

NATIVE SPRING CHINOOK AND WINTER STEELHEAD IN THE UPPER WILLAMETTE RIVER BASIN

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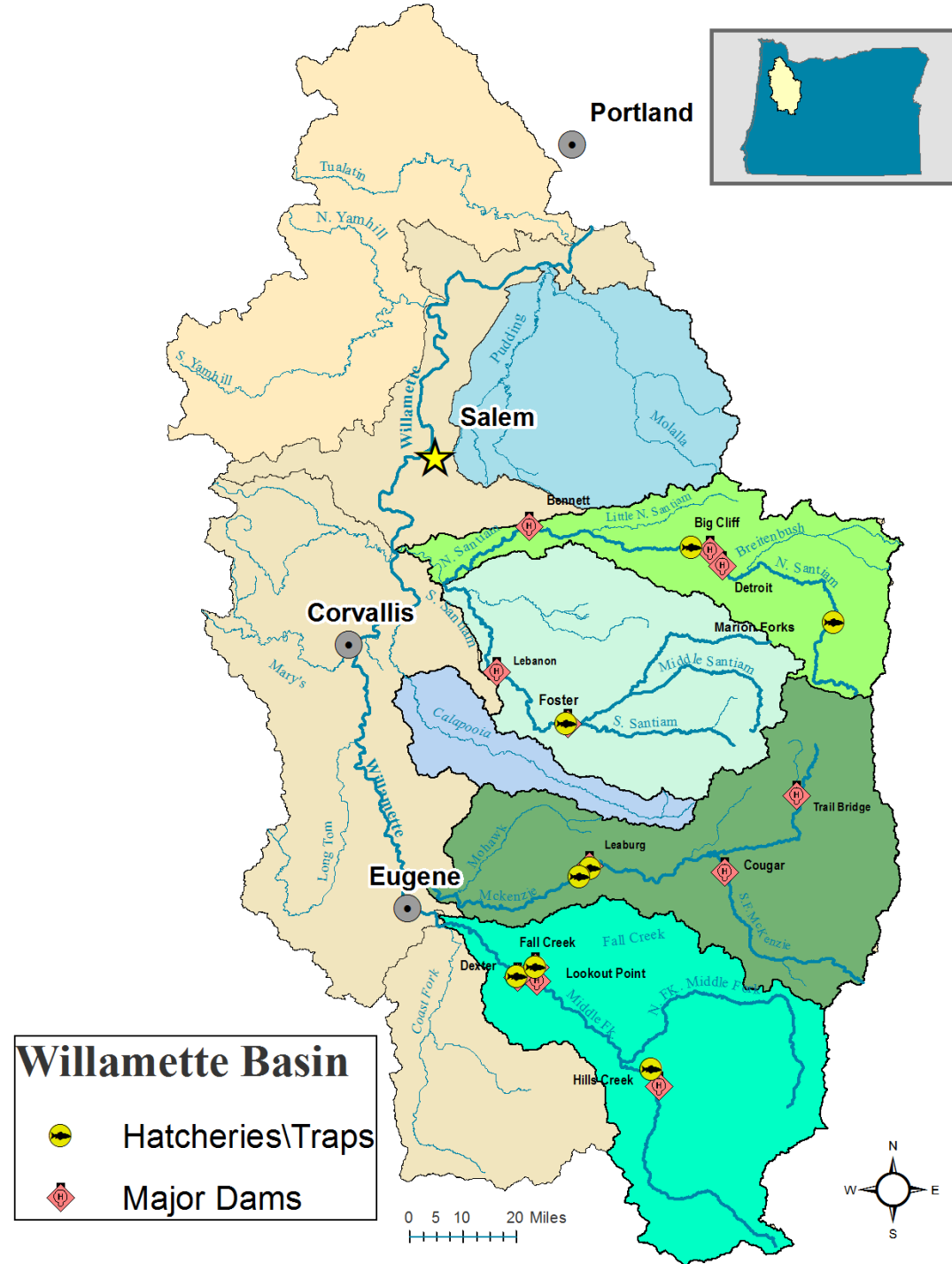


**Corvallis Research Lab
Oregon Department of Fish and Wildlife**

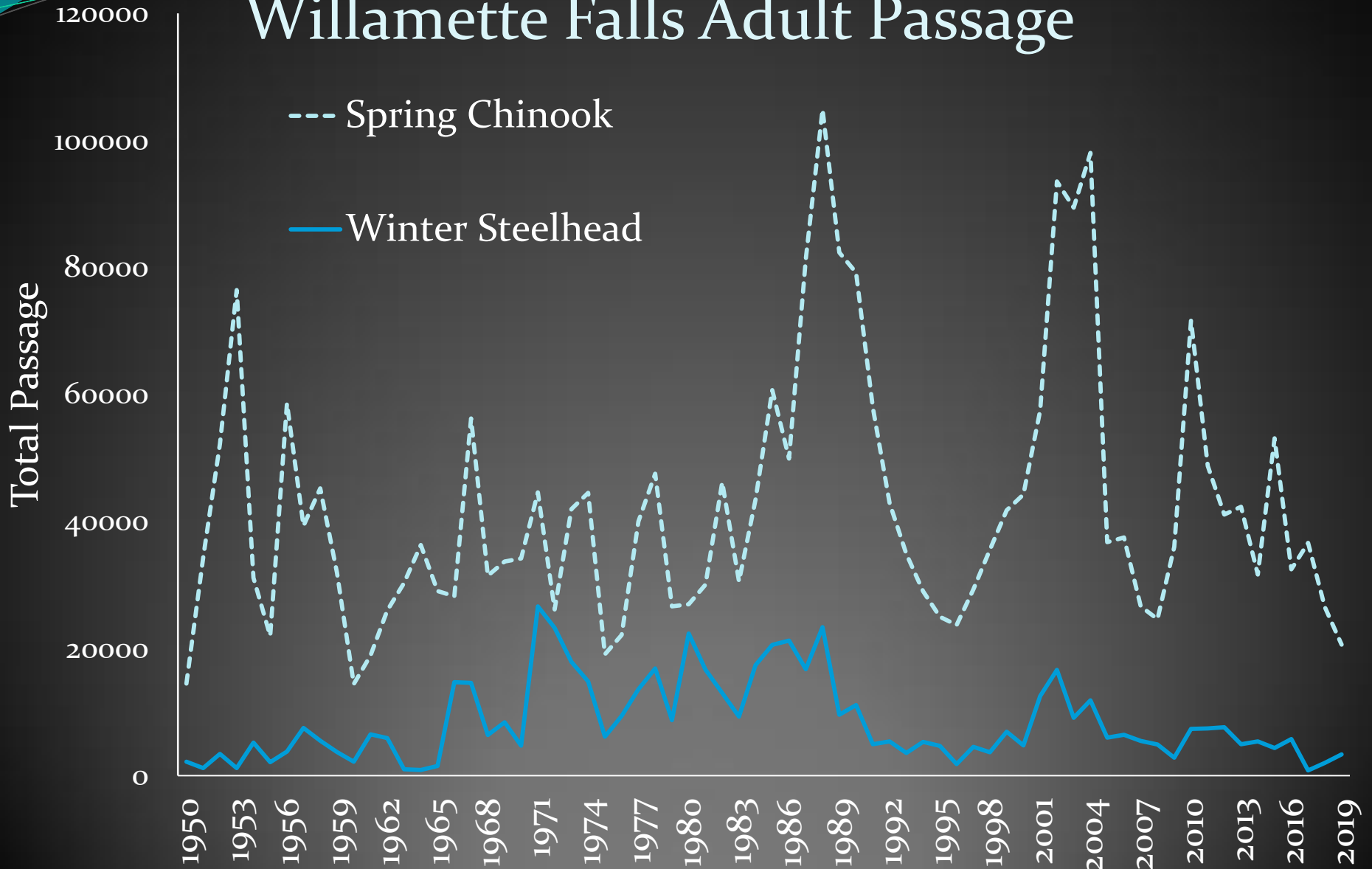
**Funded by the U.S. Fish & Wildlife Service, Sport Fish Restoration
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Upper Willamette Basin

- Spring Chinook and winter steelhead native upstream of Willamette Falls
- Primarily in large, eastside tributaries
- Listed under the ESA as threatened in 1999
- Coho, fall Chinook, summer steelhead introduced
- Large hatchery program for spring Chinook salmon
- Flood control dams on major spawning tributaries
- Most populous basin in Oregon



Willamette Falls Adult Passage



Current status

Spring Chinook



Winter Steelhead



Extinction Risk

Very High

High

Moderate

Low

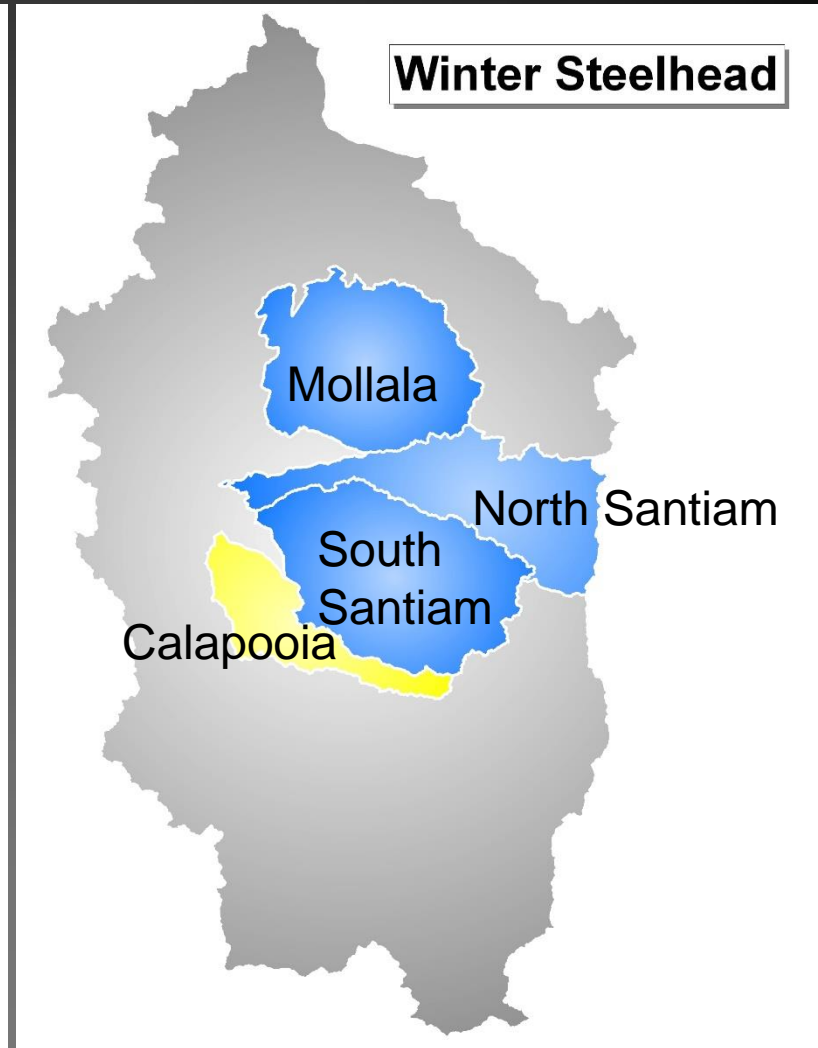
Very Low

Desired status

Spring Chinook



Winter Steelhead



Extinction Risk

Very High

High

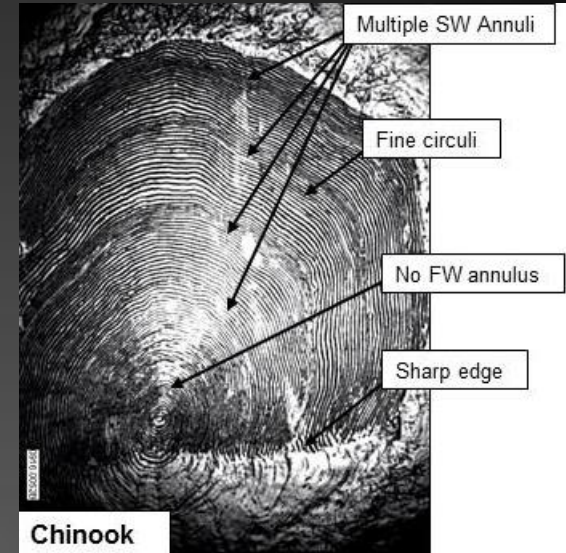
Moderate

Low

Very Low

Research and Monitoring Spring Chinook

- Spawning Surveys
 - Redd Counts
 - Carcass sampling
 - Analyze scales and otoliths
- Video Monitoring
 - Willamette Falls, upper and lower Bennett, Leaburg
- Juvenile PIT tagging studies
 - Growth and migration timing
- Seining surveys
 - Abundance
 - Distribution



Research and Monitoring Winter Steelhead

- Spawning Surveys

- Redd counts
- Index reaches



- Video Monitoring

- Willamette Falls, upper and lower Bennett



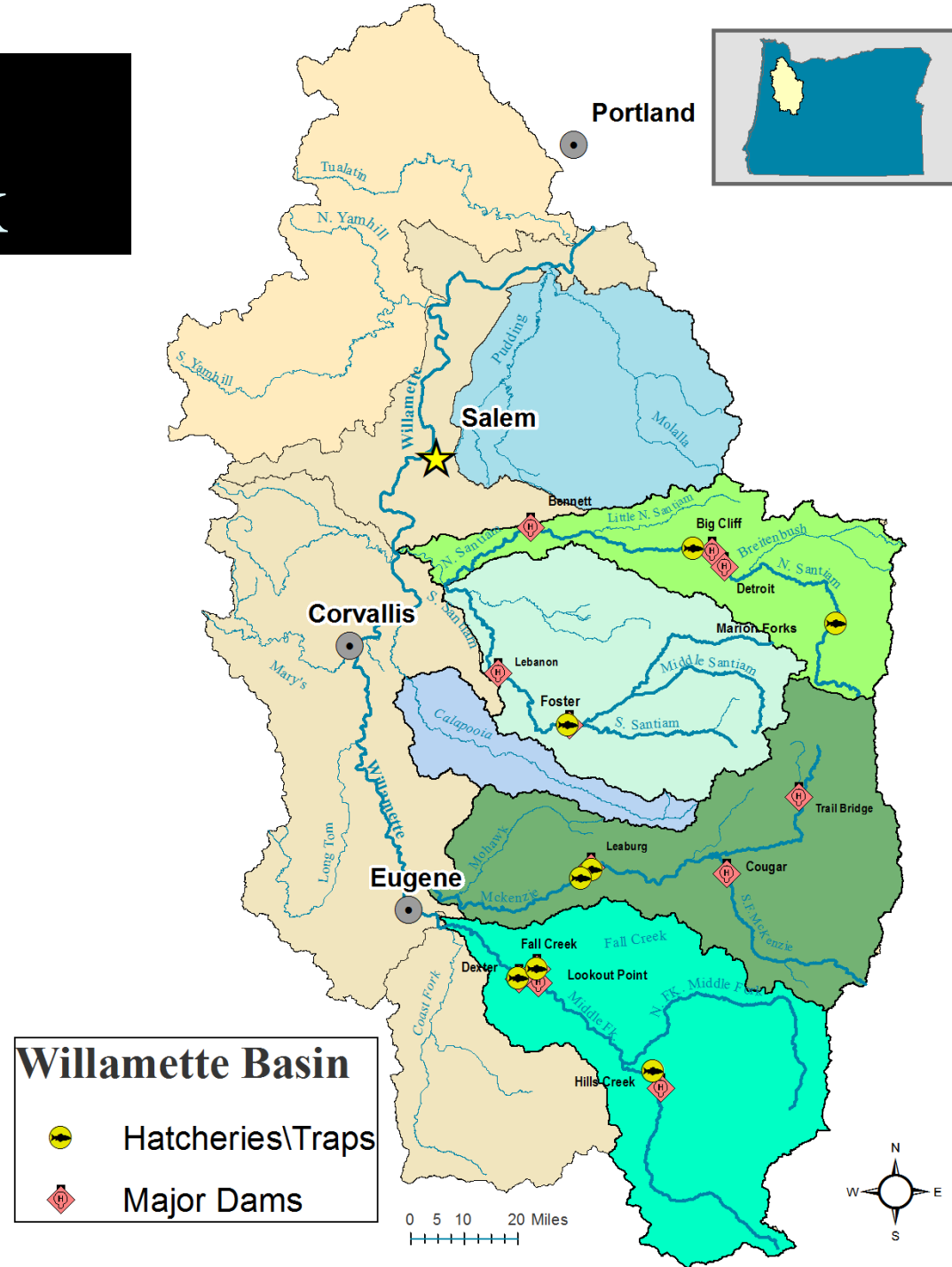
- Preliminary Juvenile PIT tagging studies

- North and South Santiam

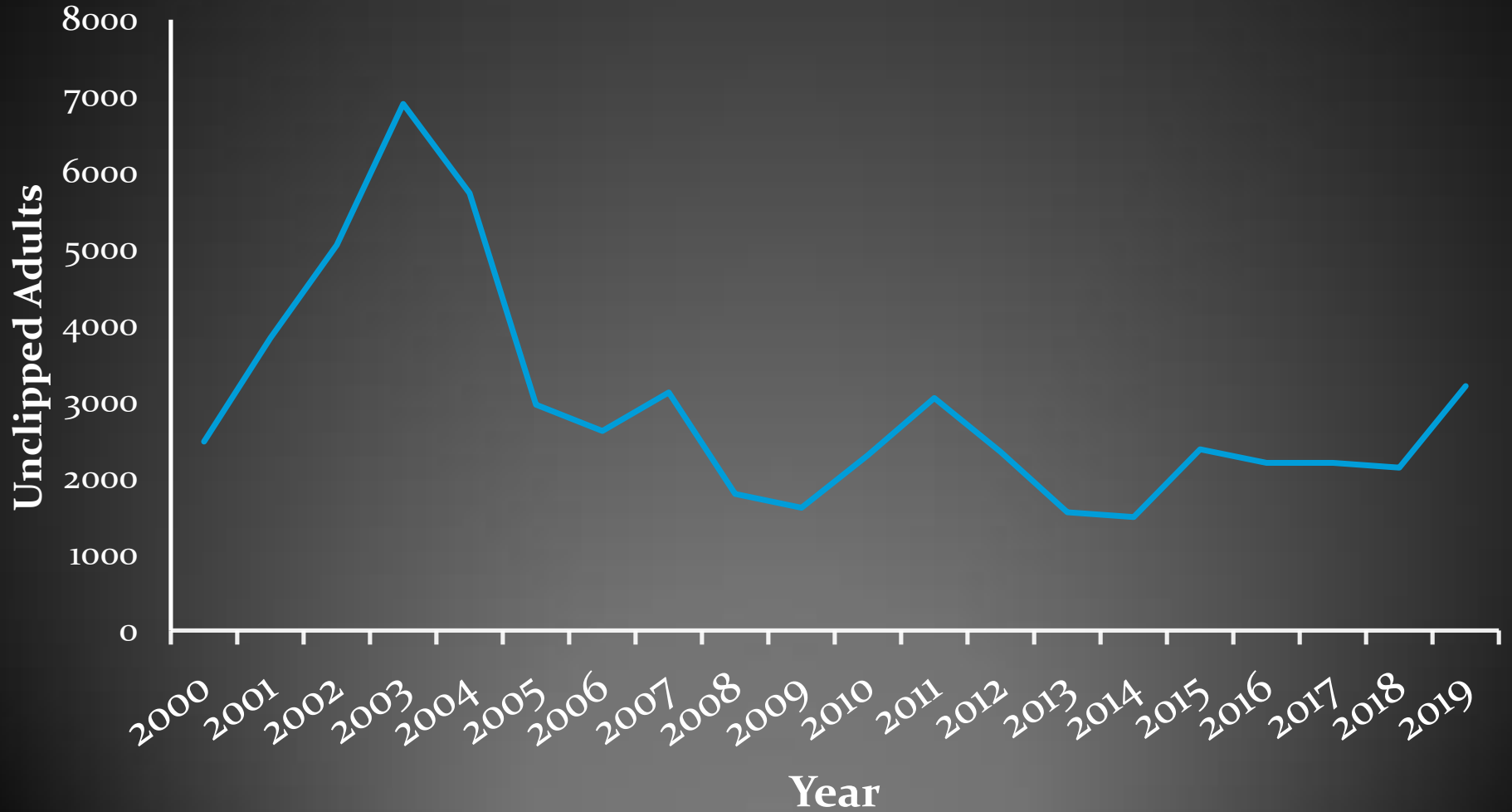


Adult Spring Chinook

- Molalla, North Santiam, South Santiam, Calapooia, McKenzie, and Middle Fork
- Adults migrate April – June
- Hold in tributaries through the summer
- Spawning in September
- Most return at age-4 or age-5

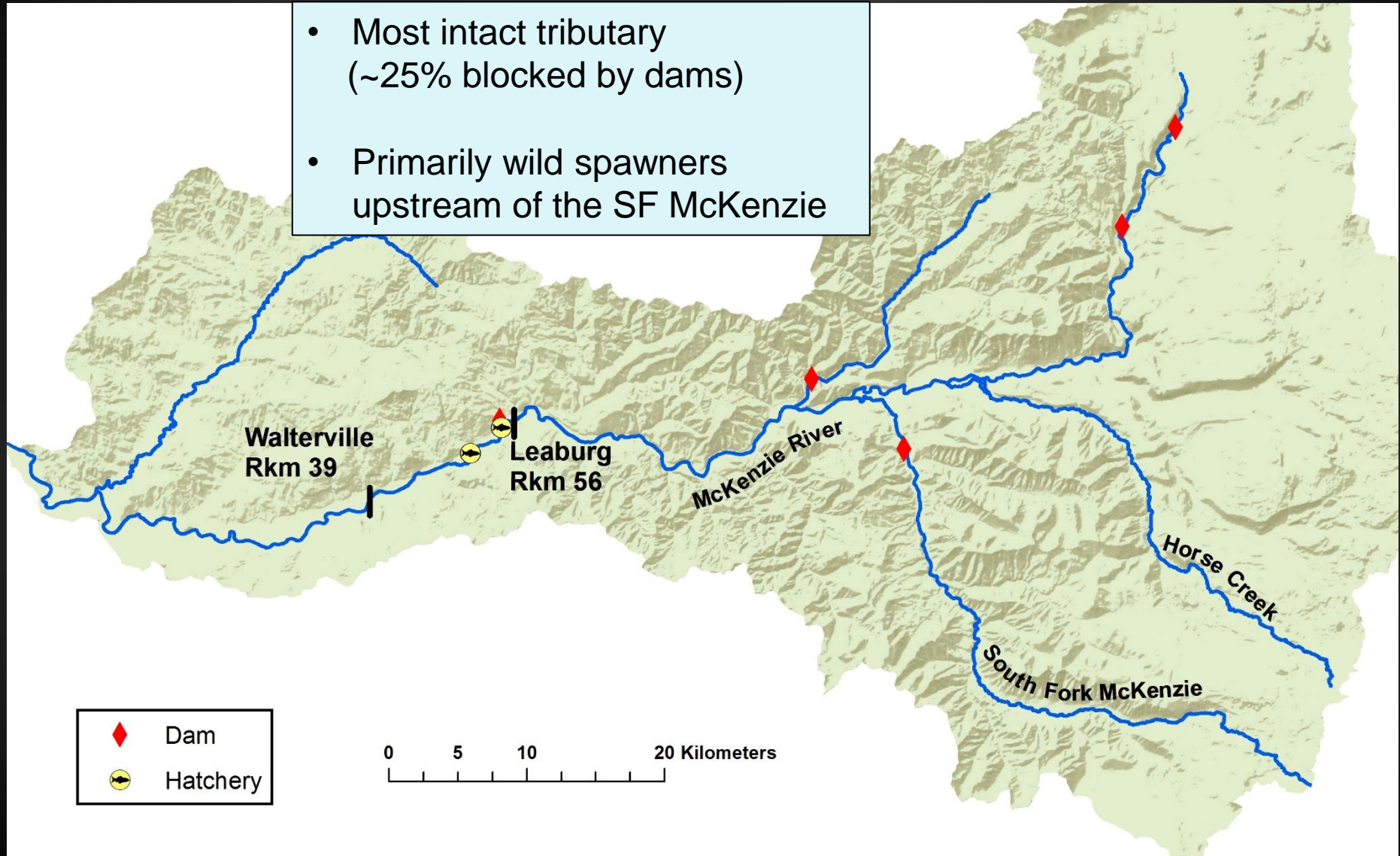


McKenzie Wild Spring Chinook



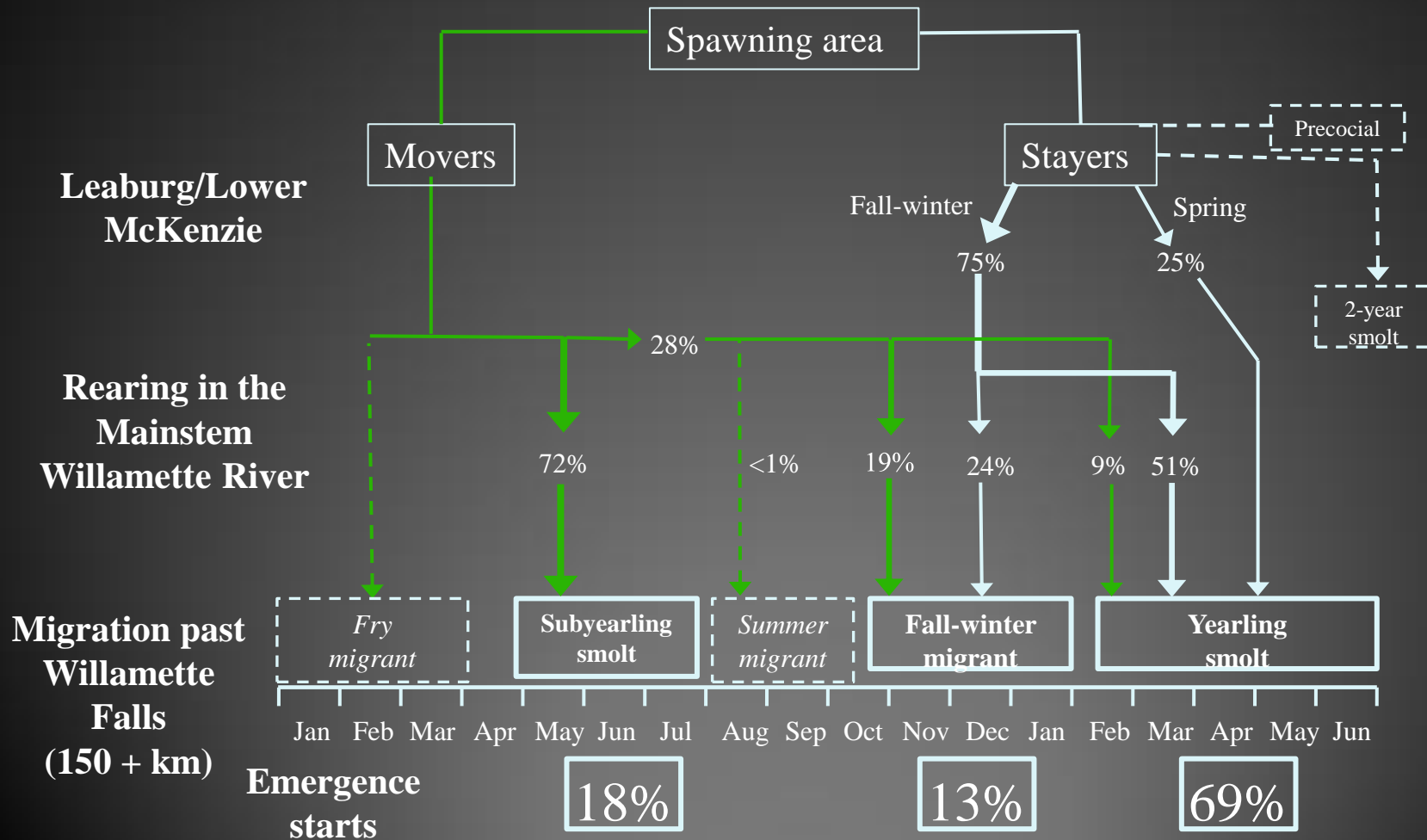
McKenzie River

- Most intact tributary (~25% blocked by dams)
- Primarily wild spawners upstream of the SF McKenzie



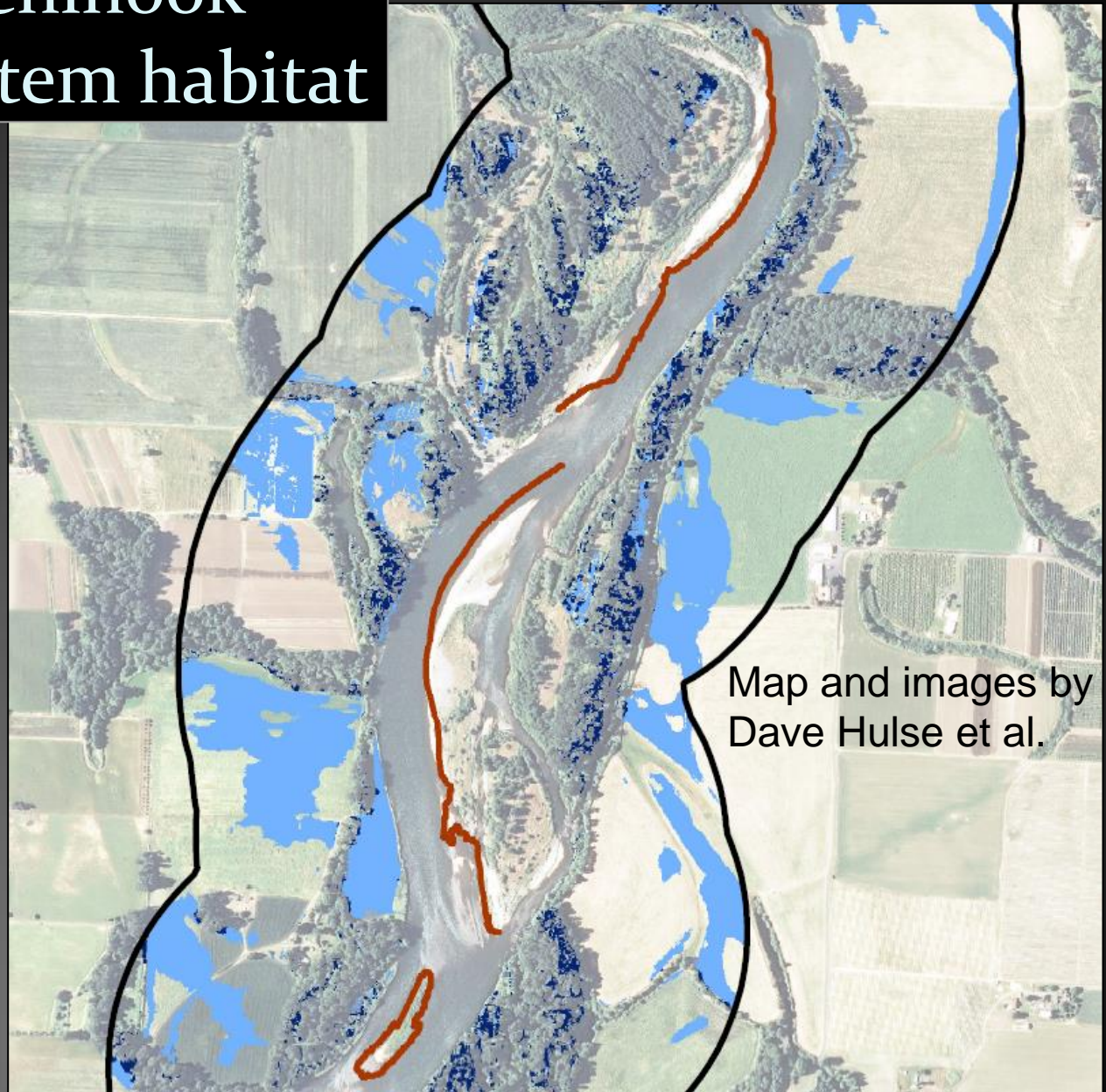
Many life history pathways

Rearing in many different habitats



Juvenile Chinook Winter mainstem habitat

- Floodplain within 1,000 m of main channel
- Gentle slope
- Shallow
- Vegetation



Map and images by
Dave Hulse et al.

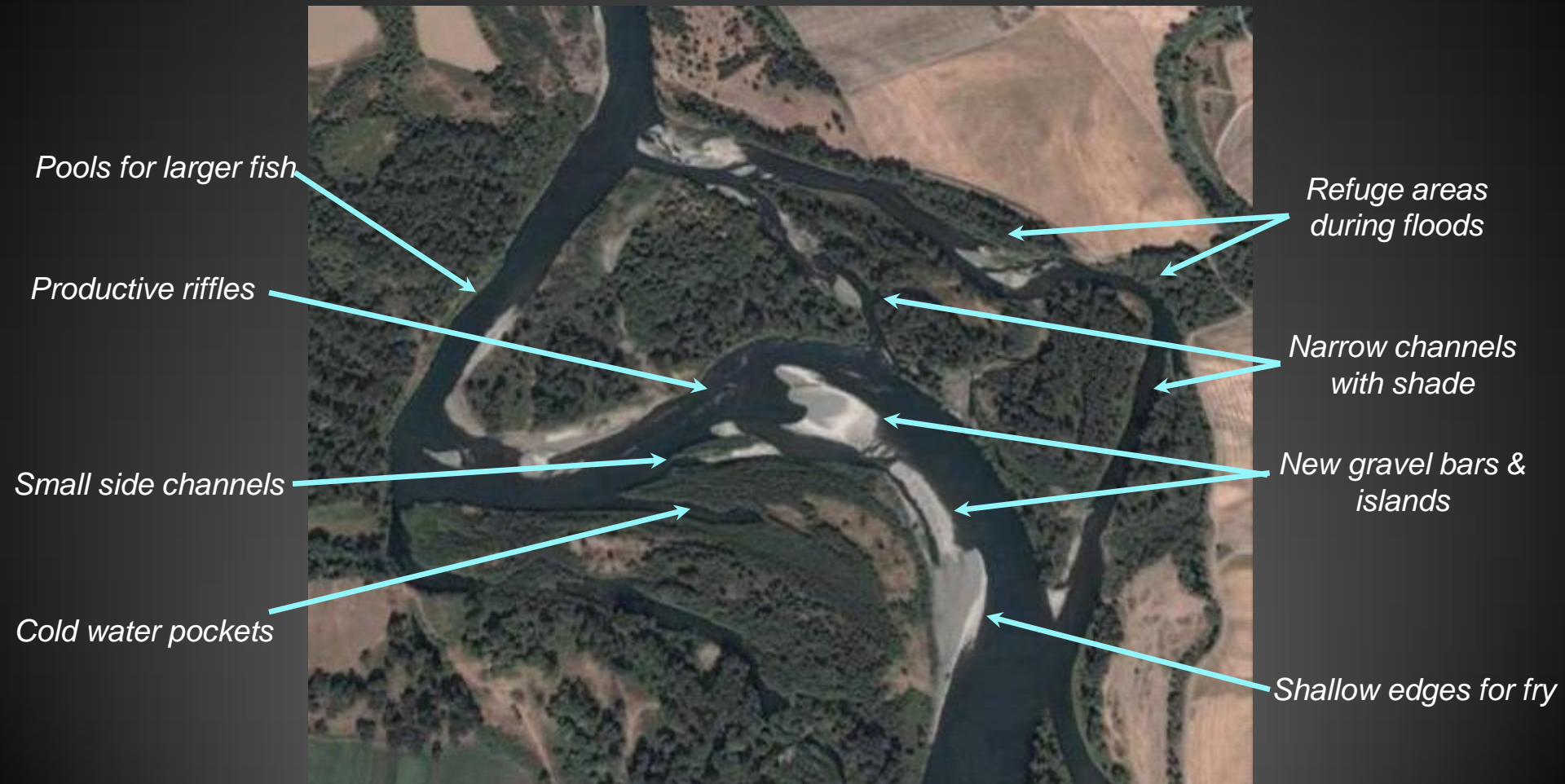
Juvenile Chinook Summer Habitat

- Inside bends on the mainstem
- At least 1/3 gravel
- Gentle slope
- Can support high densities of juvenile Chinook



Map and images by Dave Hulse et al.

Juvenile Chinook Complex Habitat and Active Channels



Willamette River downstream of McKenzie confluence near Green Island

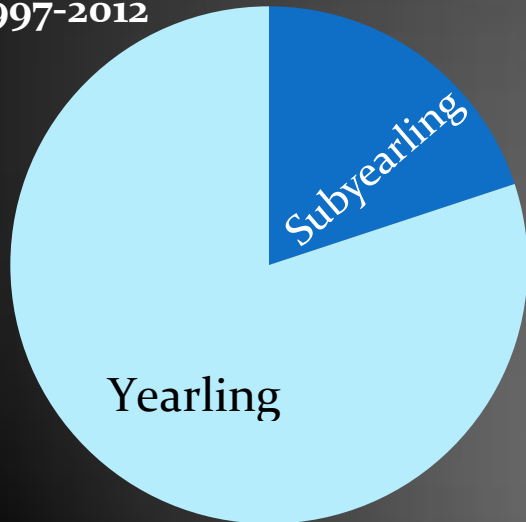
Life History Variation in McKenzie Wild Spawners



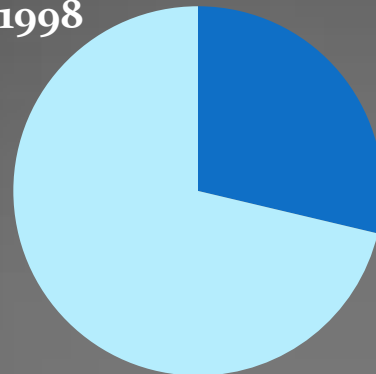
- Adult scales analyzed for total age and migrant type
- Yearling migrants spend their first year rearing in the upper McKenzie River and tributaries
- Subyearling migrants leave soon after emergence, rearing in the mainstem Willamette their first summer

McKenzie Brood Years

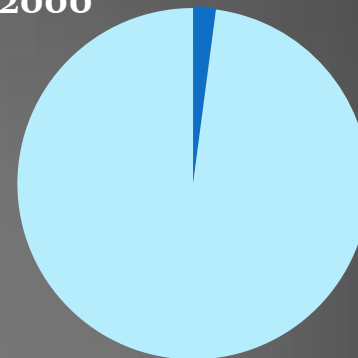
1997-2012



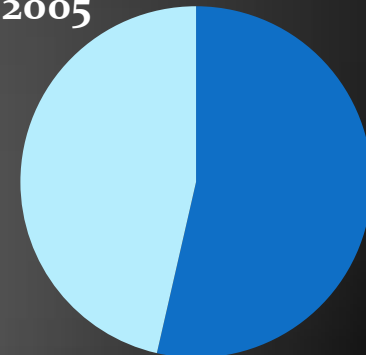
1998



2000



2005



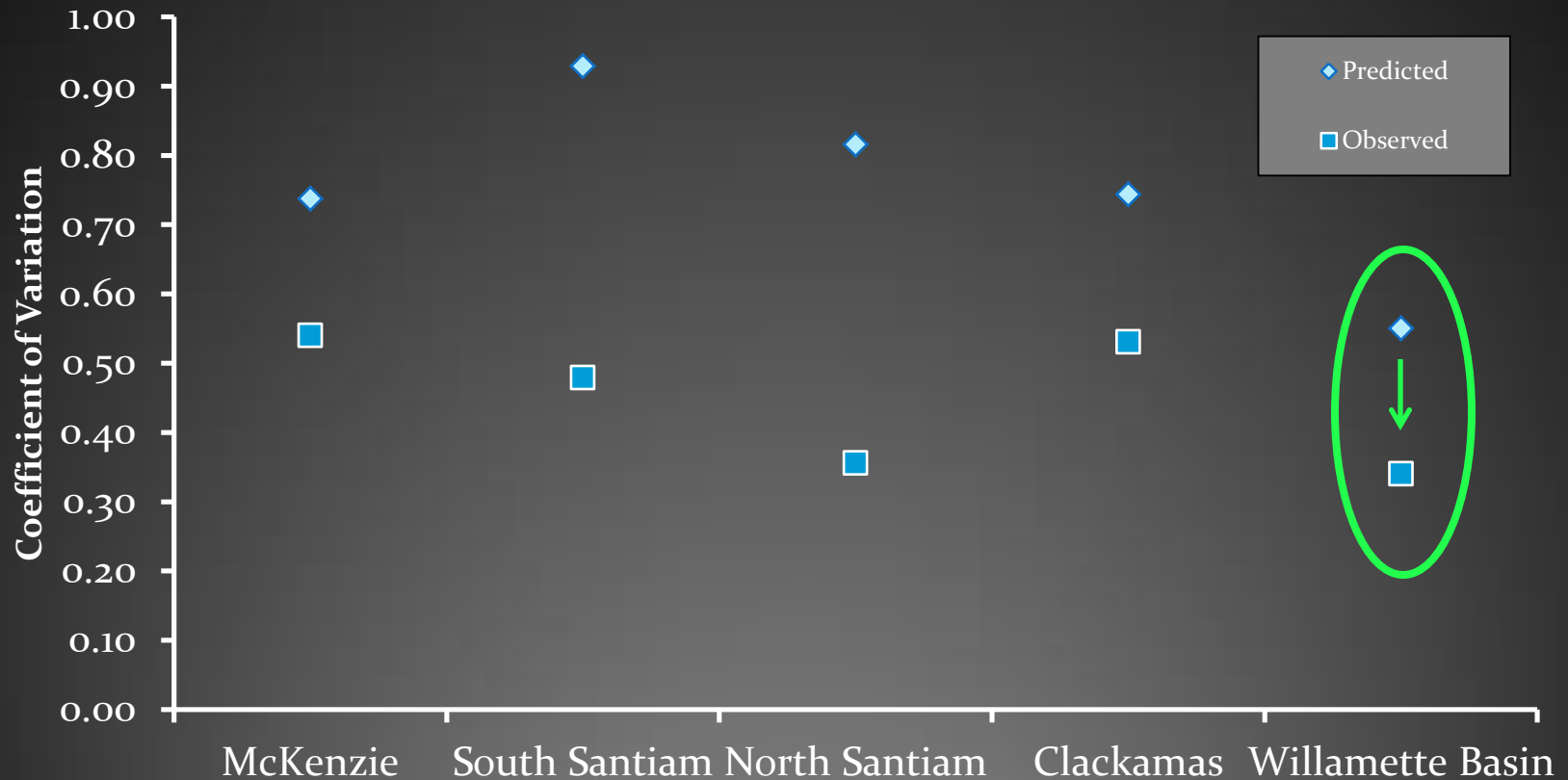
This diversity buffers for future changes

Variable Life History of Wild Spawners

Spawning Tributary	Brood Years	Proportion yearlings	Proportion subyearlings	Types	Most Common (Total Age - migrant type)
Clackamas	1998 - 2012	90%	10%	5	Age-5 yearling
McKenzie	1997 - 2012	79%	21%	6	Age-5 yearling
North Santiam	1998 - 2012	64%	36%	6	Age-5 yearling/Age-4 sub.
South Santiam	1997 - 2012	34%	66%	7	Age-4 subyearling

- Predominantly yearlings from cold systems
- Spawning and rearing habitat limited by dams in the North and South Santiam
- Higher percentage of subyearlings with earlier emergence

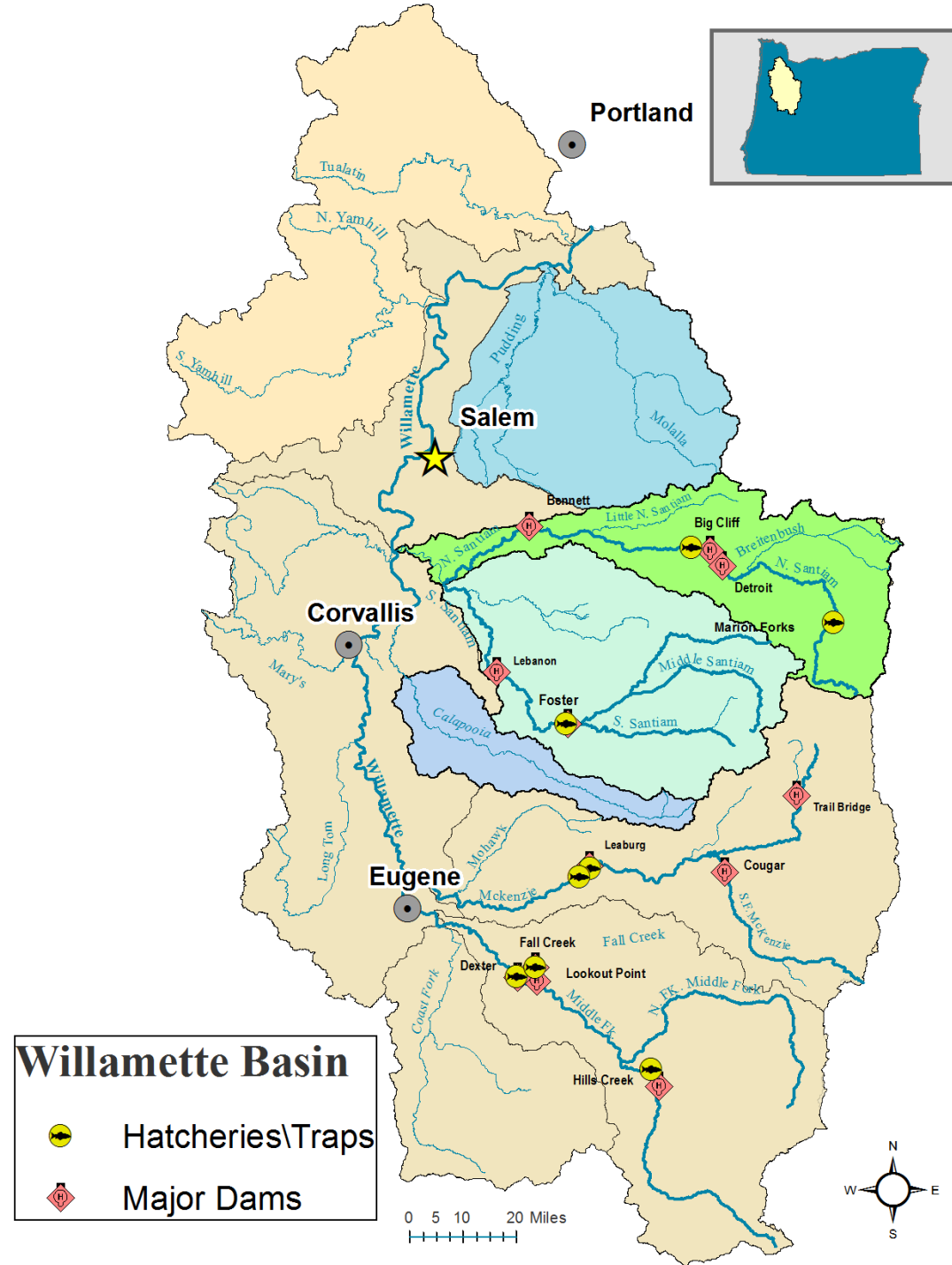
Stability in Adult Returns



- Coefficient of variation calculated for each return year by river
- Compared to total adult run size
- Observed decrease in overall population variability

Winter Steelhead

- Molalla, North Santiam, South Santiam, and Calapooia
- Adults migrate February - May
- Spawning March - May
- Most spawning in smaller tributaries



Steelhead spawning and rearing in smaller tributaries



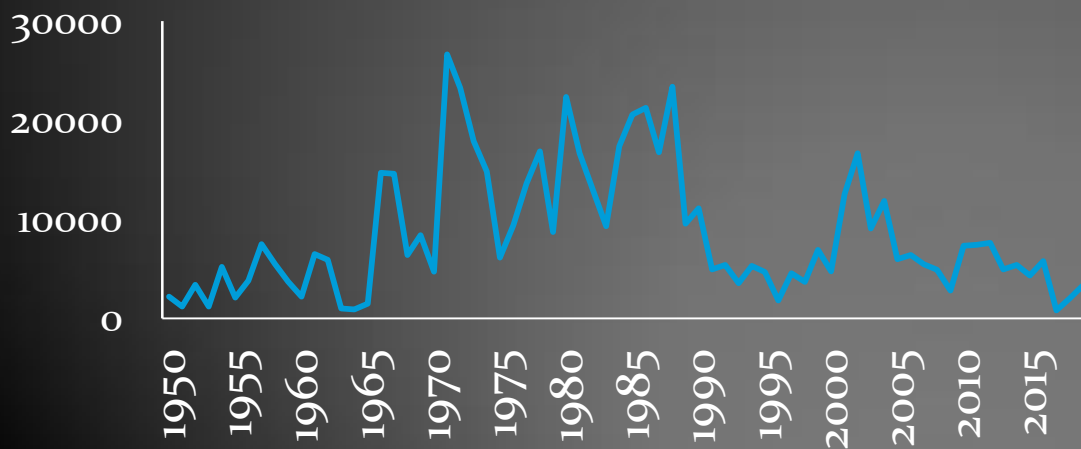
Juvenile steelhead

- Life history pathways are likely very complex, including a large resident population
- Rearing 1 - 3 years in spawning tributaries (most Age-2)
- Smolts migrate quickly through the mainstem in April and May



Data needs for Winter steelhead

- More consistent monitoring
- Contribution from resident *O. mykiss*
- Age composition
- Juvenile abundance and distribution
- Smolt survival



Habitat Restoration for Spring Chinook

- Continue to improve and connect habitat along the mainstem Willamette and floodplain
 - Fry, subyearlings, fall migrants, smolts
- Protect flows and cold water in the spawning tributaries
 - Adult holding and spawning, yearling life history
- Restore spawning habitat and side channels
 - Adults and yearlings (recent examples in McKenzie)

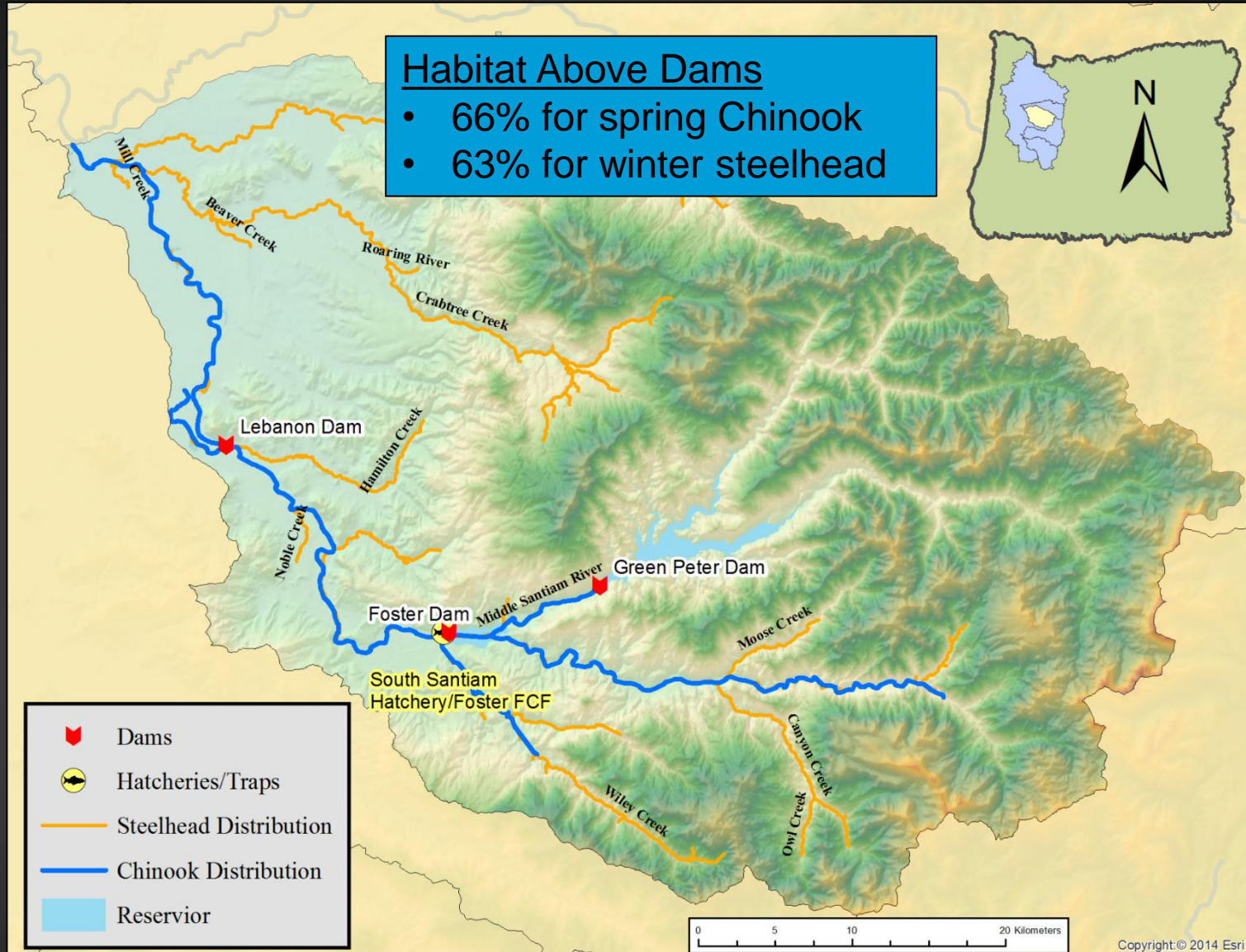
Habitat Restoration for Winter Steelhead

- Restoration projects in smaller tributaries
- Large wood and gravel
 - Spawning habitat
- Side channels and connectivity
 - Juvenile rearing, seasonal movement
- Maintain spring flows in the mainstem
 - Smolt migration

Need for Improved Dam Passage

- Much of the habitat in the large tributaries is still blocked by flood control dams
- Can greatly increase spawning habitat
- Will allow adult Chinook to hold in colder water upstream before spawning
- Can connect habitat for both juvenile and adults

South Santiam Example



Potential of the Willamette

- Pieces in place for success
- Unique part of the Columbia Basin
- Lots of habitat still intact, if passage can be improved
- Great local support and interest



“The Willamette River from a Mountain” Paul Kane, 1847



Acknowledgments



Scale Analysis

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PIT Antennae

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- Tom Friesen
- Cam Sharpe

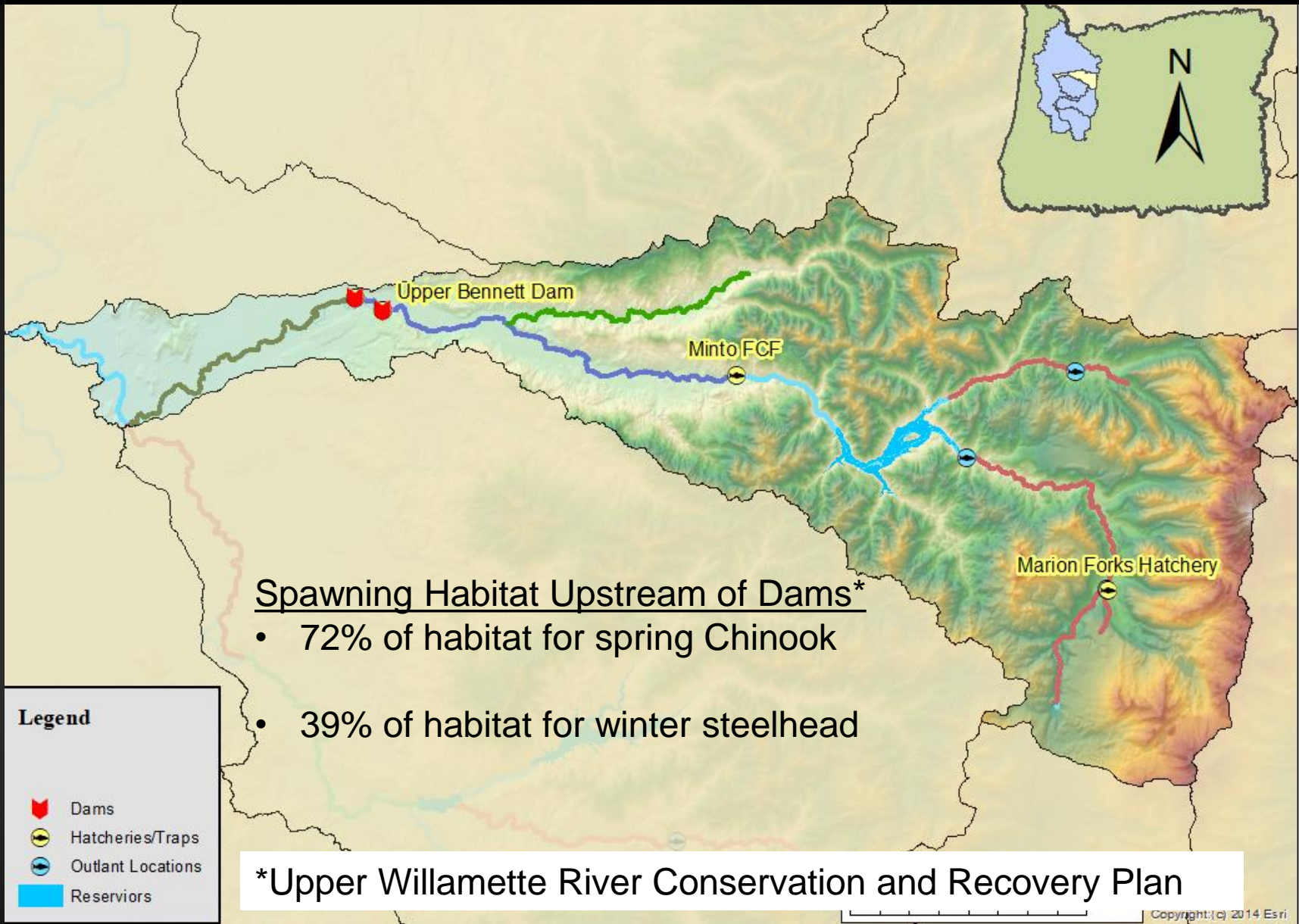


Habitat – adult winter steelhead

Recovery – habitat improvements

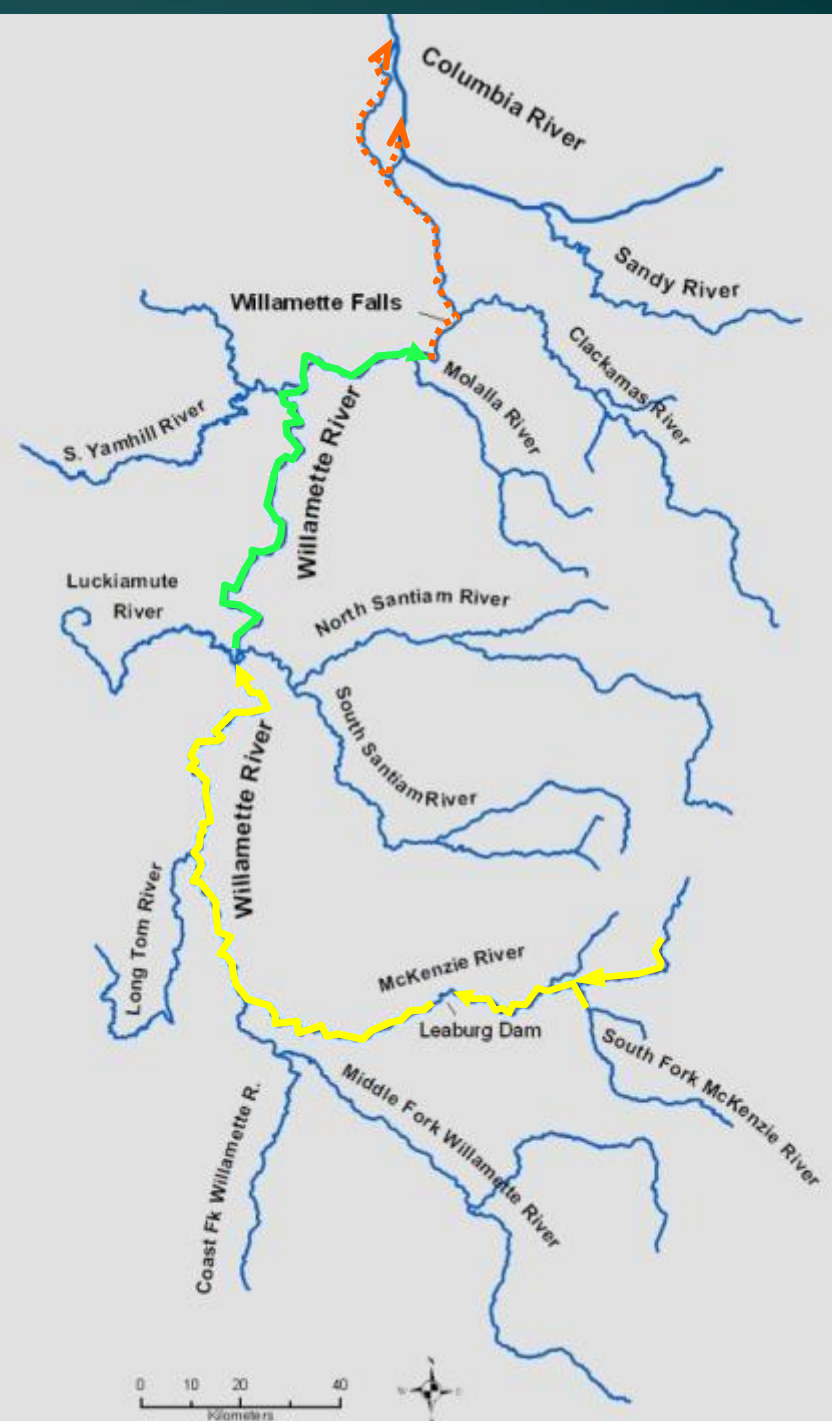
- Conserve current habitats for winter steelhead
- Maintain river levels to allow for migration (juvenile and adult)
- Recent examples of big restoration projects in the McKenzie creating new spawning habitat
- Maintain coldwater habitats in the tributaries for spawning and rearing

Recovery – Improved Dam Passage



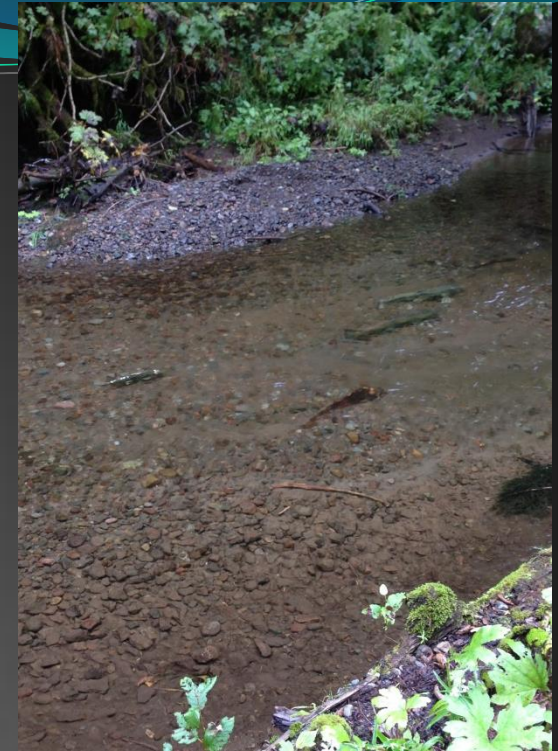
Fry Dispersal

- Wide range of emergence timing
- Fry first caught in McKenzie January
- Fry dispersed throughout the Willamette by late February
- Peak catch:
 - Lower McKenzie – February
 - Leaburg – March
 - Upper McKenzie and Horse Creek – April



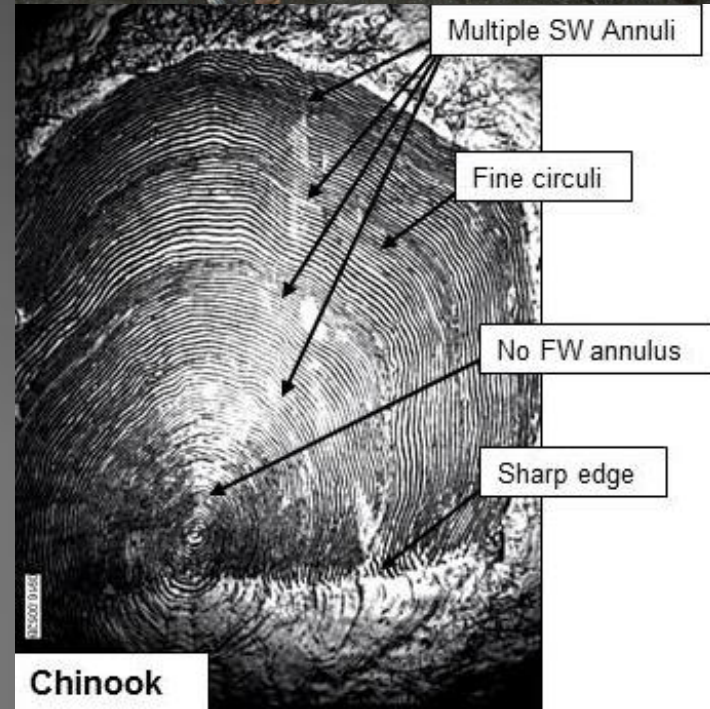
Spawning Surveys

- Complete census of all available habitat
- Surveys on a 7-10 day rotation, July-Oct.
- Carcasses recovered and sampled
 - Scales
 - Otoliths
 - Length
 - Sex
 - Spawning success

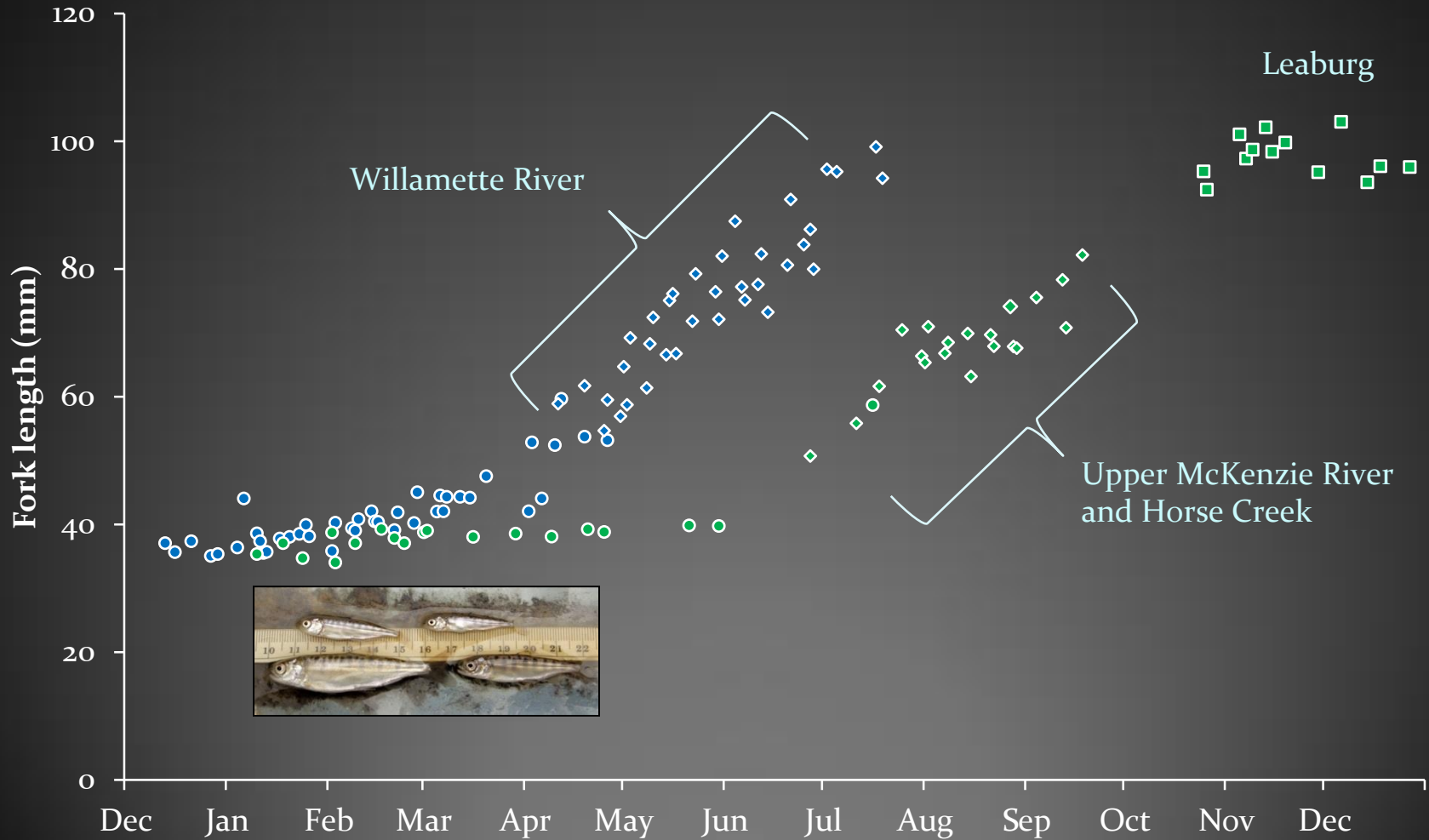


Adult Scale Analysis

- Scales read for freshwater and total age
- First annulus after saltwater entry = subyearling (FW age 0)
- First annulus before saltwater entry = yearling (FW age 1)
- If FW age can't be determined = pattern X (possible reservoir rearing)
- Summarized for each brood year after all adults returned (total age 2 through age 6)
- 50-300 scales read per return year



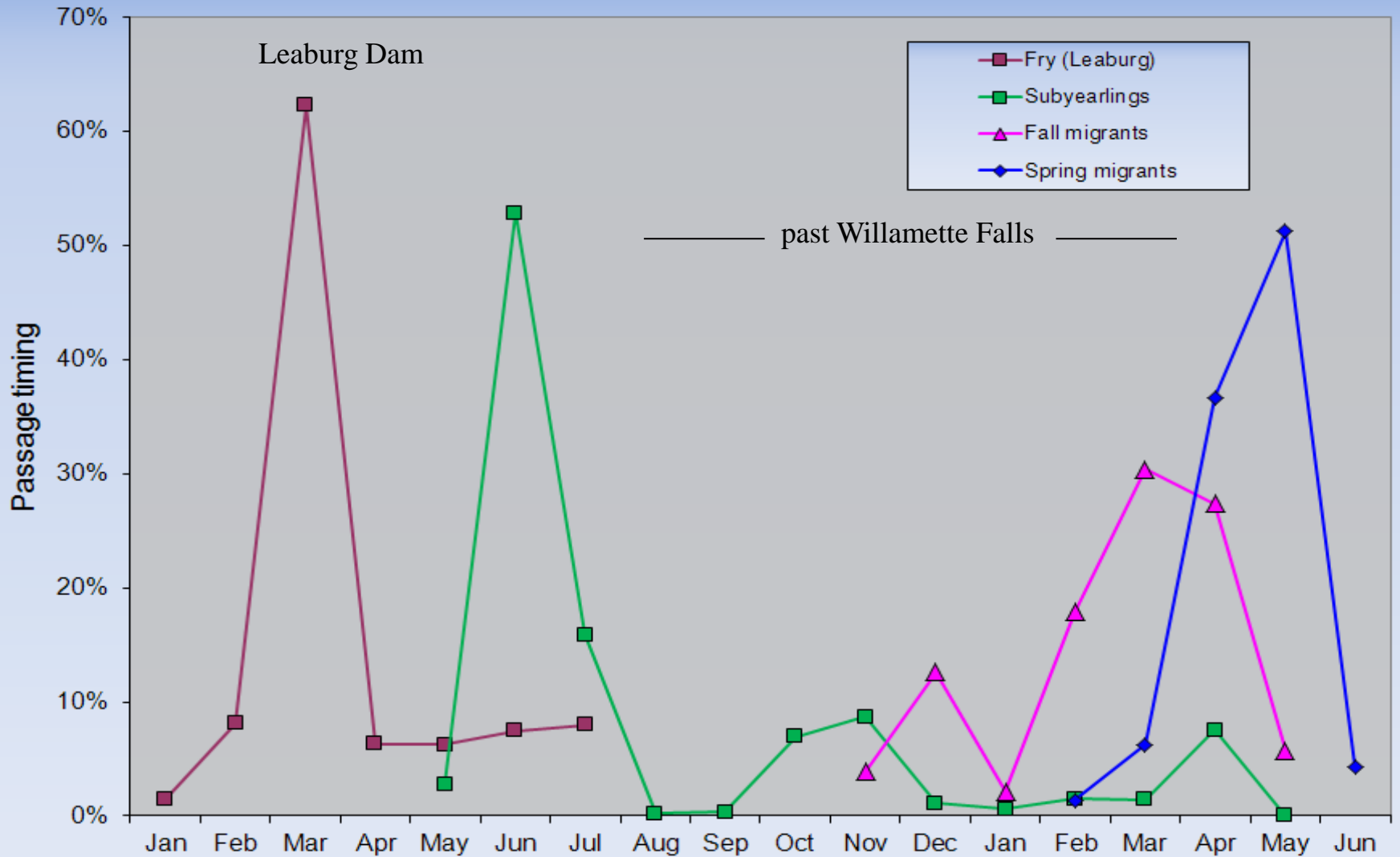
Length of spring Chinook salmon captured as fry (●) or juveniles (■) Willamette and upper McKenzie rivers



Steelhead - Adult Spawners

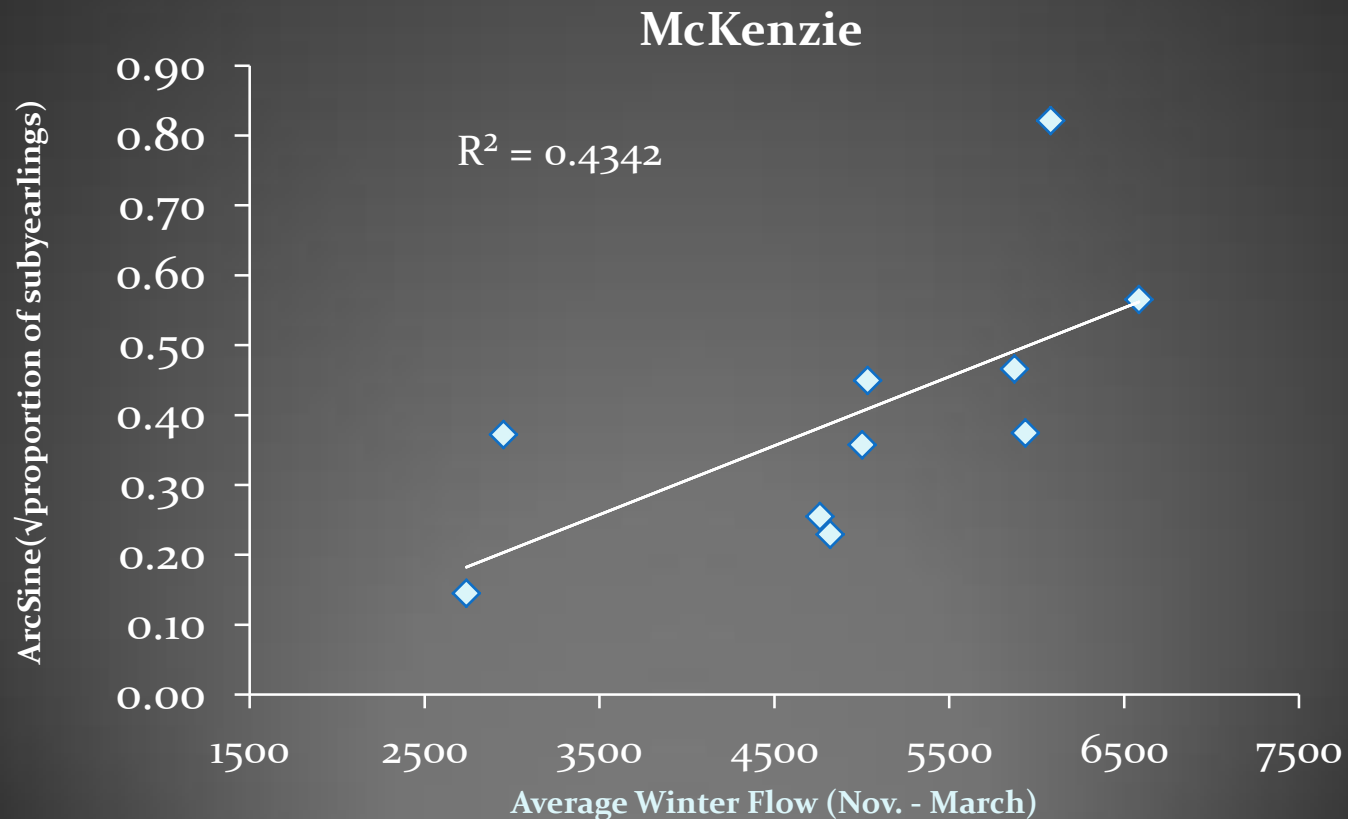
- Adult migration conditions are favorable during the winter and spring
- Spawning takes place in upper reaches of Santiams and smaller tributaries (Thomas and Crabtree)

Migration Timing



River Flow During Emergence

- The proportion of subyearlings positively correlated with winter flows
- Weaker relationships with other variables (Columbia, mainstem Willamette, etc.)

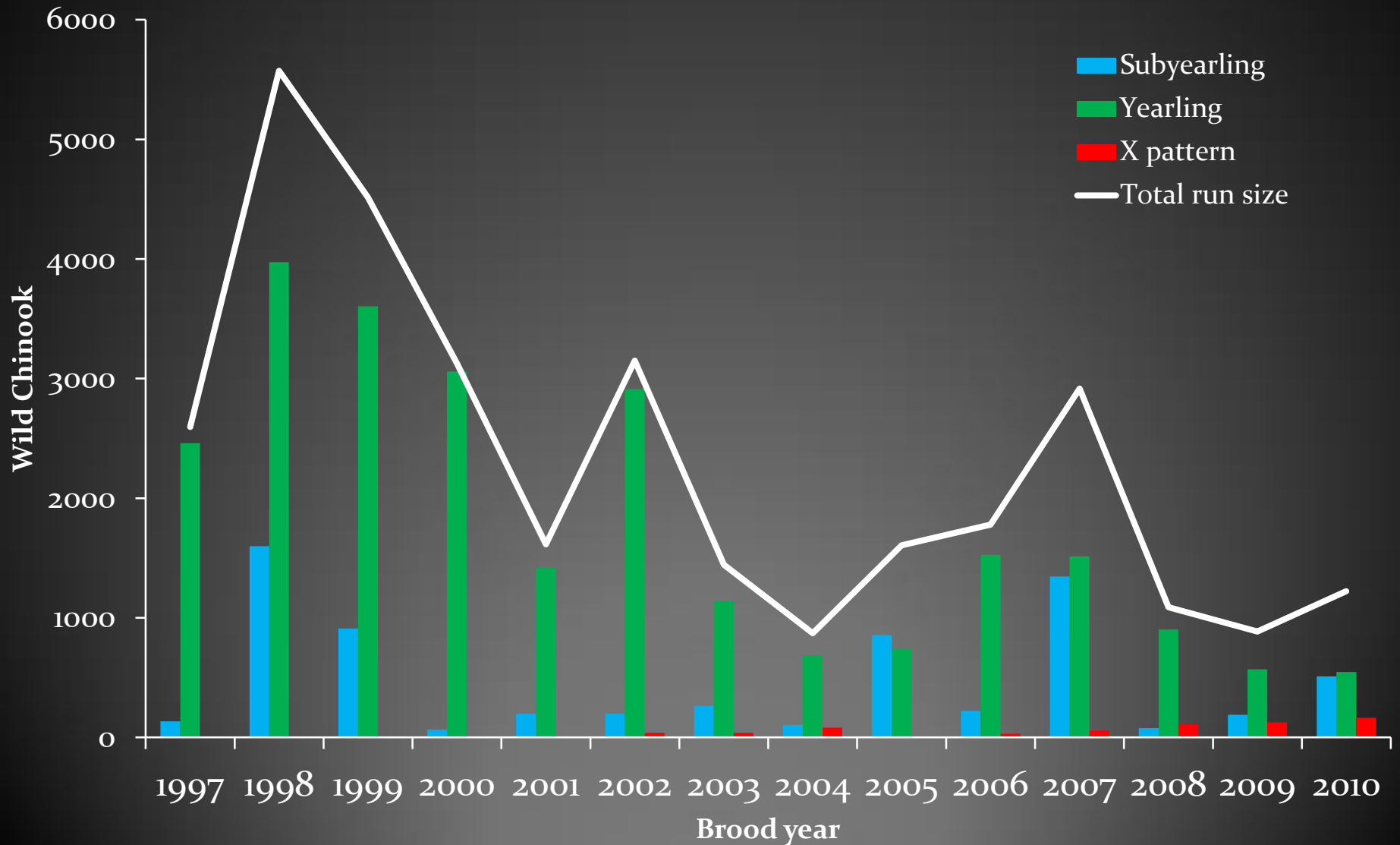


Spawning Habitat and Incubation temperatures

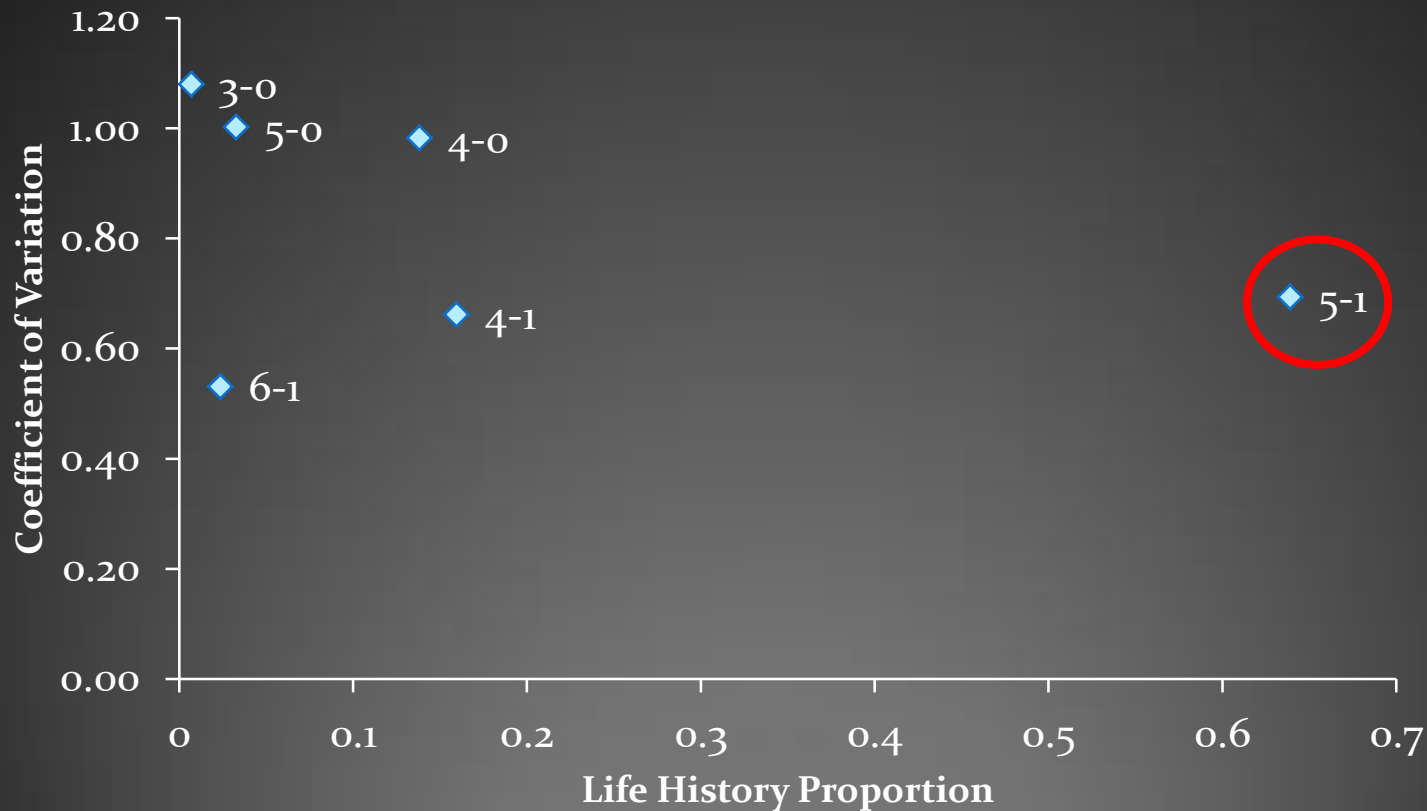
Spawning Tributary	Average Peak Emergence	Proportion subyearlings
Clackamas	March 23	10%
McKenzie	March 5	21%
North Santiam	February 15	36%
South Santiam	January 13	66%

- Warmer water downstream of dams leads to earlier emergence
- Spawning and rearing habitat limited by dams
- Higher percentage of subyearlings with earlier emergence

McKenzie Adult Returns



Portfolio Effect – McKenzie Life Histories



- Adult spawners age-5 that migrated as yearlings the most common type

Summary

- Some fry begin moving soon after emergence, to lower tributaries, the Willamette, and the estuary
- Smolts begin to migrate around 100 mm FL
- 82% of PIT tagged juveniles migrate as yearlings; 18% as subyearlings
- The floodplain in the lower Willamette provides additional rearing habitat
- Many life history types spend some time rearing in the Columbia River estuary

Summary (continued)

- Proportions of life history types varies by spawning population and by year
- Freshwater conditions can affect life history expression from year to year
- Incubation temperatures and available freshwater habitat affect life history expression
- Portfolio effect with multiple life histories that stabilize adult returns

Future Research and Challenges

- Increase sampling the lower Willamette River
- Smolt to Adult Return (SAR) survival estimates
 - By life history?
 - By brood year?
- Survival in different mainstem reaches
- Abundance of wild Chinook in the McKenzie

