



High Head Bypass Fish Passage Investigations at Green Peter Dam: Year One

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The Willamette Basin

- Biological Opinion
 - Reduce negative effects of dams on Chinook Salmon and Winter Steelhead
 - ✓ Improvements to operations and structures
-  High Head Bypass Product Delivery Team
 - Investigate alternatives to improve downstream fish passage
 - Injury and mortality studies
 - ✓ 2015, 2016, and 2017
- Copepod-infected fish
 - Increased prevalence
- What downstream passage method best minimizes stress?



Two Objectives

- Healthy Fish Passage Evaluation
 - Conduct **bypass pipe** and trap and haul (transport) simulations and analyze sub-samples for:
 - ✓ Amount of cortisol (a stress hormone) present in the blood plasma of fish.
 - ✓ Presence of major injuries (torn operculum or fins, bulging eyes, lacerations, etc.).
 - ✓ Rate of survival.
- Infected Fish Relocation Evaluation Feasibility Study
 - Evaluate practicality of using copepod-infected fish for a full study of **bypass pipe** vs. **transport** by estimating:
 - ✓ Rate of survival.

Study Site: Green Peter Dam

Bypass Pipe

**Juvenile Fish
Collector**



Transport

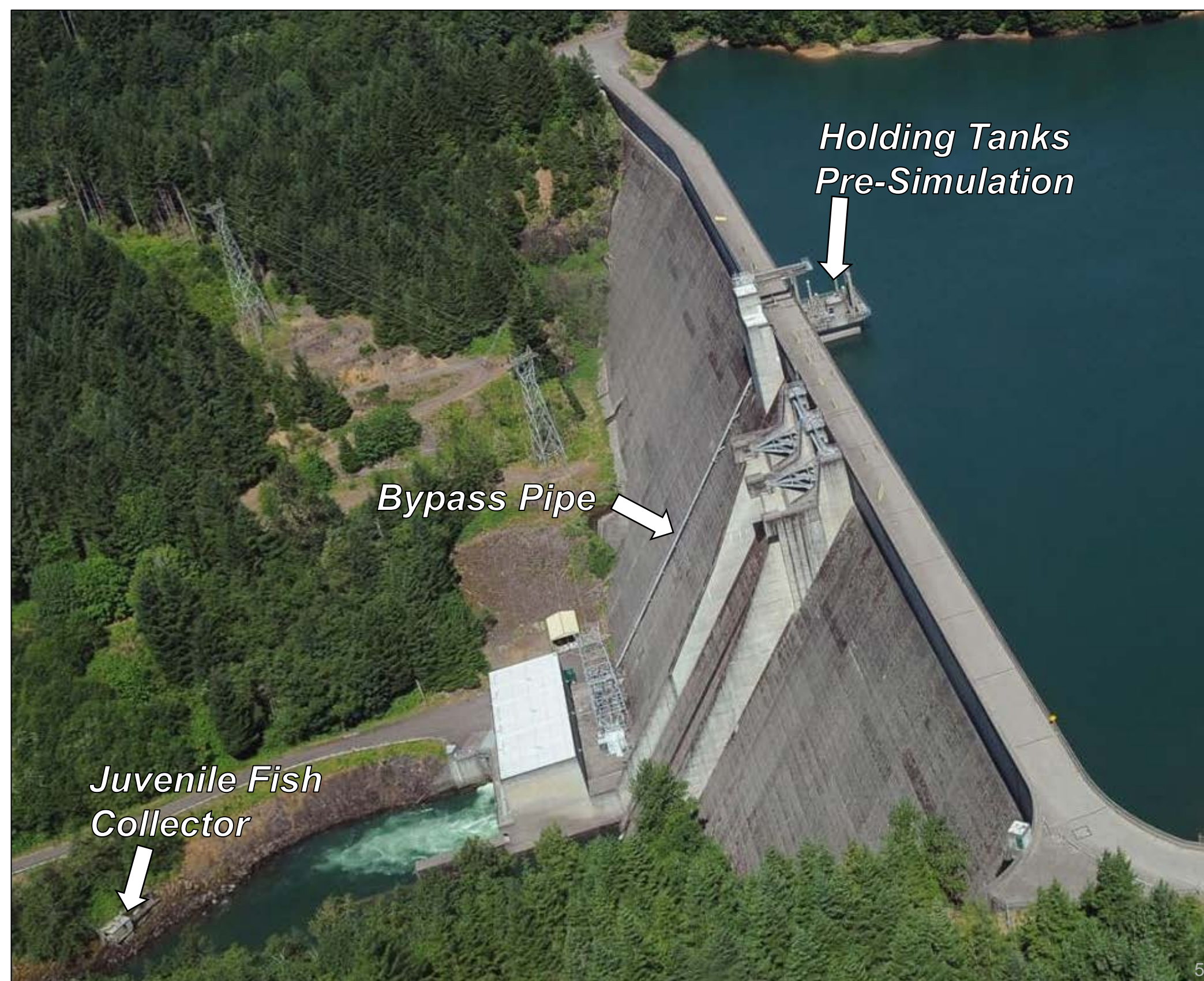


Bypass Pipe Simulation

Real world stressors:

1. Enter the Floating Screen Structure (FSS)*
2. Chute passage from FSS into bypass pipe*
3. Bypass pipe passage
4. Release into river

*Fish collection steps are the same for **bypass pipe** and transport.



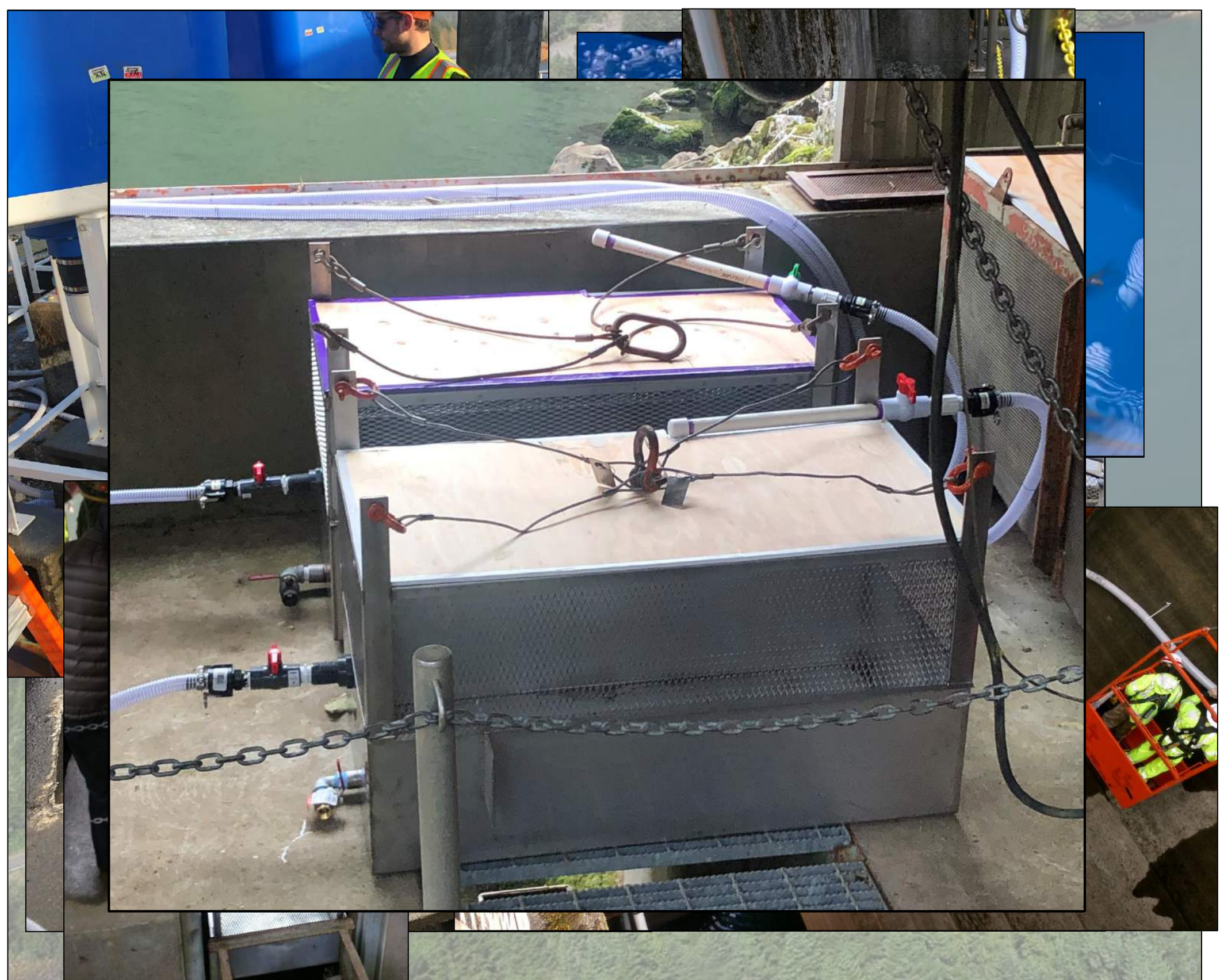
Bypass Pipe Simulation

Real world

1. --
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3. Enter Floating Screen Structure (FSS)
4. Chute passage from FSS into bypass pipe
5. Bypass pipe passage
6. Release into river

Simulation

1. Relocate fish
2. Acclimate (2wk)
3. Pull center standpipe
4. Flex pipe from tank into bypass pipe
5. Bypass pipe passage
6. Release into juv. fish collector
Blood sampling



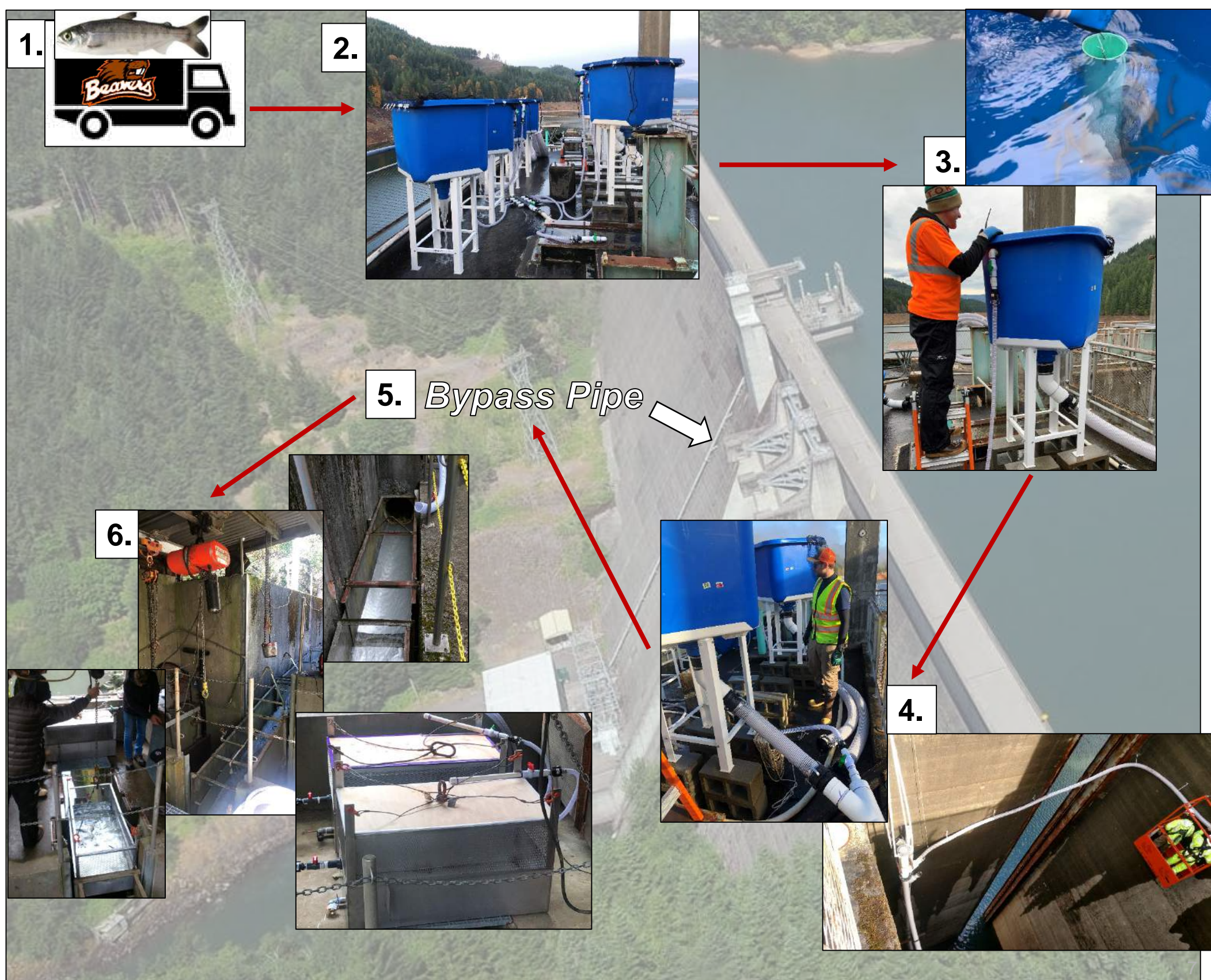
Bypass Pipe Simulation

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1. Relocate fish
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4. Flex pipe from tank to bypass pipe
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Blood sampling



Transport Simulation

Real world stressors:

1. Enter the Floating Screen Structure (FSS)*
2. Chute passage from FSS into pod*
3. Pod holding
 - Time varies: minutes to 24 h
4. Floating lid applied to pod, monorail trip from near dam to boat (15 min)
5. Crane lifts pod onto boat
6. Boat driving to boat ramp (13 min)
7. Pod moves from boat to truck
8. Truck driving to release site (15 min)
9. Pipe attached to pod on truck, fish released into river

*Fish collection steps are the same for **bypass pipe** and transport.



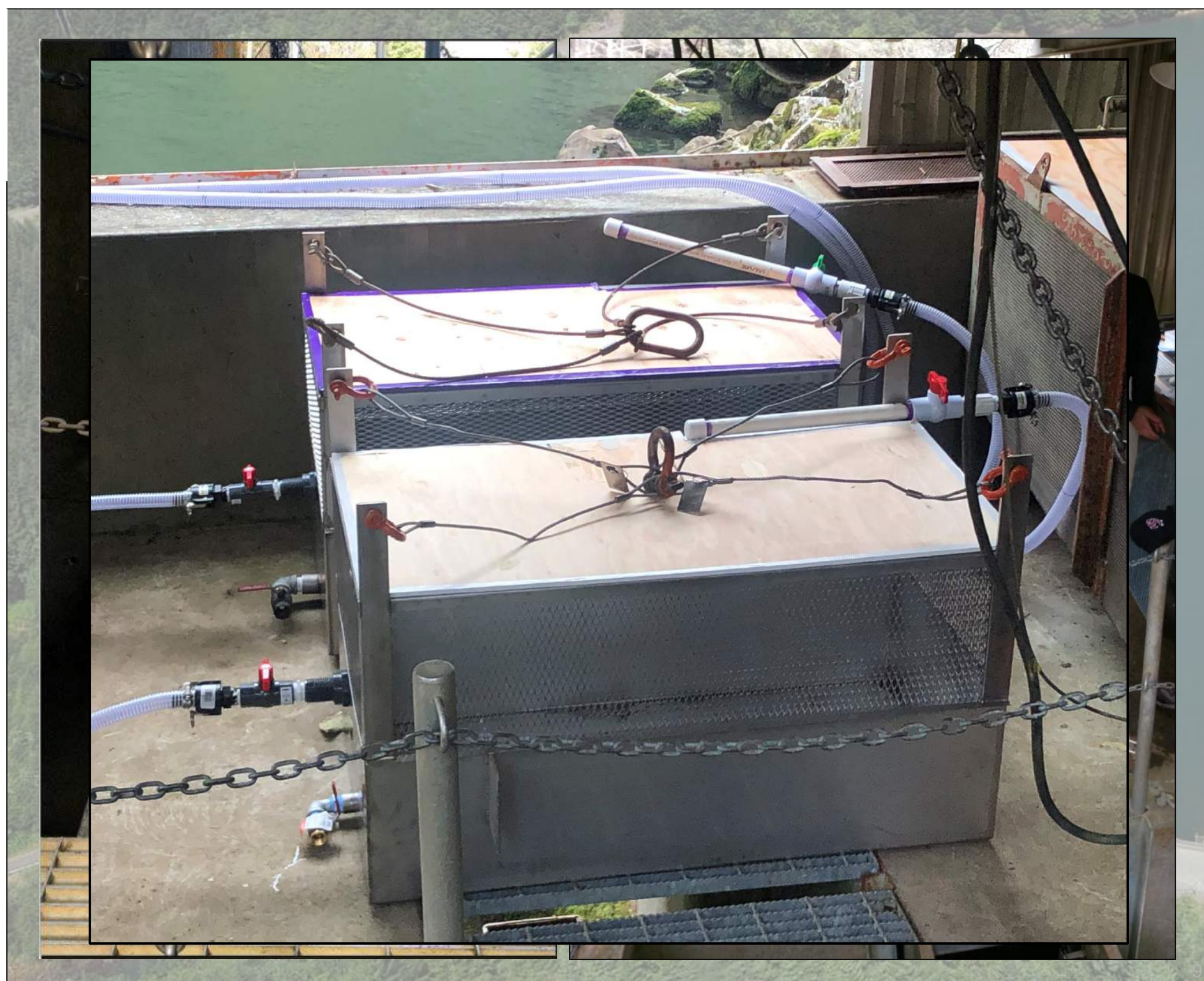
Transport Simulation

Real world

1. --
2. --
3. Enter FSS
4. Chute passage from FSS to pod
5. Pod holding
6. Floating lid, monorail trip
7. Crane lifts pod onto boat
8. Boat driving
9. Pod moves from boat to truck
10. Truck driving
11. Pipe attached to pod, fish released into river

Simulation

1. Relocate fish
2. Acclimate (2wk)
3. Forklift tank
4. Flex pipe from tank to pod
5. Pod holding
6. Floating lid, forklift driving
7. Forklift lifts pod to truck
8. Truck driving
9. Forklift removes/ replaces pod on truck
10. Truck driving
11. Flex hose from pod to release to juv. fish collector
Blood sampling



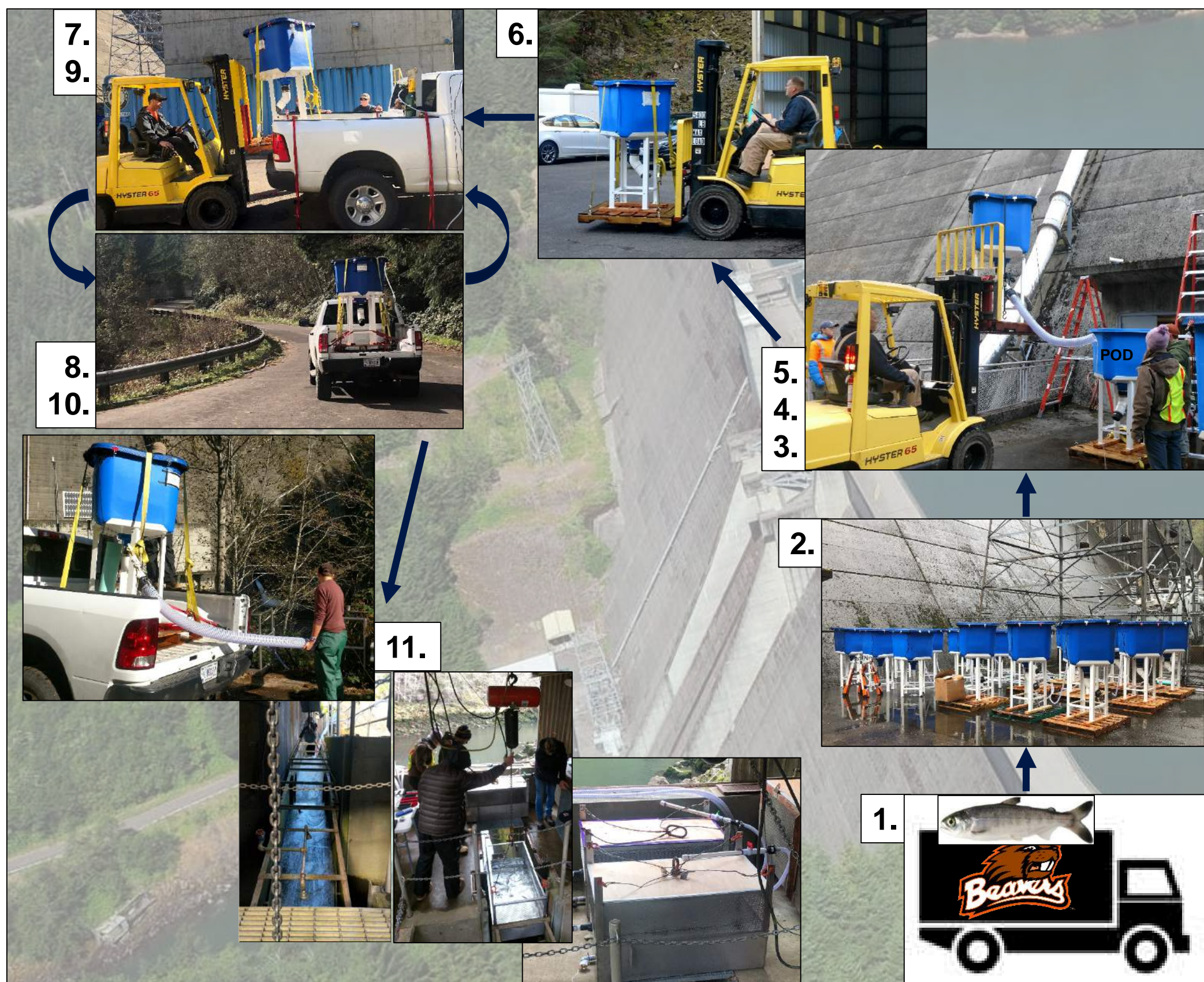
Transport Simulation

Real world

Simulation

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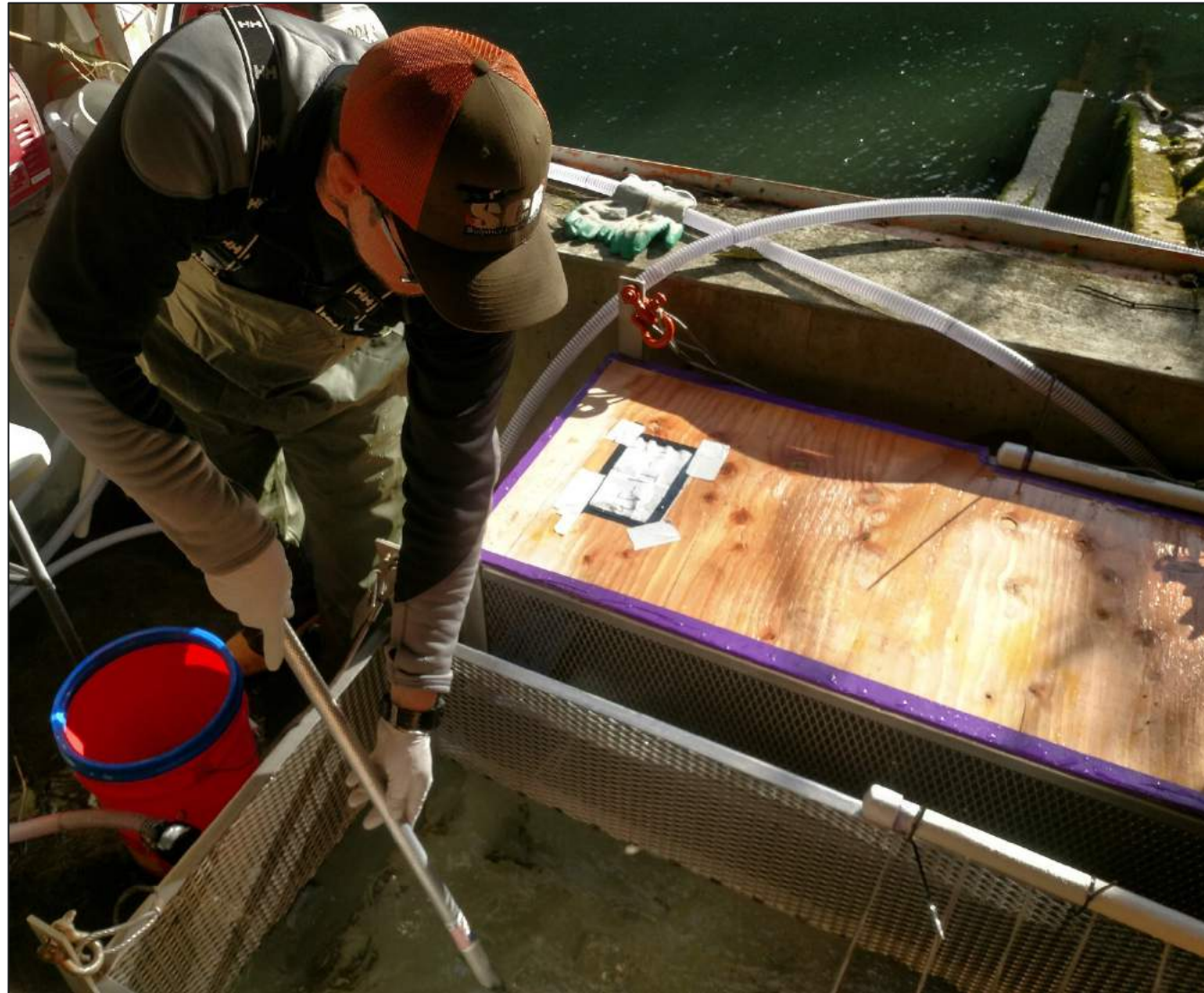


Mitigation Measures for Bypass Pipe and Trap and Haul Evaluations

- Not an exact 1:1 comparison → a laboratory study performed outside
 - Logistical constraints
 - ✓ FSS and pod
 - ✓ Bypass pipe
 - Better understanding of stress response
- Collaboration with experts
 - Stress physiology
 - Conveyance methods
- Specific mitigations
 - Minimize disturbance to fish
 - ✓ Minimal human contact once in holding tanks
 - ✓ Acclimation to net presence
 - Timing
 - ✓ Monorail, boat, and truck driving times



Blood Sampling via Caudal Venipuncture



1. Net ~5 fish from post-simulation tank



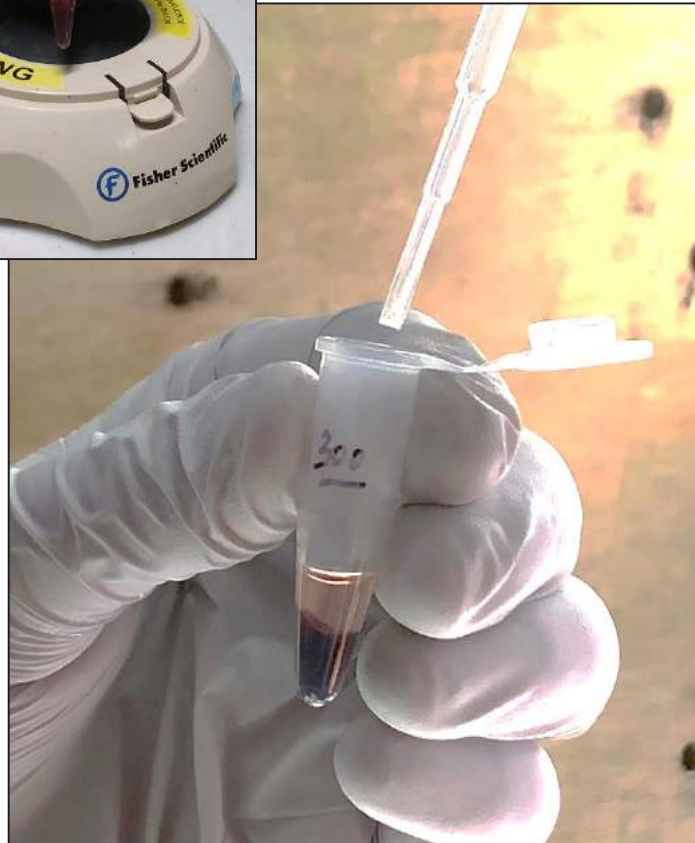
2. Two-person teams taking blood samples



3. Caudal venipuncture

Plasma Extraction and Data Collection

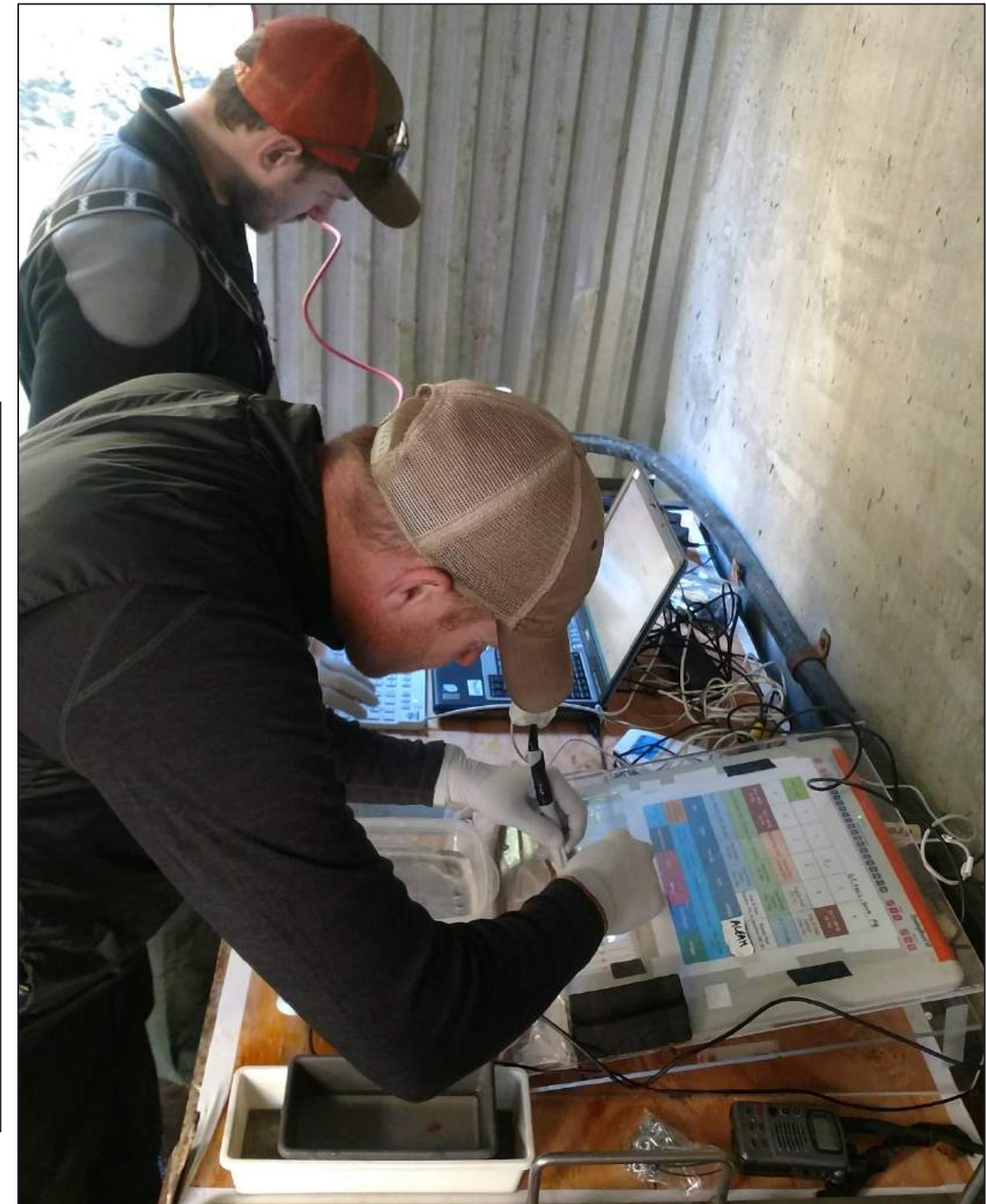
4. Separate plasma from red blood cells using a centrifuge



5. Extract plasma



6. Split plasma into
duplicate vials



7. Data collection – injury eval.

Post-Simulation Replicates

One Replicate		
Post-Simulation Blood		
Sampling Periods	Sample Size	
0 h	5	
0.5 h	5	
1 h	5	
3 h	5	
6 h	5	
24 h	5	
Total	6 periods	30 fish

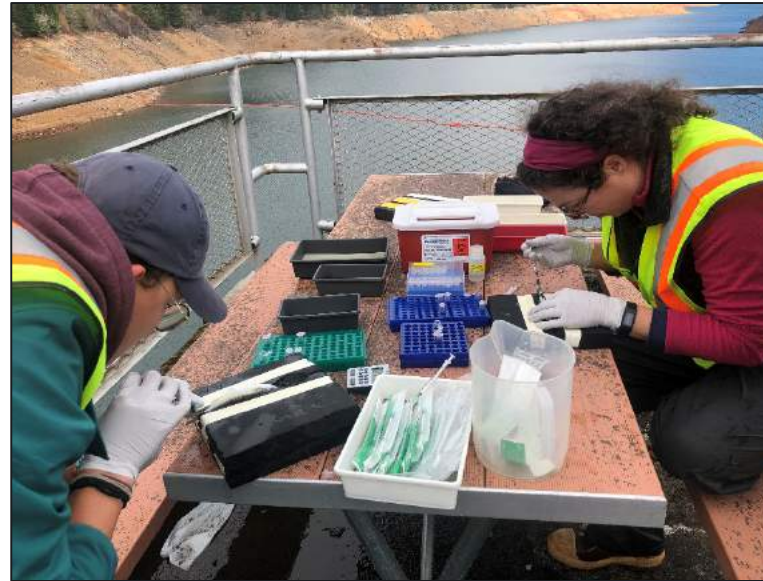
- **Bypass Pipe = 3 replicates**
- **Transport = 9 replicates**
 - **Different pod holding times**
 - ✓ 1 h = 3 replicates
 - ✓ 12 h = 3 replicates
 - ✓ 24 h = 3 replicates



Control Fish Samples Necessary for More Accurate Simulation Comparisons

- Control fish held under similar conditions as experimental fish
- Used for comparison of underlying stress
 - General holding
 - ✓ Is one holding tank location more stressful than the other?
 - Human-introduced stress
 - ✓ Feeding, water quality measurements, net acclimation
- Allowed for more accurate comparison of stress between the two simulations

Bypass Pipe Controls



Transport Controls



Feasible to Relocate of Copepod-Infected Fish

- OSU infected fish with copepods
- 184 copepod-infected fish relocated
 - Placed into 4 tanks
 - ✓ 2 tanks = bypass pipe holding tank location
 - ✓ 2 tanks = trap and haul holding tank location
 - All fish survived 2-day holding period
- **Bypass Pipe** and **Transport**
 - No blood samples
 - ✓ No 2-week acclimation → not comparable to healthy fish
- Feasible to relocate infected fish
 - Will they remain infected and alive after a 2 week acclimation?



Green Peter Year One: Successful Field Season

- Multiple steps taken to simulate real world and minimize added stress to fish
- Healthy fish evaluation: methods executed, analyses ongoing
 - Cortisol
 - ✓ Collaboration with OSU
 - Injury evaluations and rate of survival completed in conjunction with the cortisol results
- Infected fish relocation evaluation
 - Feasible to relocate and test copepod-infected fish at Green Peter
- Fall 2020
 - Potential full-scale study with healthy and copepod-infected fish

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Questions?

