

# Migration, survival, growth and fate of hatchery juvenile Chinook salmon and steelhead released above and below dams in the Willamette River Basin



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# OBJECTIVES

- 1) Estimate the effects that passage through Willamette Project dams and reservoirs have on:**
  - a) the success and timing of outmigration by juvenile Chinook salmon (North Santiam and MF Willamette rivers)
  - b) the success and timing of outmigration by juvenile steelhead (North Santiam)
  - c) survivorship to adulthood for released fish at different sites
  
- 2) Provide information on the growth and fate of fish released above and below dams**

RPA 4.10: *“...Assess juvenile fish passage through ...Lookout Point and Dexter, Detroit and Big Cliff [dams]” ...*

-The BiOp



# METHODS

## Juvenile Chinook salmon and steelhead were:

- PIT tagged
- Released at specific locations above and below dams
- Detected at downstream interrogation sites (e.g. Willamette Falls)
- Occasionally captured by other researchers
  - Fork length (growth) and fate data

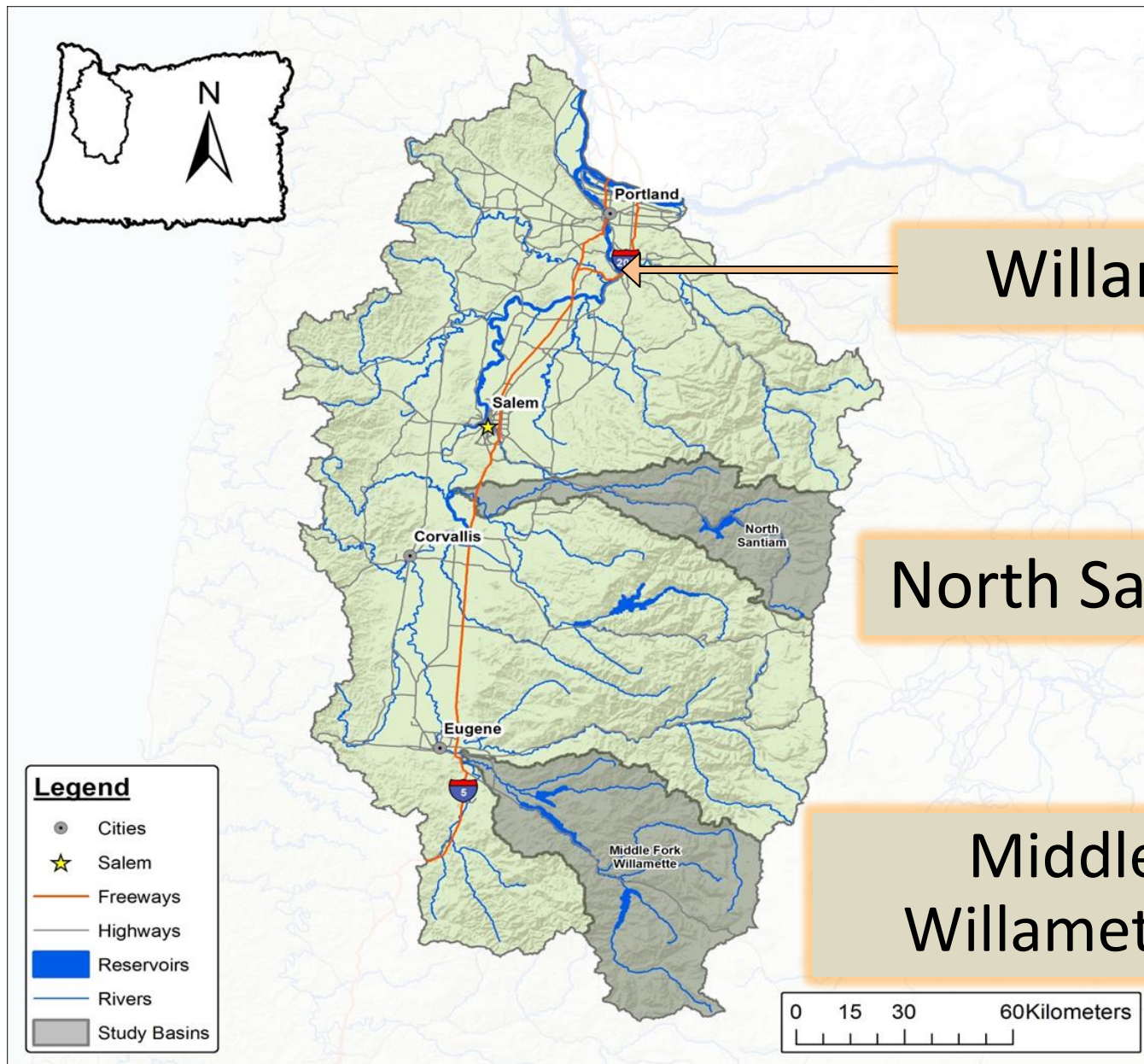
## We then compared:

- Growth rates
- Movement rates
- Daily and cumulative detections
- Number of adult returns

**...for all release groups (within subbasins)**

<http://odfw.forestry.oregonstate.edu/willamettesalmonidrme/>

# STUDY AREAS OF THE UPPER WILLAMETTE

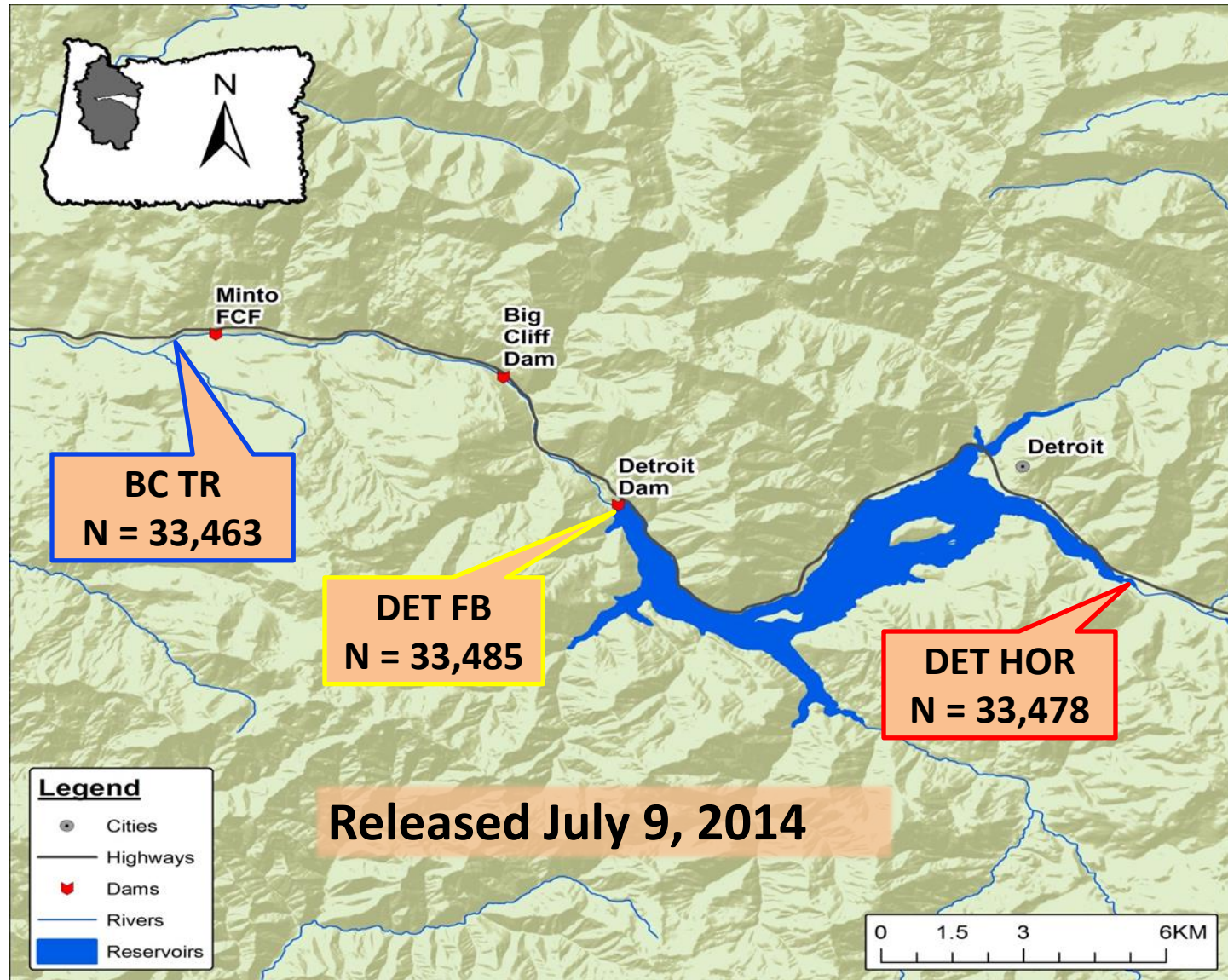


Willamette Falls

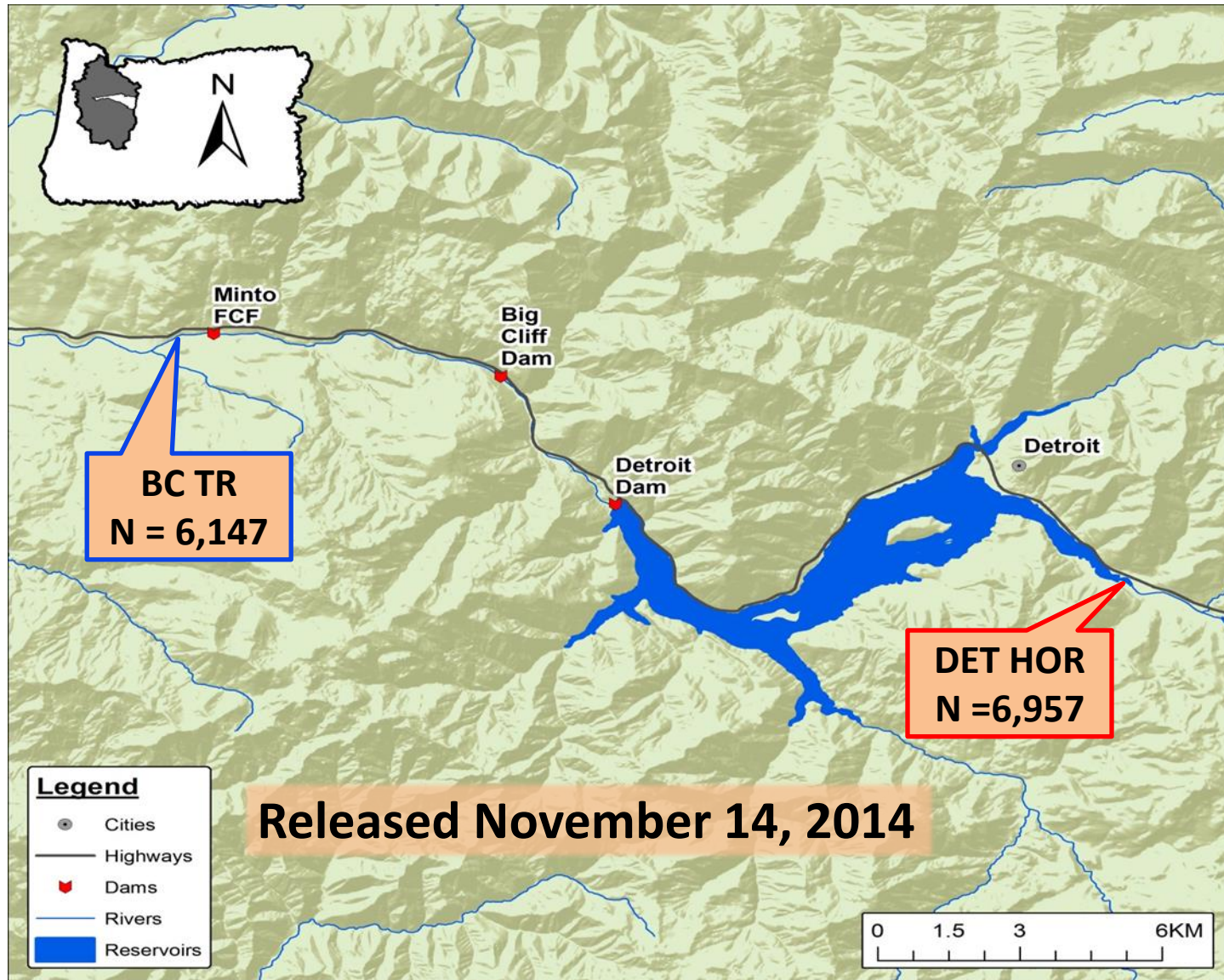
North Santiam River

Middle Fork Willamette River

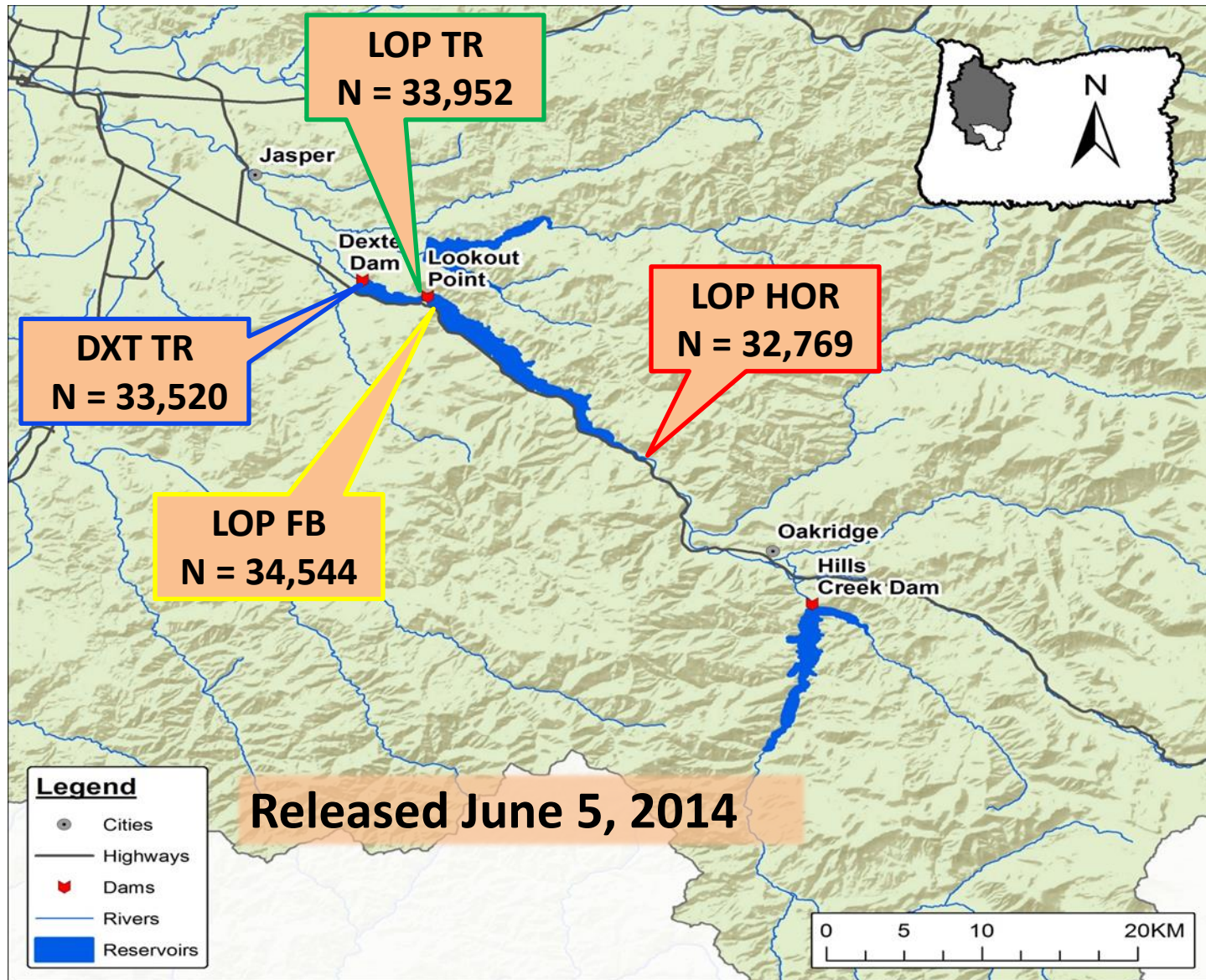
# 2014 Releases – North Santiam - Chinook



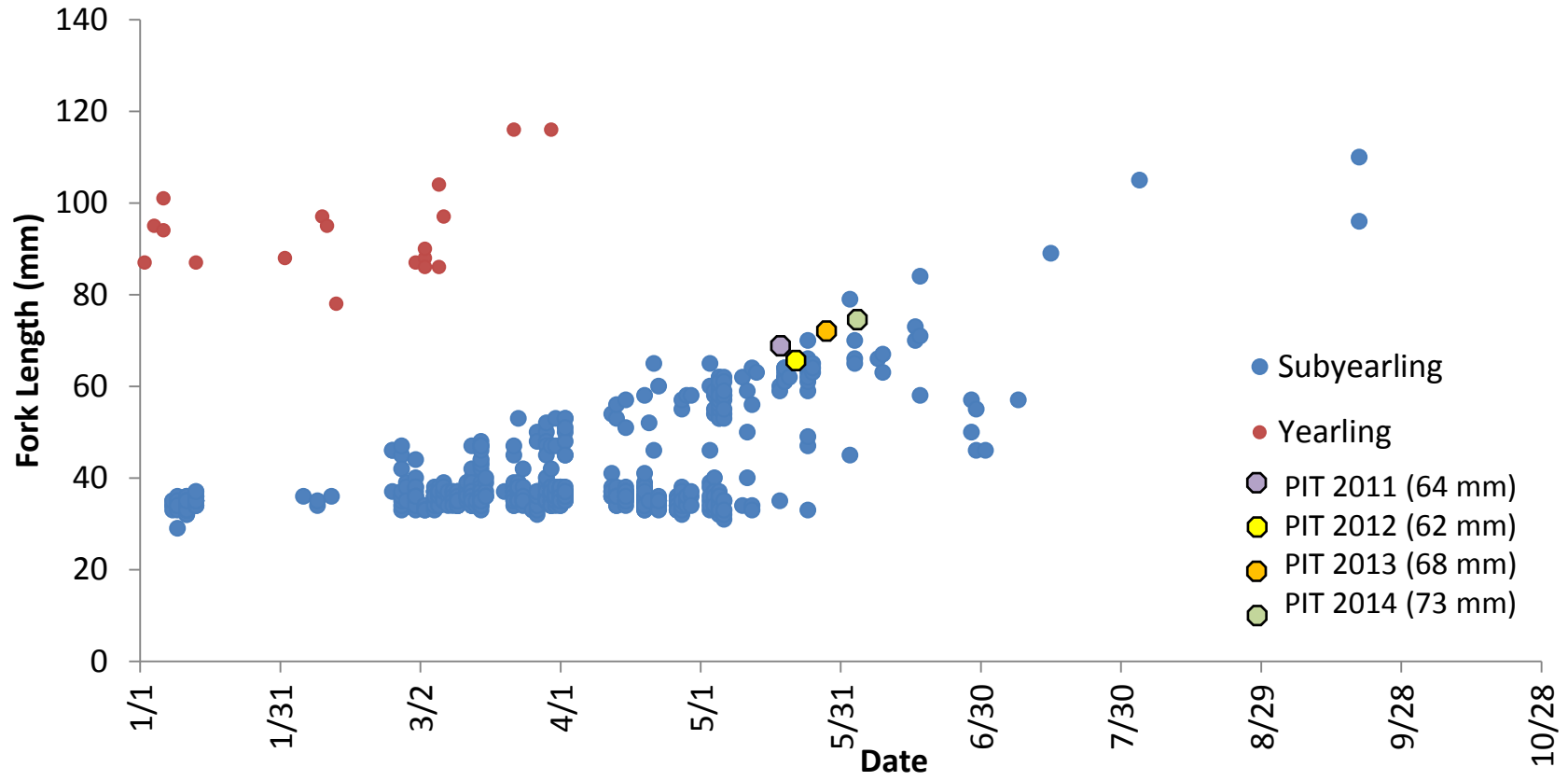
# 2014 Releases – North Santiam - Steelhead



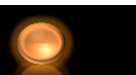
# 2014 Releases – MF Willamette - Chinook



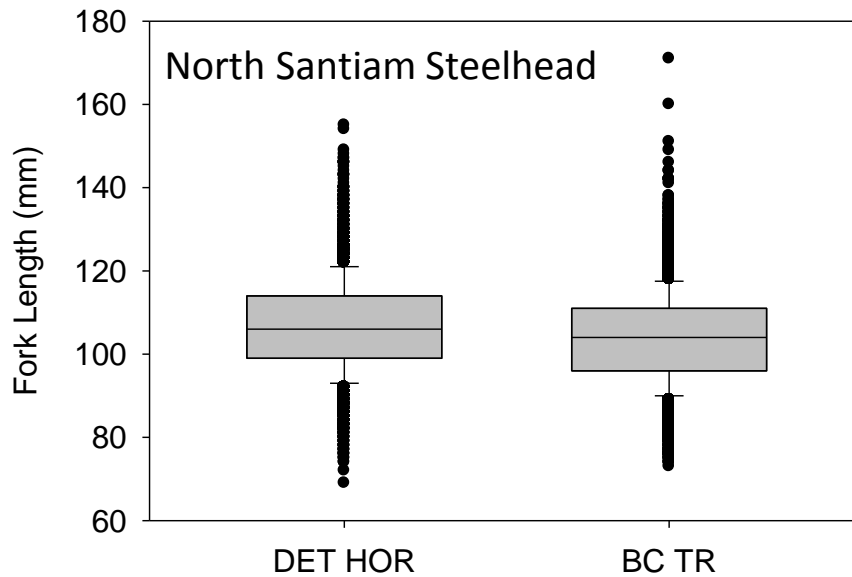
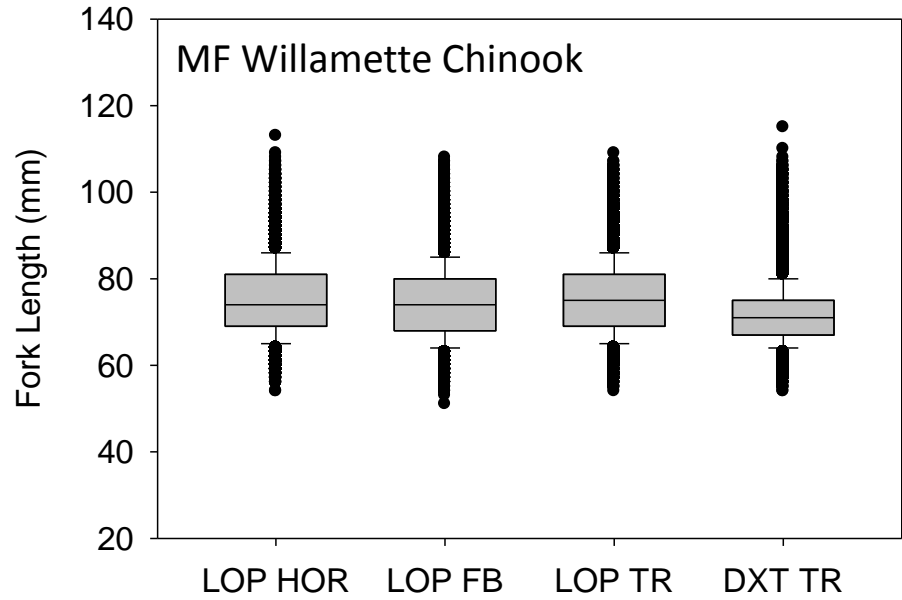
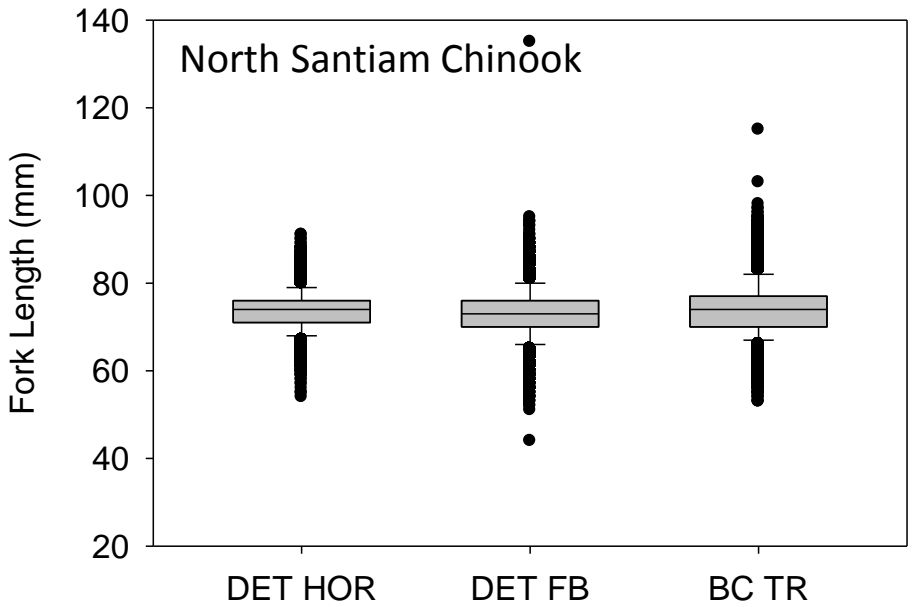
# Fork Lengths





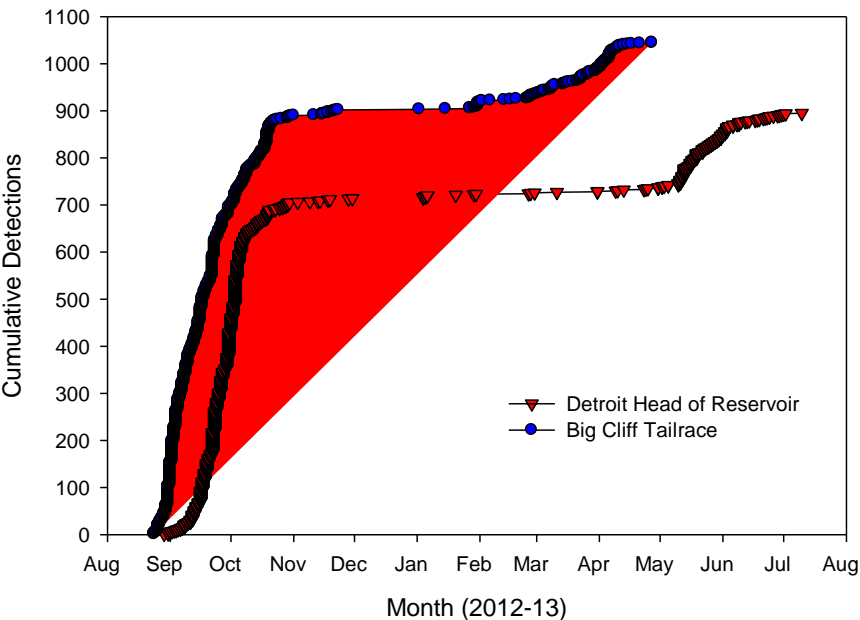
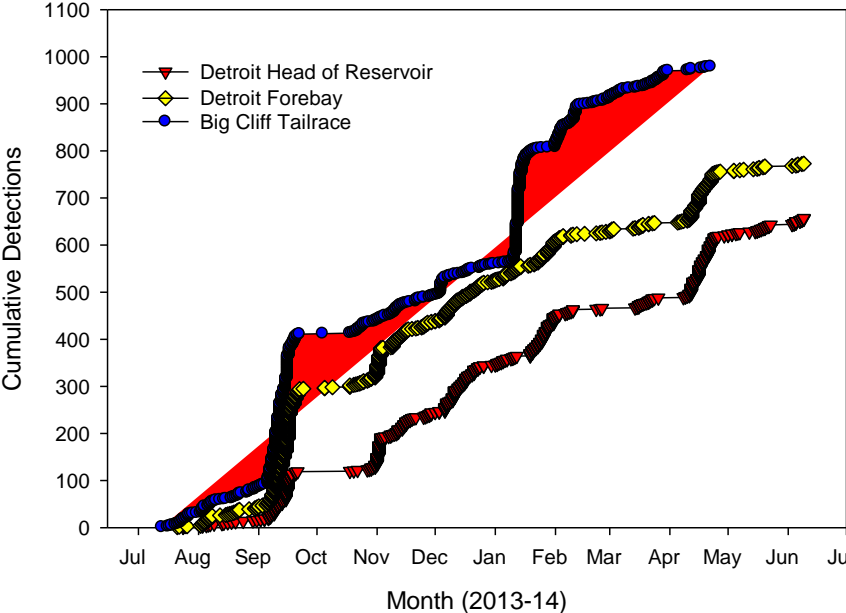
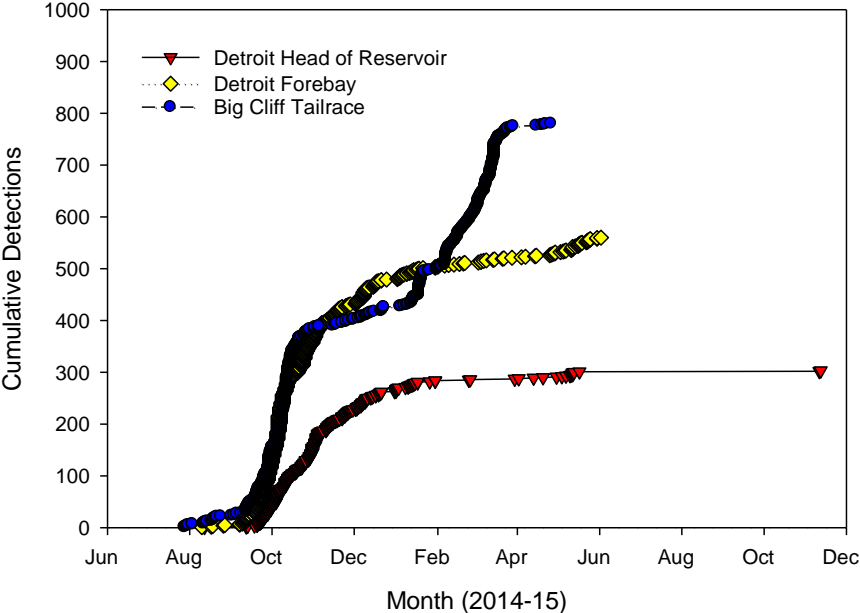


# Fork Lengths of Tagged Fish - 2014



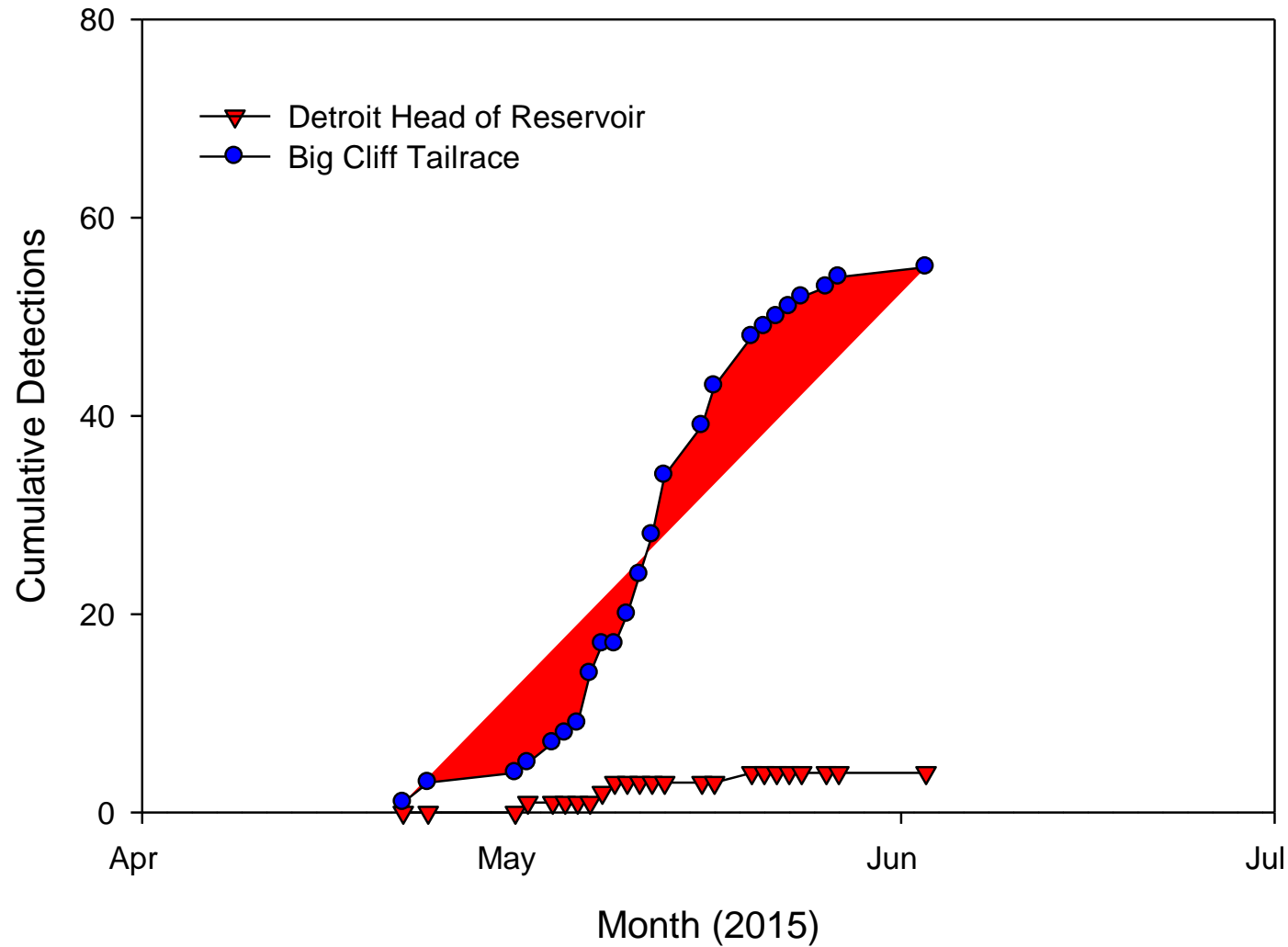


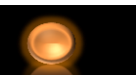
# Detections at W. Falls – North Santiam Chinook



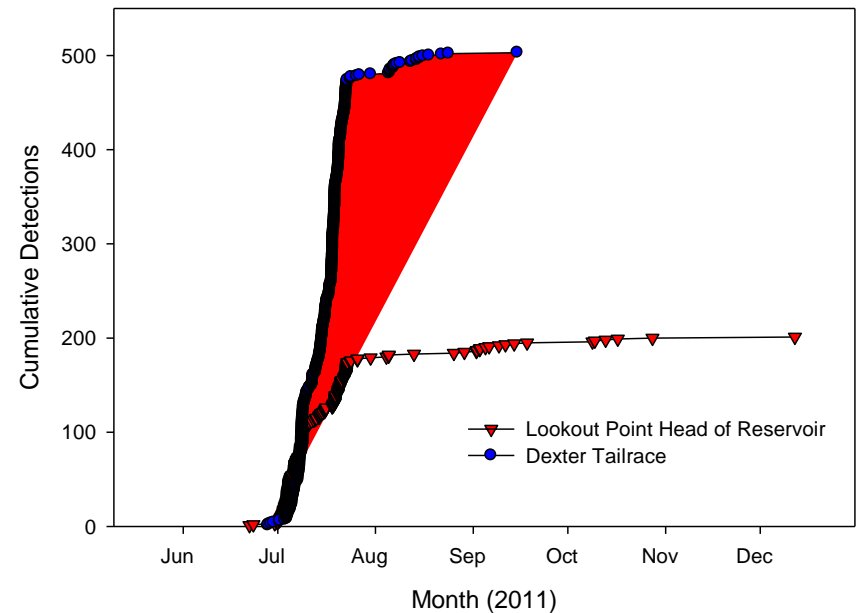
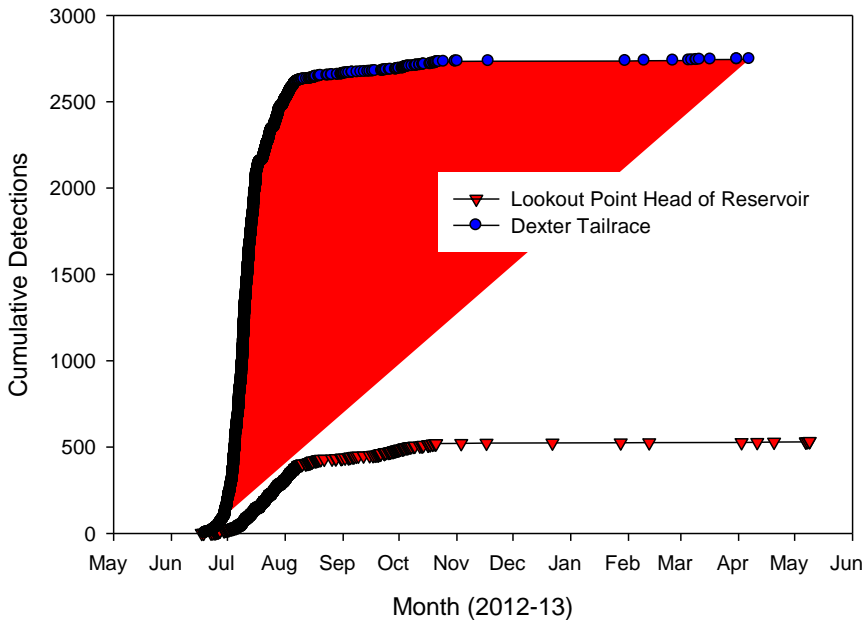
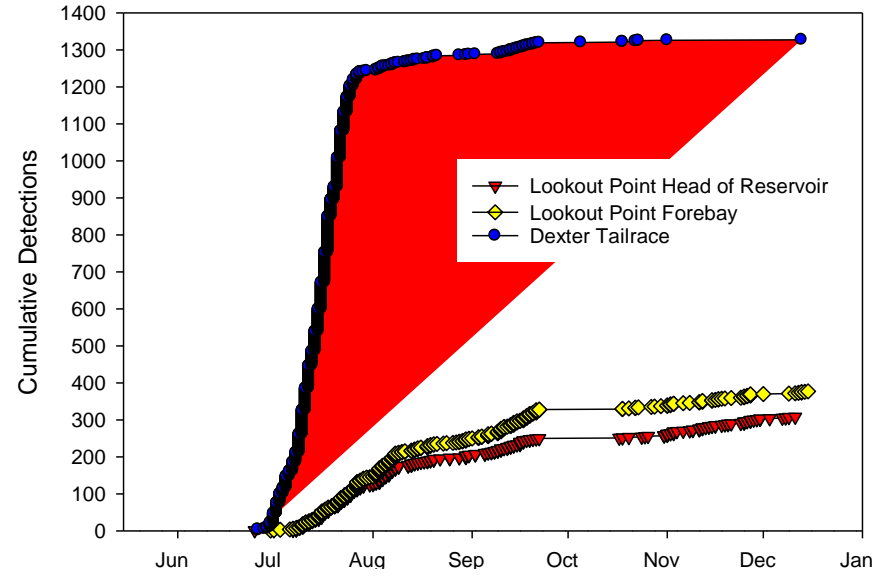
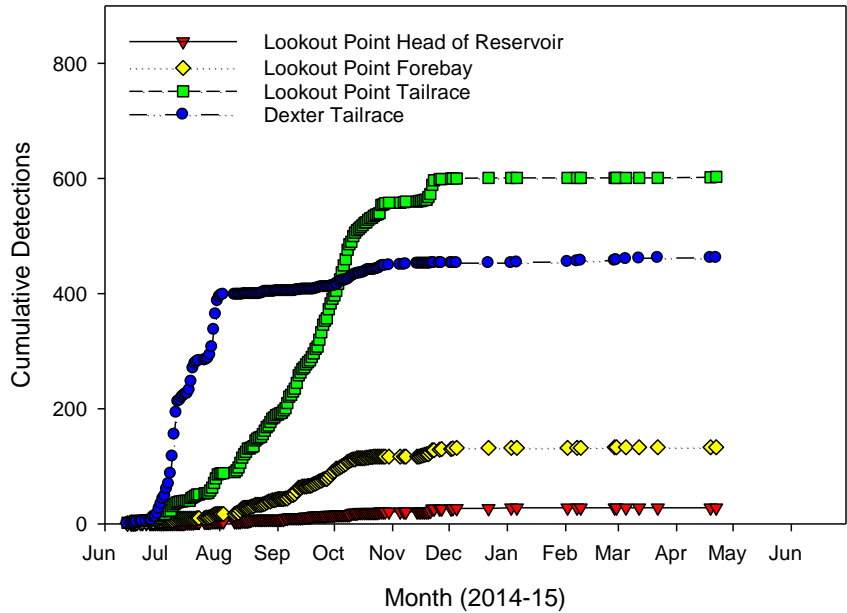
Detroit Forebay release (2014)

# Detections at W. Falls – North Santiam Steelhead





# Detections at W. Falls– MF Willamette Chinook



# Median Travel Rates

## Travel Rates (km/d)

### Middle Fork Willamette River – Chinook

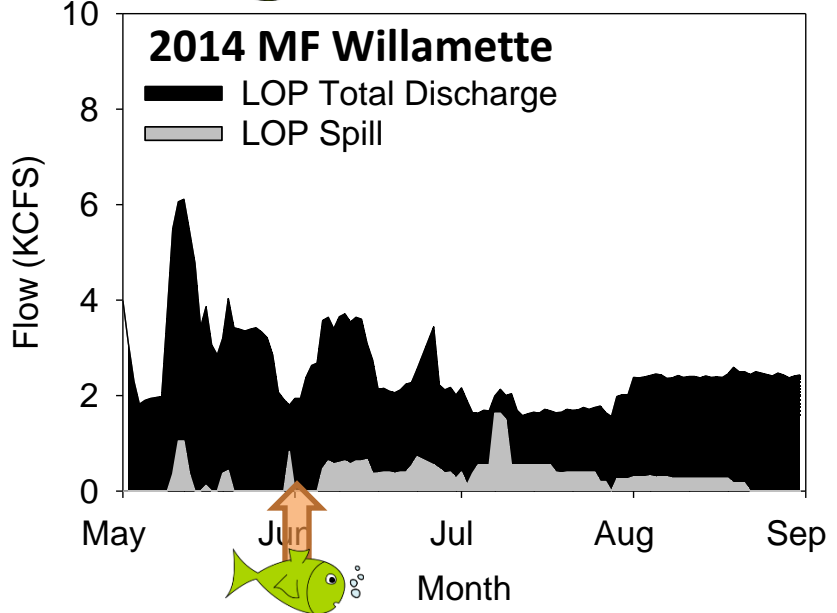
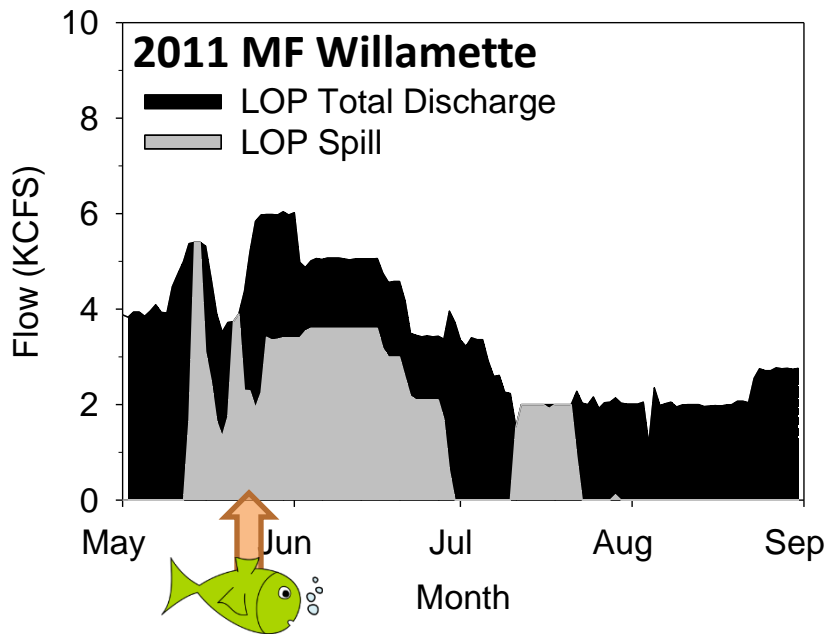
Year	LOP HOR	LOP FB	LOP TR	Dexter TR
2011	5.35 <sup>x</sup>	-	-	6.09 <sup>x</sup>
2012	4.71 <sup>x</sup>	-	-	5.85 <sup>y</sup>
2013	4.60 <sup>x</sup>	4.32 <sup>y</sup>	-	6.20 <sup>z</sup>
2014	2.79 <sup>x</sup>	2.74 <sup>x</sup>	2.67 <sup>y</sup>	6.95 <sup>z</sup>

## Travel Rates (km/d)

### North Santiam River - Chinook

Year	Detroit HOR	Detroit FB	Big Cliff TR
2012	7.77 <sup>x</sup>	-	9.48 <sup>y</sup>
2013	1.88 <sup>x</sup>	2.78 <sup>x,y</sup>	2.77 <sup>y</sup>
2014	2.21 <sup>x</sup>	2.38 <sup>x</sup>	4.91 <sup>y</sup>

Above: Within rows, values with different superscript letters are significantly different; Dunn's pairwise test ( $P < 0.05$ )

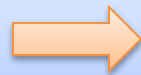


# Adult Returns

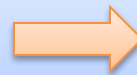
Release Year	Ages	<u>Middle Fork Willamette River</u>			<u>North Santiam River</u>		
		LOP HOR	LOP FB	Dexter TR	Detroit HOR	Detroit FB	Big Cliff TR
2011	3+4+5	2	-	2	-	-	-
2012	3+4	26	-	11	23	-	23
2013	3	2	4	1	4	6	2

## Hypothesis:

Faster growth in reservoirs

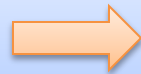


Larger smolt size

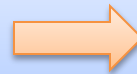


Increased chance of survivorship to adulthood

Larger smolt size



Younger age at maturity



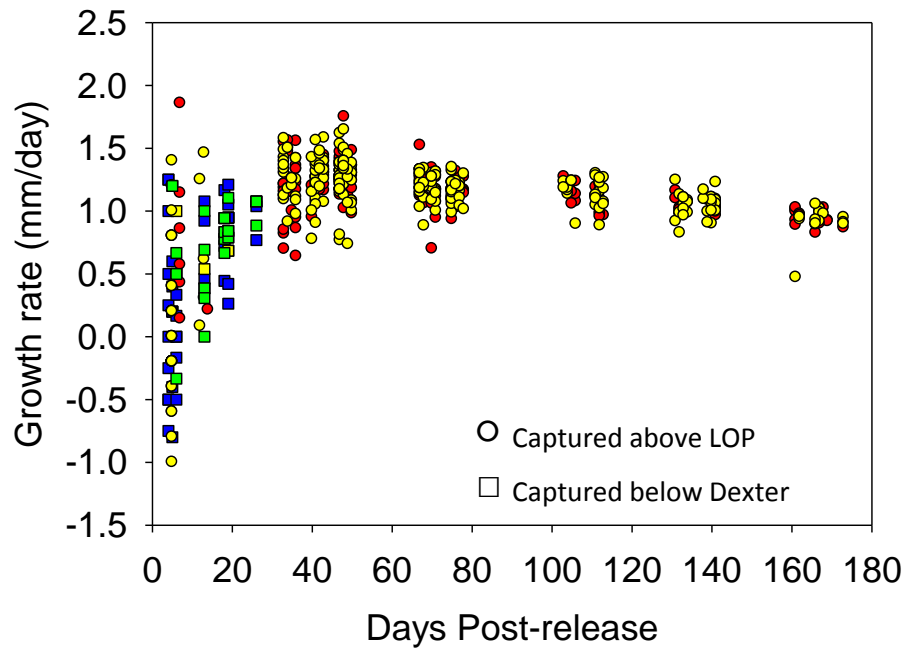
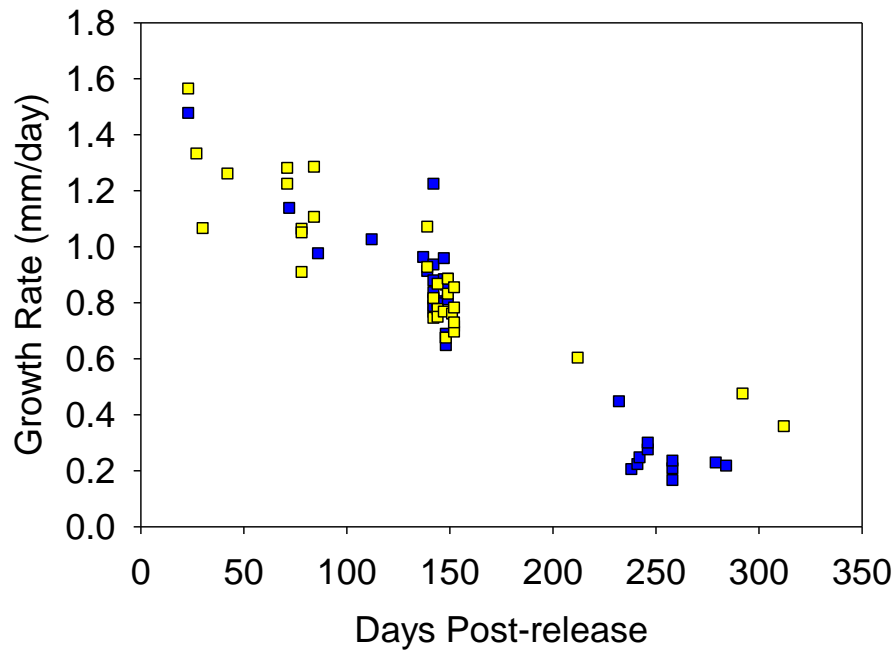
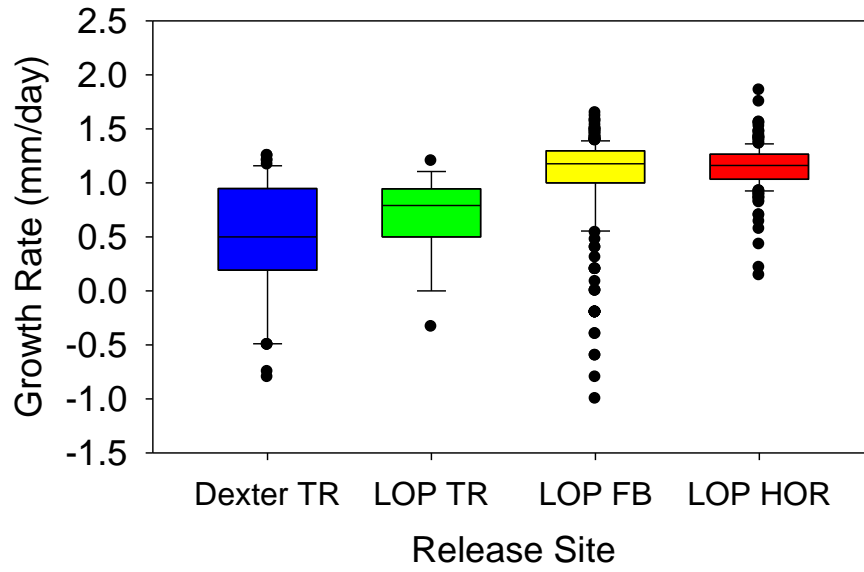
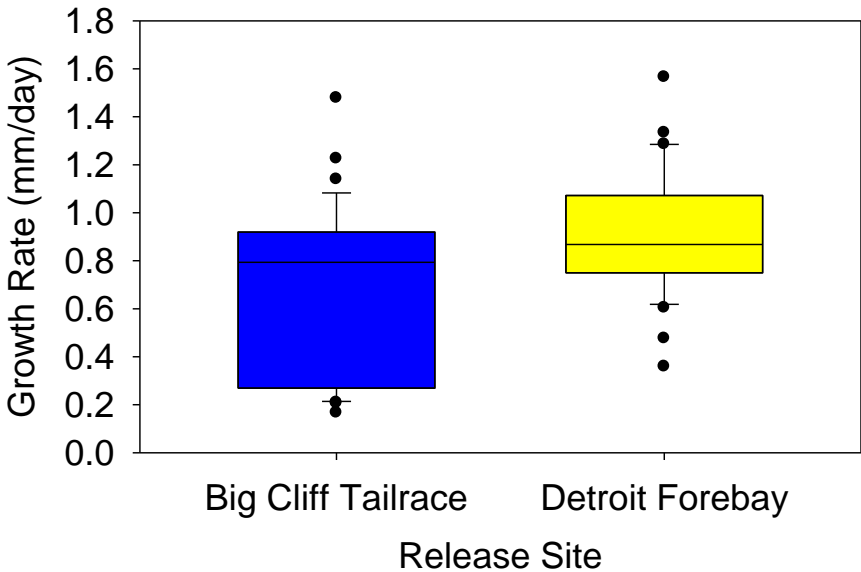
Lower mean fitness and productivity



# Growth

### North Santiam - 2014

### MF Willamette - 2014



# Conclusions

- Outmigration success of TR groups was consistently higher than HOR groups, in all years and both subbasins
  - Intermediate release groups typically had intermediate success
  - Reservoir/dam passage effect appears to be very strong for steelhead
- Dams and reservoirs in North Santiam River may select against some juvenile life histories
- Travel rate to Willamette Falls was consistently greater for TR groups than HOR groups, in all years and both subbasins
- Outmigration success and travel rate appear to be positively associated with spill
- Adult returns from head of reservoir groups may meet or exceed those of tailrace groups
  - Data are still incomplete
  - Mechanism unclear – might be effect of reservoir on smolt growth & survivorship?



# Acknowledgments

William Muir (NOAA - retired)

Dan Peck, Greg Grenbemer & Chris Boyd (ODFW);  
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Project concept

Wild-like study fish

Tagging coordination

Juvenile captures data

Analytical support

Administration

## QUESTIONS?

