

An aerial photograph of a river winding through a dense forest. The river is the central focus, flowing from the upper left towards the lower right. The surrounding forest is lush and green, with some trees showing early autumn colors. The lighting is bright, suggesting a sunny day.

Lower Cowlitz River Spawner Abundance Estimate Methods

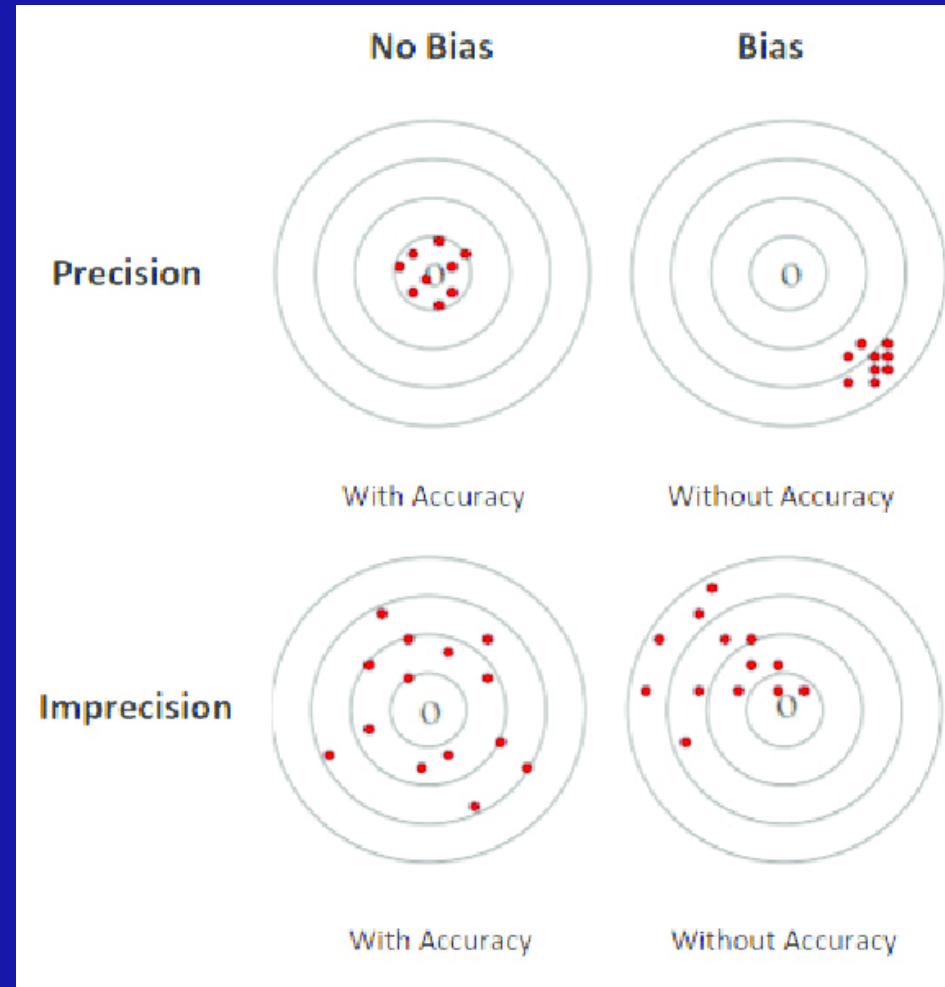
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Washington Department of Fish and Wildlife
Cowlitz River Annual Program Review
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Overview

- Purpose: To estimate the number of natural and hatchery spawners in the natural environment
- Coho and steelhead are monitored in tributary habitat
- Chinook are monitored in the mainstem Cowlitz River habitat

Monitoring Objectives

- Abundance of spawners
 - Unbiased, known precision*
- Spawner composition by
 - Origin (Natural, Hatchery)
 - Also program, raceway, etc.
 - Age
- Spatial distribution of spawning



* Following NOAA guidelines for monitoring of ESA-listed salmon and steelhead populations (Crawford & Rumsey 2011)

Coho and Steelhead Methods



Tributary Monitoring Overview

- Tributary Weirs
 - Mark-Recapture
 - Females per Redd
 - Control pHOS
- Spawner Surveys
 - Census and GRTS surveys
 - Redd Counts
 - Tag recovery
- Trends in Abundance Estimates

Tributary Weir



Methods: Tributary Weirs

- Daily operation, year-round
- Natural coho and steelhead
 - Enumerate
 - Sampled for biological information (e.g., origin, sex, length, age)
 - Tagged, marked, and released upstream to spawn
 - Weir wash-ups and kelts are checked for tags
- Hatchery salmon and steelhead are removed from the stream

Methods: Spawner surveys

- October - January for Coho
- February - May for Steelhead
- Foot and raft
- Redds are flagged and georeferenced
- Live fish are counted
 - Tag or no tag, ad-clip, or unmarked
- Carcasses are biologically sampled
 - Tag vs. no tag
 - Sex, length, scale, age

Spawner Surveys:

Survey Types Differ in Spatial and Temporal Coverage

Type	Spatial Coverage	Survey Frequency	Locations
Census	All area is surveyed	Bi-weekly (steelhead) Weekly (coho)	Above weirs, outside weirs in high-density spawning areas (including Blue Creek)
Generalized Random Tessellation Stratified (GRTS)	Subset of areas are surveyed (random, 1-mile)	Bi-weekly (steelhead) Weekly (coho)	Outside weirs
Supplemental	All area is surveyed	Once (peak spawn timing)	Above weirs

Spawner Surveys: Examples of Steelhead Redds



Methods: Data Analysis

Mark-Recapture
above tributary weirs

+

Redd expansion
outside of tributary
weirs

=

Total Spawners

Methods: Data Analysis

**Mark-Recapture
above tributary weirs**

+

Redd expansion
outside of tributary
weirs

=

Total Spawners

$$N = n1 * n2/m2$$

$n1$ = tagged and released
above the weir

$n2$ = tagged and untagged
observed above the weir

$m2$ = tagged observed above
the weir

N = abundance

Methods: Data Analysis (2)

Mark-Recapture
above tributary weirs

+

**Redd expansion
outside of tributary
weirs**

=

Total Spawners

$$R * RpF / pF = N$$

Redds (R) = observed +
estimated

Redds per female (RpF) =
tributary mark-recapture and
redd counts

Proportion female (pF) = arrivals
at tributary weirs

N = abundance

Methods: Data Analysis (3)

Mark-Recapture
above tributary weirs

+

Redd expansion
outside of tributary
weirs

=

Total Spawners

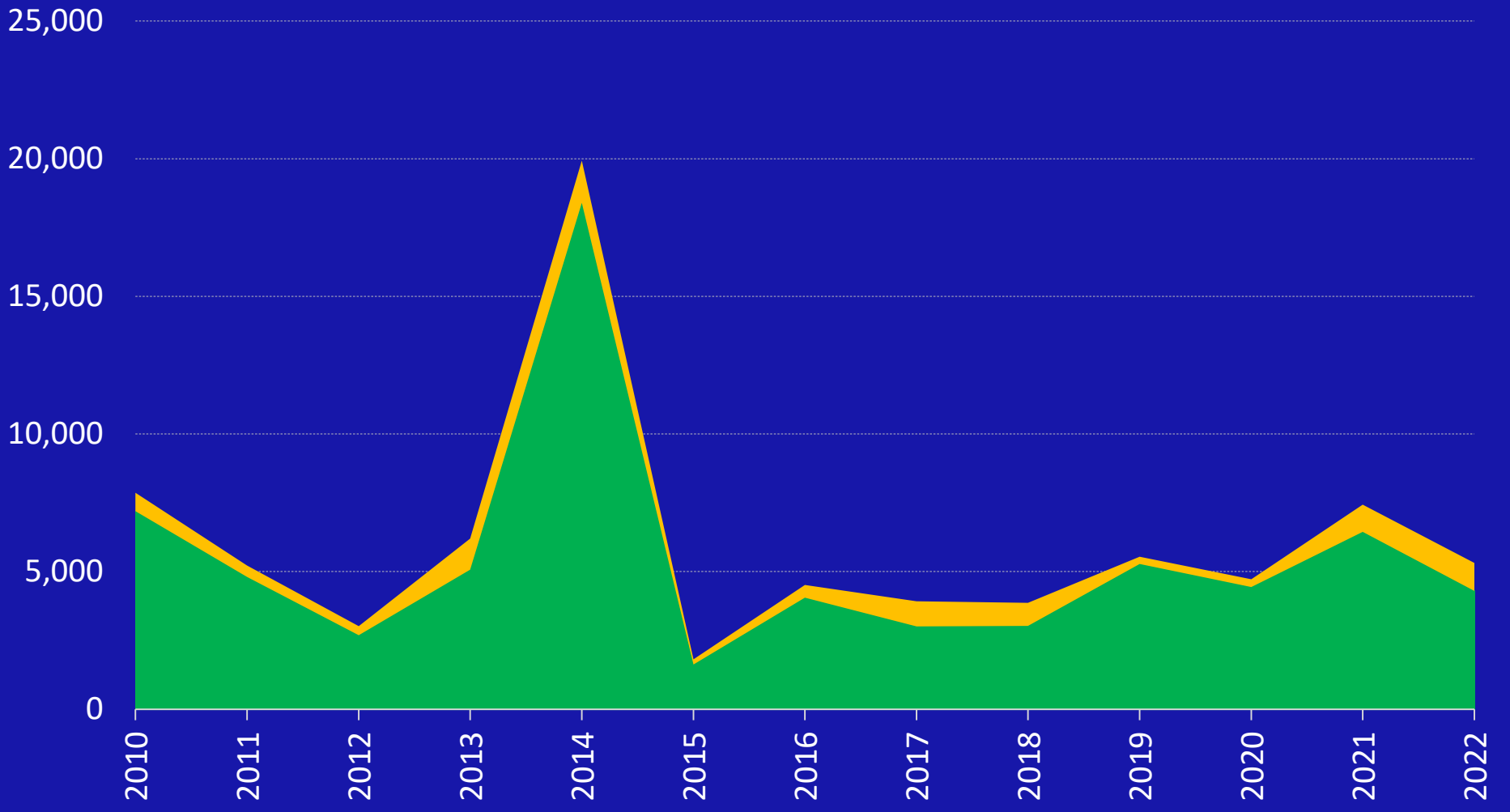
$$N = NOR + HOR$$

- Above tributary weirs
- Outside tributary weirs
- Outside tributary weirs
(Blue/Mill Creek)

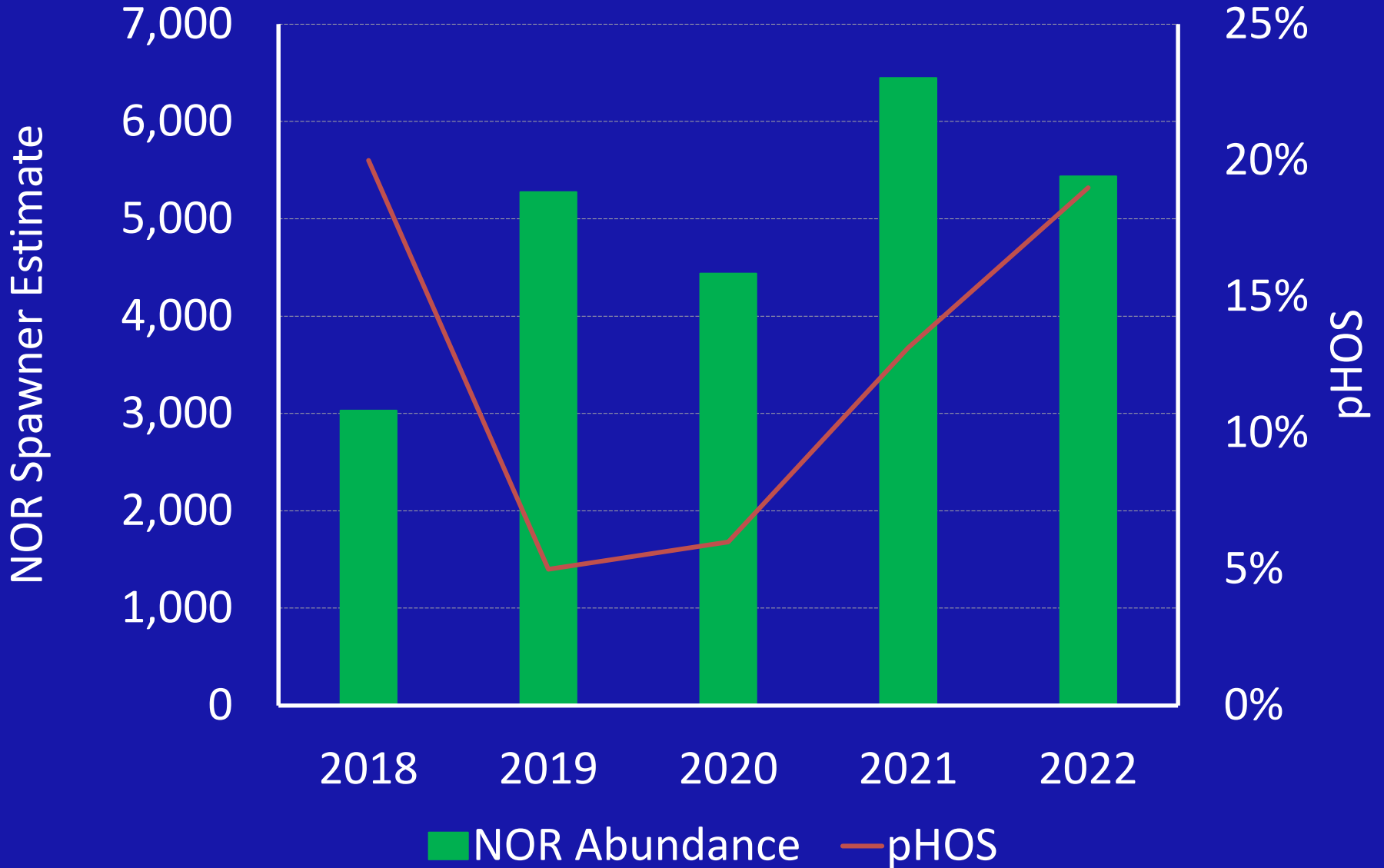


Lower Cowlitz Tributary Coho

Lower Cowlitz Spawners NOR Lower Cowlitz Spawners HOR



Lower Cowlitz Tributary Coho



Lower Cowlitz Tributary Coho

Estimate

- Lower Cowlitz Separator HOR
- Lower Cowlitz Separator NOR
- Lower Cowlitz Harvest HOR
- Lower Cowlitz Spawners HOR
- Lower Cowlitz Spawners NOR

200,000

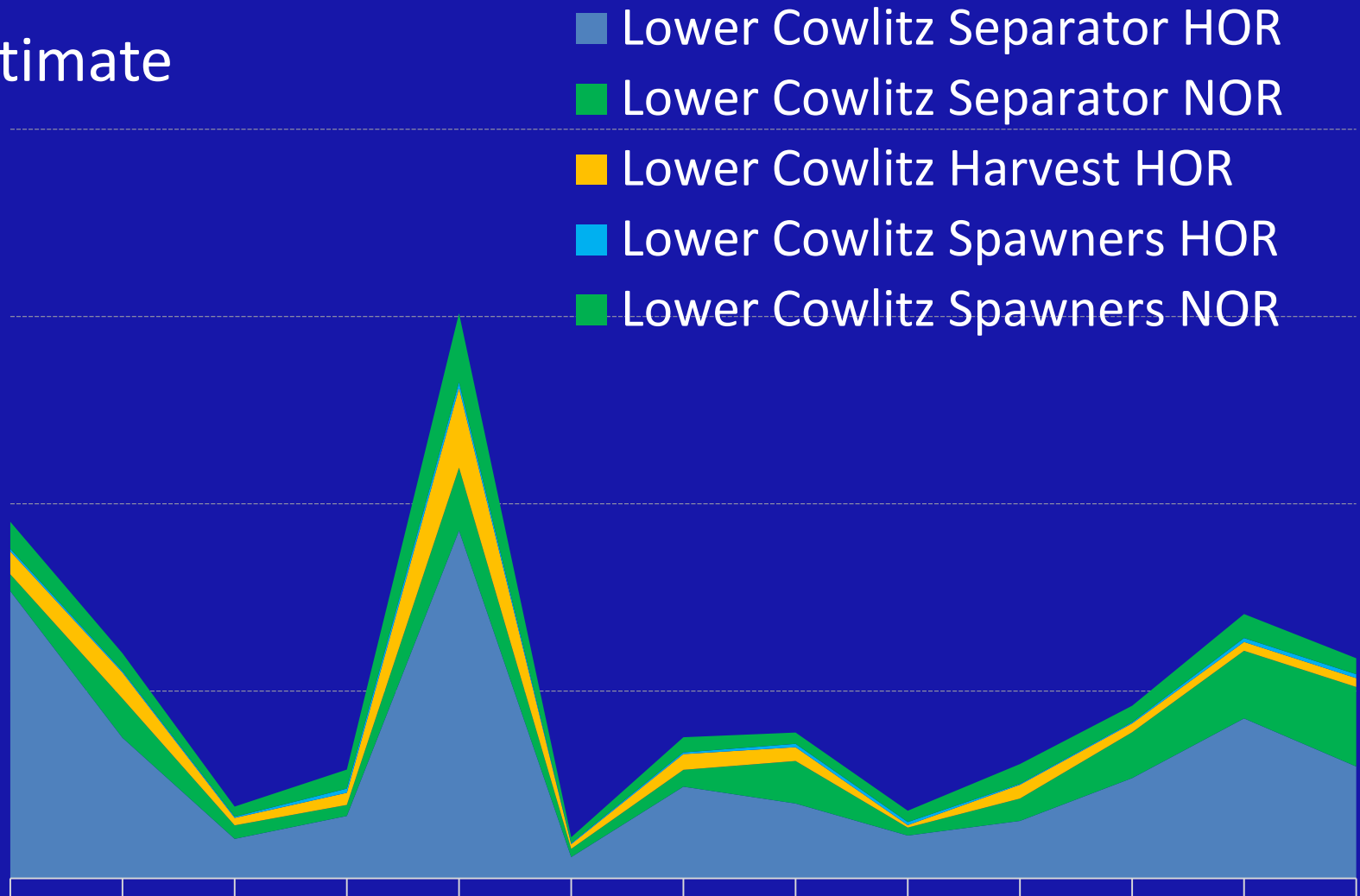
150,000

100,000

50,000

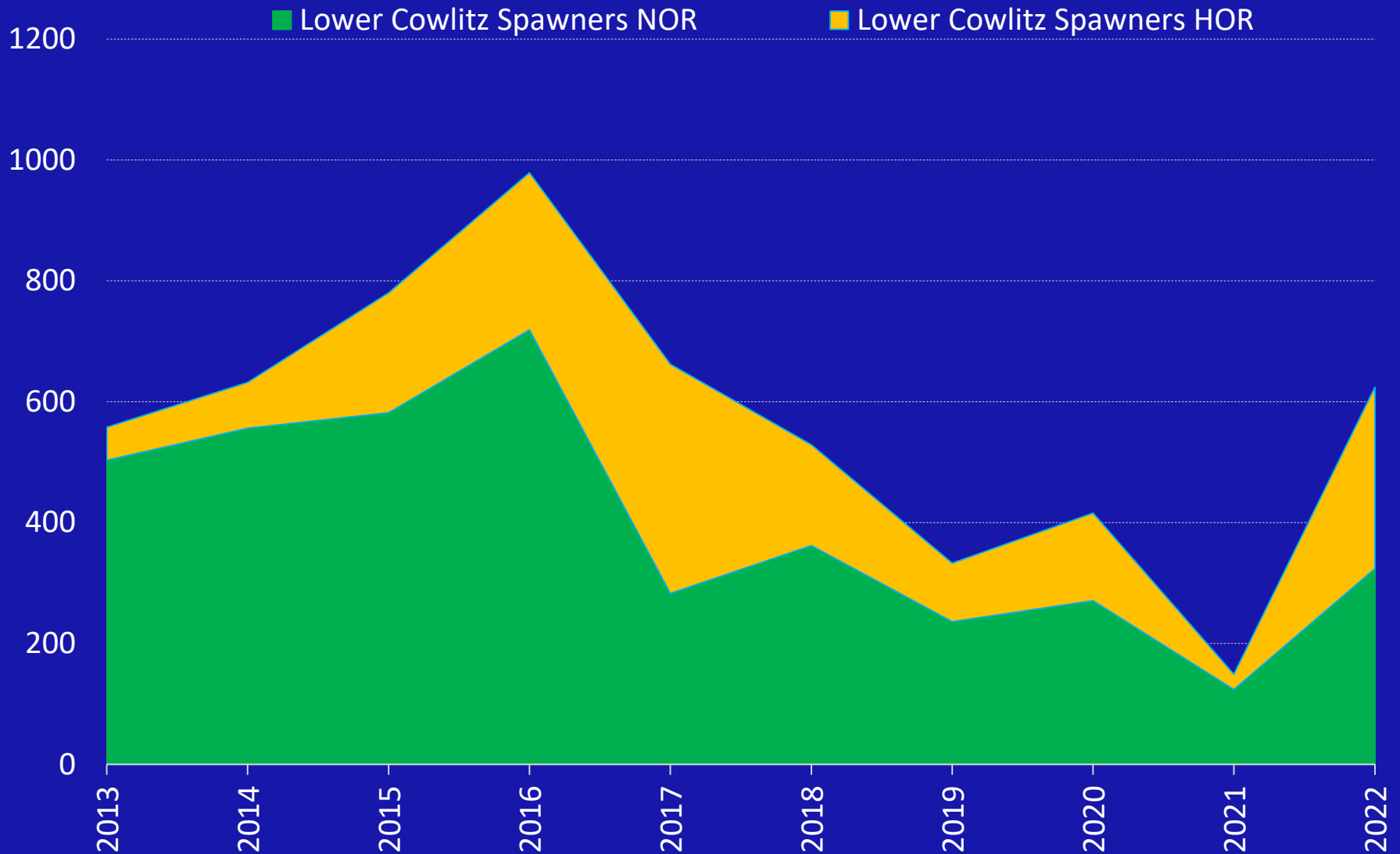
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2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022

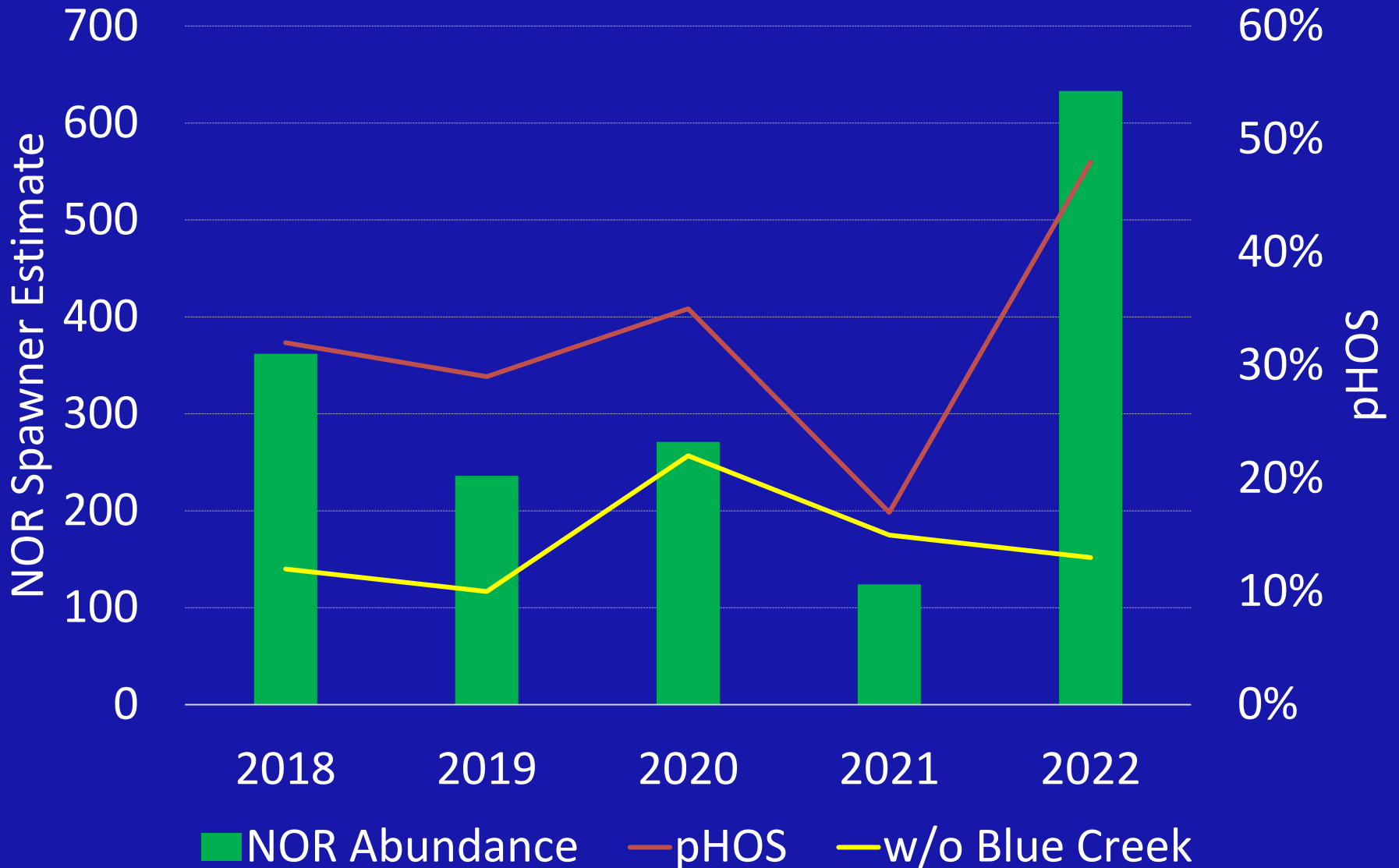




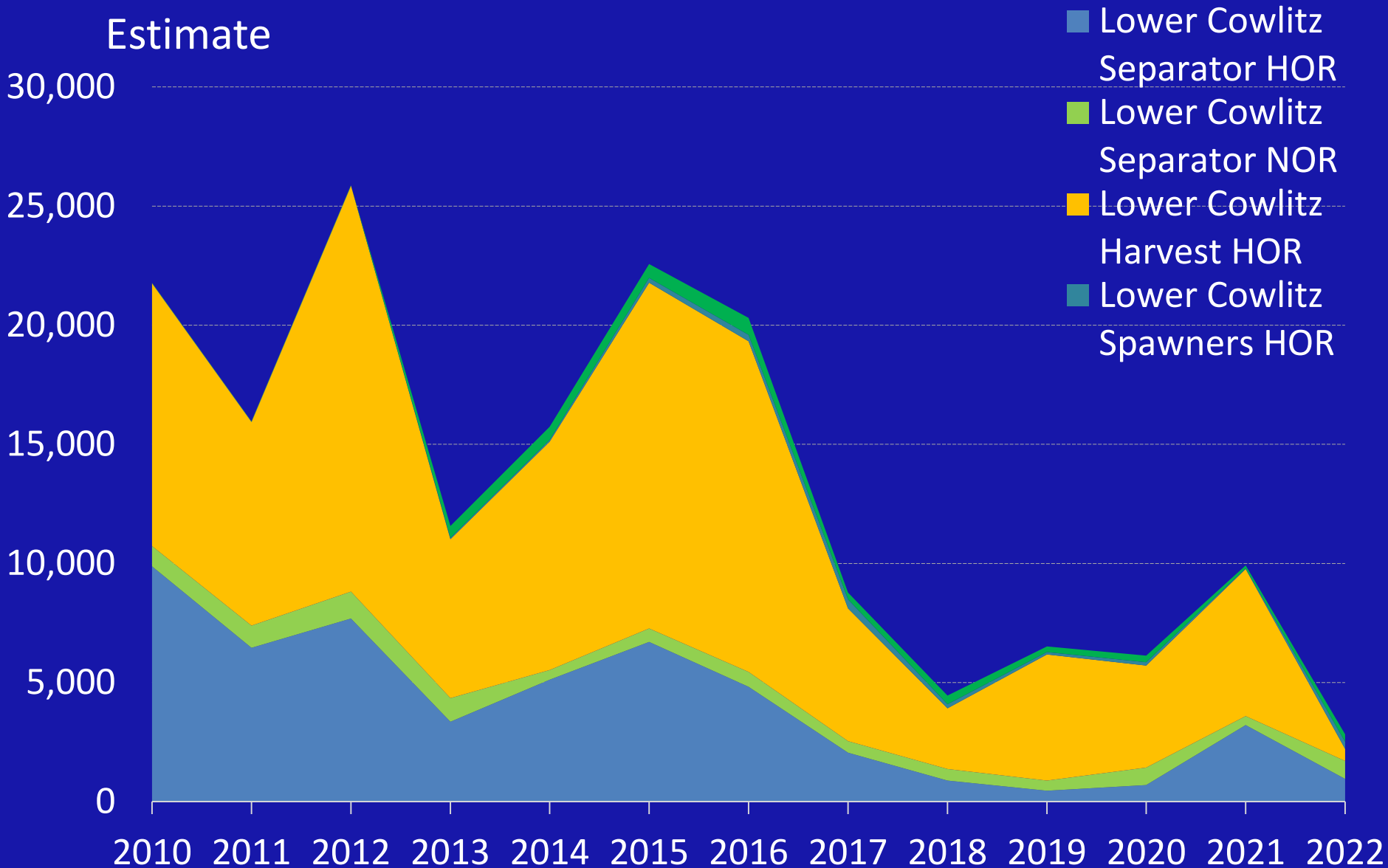
Lower Cowlitz Tributary Steelhead



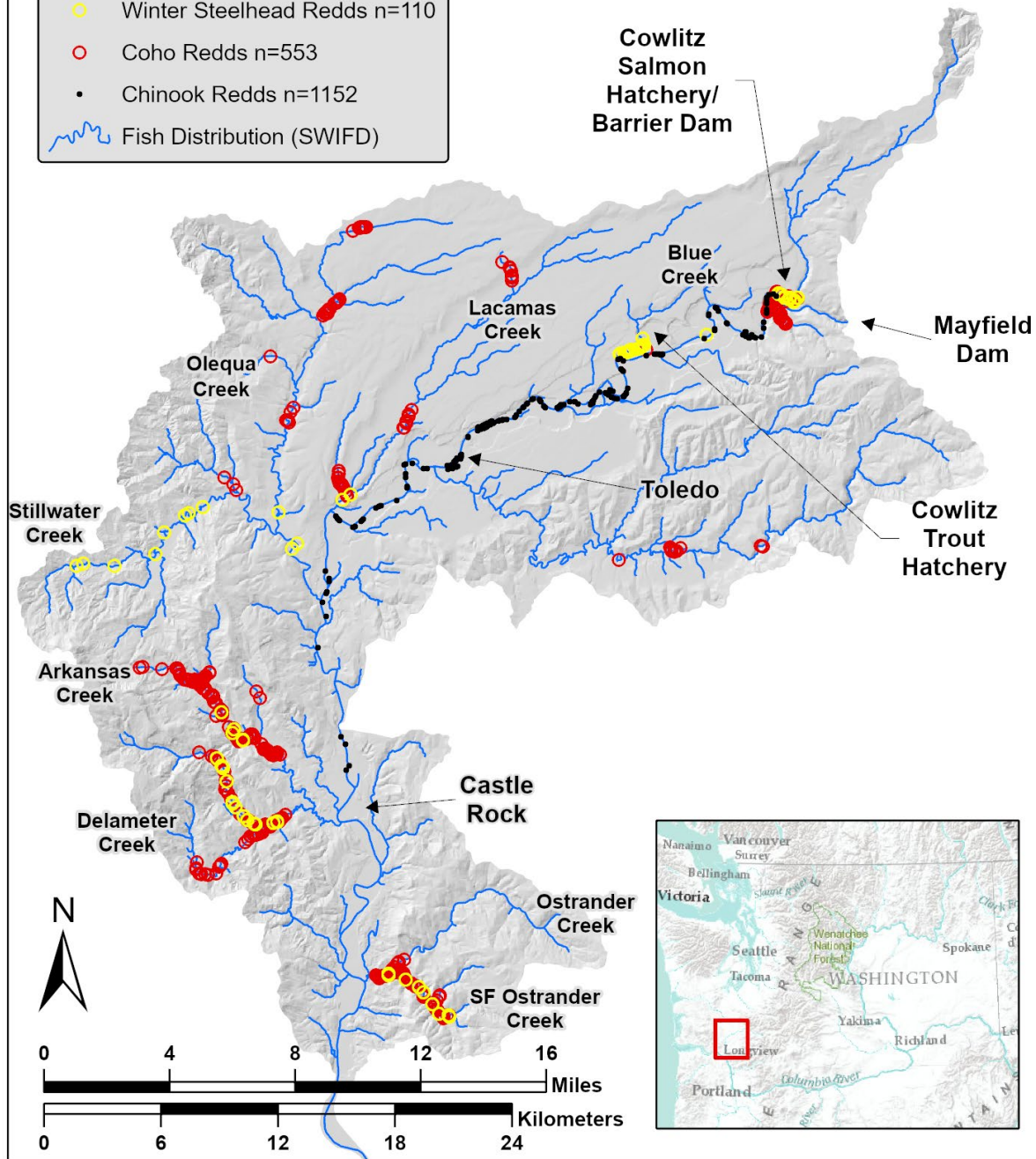
Lower Cowlitz Tributary Steelhead



Lower Cowlitz Tributary Steelhead



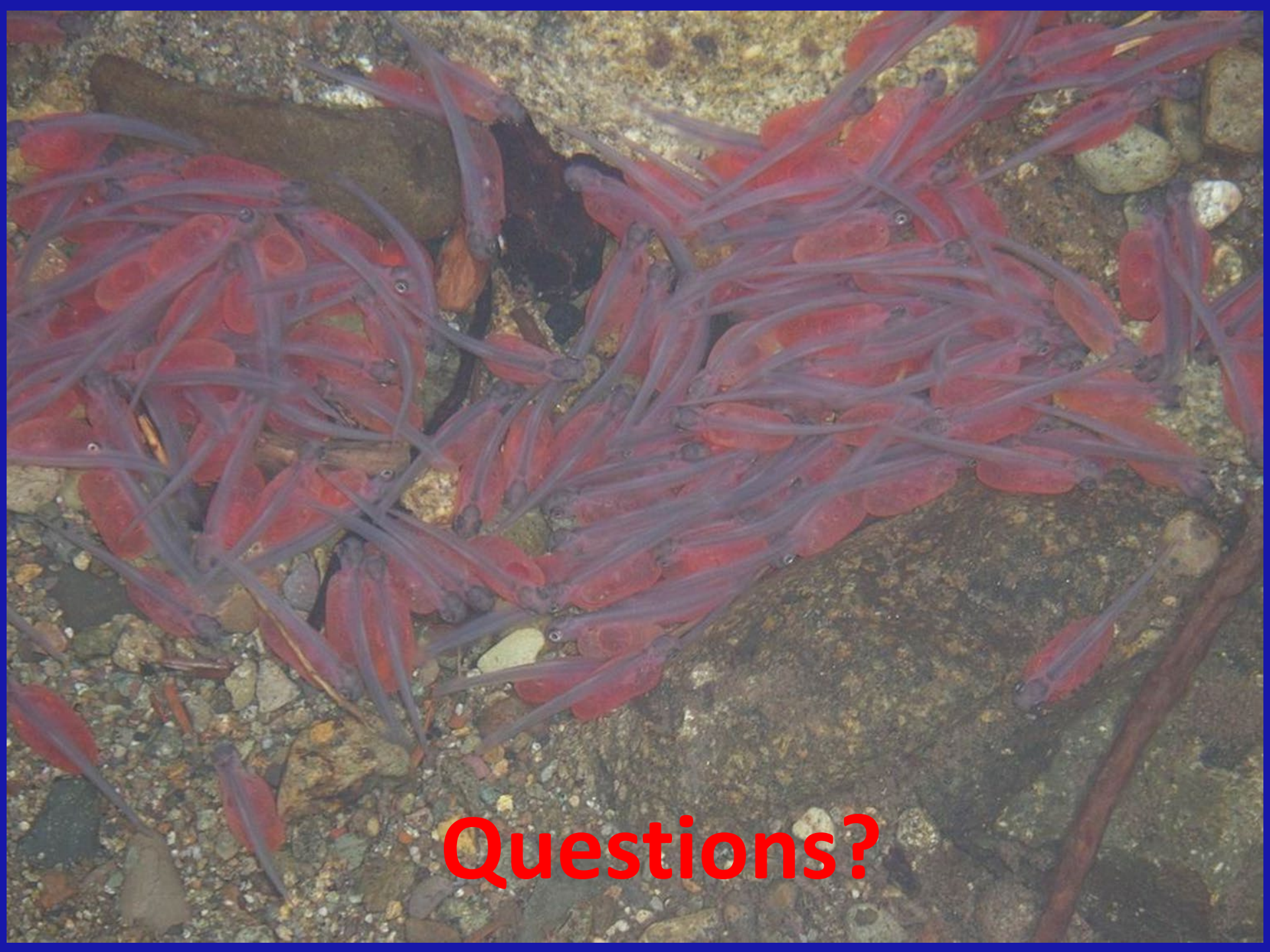
- Winter Steelhead Redds n=110
- Coho Redds n=553
- Chinook Redds n=1152
- Fish Distribution (SWIFD)



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Questions?