Migration and Survival of Juvenile Winter Steelhead using Wild Fish Surrogates Above and Below High-Head Dams


Karen M. Cogliati, Thomas A. Friesen, Marc A. Johnson,

Paul Olmsted, Carl B. Schreck, David L.G. Noakes

Oregon State University

OREGON Fish & Wildlife

Oregon Hatchery Research Center

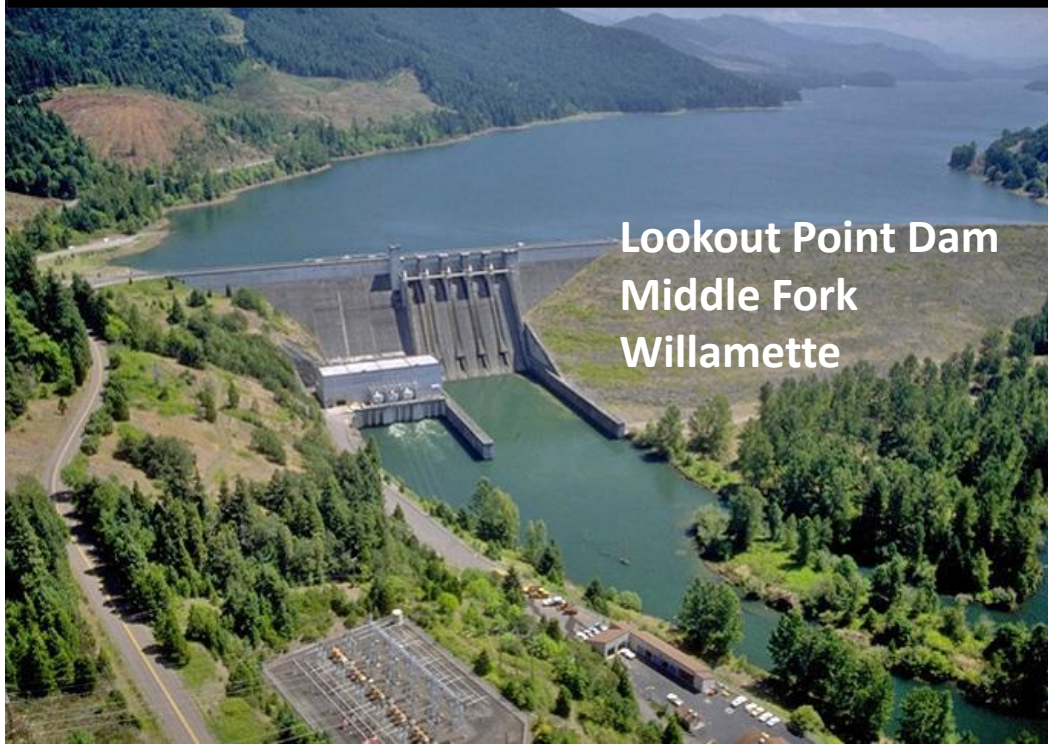
US Army Corps of Engineers.

USGS science for a changing world

Oregon Cooperative Fishery Research Unit

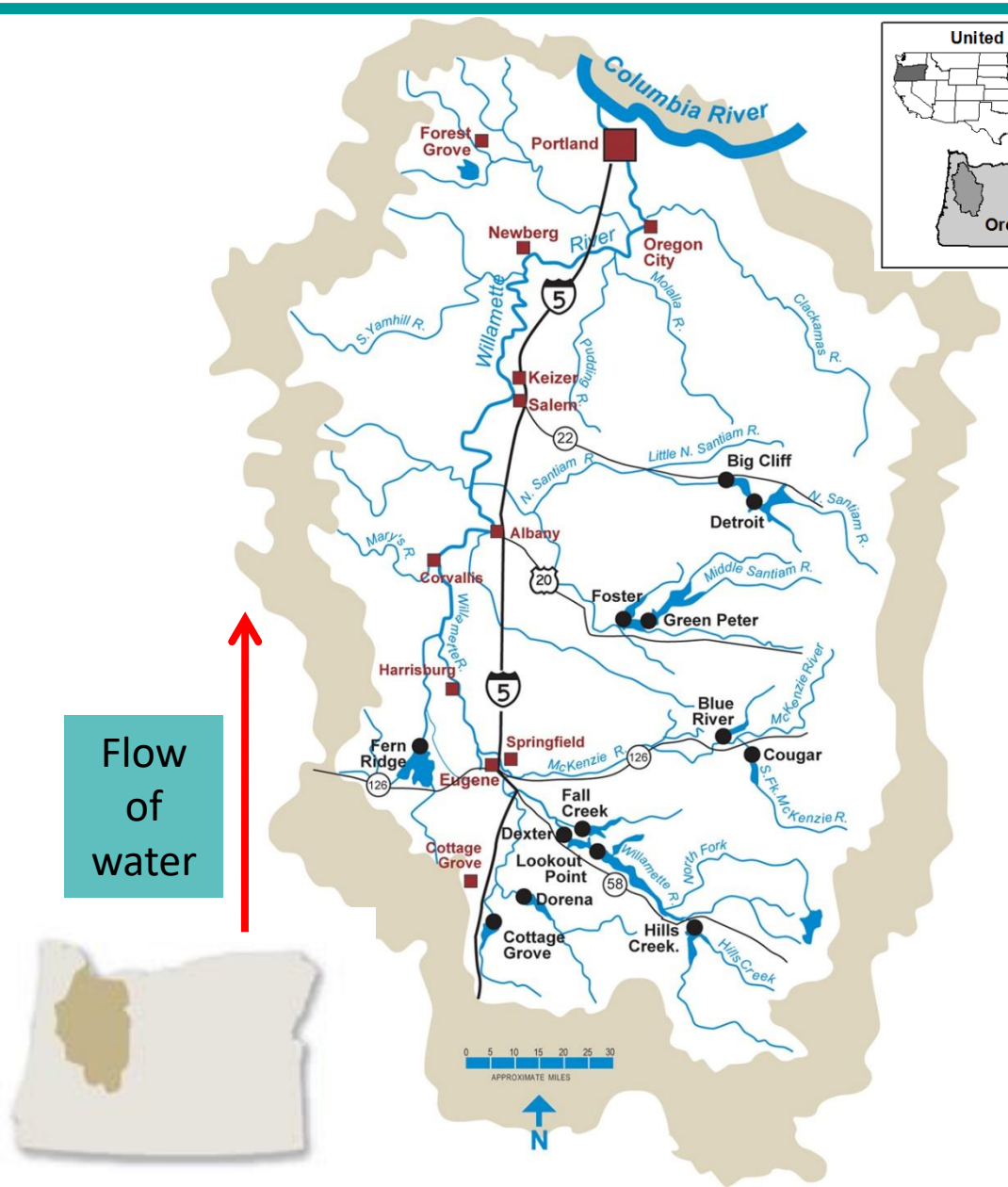
The complex issue of dams

- Numerous benefits:
  - Hydroelectricity, flood control, recreation
- But, they change the landscape and environment
- Impair anadromous fish passage
  - Declines in wild fish populations
  - Hatchery fish added to the system



Willamette Valley Project Dams (Oregon USA)

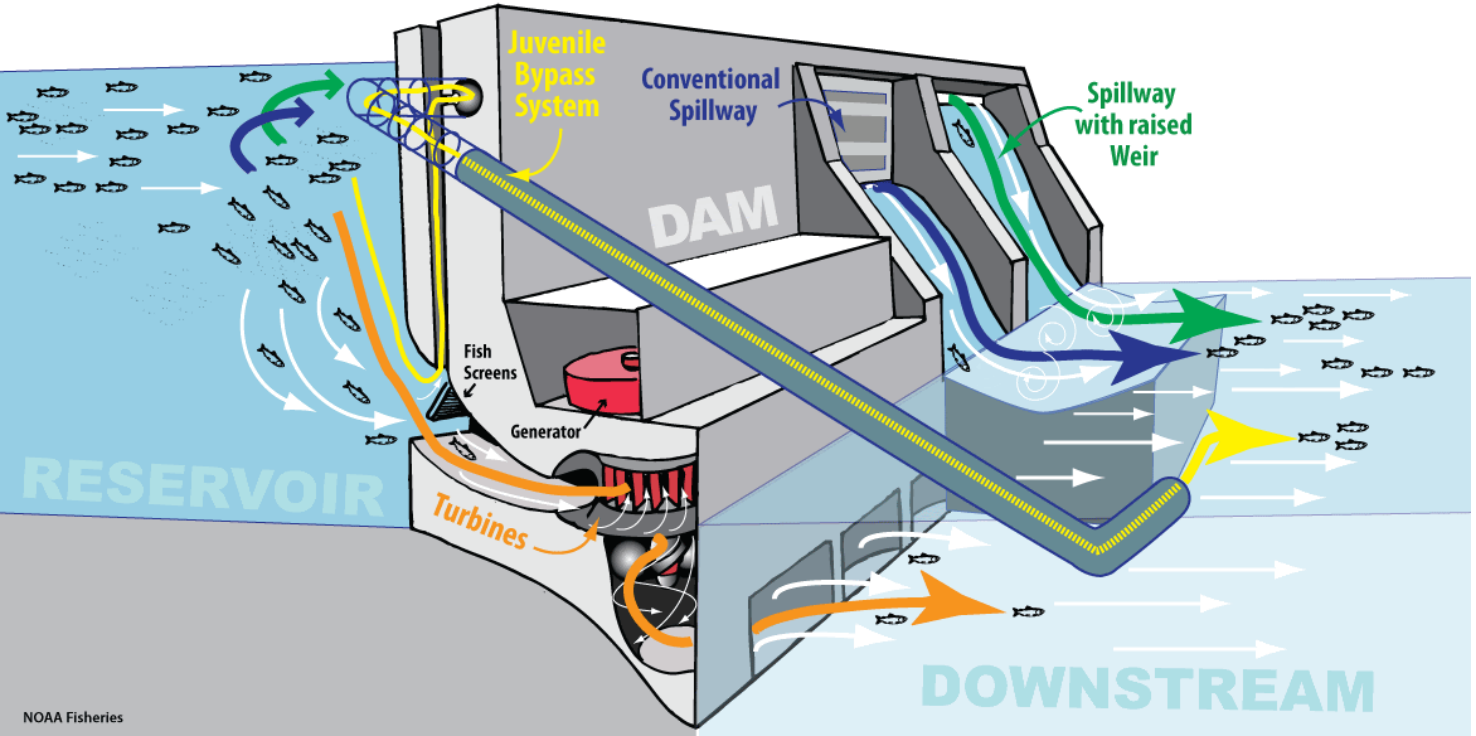
- Blocked access to historical spawning habitat
- Adults moved above dams



WHAT GOES UP MUST COME DOWN

Juveniles faced with unnatural:

- reservoir habitat
- altered fish communities
- downstream passage



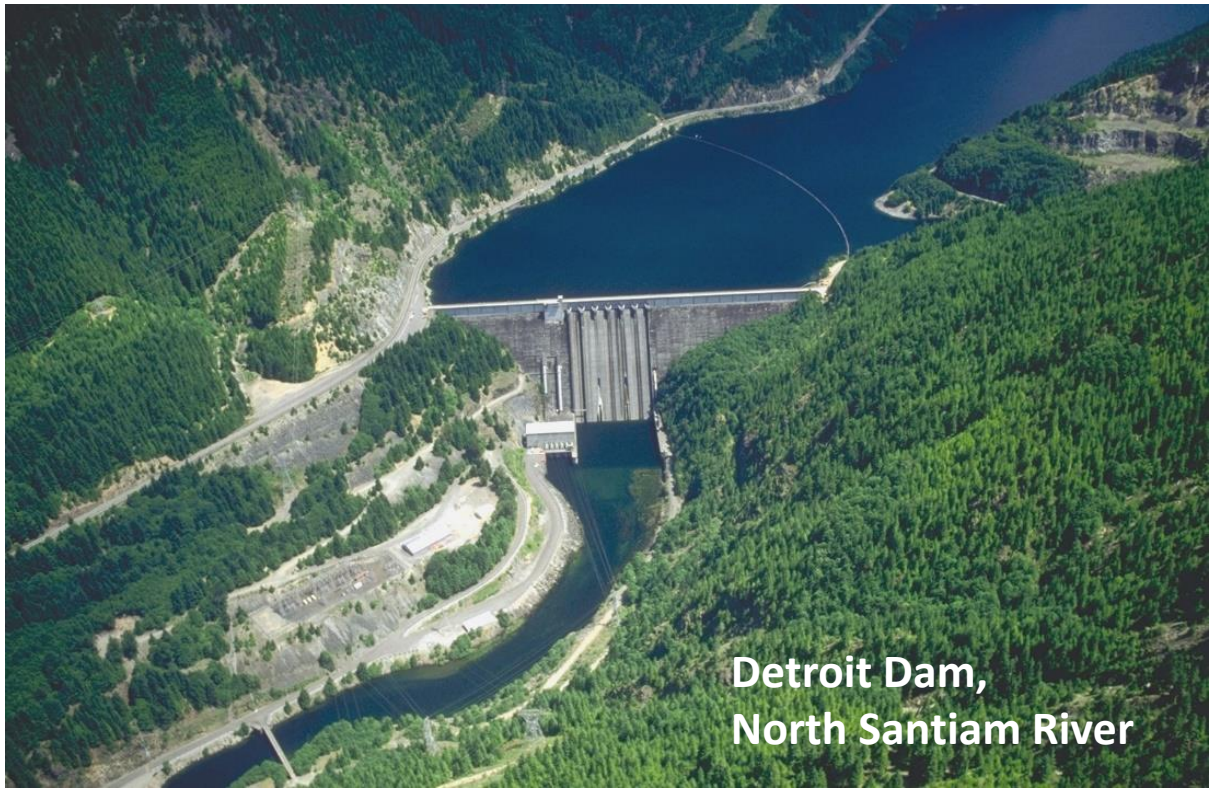
- Research often needed to understand impacts of reservoir and dams on fish movement and survival
- Many impacted fish are ESA-listed species

Challenge

Evaluate impacts on wild fish, with no wild fish available?

Option to use hatchery fish

- Sufficient numbers to conduct rigorous tests
  - Paired release above and below dams
  - Multiple treatments and control for bypass tests



WILD FISH SURROGATE PROJECT – OSU

Produce juvenile salmonids in artificial environments that look and act more wild-like

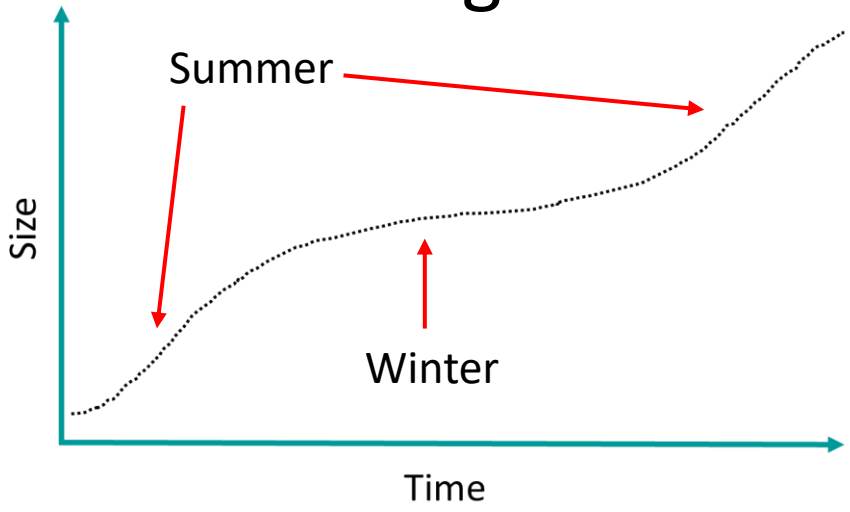
Steelhead

Chinook Salmon

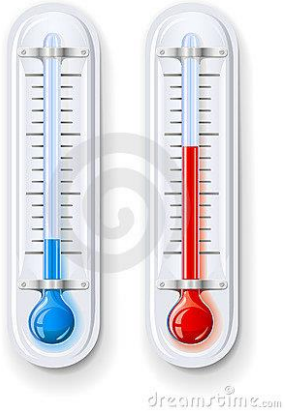

Photo by Roger Tabor

ALTERED REARING ENVIRONMENT

Wild-like growth



Temperature



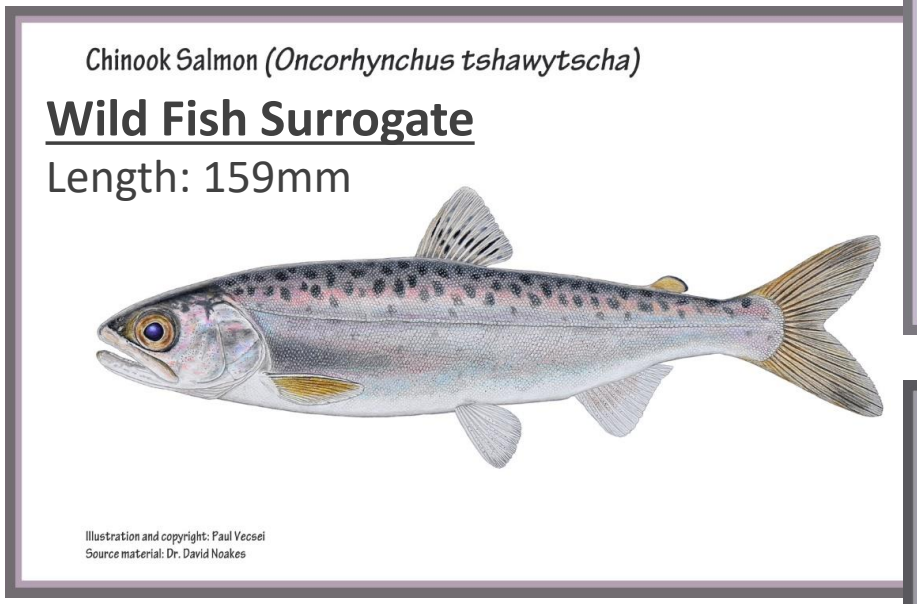
Diet quality and pattern of delivery

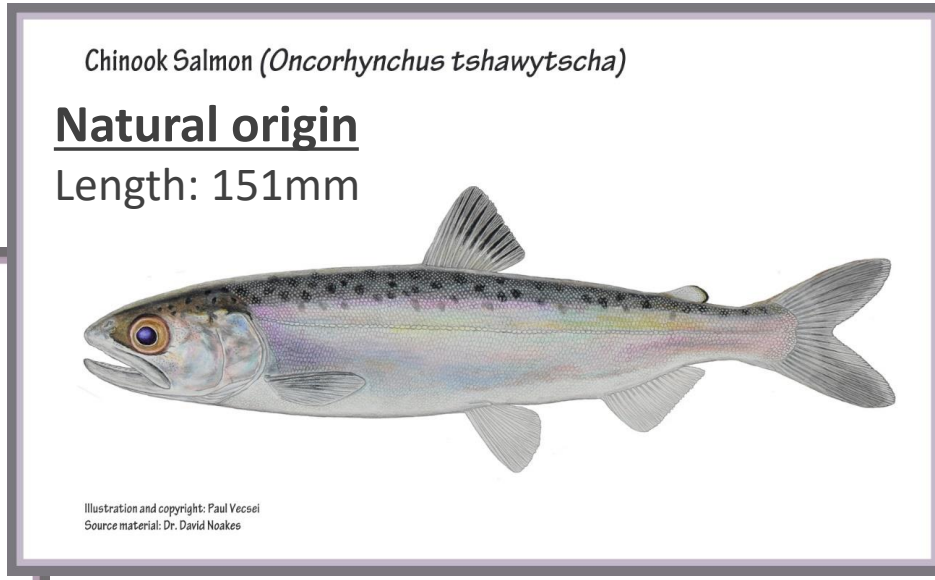
Density

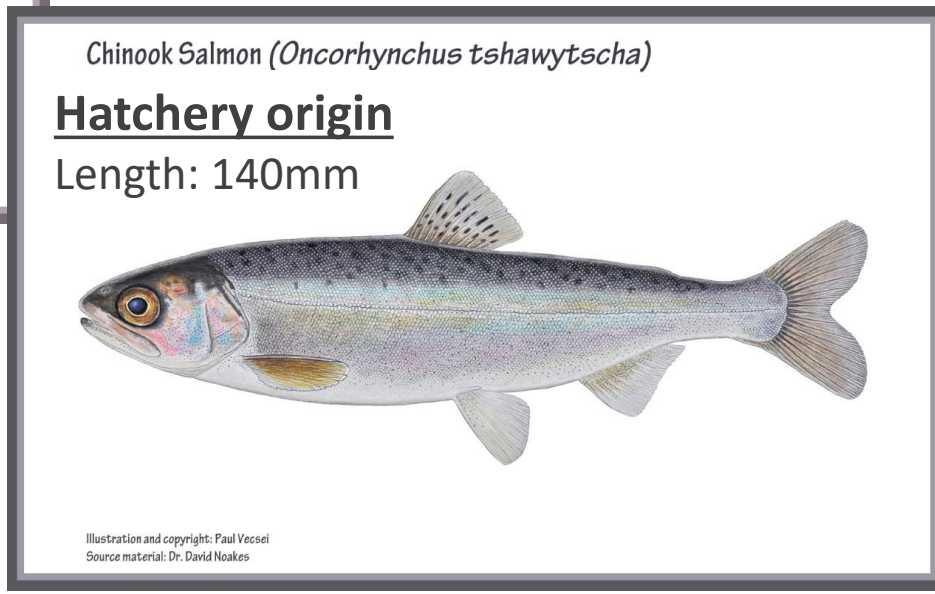
Tank environment

Our surrogates are more like wild fish migrants

- Body shape
- Osmoregulation
- Physiology
- Behaviour
- Genetics
- Fin quality
- Gene expression
- Body composition
- Sexual maturation
- Migration

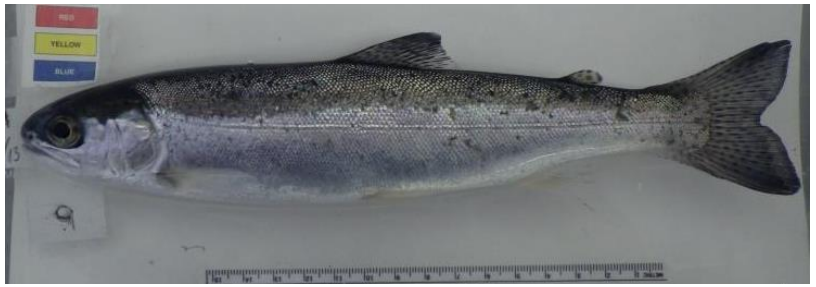


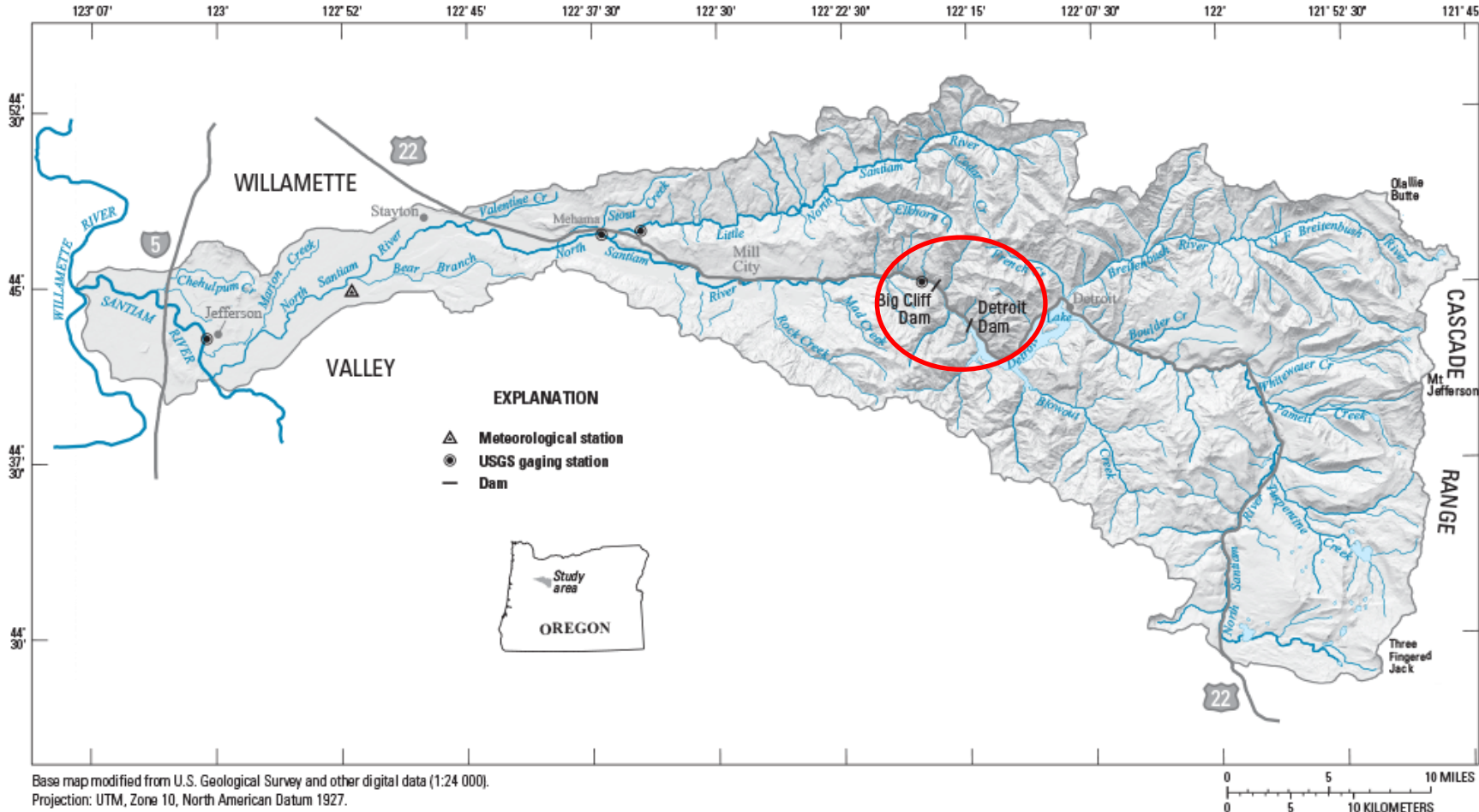




STUDY OBJECTIVES

- Evaluate effects of North Santiam River dams on winter steelhead outmigration and survival
  - Juvenile detections
  - Juvenile movement
  - Adult returns
- 2014, 2015, 2016





Spawning at Minto Fish Collection Facility

Wild broodstock adults

Brood year	Release year	Numbers spawned
BY13	2014	5 females and 3 males
BY14	2015	7 females and males
BY15	2016	10 females and males

EARLY REARING

- Embryos brought to OHRC for rearing
- Followed Surrogate rearing protocols

OREGON HATCHERY RESEARCH CENTER

Final rearing

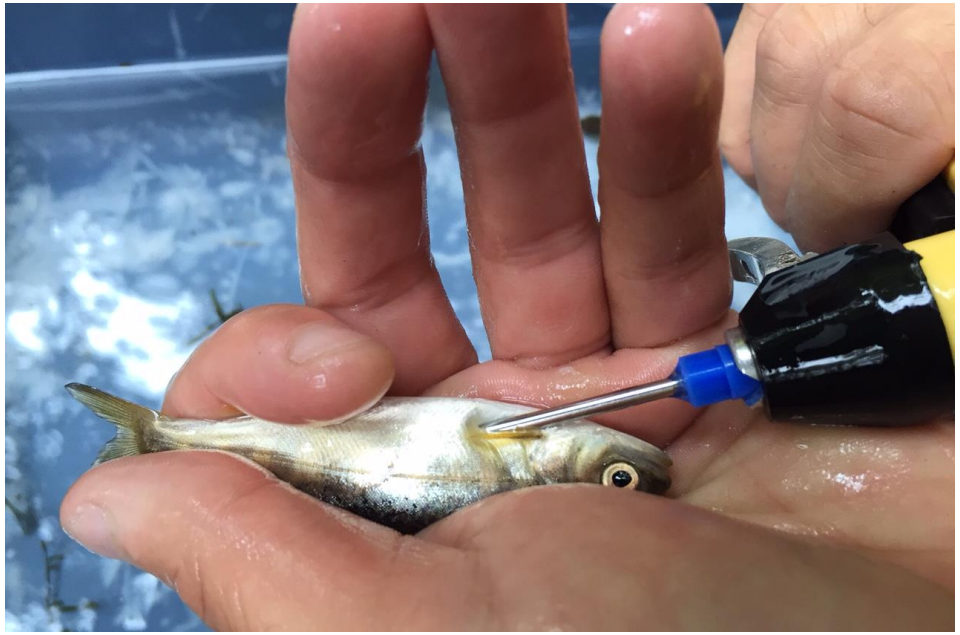
- Fish transported to Marion Forks Fish Hatchery as subyearlings for final rearing
- Two circular ponds, equally divided
- Surrogate protocols:
  - Overhead shading
  - Lower density
  - Wild fish surrogate experimental feed

Release year	OHRC -> Marion Forks (by weight)
2014	12,600
2015	22,500
2016	28,800

PIT TAGGING

- Tagged in June and July of release year by Biomark
- Lengths measured from majority of fish

Biomark
SPECIALISTS IN IDENTIFICATION SOLUTIONS

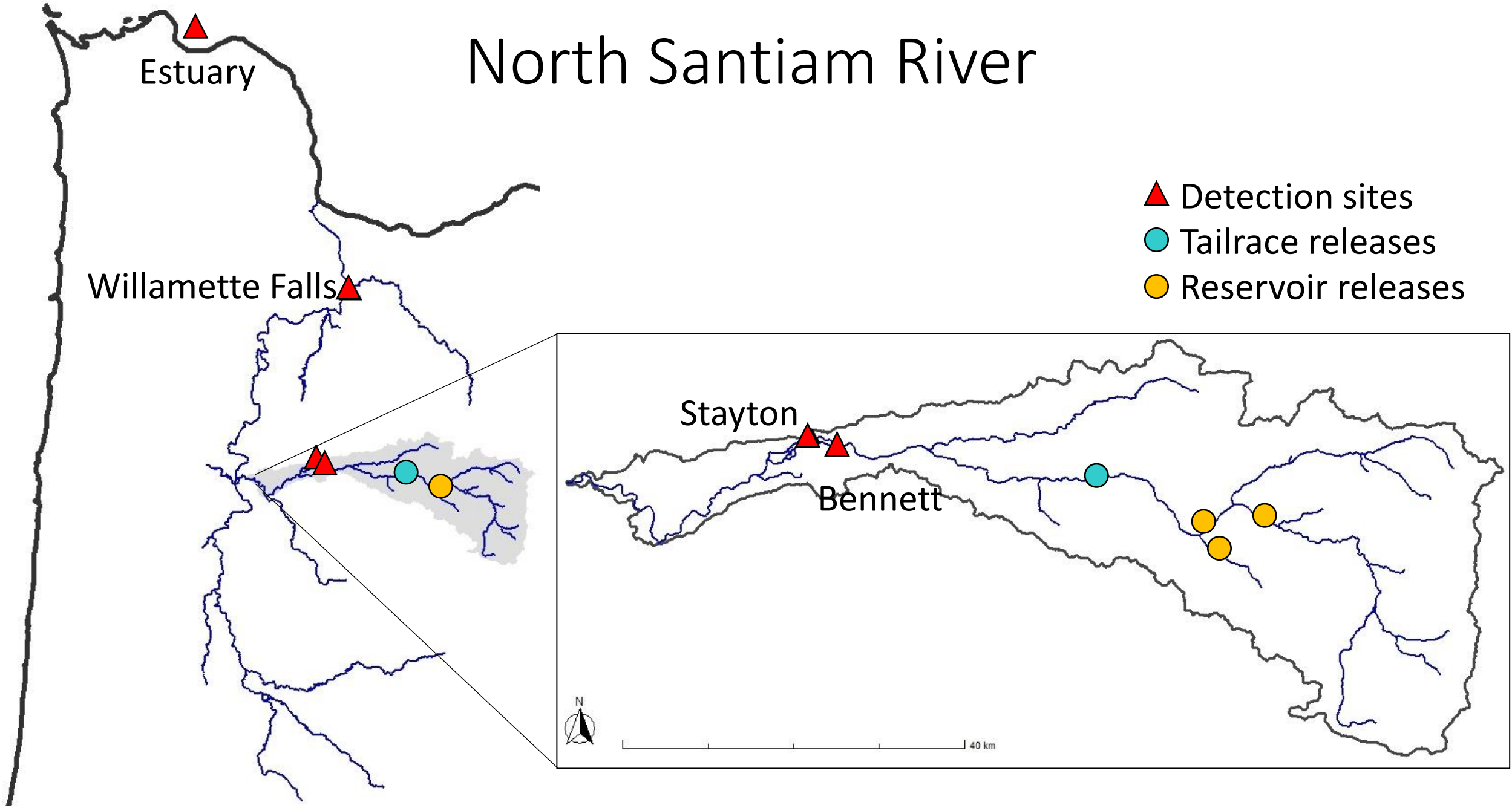


Fish releases

Released mid-November each year

Release Site	Release Number
2014	
Packsaddle Park (Tailrace)	6,147
Mongold State Park (Reservoir)	6,957
2015	
Minto Fish Facility (Tailrace)	9,628
Blowout Creek (Reservoir)	9,694
2016	
Packsaddle Park (Tailrace)	11,057
Dry Creek (Reservoir)	11,133

North Santiam River



Summary of detections

387 total detections across three release years

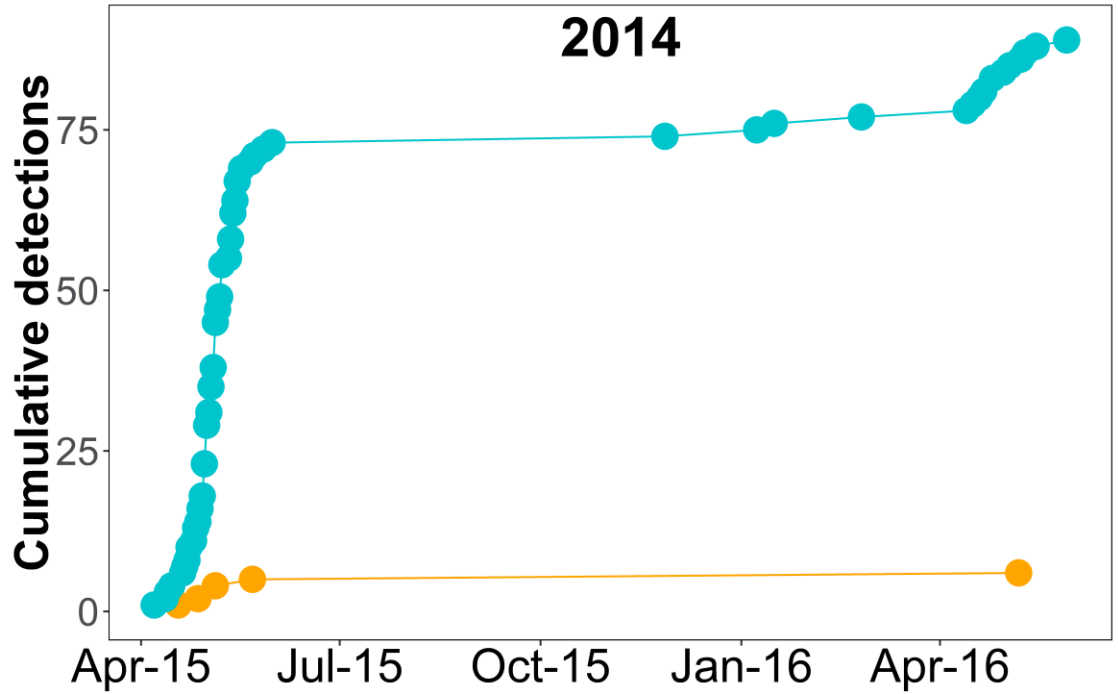
By year

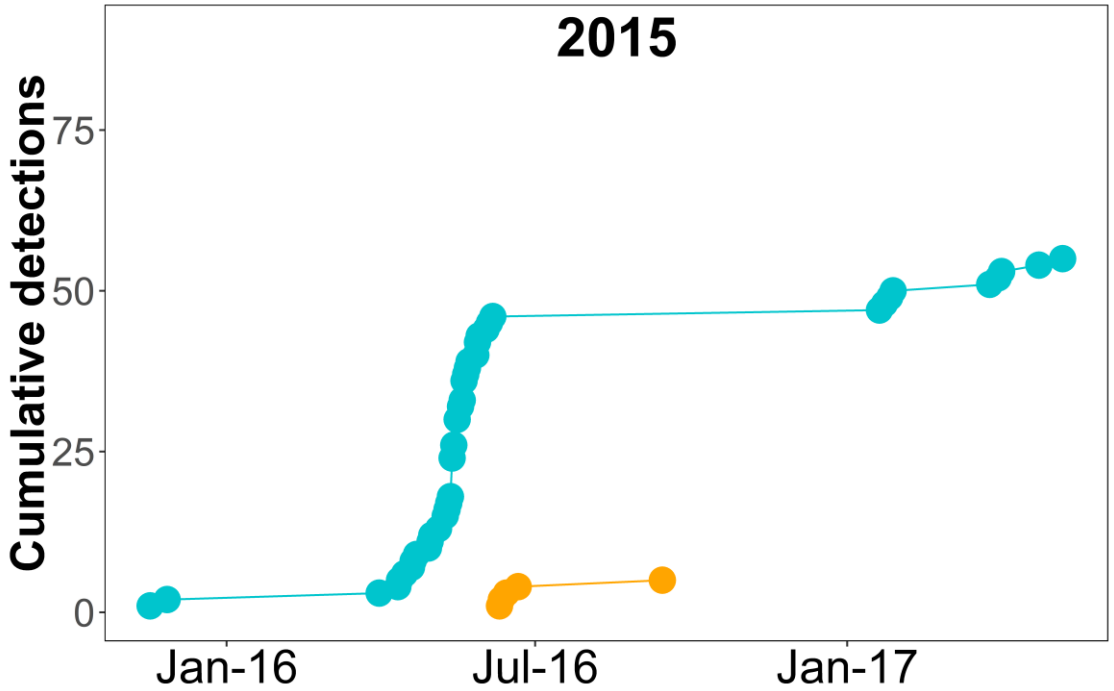
- 2014: 177 detections
- 2015: 107 detections
- 2016: 103 detections

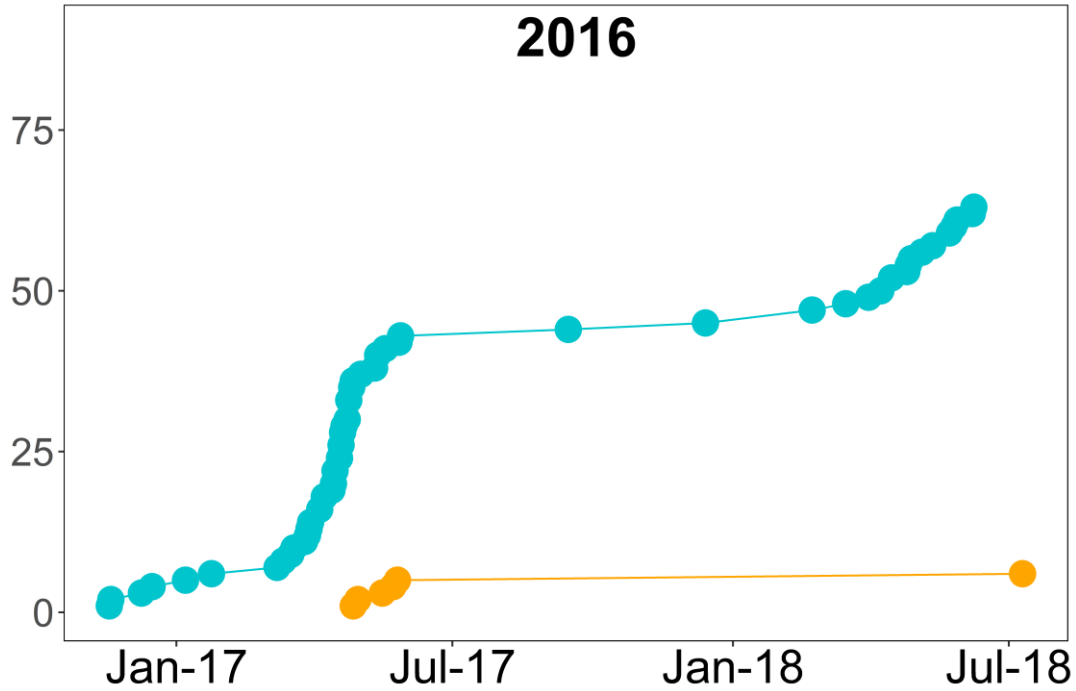
By detection site

- Bennett/Stayton: 224 detections
- Willamette Falls: 144 detections
- Estuary: 19 detections

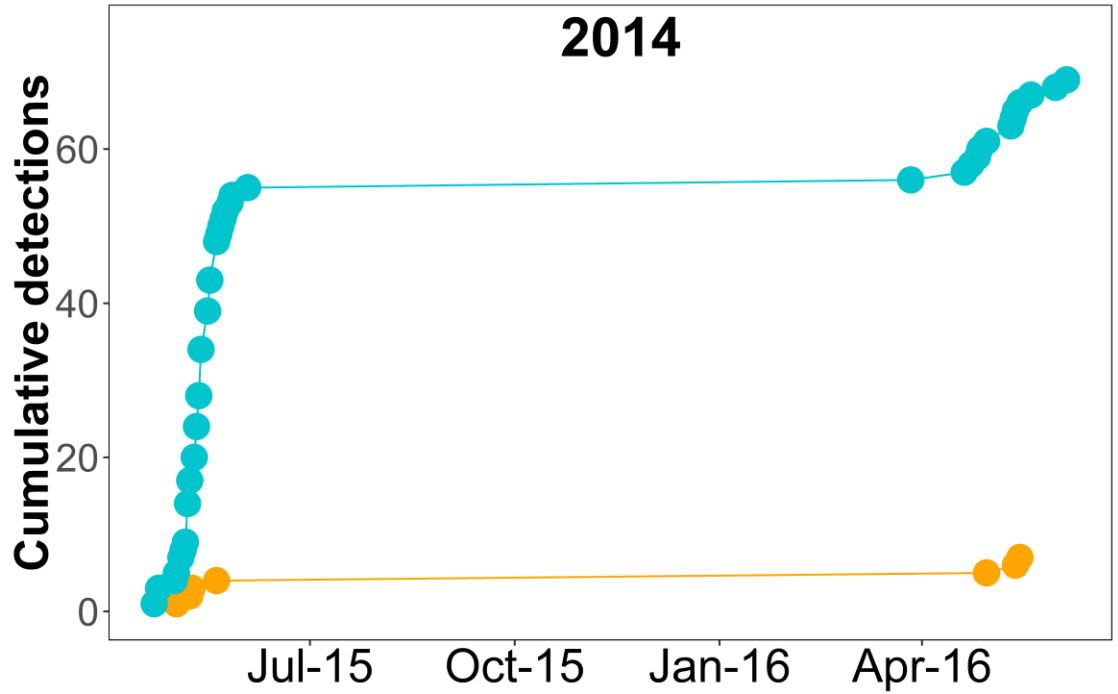
Bennett/ Stayton

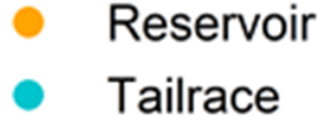


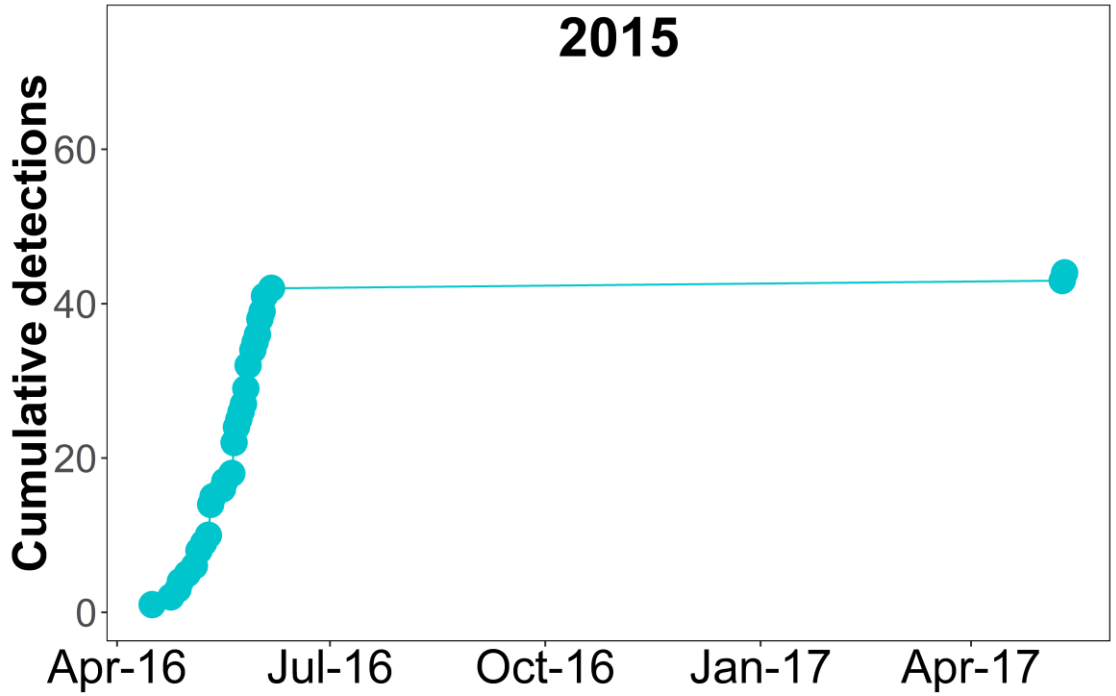


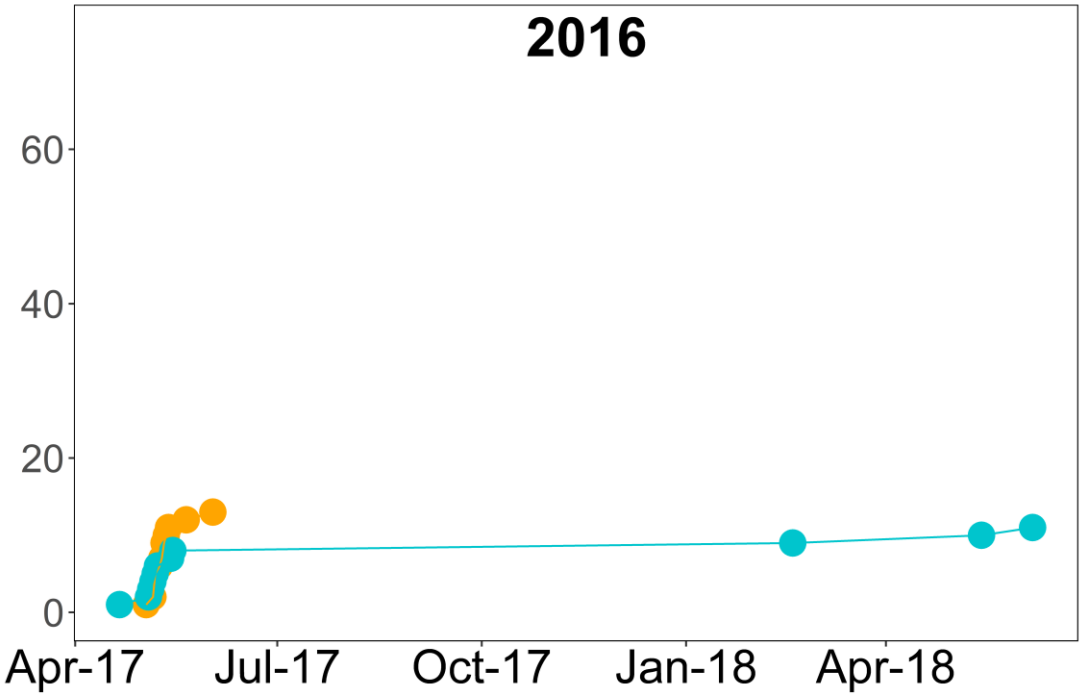


Willamette Falls

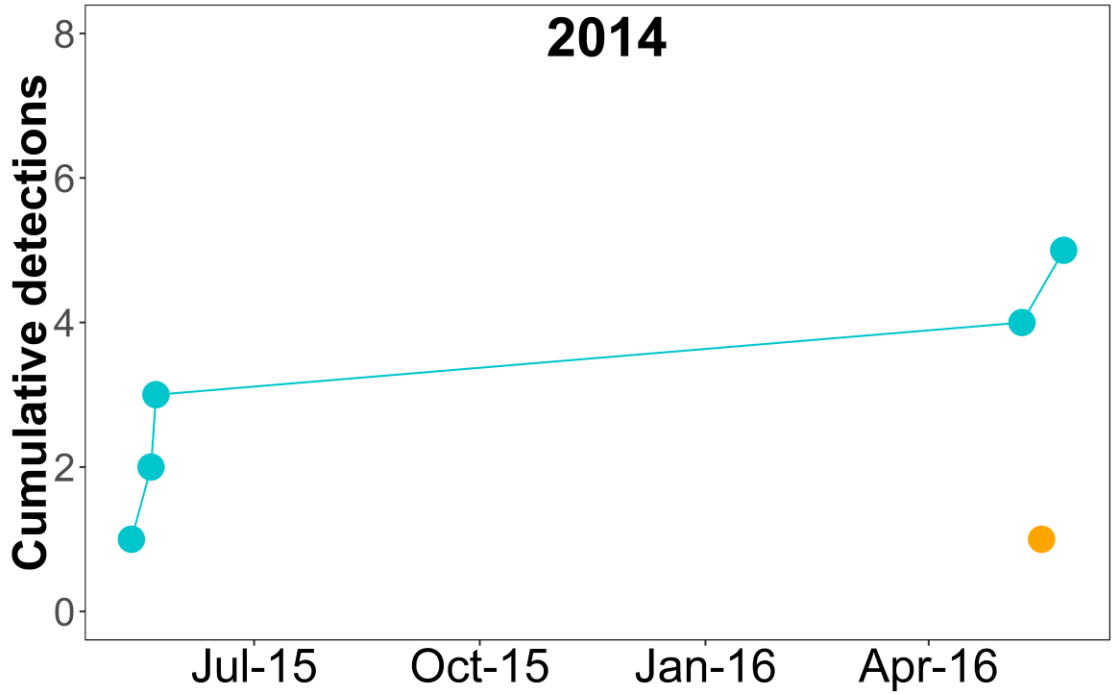


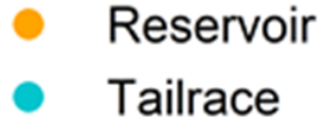


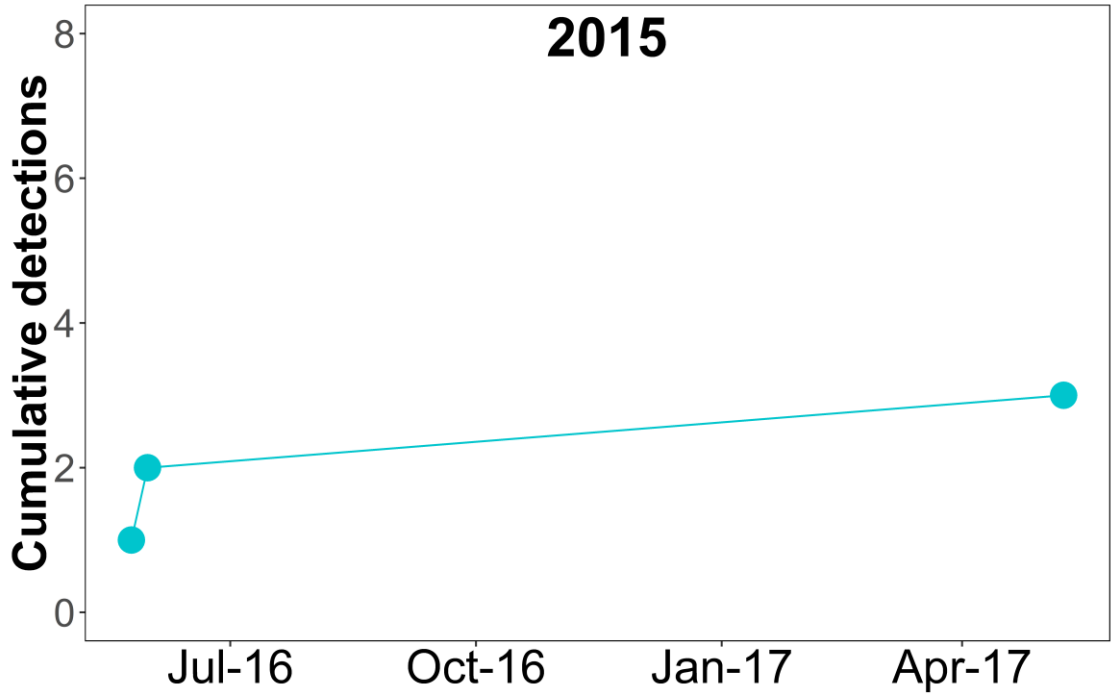


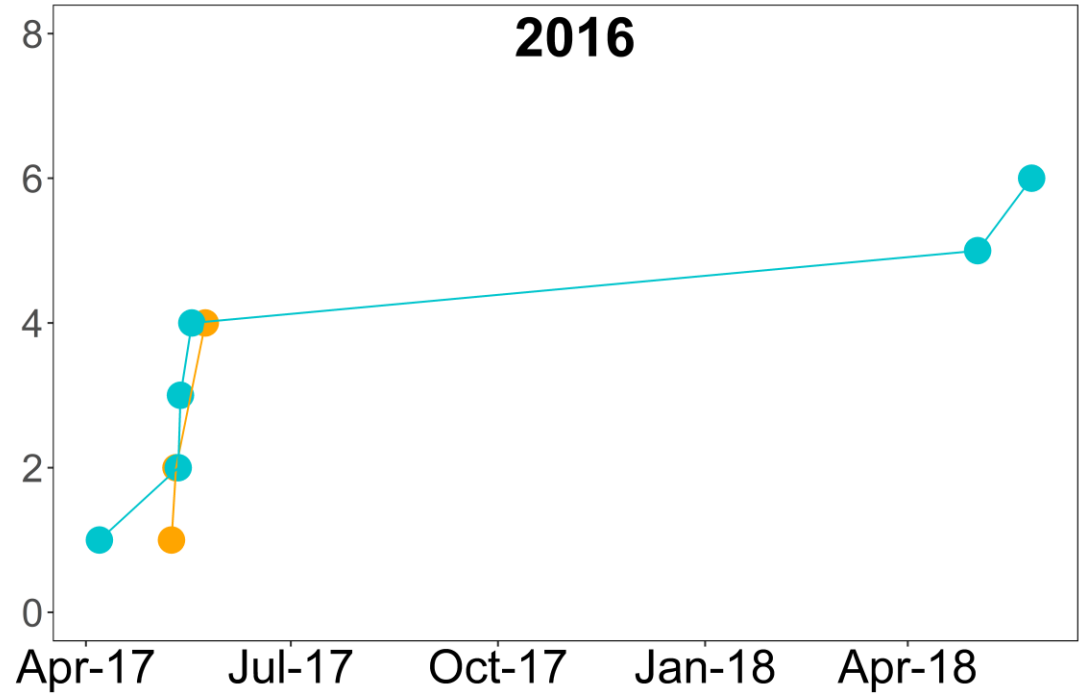


Estuary

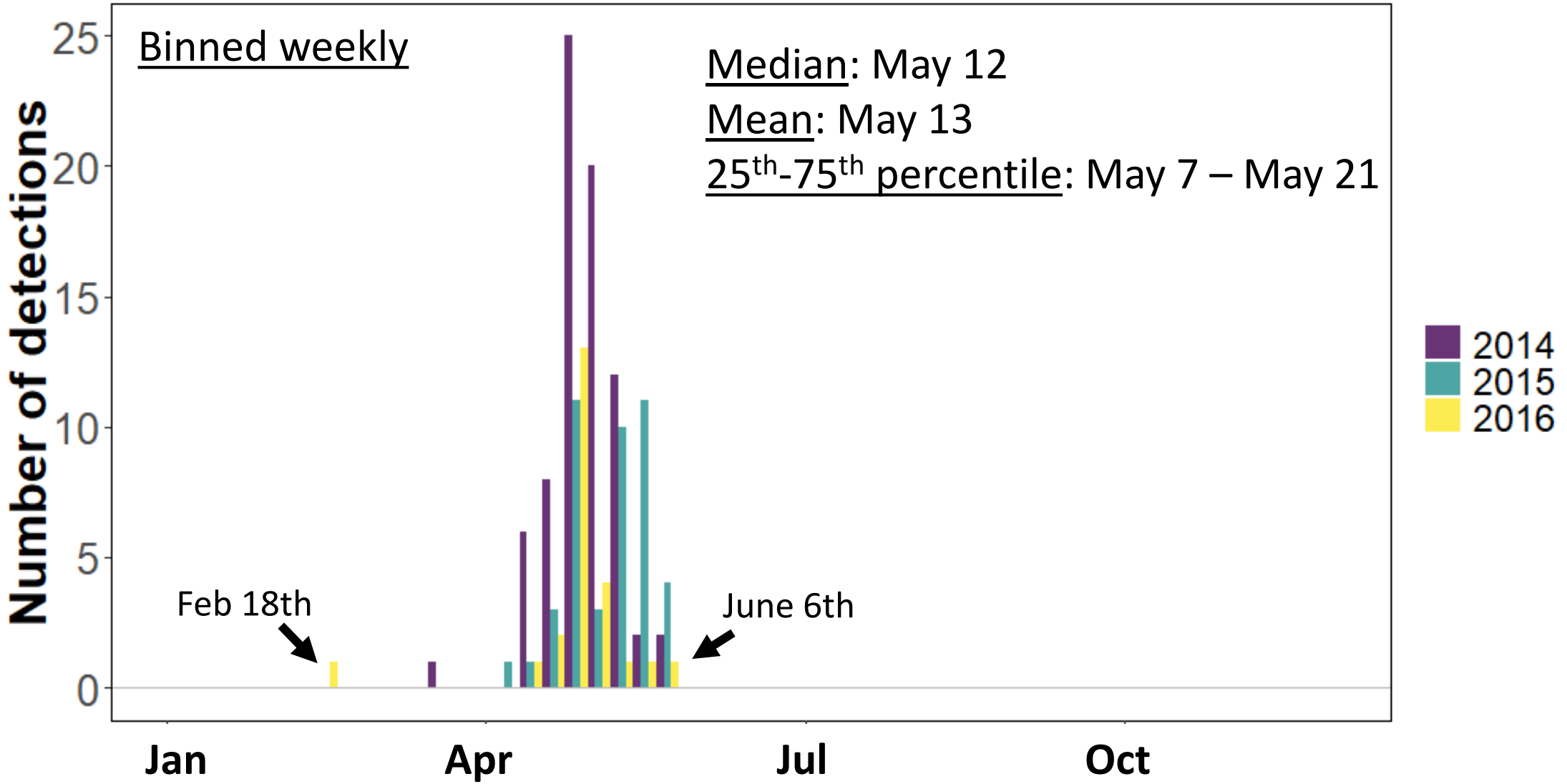

2014
Cumulative detections
0
2
4
6
8
Jul-15
Oct-15
Jan-16
Apr-16


Reservoir
Tailrace


2015
Cumulative detections
0
2
4
6
8
Jul-16
Oct-16
Jan-17
Apr-17

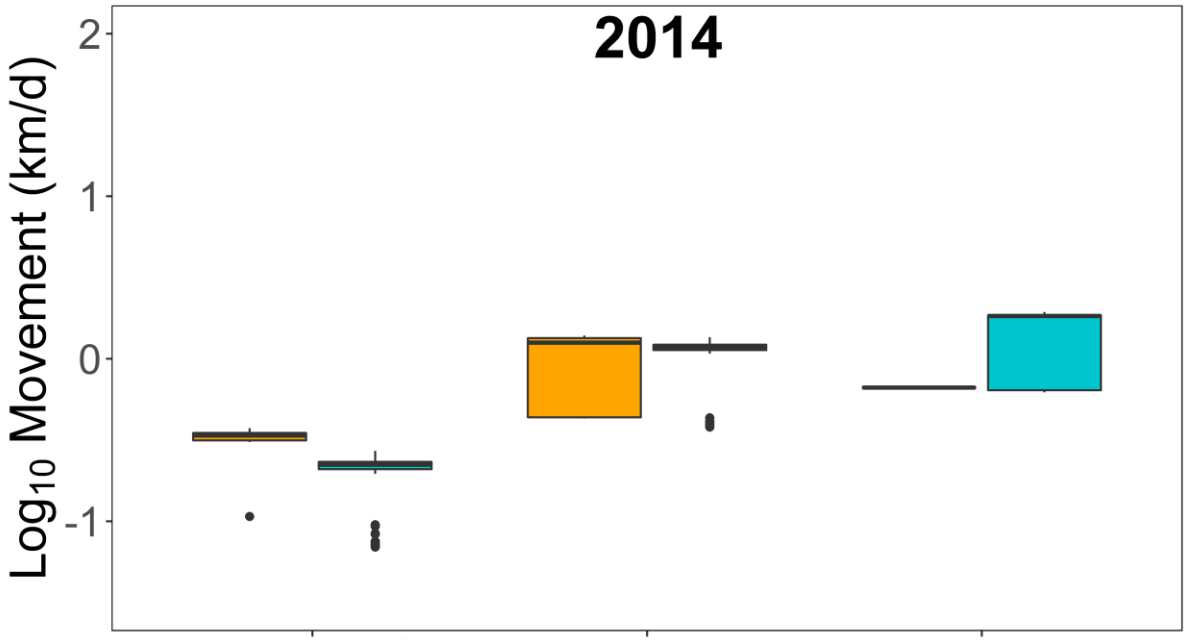

2016
0
2
4
6
8
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18

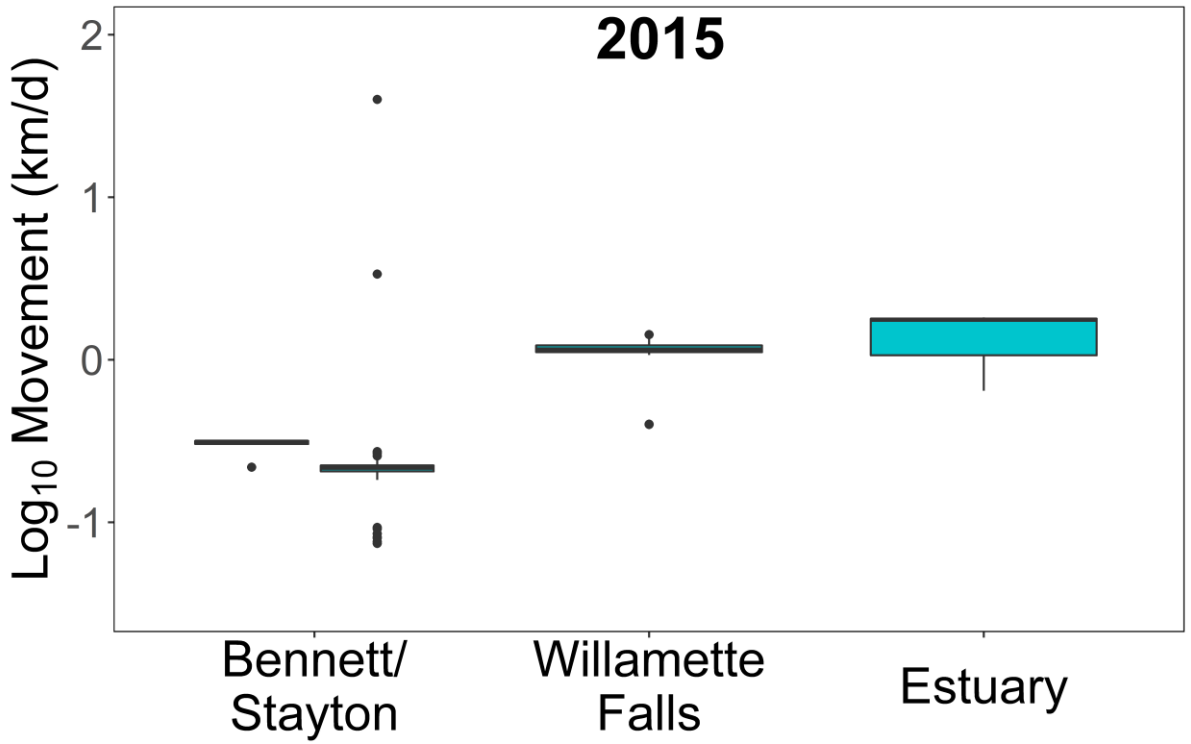
2014-2016 Detections at Willamette Falls

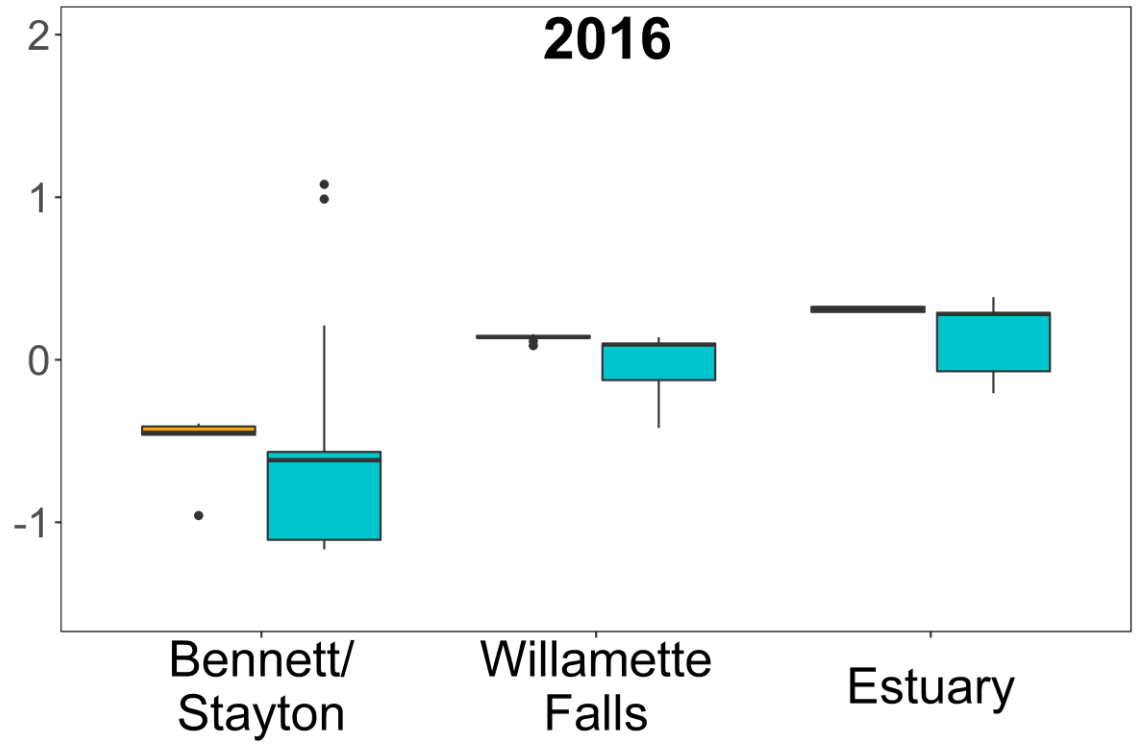


Movement rates

- From release to detection sites
  - Mean = 0.78 km/d
  - Max = 40 km/d





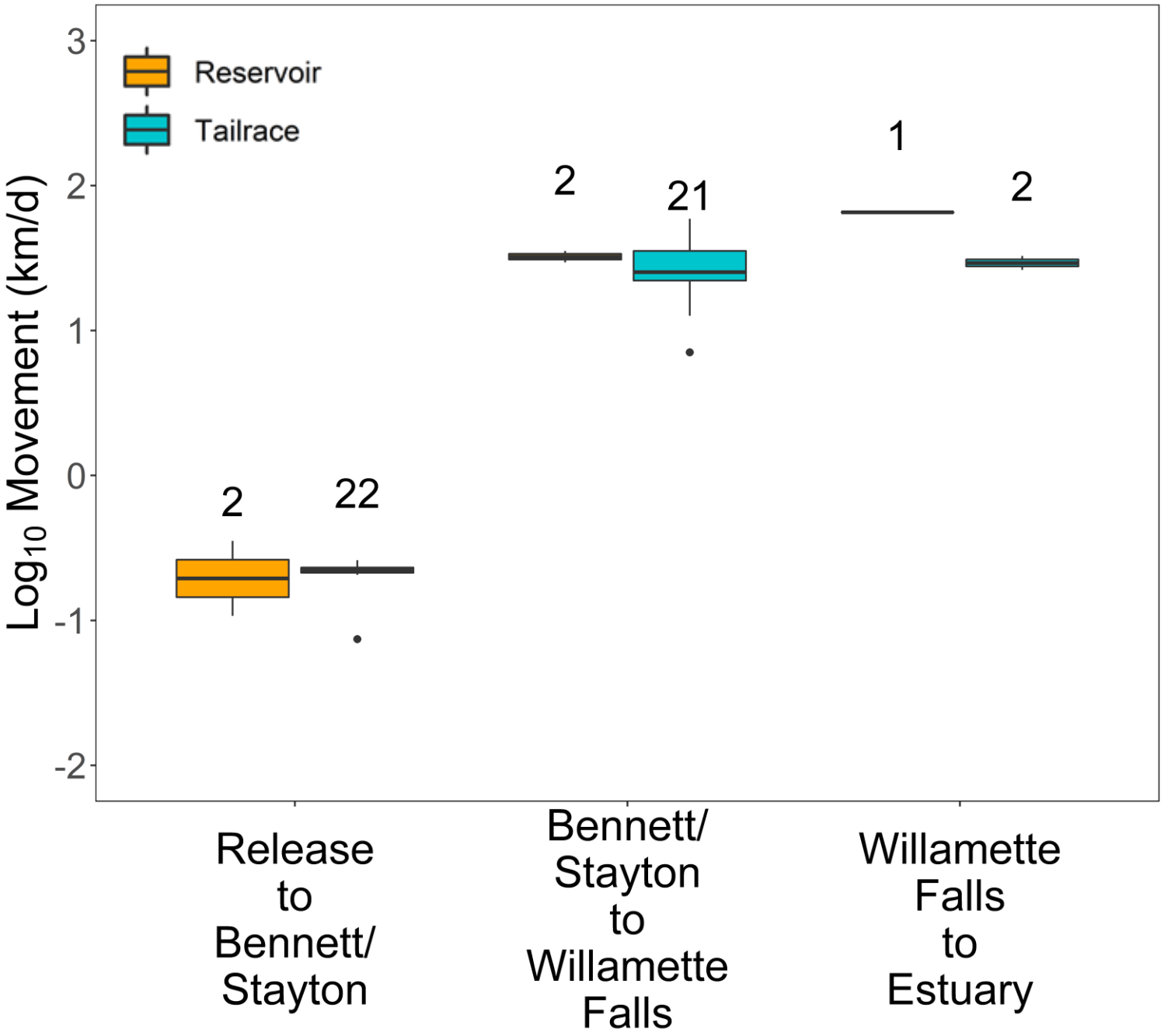


Reservoir

Tailrace

Multiple detections

- Few “reservoir” fish detected at multiple locations
- Comparable in movement rates to “tailrace” fish detected at multiple locations
- Once detected in at Bennett/Stayton, movement rates increase to the falls and estuary



Adult return observations (3 total)

- Two from 2015 release (BY 2014)
  - One from each tailrace and reservoir release
  - Both detected in 2019, at age 5
- One from 2016 release (By2015)
  - Tailrace release detected in 2020 (age 5)

RELEASE YEAR	RETURN SCHEDULE		
	AGE 3	AGE 4	AGE 5
2014	2016	2017	2018
2015	2017	2018	2019
2016	2018	2019	2020

Adult return observations (3 total)

- Period of historically low returns due to poor freshwater and ocean conditions
- Escapement affected by pinniped predation
- Total return to entire basin in 2017-2019 only averaged 1,951/year
- Overall poor basin-wide survival

SUMMARY

- Steelhead released below dams consistently outperformed their counterparts above the dams, despite low detections overall
- Travel time (km/d) to detection sites was comparable between above and below dam release groups across years
- Juveniles spend extensive time rearing in subbasins
- Once detected at an upstream location, movement rates increased to the Falls and estuary, suggesting active migration
  - Majority of detections at Willamette Falls occurred in May
- Adult returns were very low

Management Implications

- Reintroducing steelhead to historic habitat above dams in the North Santiam is unlikely to succeed until passage is improved
- Subbasin habitat important for juvenile steelhead rearing prior to quick outmigration from April-June
- However, juvenile survival may have been poor basin-wide and other ecological factors may have led to low survival and adult returns

http://www.northumpquaretreat.com/

ACKNOWLEDGEMENTS

The Surrogate Project Team:

Rob Chitwood, Olivia Hakanson, Kate Self, Ryan Koch, Michelle Scanlan, Amanda Pollock, Julia Unrein

The Oregon Hatchery Research Center:

Ryan Couture, Joseph O'Neil, Jen Krajcik, Alex Powell, Joyce Mahr

ODFW:

Cameron Sharpe, Luke Whitman, Brian Cannon, Greg Grenbemer, Chris Boyd, Isaac Morris, Bart Debow

Funding: Army Corps of Engineers

Number other OSU and ODFW staff and students!

Biomark
SPECIALISTS IN IDENTIFICATION SOLUTIONS

Oregon State University

OREGON HATCHERY RESEARCH CENTER

OREGON Fish & Wildlife

US Army Corps of Engineers.

USGS science for a changing world

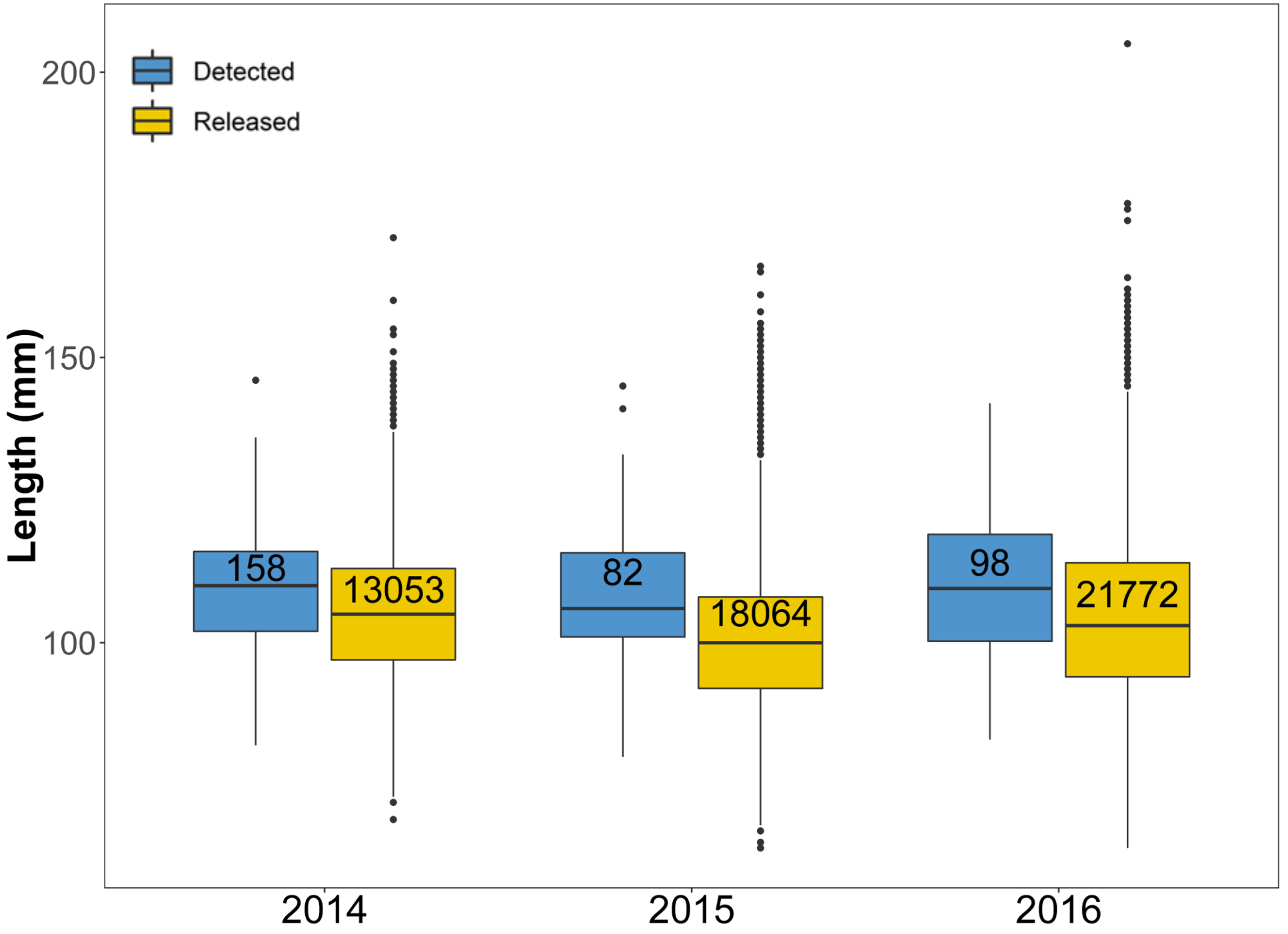
OREGON COOPERATIVE FISHERY RESEARCH UNIT Semper Catostomus

Thank You

Questions?

Lengths

Detected fish were larger compared to all fish released



Movement rates (raw)

- From release to detection sites
  - Mean = 0.78 km/d
  - Max = 40 km/d