



Yale Entrainment Study

PacifiCorp
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CH2MHILL



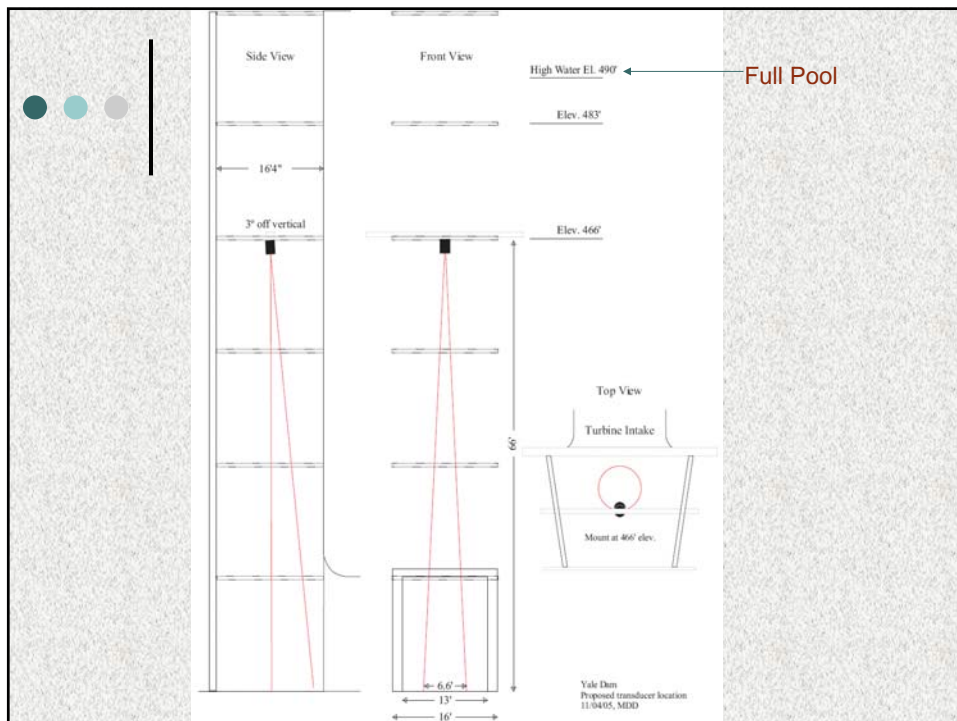
Study Objectives

- Evaluate fish entrainment into the turbine intakes at Yale and Merwin dams
 - How many fish entrained?
 - Are any of the entrained fish bull trout?
- Develop a draft Entrainment Reduction Plan for review by the ACC



Methods

- Hydroacoustic detection
 - 2 transducers – one over each turbine intake
 - 24/7 monitoring from Nov. 2005 to July 2006
- Video recording
 - Two 4-hour blocks per day



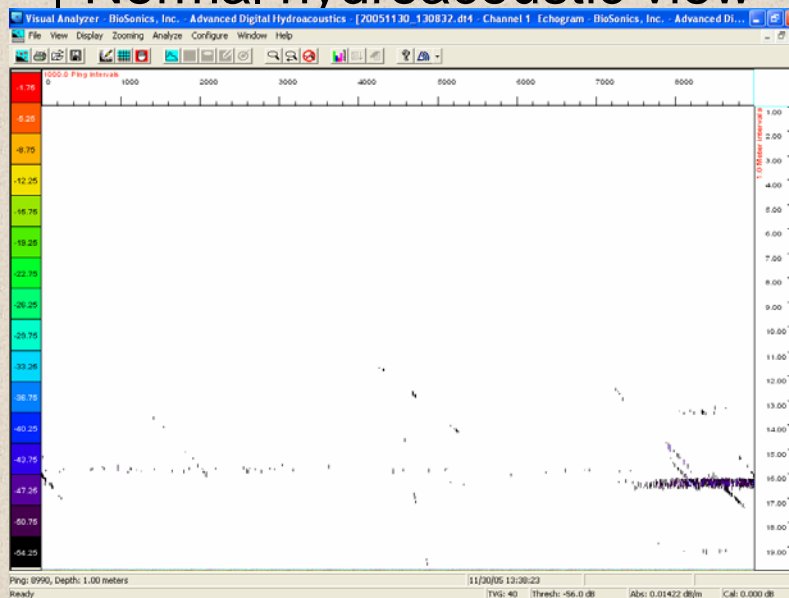


Two Data Questions

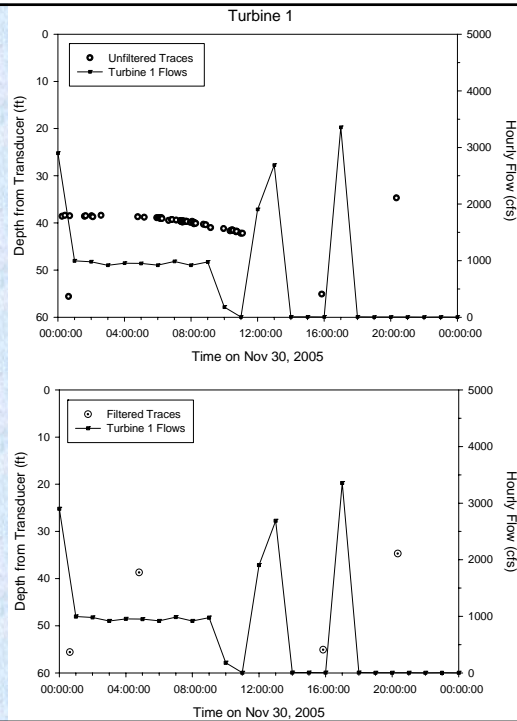
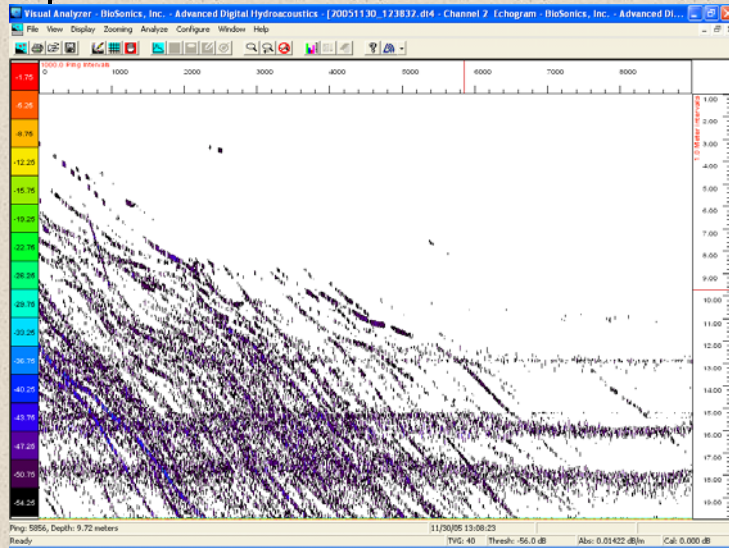
- 1) Are all the targets actual fish?
- 2) Are all the fish within the detection area actually entrained?



Normal hydroacoustic view

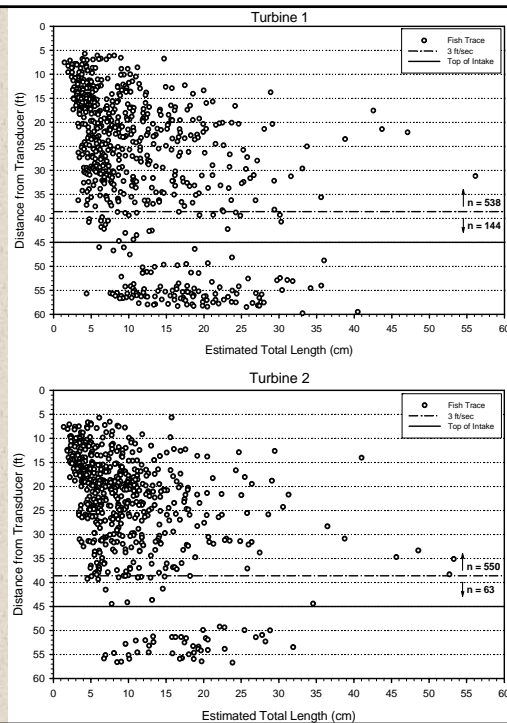
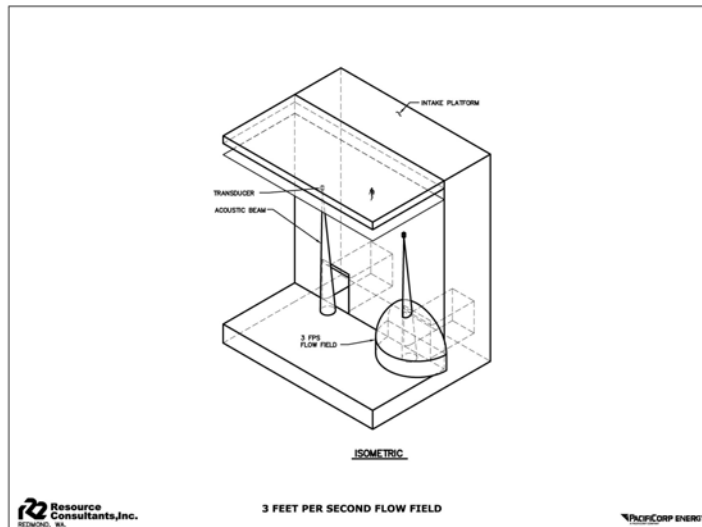


Acoustic View at Turbine Shutdown





Fish Entrainment Zone





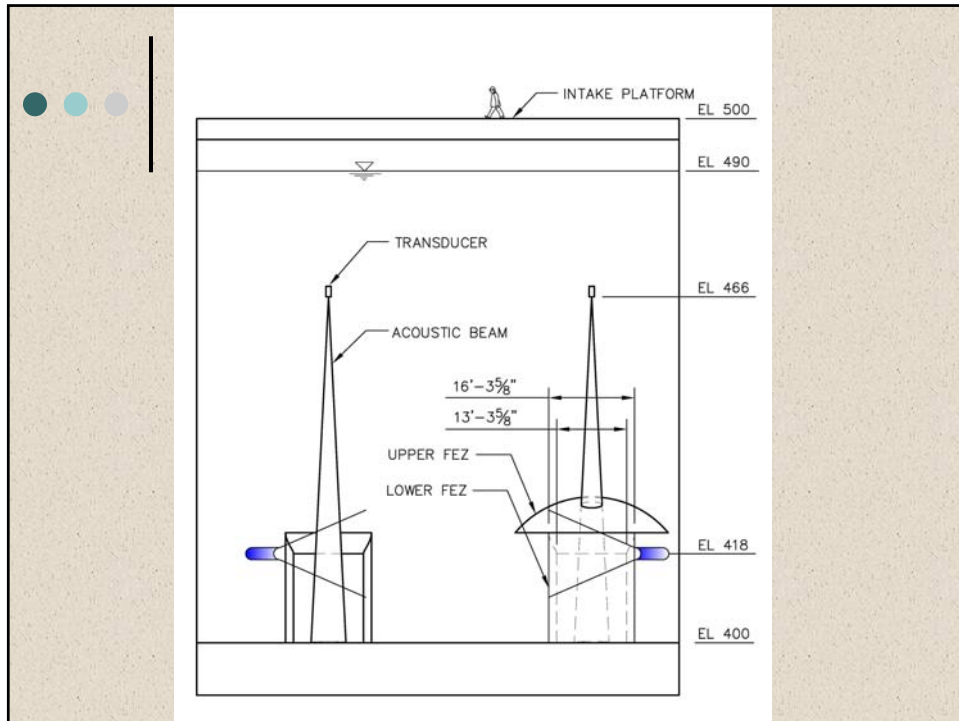
Hydroacoustic Results

- Turbine 1
 - Weighted total of entrained fish = 796
 - Mean fish length = 17 cm (6.7 in.)
 - Mean Daily entrainment rate = 0.26 f/h
- Turbine 2
 - Weighted total of entrained fish = 336
 - Mean fish length = 16 cm (6.3 in.)
 - Mean Daily entrainment rate = 0.14 f/h



What Species are Being Entrained?

- Video Analysis
 - 616 hours of record
 - 2 blocks per day
 - 0600 to 1000 hrs
 - 1600 to 2000 hrs

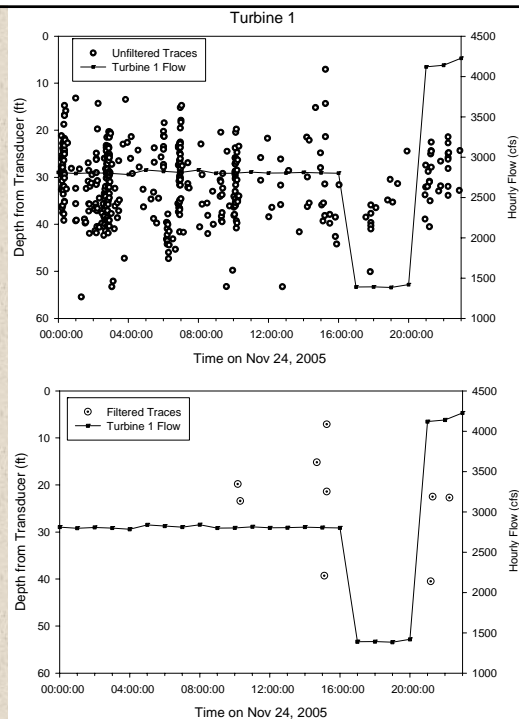


Video Results

- Only two fish actually observed that could be positively identified
- Video field too small to be useful

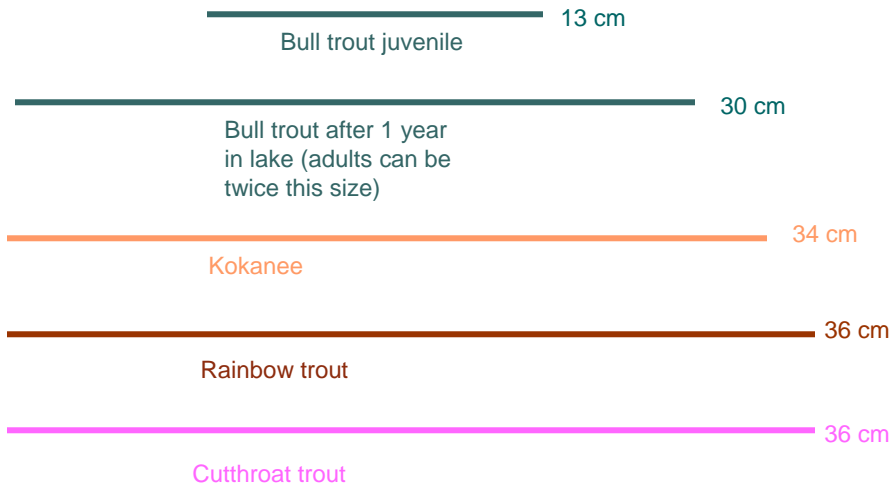
Comparison to 1997 Entrainment Study

- | 1997 | 2006 |
|----------------------|----------------------|
| ○ Duration 11 weeks | ○ Duration 34 weeks |
| ○ Random samples | ○ Continuous |
| ○ 28.5 fish per hour | ○ 0.19 fish per hour |
| ○ 50,780 total fish | ○ 1,132 total fish |
| ○ 138 mm (5.4 in.) | ○ 178 mm (7 in.) |
| ○ No FEZ | ○ Used FEZ |

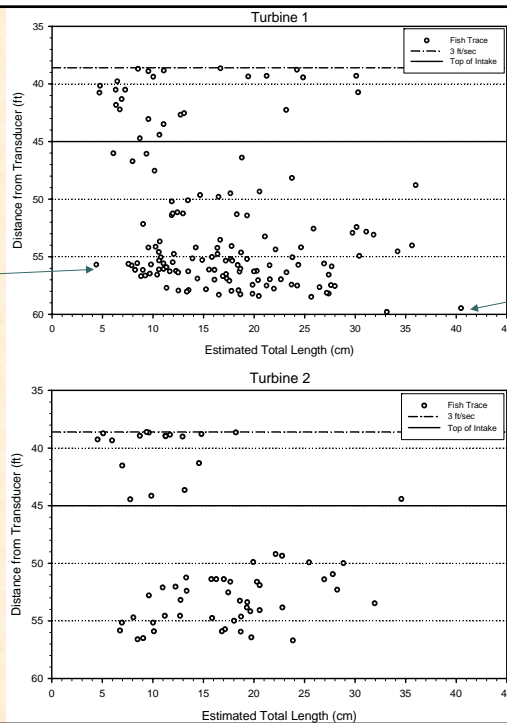




Fish size comparison on a relative scale



2" fish



16" fish

Majority of the entrained fish are 5cm to 25 cm



Recommendation

- Based on size statistics, bull trout are not likely the primary species being entrained through the turbines
- Most likely that bull trout enter Lake Merwin via the Yale spillway
- Entrainment reduction device does not seem warranted for protection of bull trout.