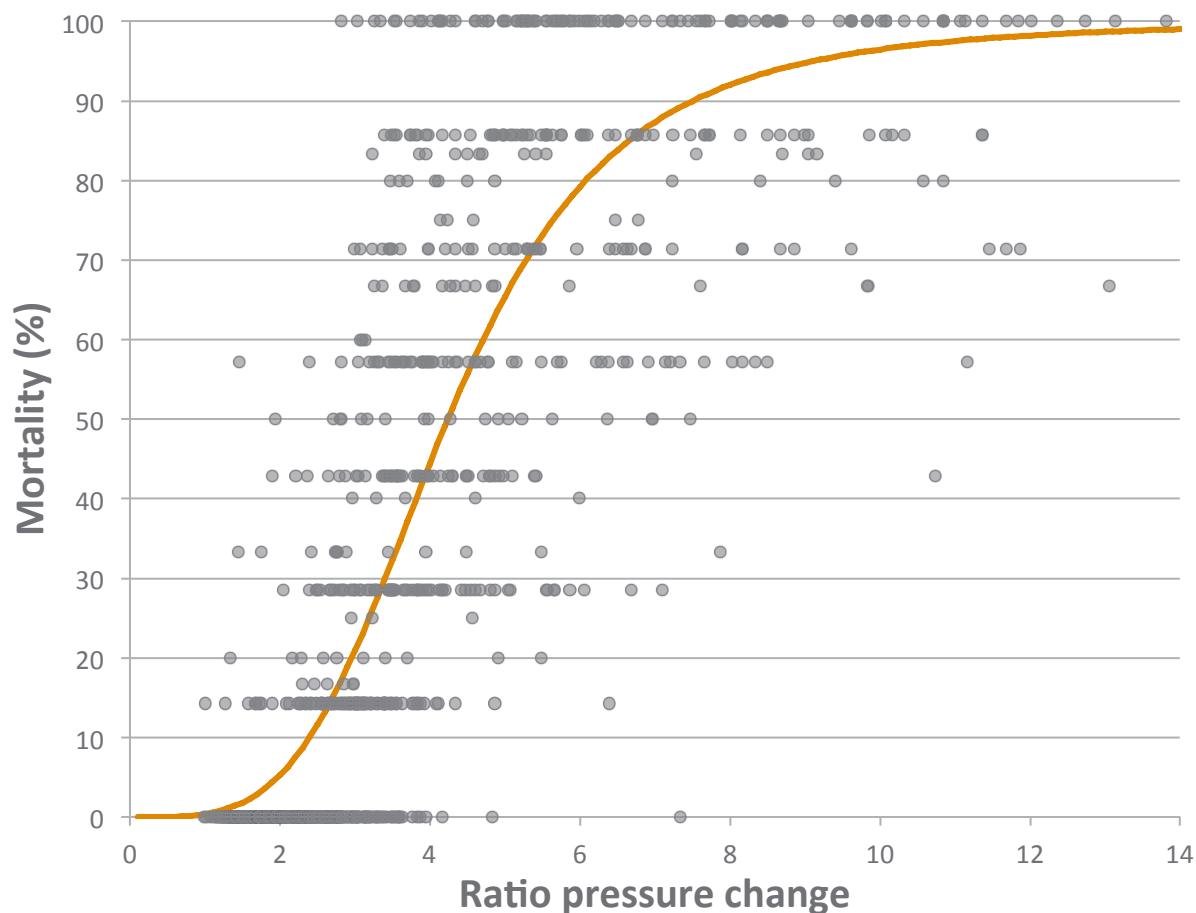


Photo Credit: Briana Rhode

- ▶ Why American eels?
- ▶ What is the significance of this?
- ▶ How will it be done?

► Relationship between mortality/injury and pressure change for juvenile Chinook salmon

Brown et al. 2012 Transactions of the American Fisheries Society



Goal was to collect data to make a similar graph for American eels

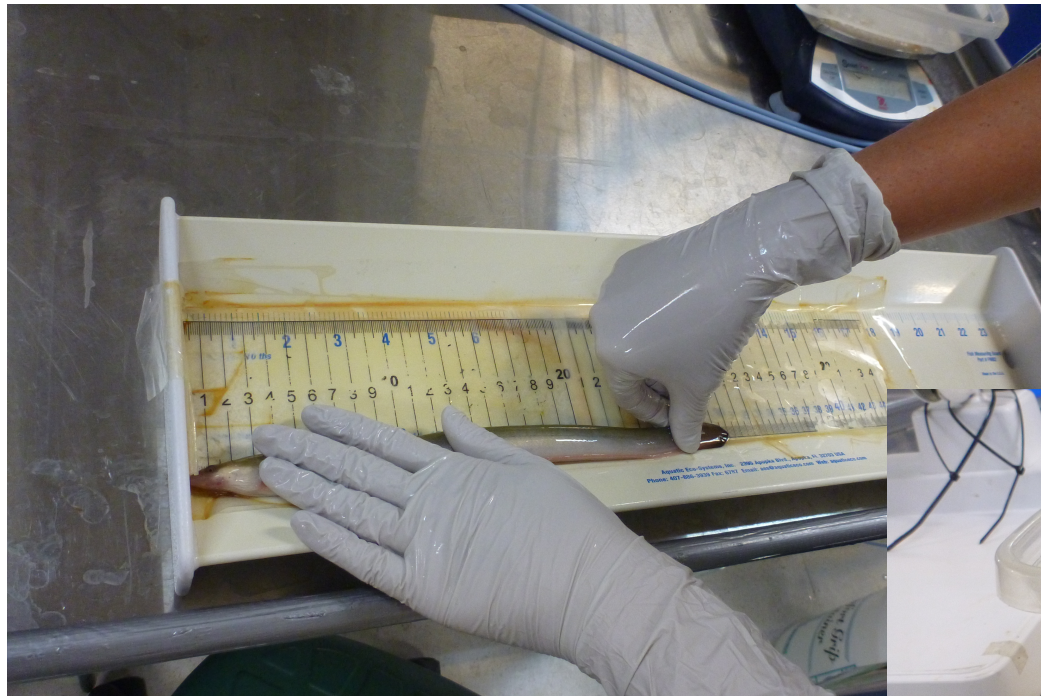


Marking set-up

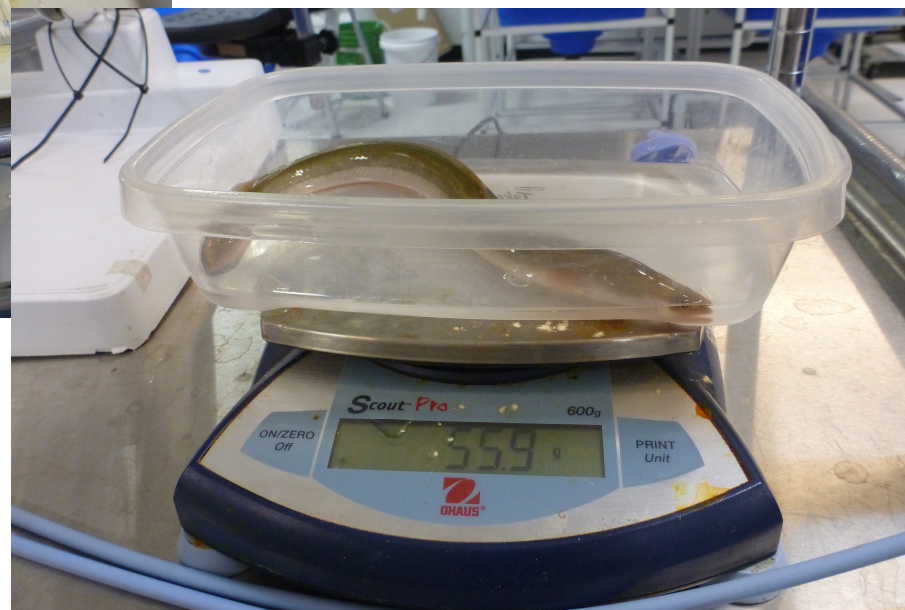
Eels being anesthetized



Methods



Measuring length and weight of eels before testing





Loading eels



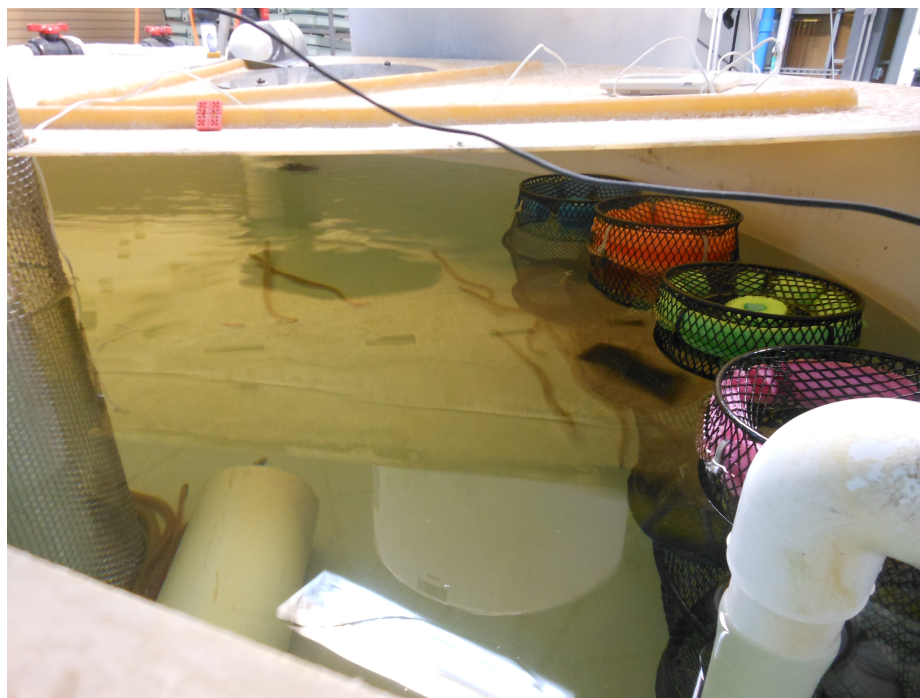
Eels in chamber being acclimated to 25 psi
(equivalent of 25 ft depth)

Methods





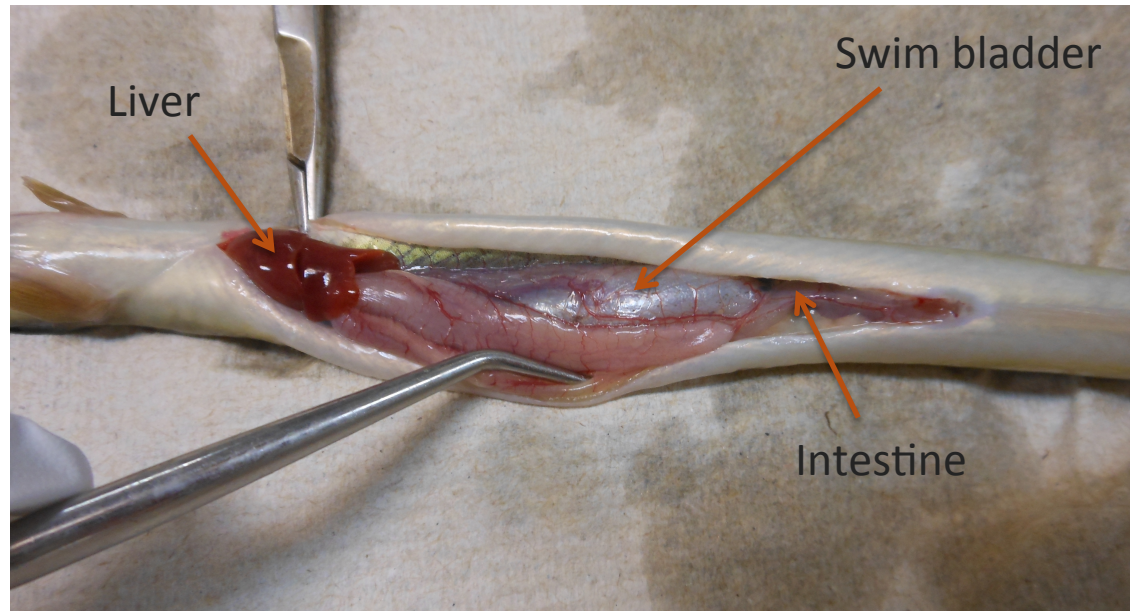
Two day holding period



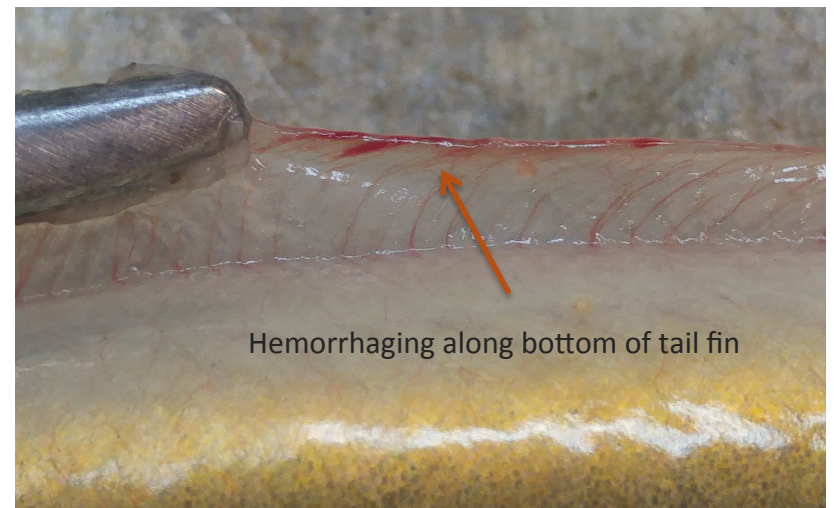
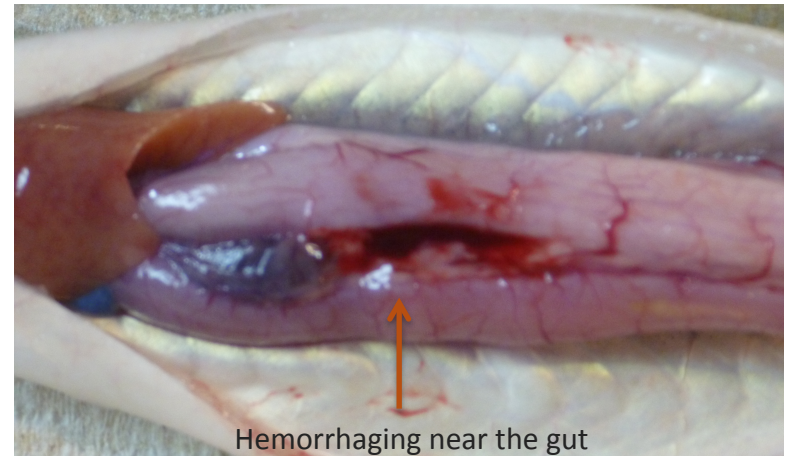
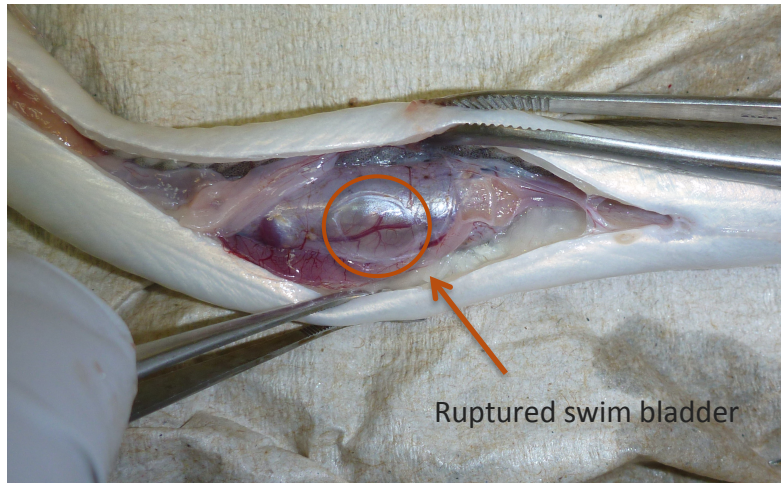


Methods- Necropsy

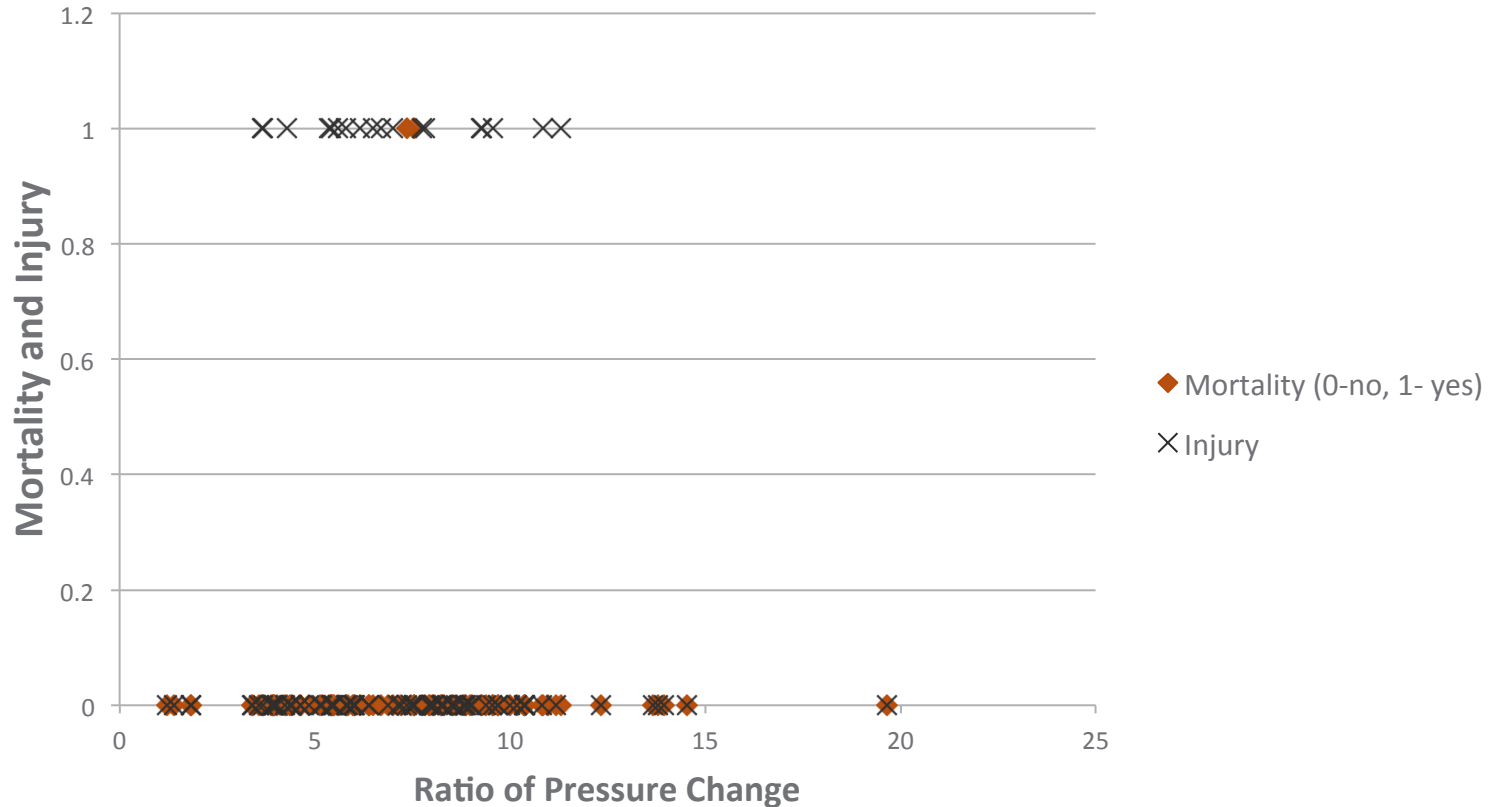
- ▶ Check externally & internally
- ▶ Pictures of injuries
- ▶ Write observations on data sheet



Injuries found



Results



- ▶ Total of 101 eels tested
- ▶ Only 2% mortality found in two day holding period (had injuries)
- ▶ 21 found with injuries
- ▶ Max. ratio change with injury was 11.32
- ▶ Range of ratio change was 1.21 to 19.66



Discussion

- ▶ Only 2% mortality found in two day holding period (had injuries)
- ▶ 21 found with injuries
- ▶ Eels are very resilient to rapid decompression
 - Many burped during spike potentially reducing barotraumas
- ▶ Further research needed to find the ratio of pressure changes that results in 100% mortality in eels





References

Brown RS, AH Colotelo, BD Pflugrath, CA Boys, LJ Baumgartner, Z Deng., LGM Silva, CJ Brauner, M. Mallen-Cooper, O Phonekhampeng, G Thorncraft, and D Singhanouvong. 2014. Understanding barotrauma in fish passing hydro structures: a global strategy for sustainable development of water resources. *Fisheries* 39(3):108-122. DOI: 10.1080/03632415.2014.883570.

Brown RS, BD Pflugrath, AH Colotelo, CJ Brauner, TJ Carlson, and ZD Deng. 2012d. Pathways of barotrauma in juvenile salmonids exposed to simulated hydroturbines passage: Boyles Law vs. Henry's Law. *Fisheries Research* 121-122:43-50.

Brown RS, RW Walker, and JR Stephenson. 2016. A preliminary assessment of barotrauma injuries and acclimation studies for three fish species. Pacific Northwest National Laboratory: PNNL- 24720



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