

Surface Collectors in the Pacific Northwest: Operating Characteristics and Collection Success

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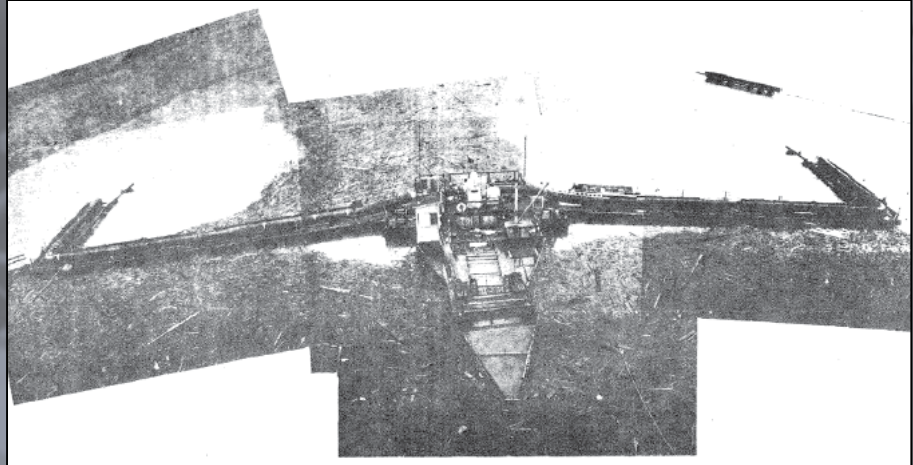
⁵U.S. Army Corps of Engineers

Acknowledgements

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- Several entities provided data and information for their collection facilities including,
 - Puget Sound Energy, special thanks to Nick Verretto
 - Tacoma Power, special thanks to Matt Peter
 - PacifiCorp, Inc., special thanks to Frank Shrier
 - Portland General Electric, special thanks to Garth Wyatt, Nick Ackermann, Bob Spateholts, and Jim Bartlett
 - U.S. Army Corps of Engineers, special thanks to Scott Fielding

First Generation Forebay Collectors

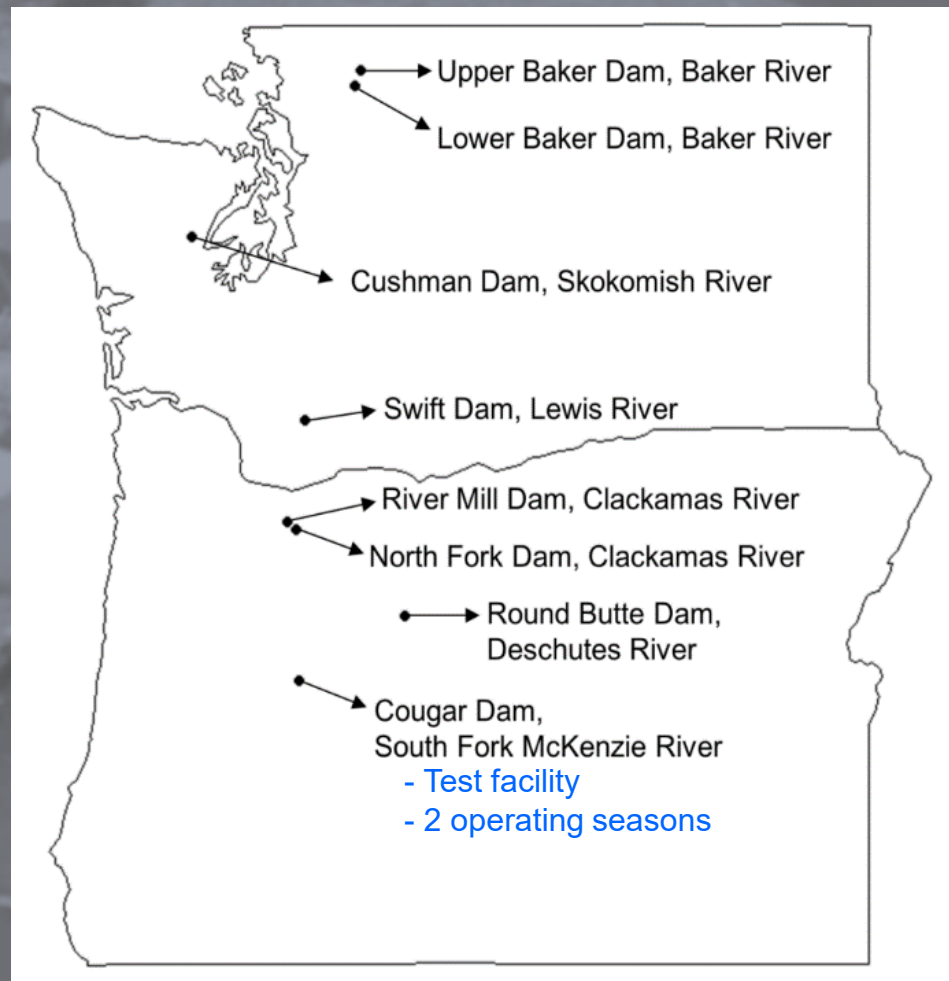
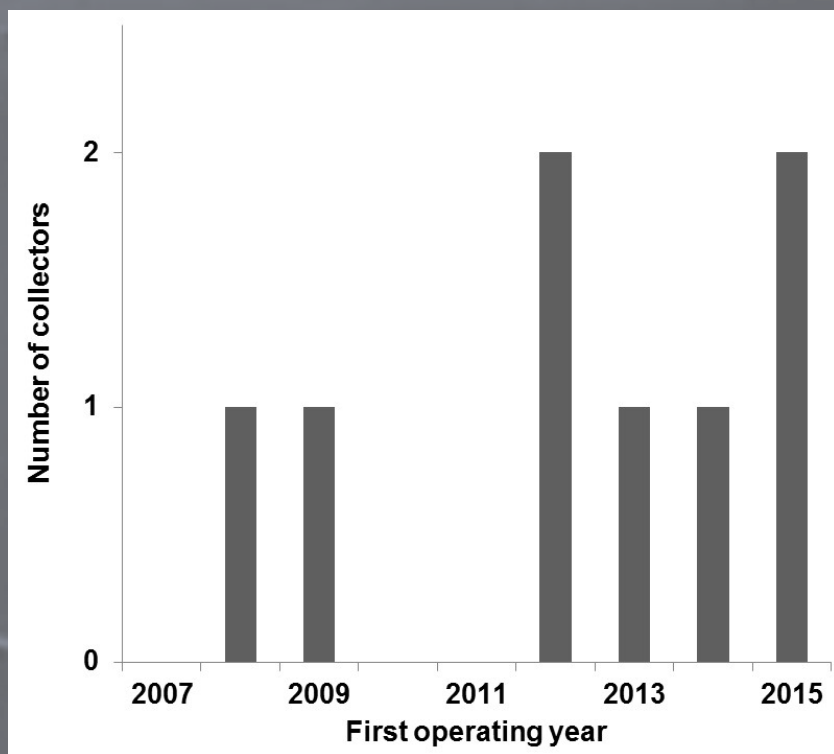
- “Gulpers”: 1950s and 1960s
 - <math><150\text{ ft}^3/\text{sec}</math>
 - Brownlee Dam
 - Lookout Point Dam
 - Upper Baker Dam
 - Merwin Dam



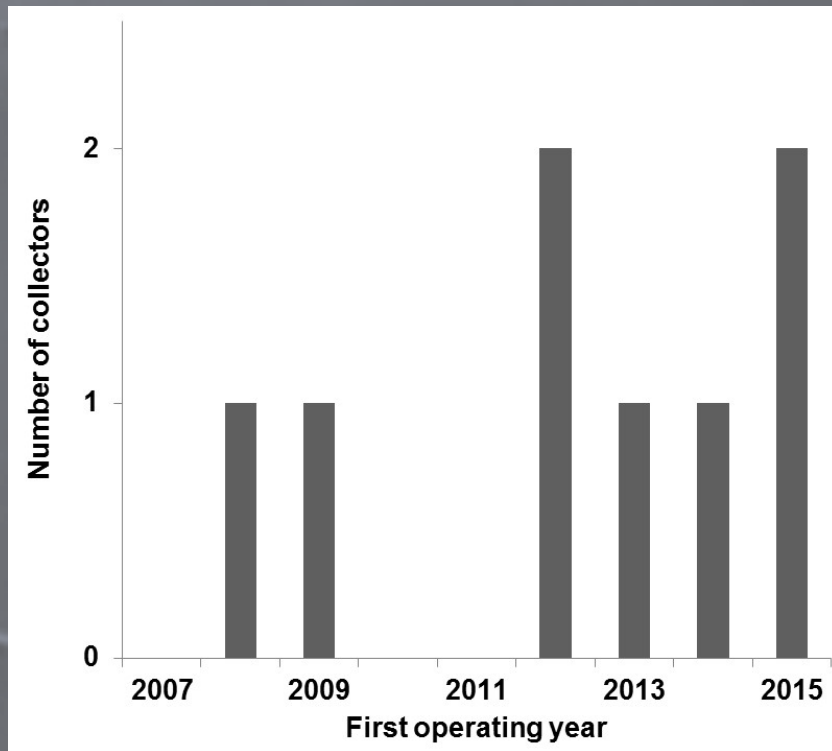
- Most abandoned within a few years

The conclusion of the study was that this artificial outlet did not attract or collect a satisfactory number of downstream-migrant salmon or steelhead trout. Insufficient volume of flow and poor entrance design of the device were thought to be the limiting factors. It was recommended that the development of a floating artificial outlet be continued using optimum volumes of attraction flow, as determined by spillway experiments, and entrance design criteria established through other studies. The device should also be tested at the head of a reservoir.

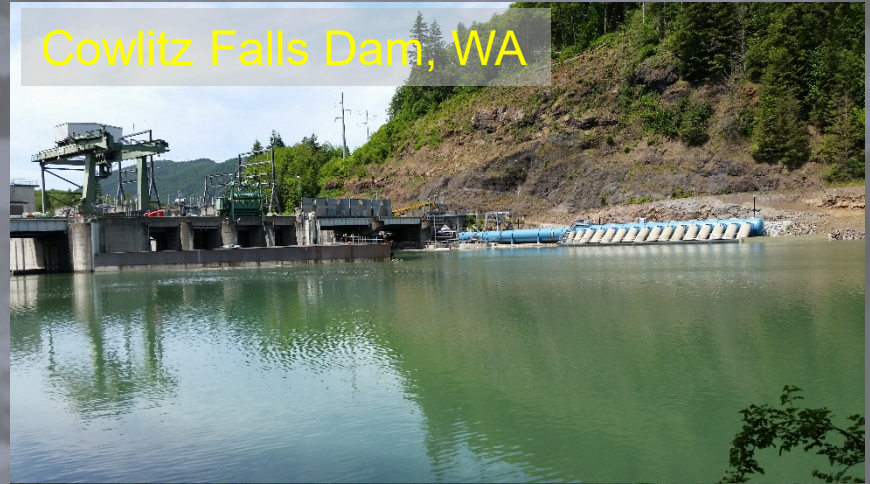
Second Generation Forebay Collectors



Second Generation Forebay Collectors



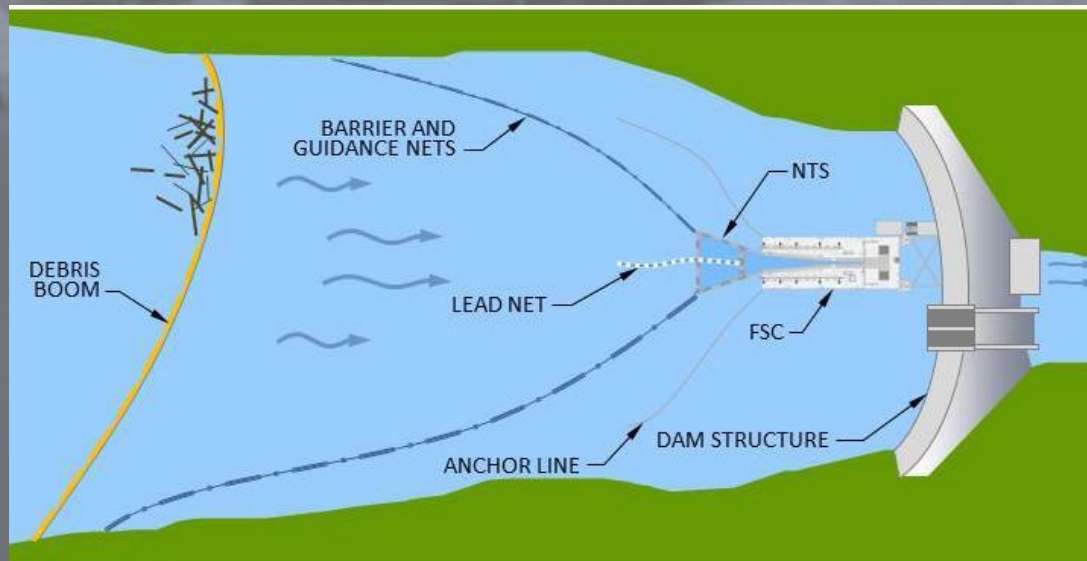
Cowlitz Falls Dam, WA



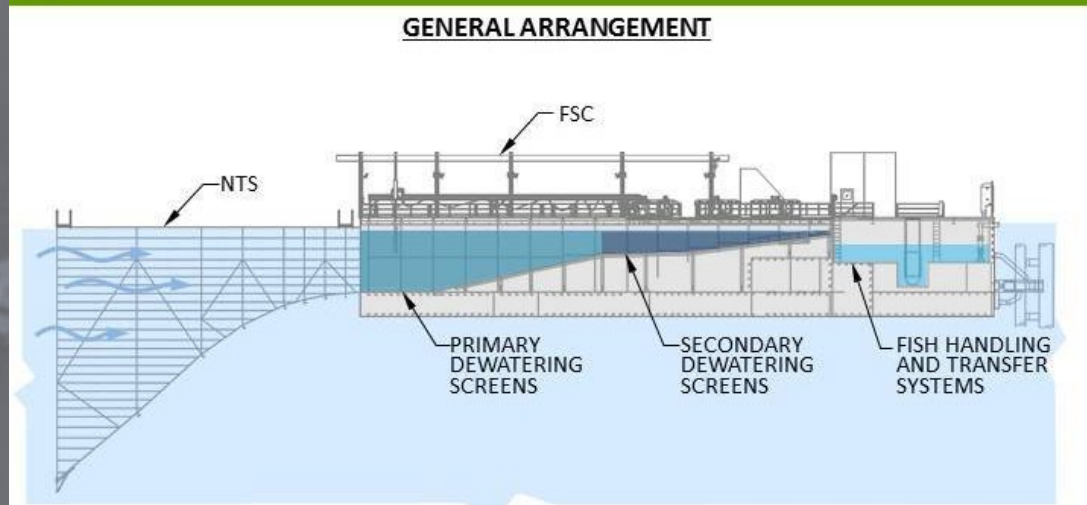
Cle Elum Dam, WA



Second Generation Forebay Collectors



GENERAL ARRANGEMENT



FSC AND NTS PROFILE

Upper Baker and Lower Baker Dams

Upper Baker Collector

First year of operation = 2008



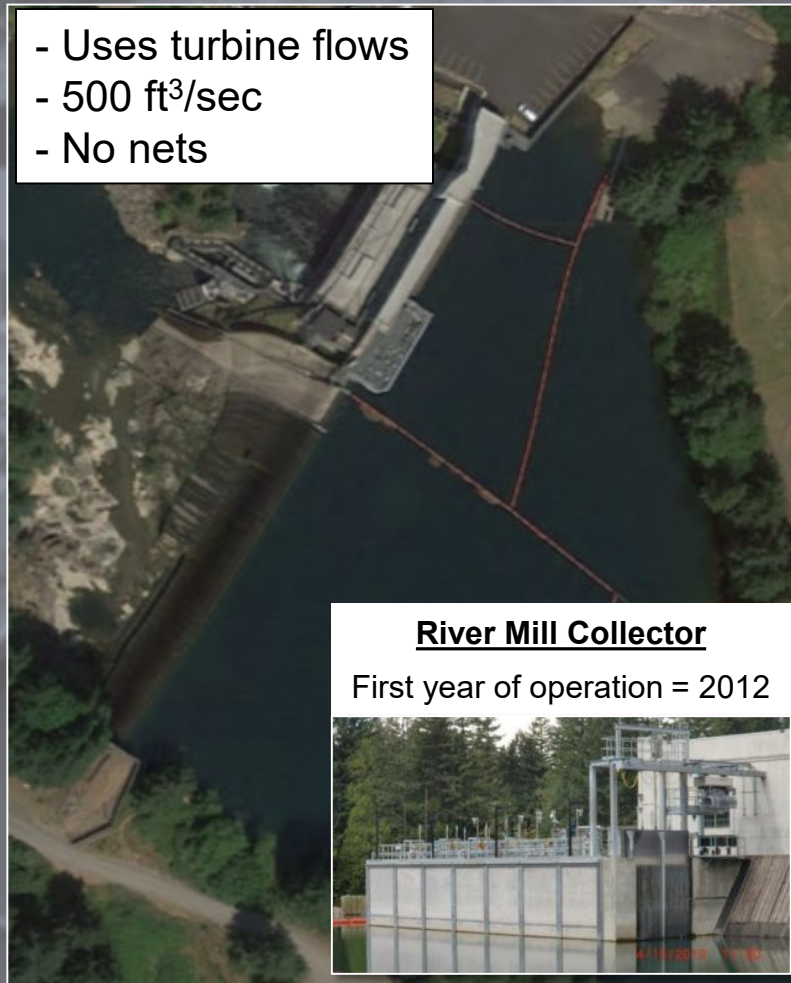
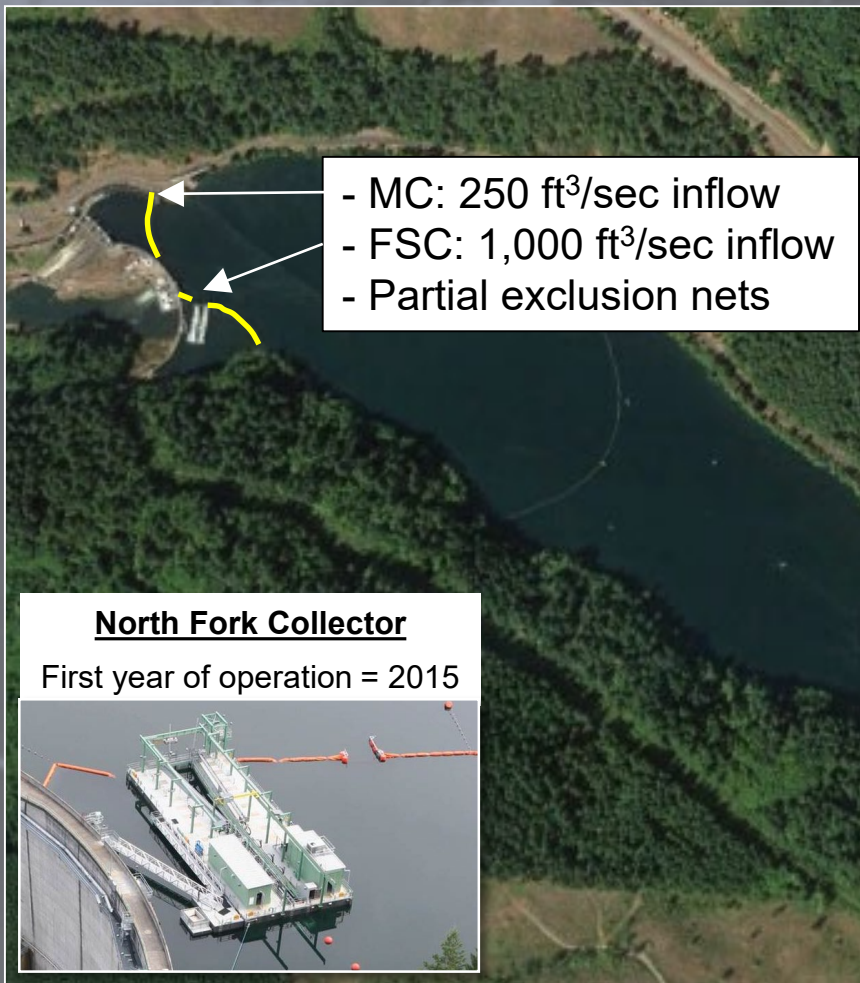
Lower Baker Collector

First year of operation = 2013



- 500 and 1000 ft³/sec inflow
- Guide, exclusion, and lead nets

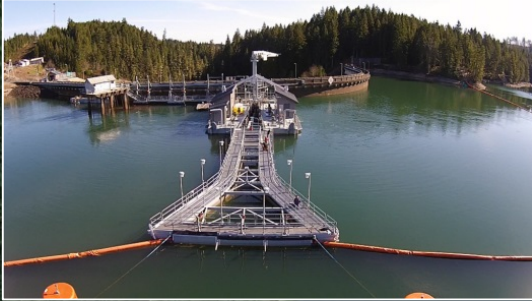
North Fork and River Mill Dams



Cushman Dam

Cushman Collector

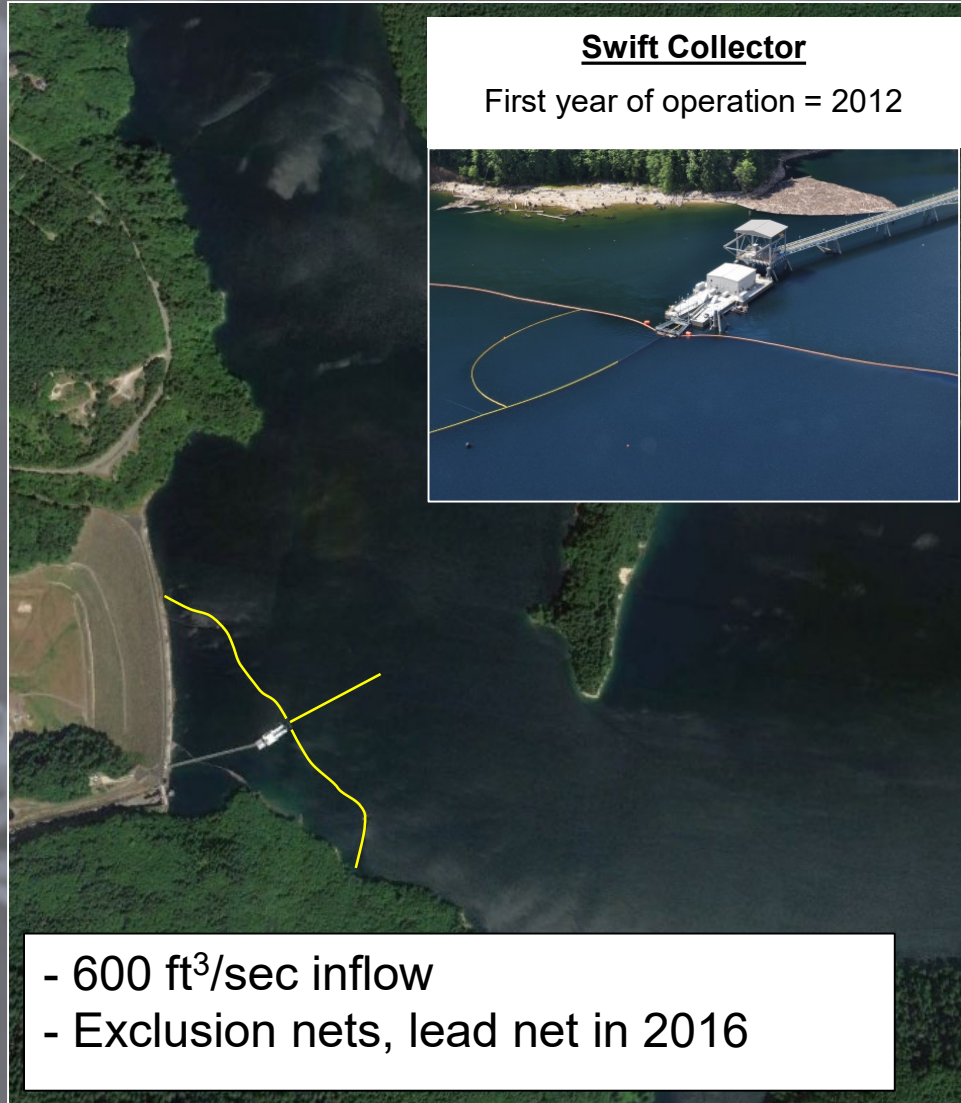
First year of operation = 2015



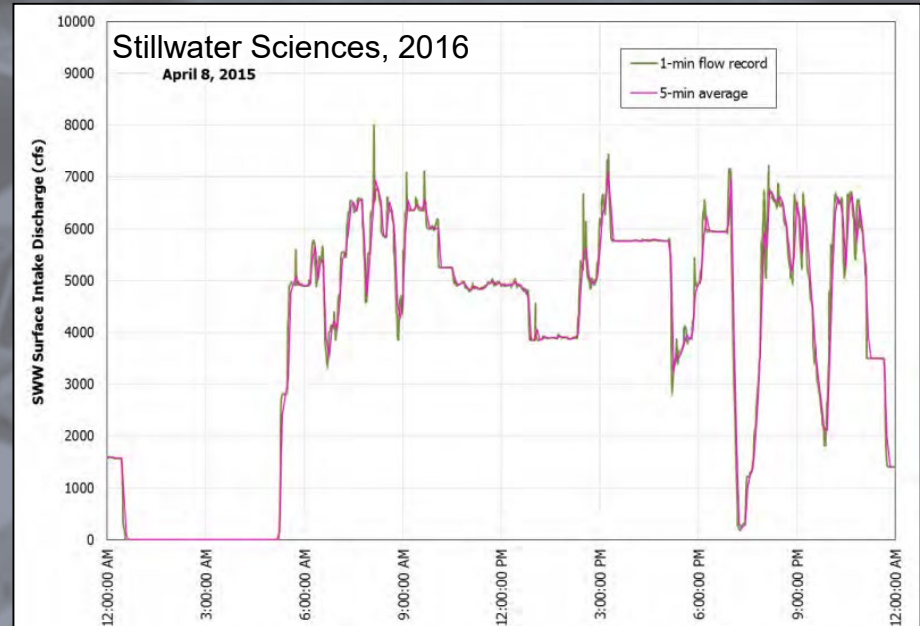
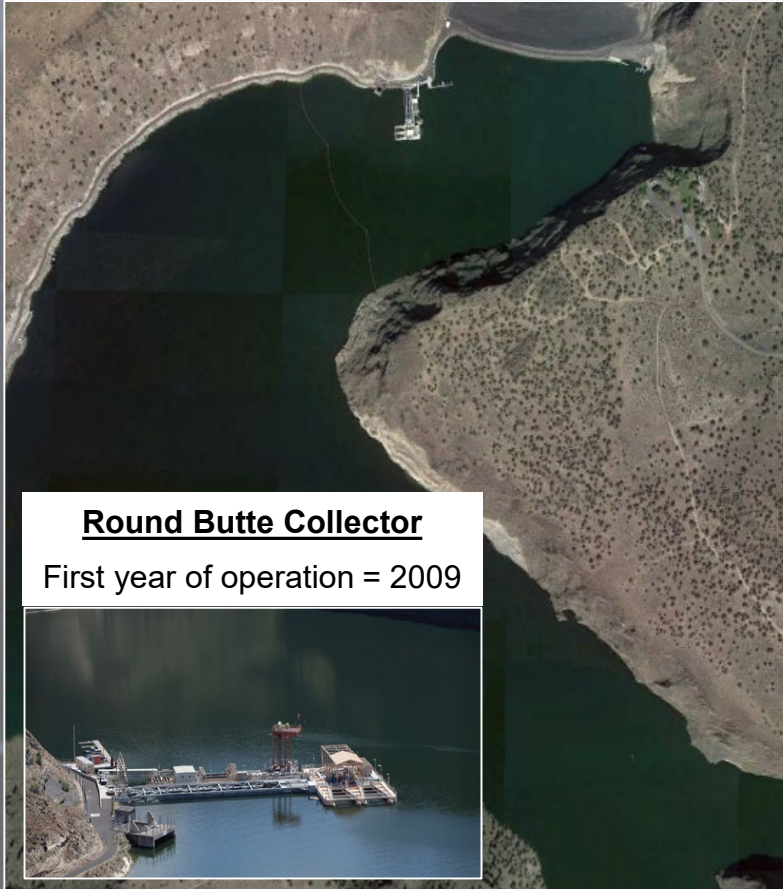
- 250 ft³/sec inflow
- Exclusion nets
- Lead net in 2017



Swift Dam



Round Butte Dam

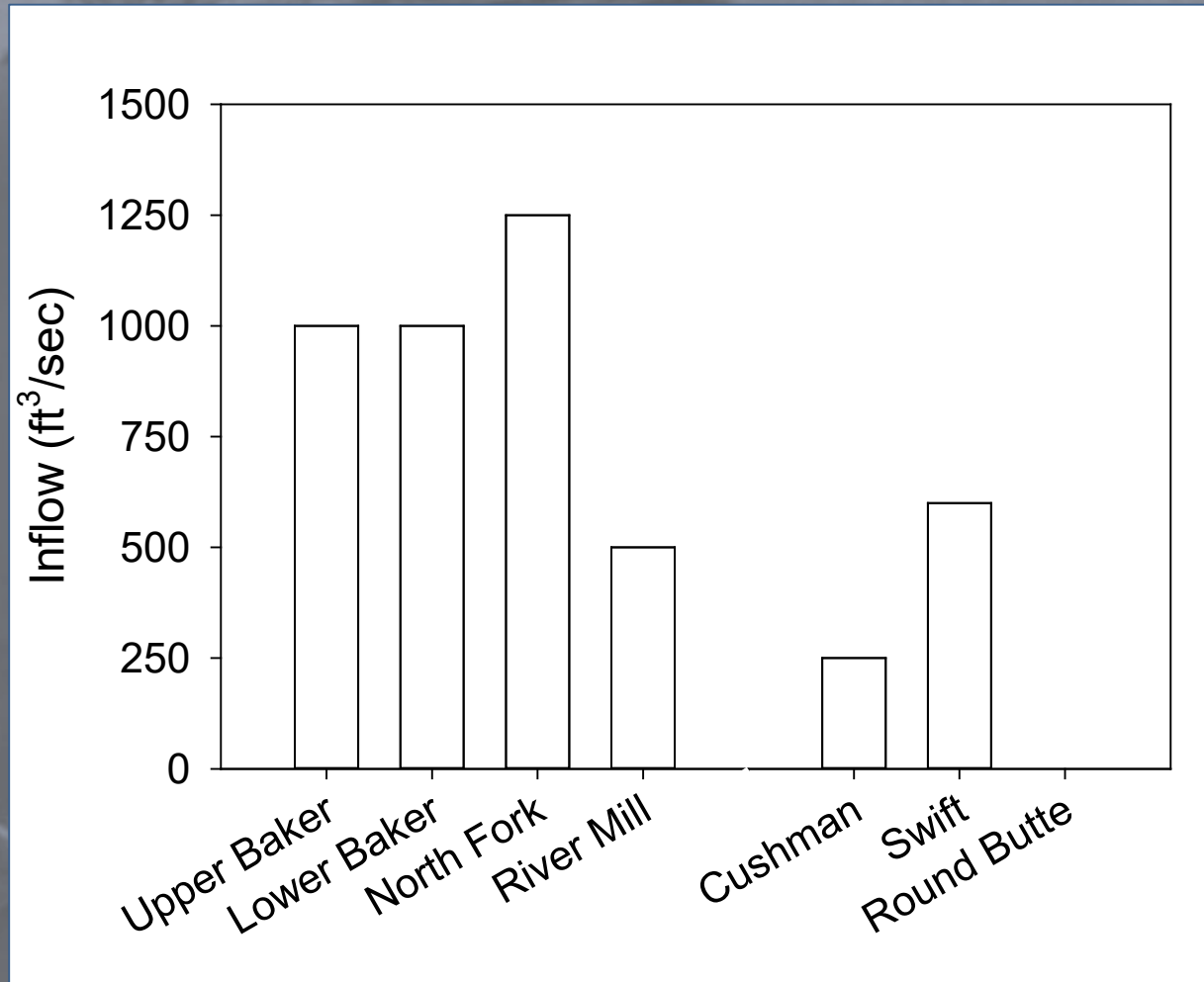


- 0-6,000 ft³/sec
- No nets

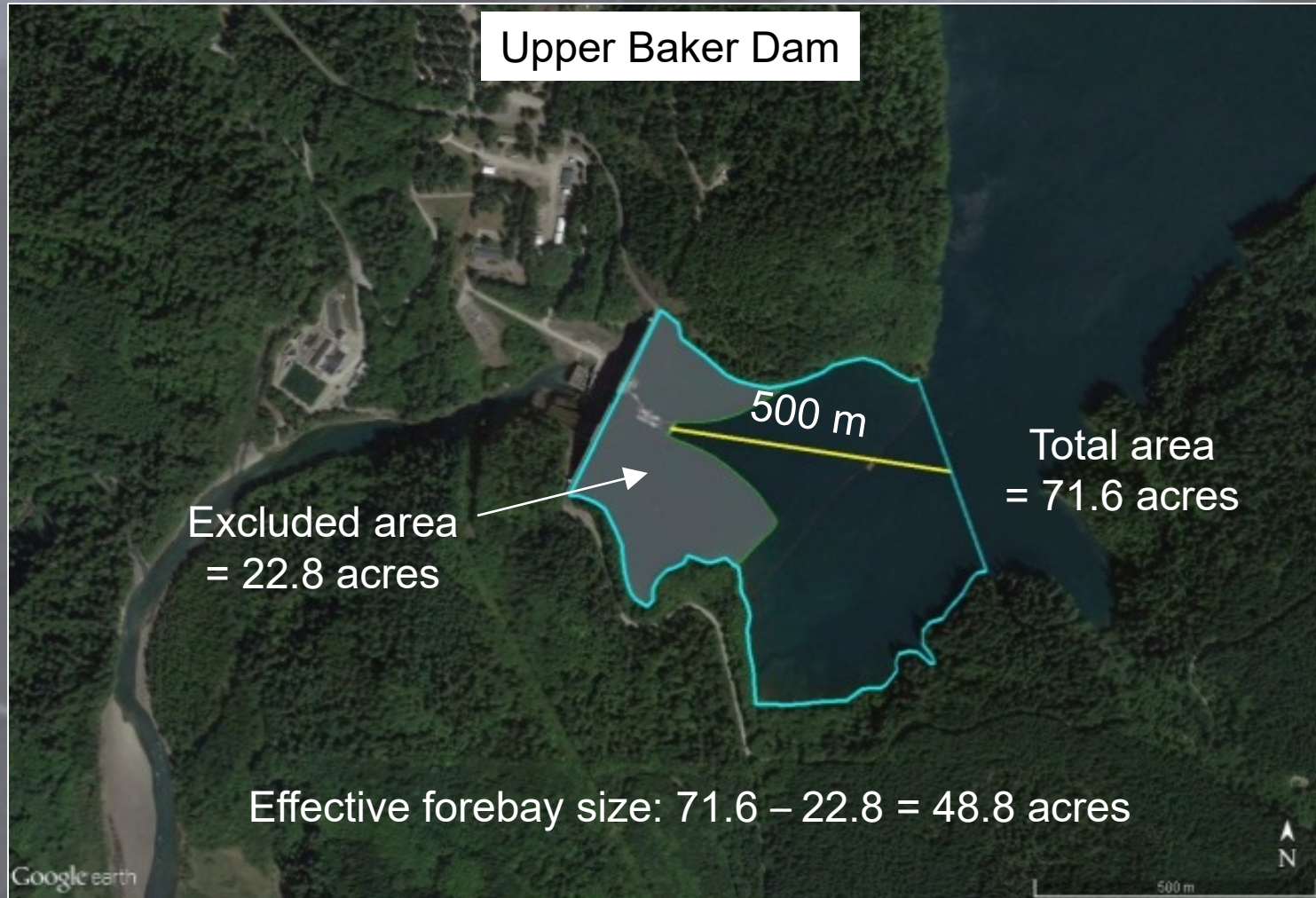
Fish Collection Efficiency

Project	Sockeye	Steelhead	Coho	Chinook
Upper Baker	88%		92%	
Lower Baker	87%		92%	
North Fork		98%	97%	90%
River Mill		97%	99%	98%
Cushman			23%	
Swift		11%	14%	2%
Round Butte		16%		32%

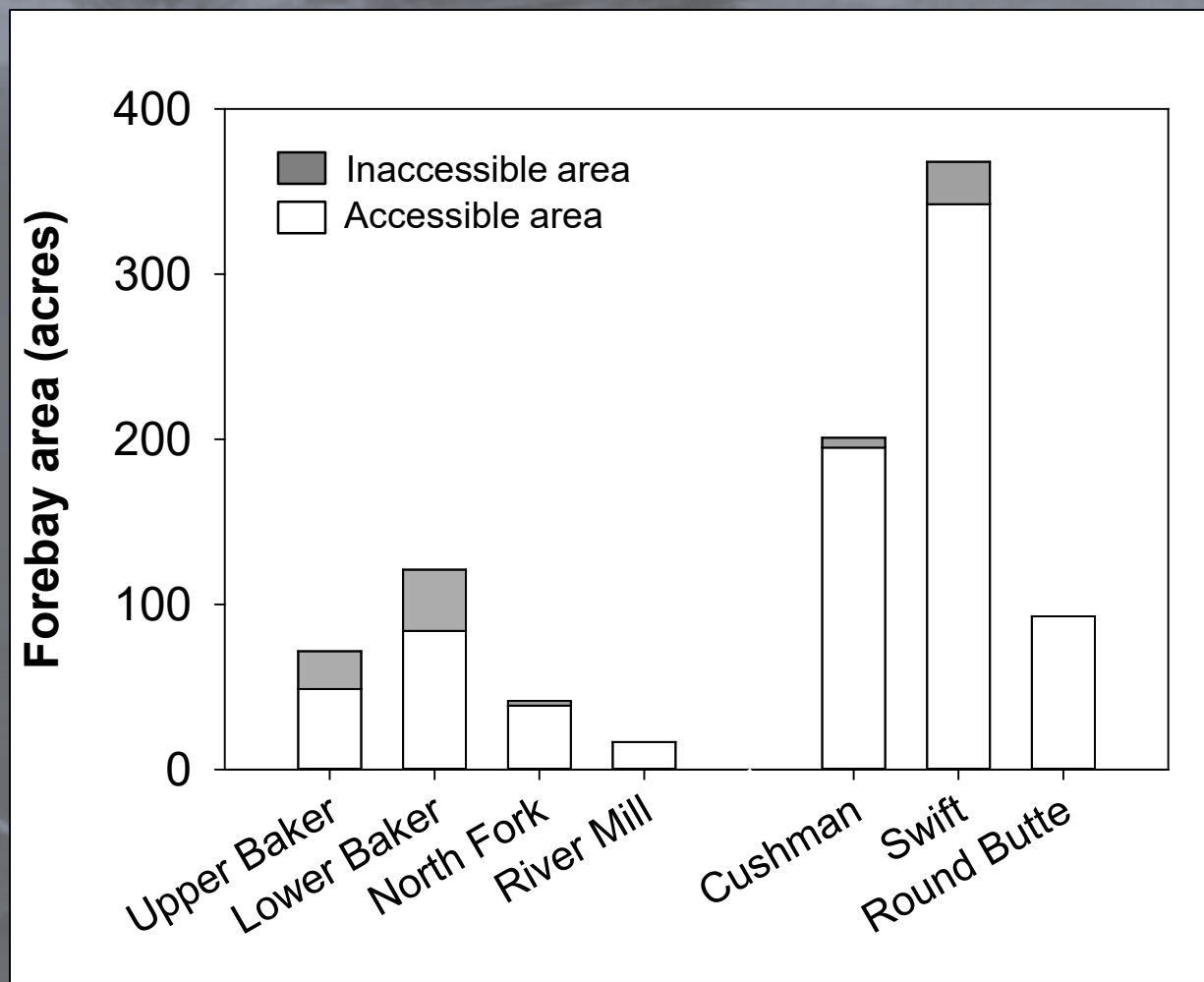
Collector Inflow



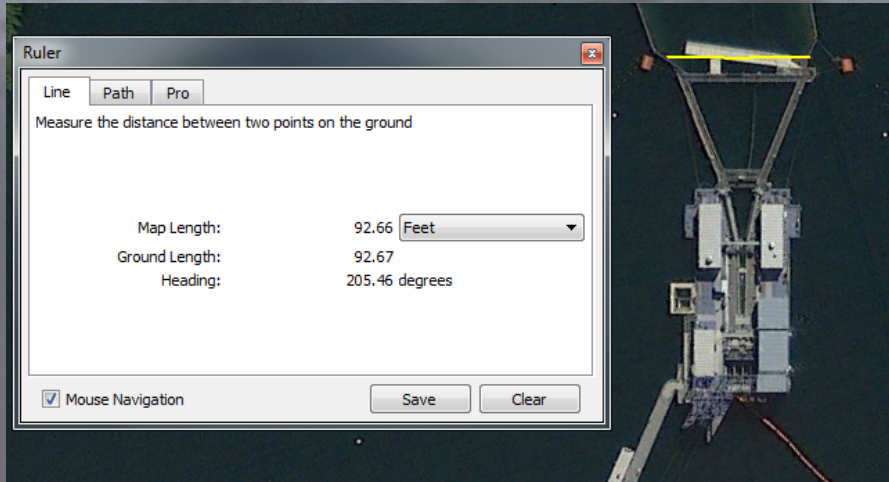
Effective Forebay Size



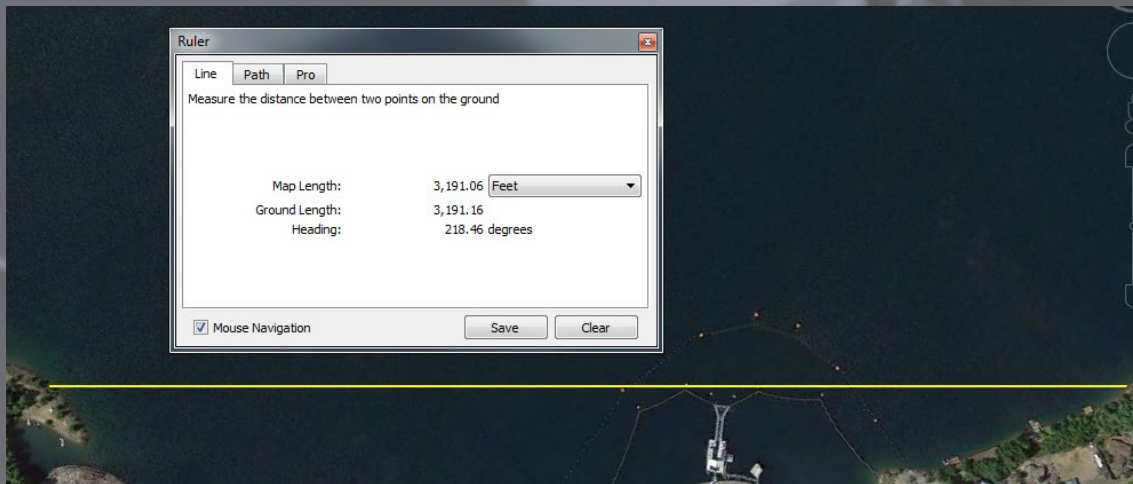
Effective Forebay Size



Confinement Distance

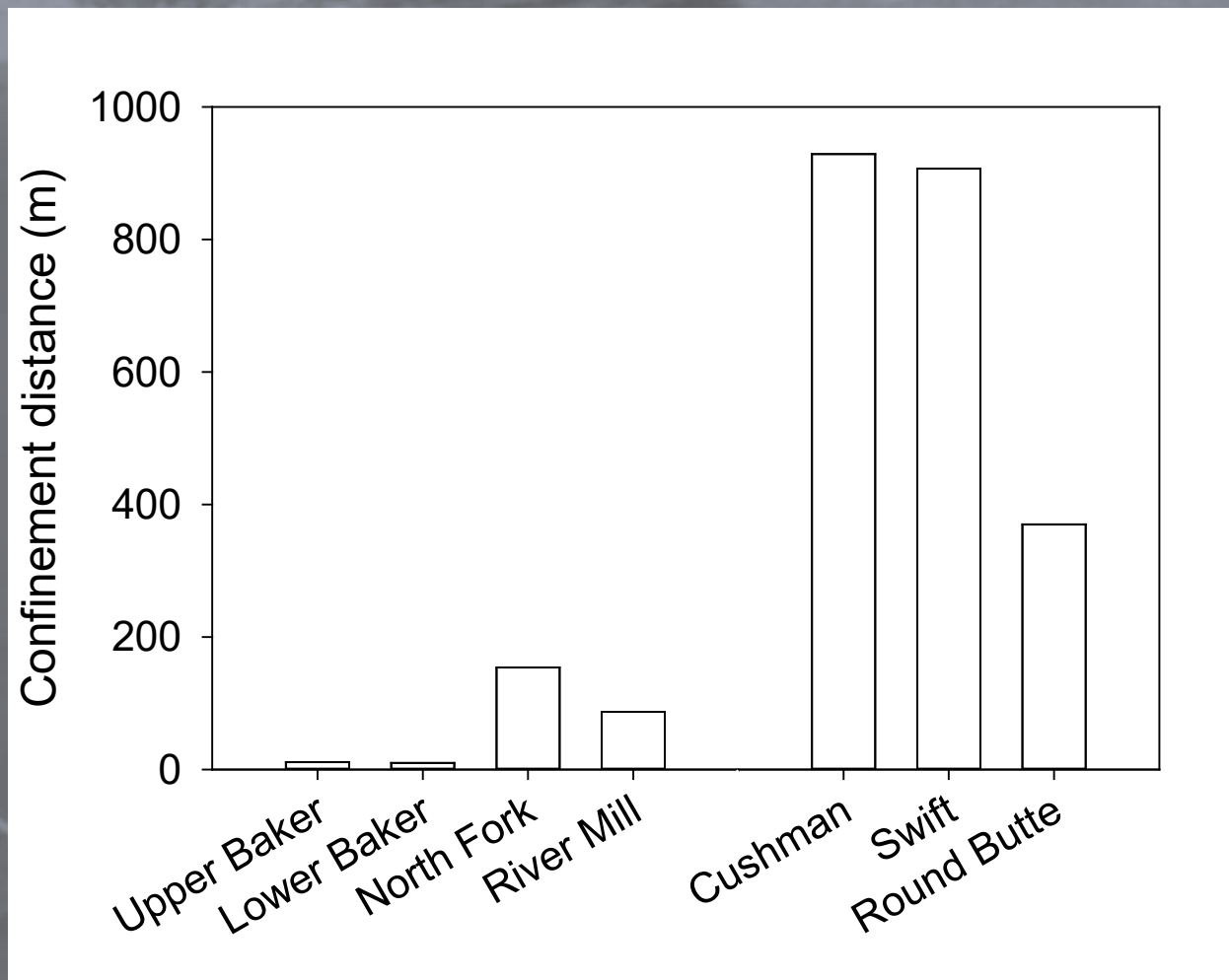


Upper Baker Dam

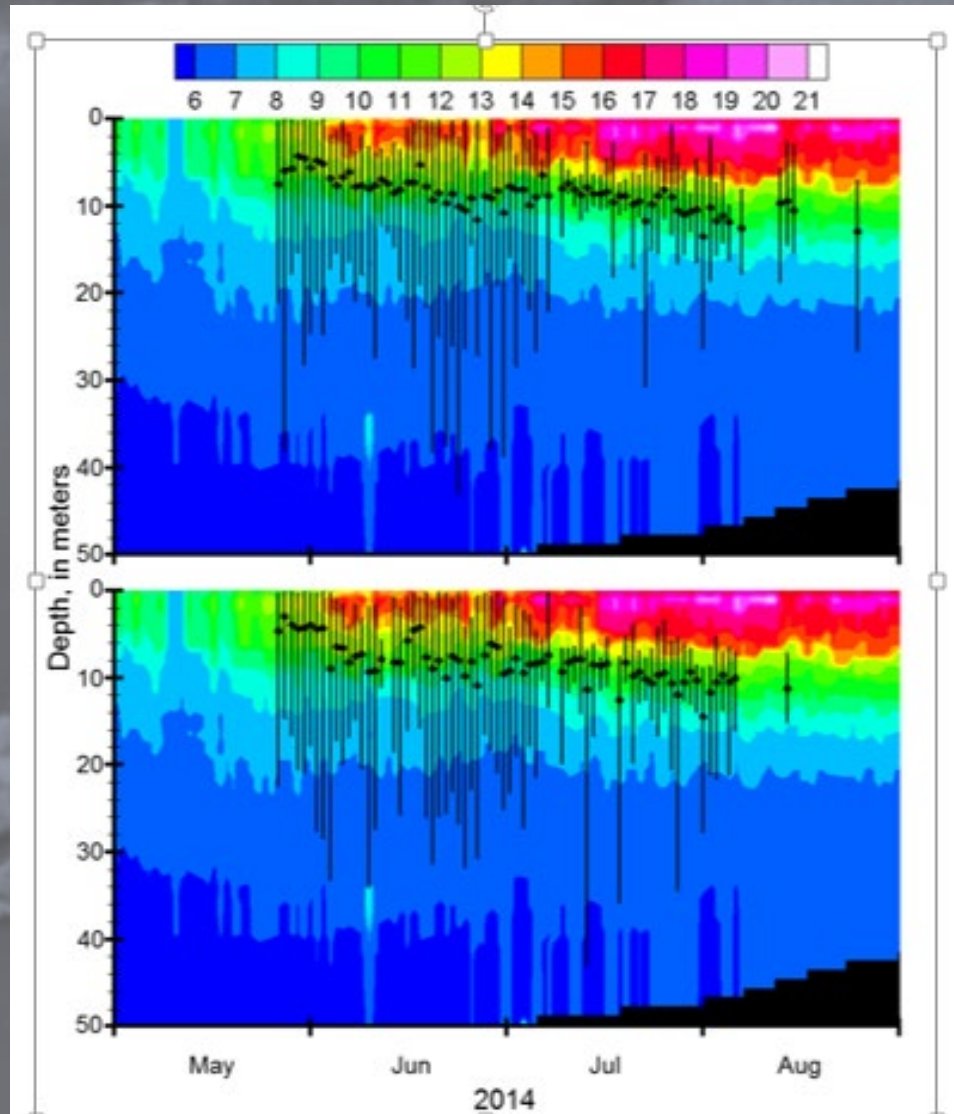


Cushman Dam

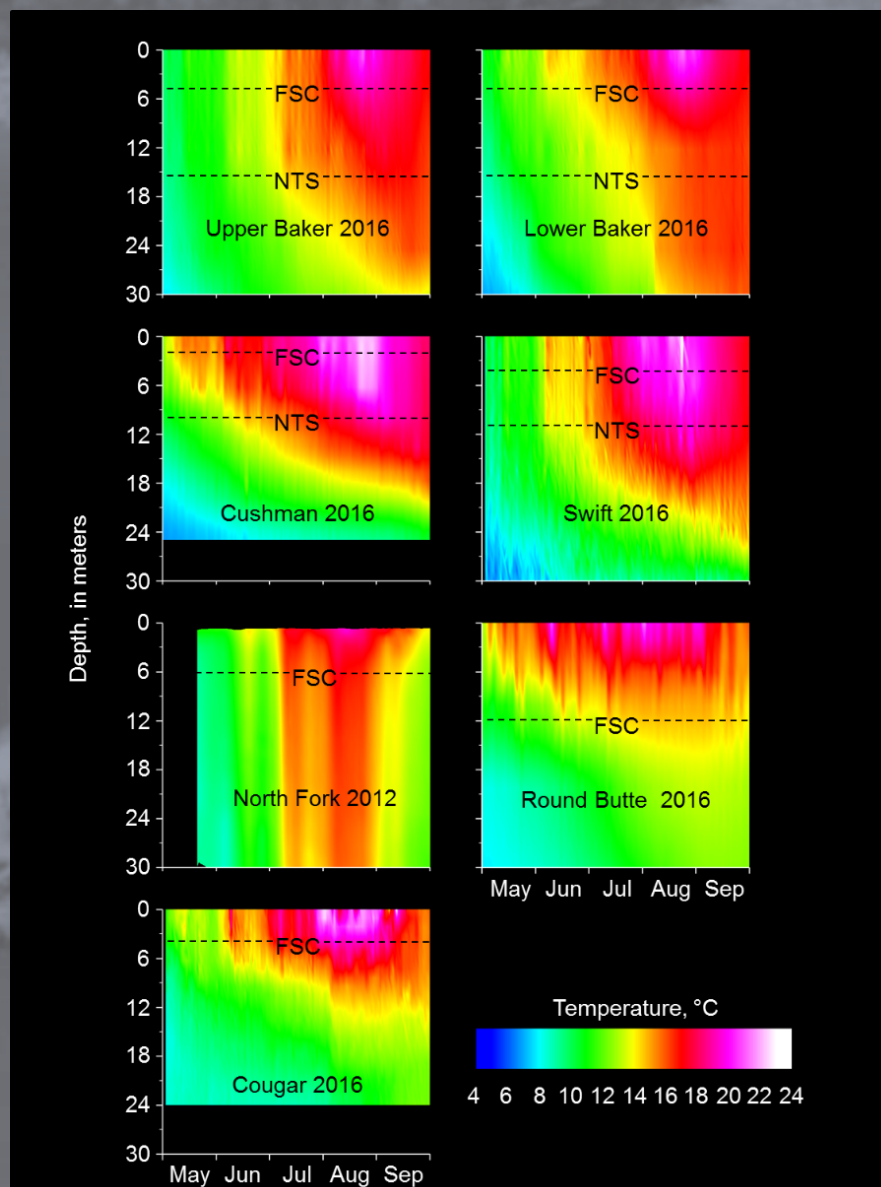
Confinement Distance



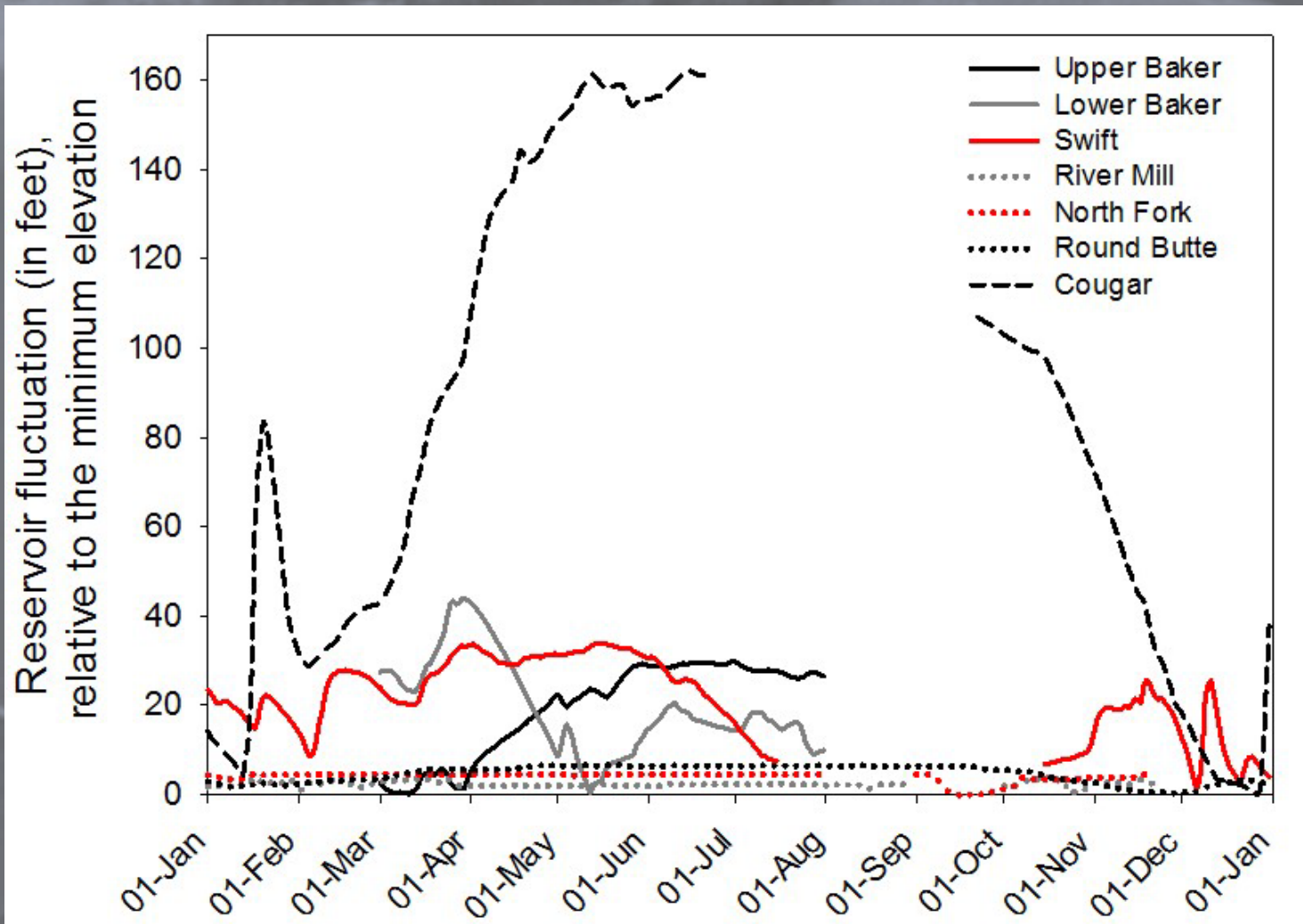
Chinook Salmon Temperature Use



Summer Water Temperature



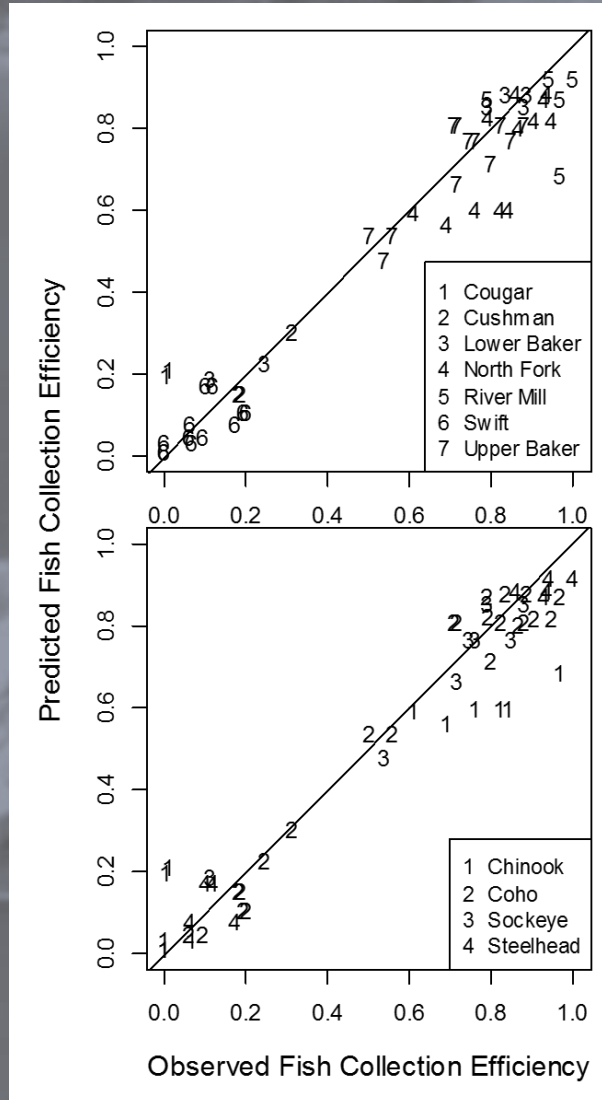
Reservoir Fluctuations



Analysis of Factors Affecting Performance

- The Data
 - 7 projects
 - 4 species
 - 52 FCE estimates
 - $\text{FCE} = \text{number collected} / \text{number released}$
- Predictor variables
 - Species
 - Inflow
 - Collector entrance area
 - Effective forebay area
 - Lead nets
 - Effective forebay area x collector entrance area
- Quasi-binomial regression model

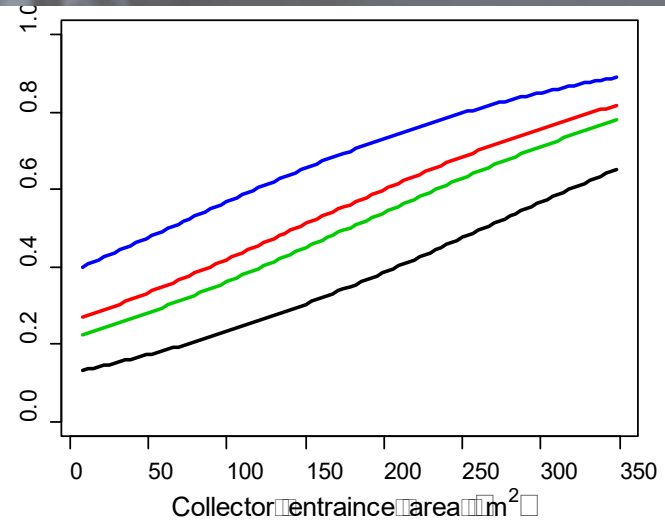
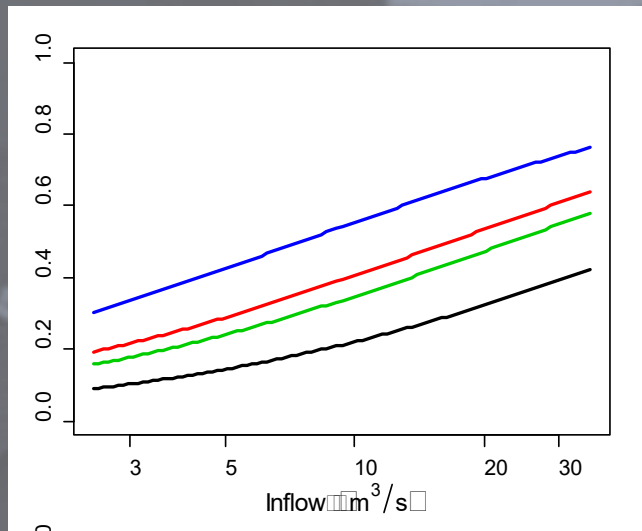
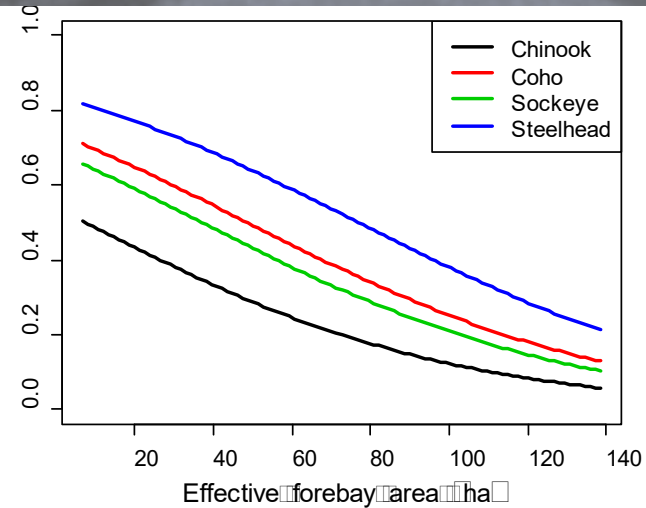
Analysis of Factors Affecting Performance



Analysis of Factors Affecting Performance

Predictor variables

Species
Inflow*
Collector entrance area*
Effective forebay area*
Lead nets*
Effective forebay area x
collector entrance area*



Lessons Learned

- Broad range of environmental conditions and collection success
- Significant predictors of collection success:
 - Inflow
 - Lead net presence
 - Entrance area
 - Effective forebay area
 - Entrance area x effective forebay area
- Emerging information
 - Modifications leading to increased collection

Questions

