

Improving Lamprey Passage at Dams in a Salmon-centric World



David Clugston
Corps of Engineers
Portland District Office



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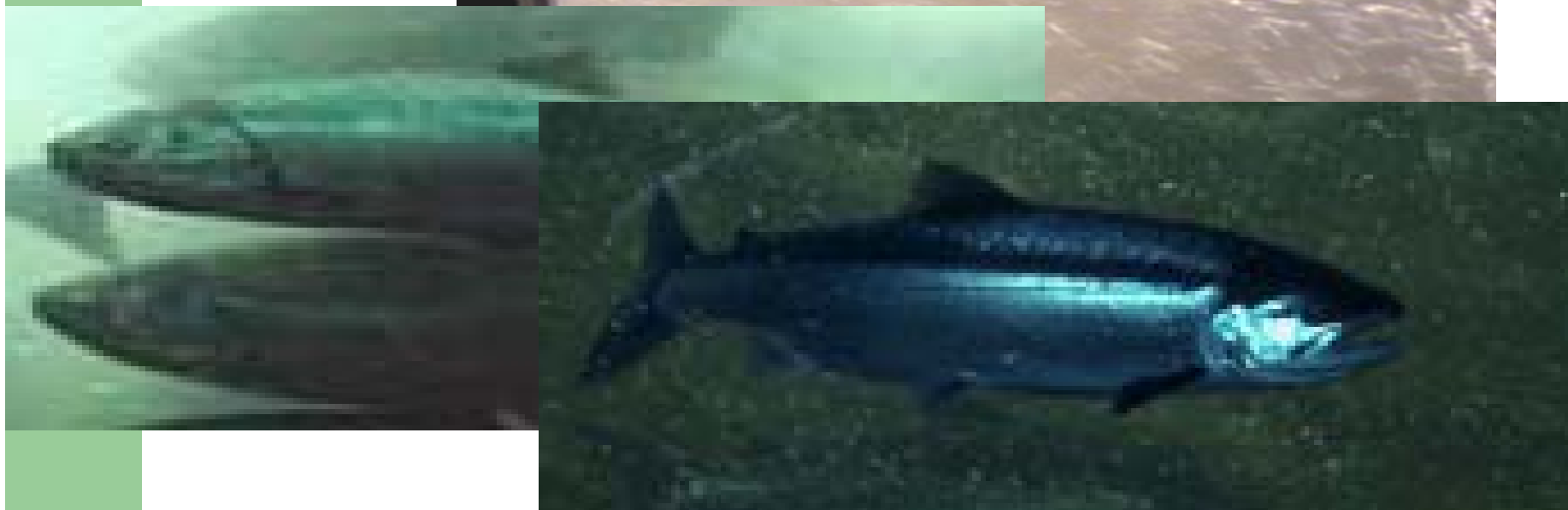
Increased Management Focus in 2008

- **Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin**
- **USFWS Pacific Lamprey Conservation Initiative**
- **Range-wide Pacific Lamprey Steering Committee**
- **Action Agency-Tribes Accord (RPA)**
- **COE Pacific Lamprey Passage Improvements Implementation Plan: 2008-2018**



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Lamprey vs. Salmon Passage





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Historical Perspective & Priorities:



Baseline Knowledge

- **Low 00-02 mean RT passage efficiencies at BON & JDA (47 & 53%); better at TDA (74%).**
- **Primary obstacles to passage: entrances, entrance pools, serpentine weirs, auxiliary water system (AWS).**
- **Primary problems relate to hydraulics (high velocities, confusing currents), attachment (right angles, gratings), and separation (gap size in screens and gratings) .**

Ongoing Actions

- **Install Lamprey passage systems (LPS).**
- **Improve monitoring (night time & LPS counts).**
- **Incorporating lamprey criteria into modification at JDA north ladder exit section.**
- **New entrance designs (Cascade Island and JDA north entrances).**
- **Juveniles screening and separation improvements.**
- **Develop juvenile assessment methods.**



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Lamprey Passage Systems



YEAR	Window	BI LPS	BI LPS %
2004	11,971	7,490	21
2005	10,257	9,242	30
2006	14,862	14,975	34
2007	6,473	7,387	38





Count Improvement Study: Adding Night Video to Window Counts

Ladder	Night	Day	Total	(%)
TDA N	3,137	3,246	6,383	(49.1)
TDA E	1,008	2,545	3,553	(28.4)
BON 2	-439	9,931	9,492	(<0)
BON 1	18,352	8,430	26,782	(68.5)
BON 2 LPS Count			2,013	
BON 1 LPS Count			6,817	



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Grating Replacement

- New effective $\frac{3}{4}$ inch gap grating design.
- Intakes and trash racks.
- Galvanizing issues.
- Supports.





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Modifications to Entrance Areas

- **Night time flow reduction test**
 - 2nd year of testing in 2009.
- **Entrance structural changes**
 - New larger fixed opening shape.
 - Add floor structures to
 - reduce velocities.
 - Guide to an LPS.





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BON P2 Ladder Entrance Reduced Nighttime Velocity Test: 2007

PH2 South	HI Flow	LO Flow
Entrances	26	10
Approaches	49	15
Ent Efficiency	53%	67%
PH2 North		
Entrances	5	16
Approaches	65	36
Ent Efficiency	8%	44%

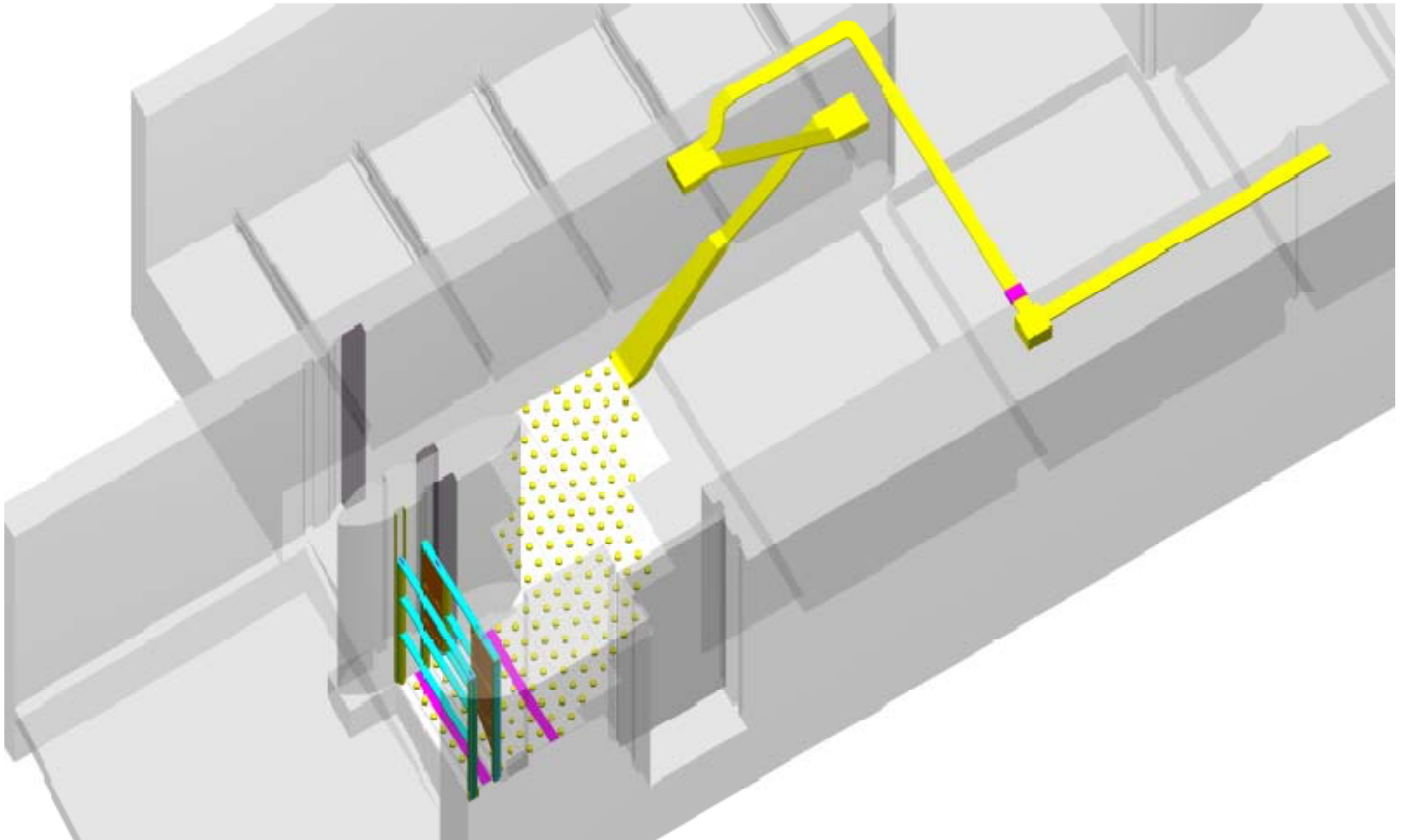


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New Entrance Design and Implementation

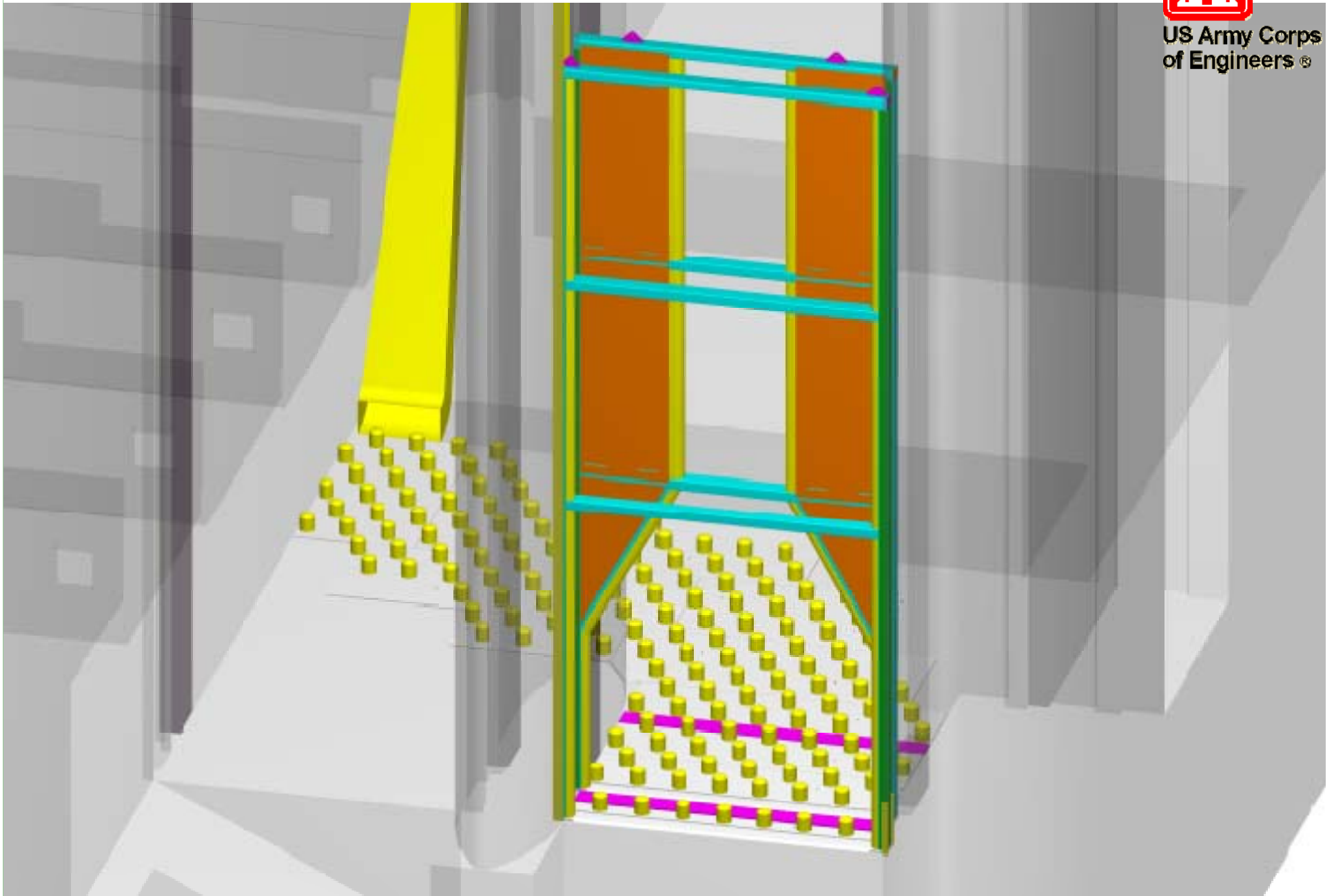
- JDA North Ladder (2010-2011)
 - Adult salmon based design incorporating lamprey features.
 - Contiguous smooth path in redesigned exit area.
 - Fixed weir open to floor of ladder.
 - Velocity reducing floor structures.
 - Leading to LPS along wall of ladder.
- BON CI Ladder Entrance (2009)
 - Real world test of above new entrance designs.

Bonneville Cascade Island Entrance Modifications





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Cascade Island Entrance Modification Installation



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Cascade Island Entrance Modification Installation



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Juvenile Lamprey Passage



- **Downstream passage evaluations in late 90s, early 00s.**
 - **Fyke nets, PIT tagging, screen videotaping, turbine passage simulations.**
- **Most migrate at night, deep in water column, below screens at PH & into turbines intakes (> 30-40 ft.).**
- **Impingement problems on screens changed screen criteria (smaller mesh).**
- **No effect from simulated turbine passage.**
- **Problems with separating in JBS for small % passing dams that use this route (can be large #s at one time).**
- **No effective tag for needed studies.**



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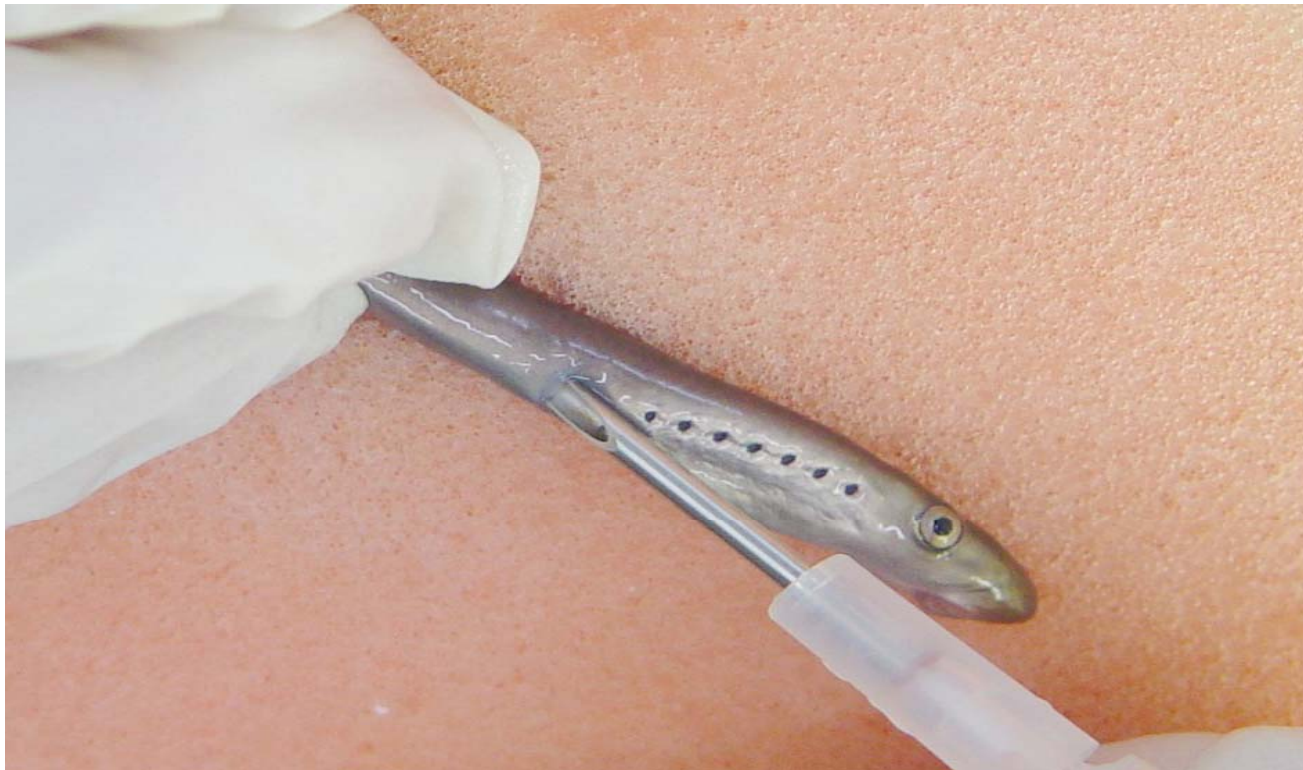
Assisting Juvenile Lamprey Passage: Screening and Separation

- Successful 6.4mm vertical MCN JBS separation screen completed.
- Smaller gap screening criteria when older screens wear out
 - Last a long time and cost \$1M/screen.
- MCN screen pulling possibilities?



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PIT Tagging Juvenile Lamprey

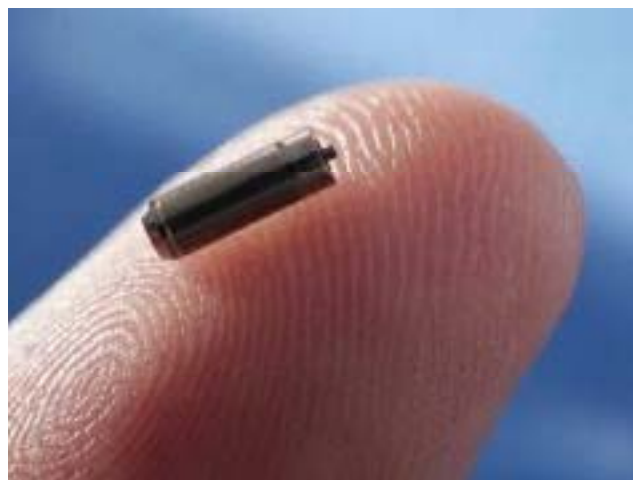




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Develop Juvenile Passage Monitoring Methods: Tags & Recapture

- Developing tag technology
- Recapture challenges





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