

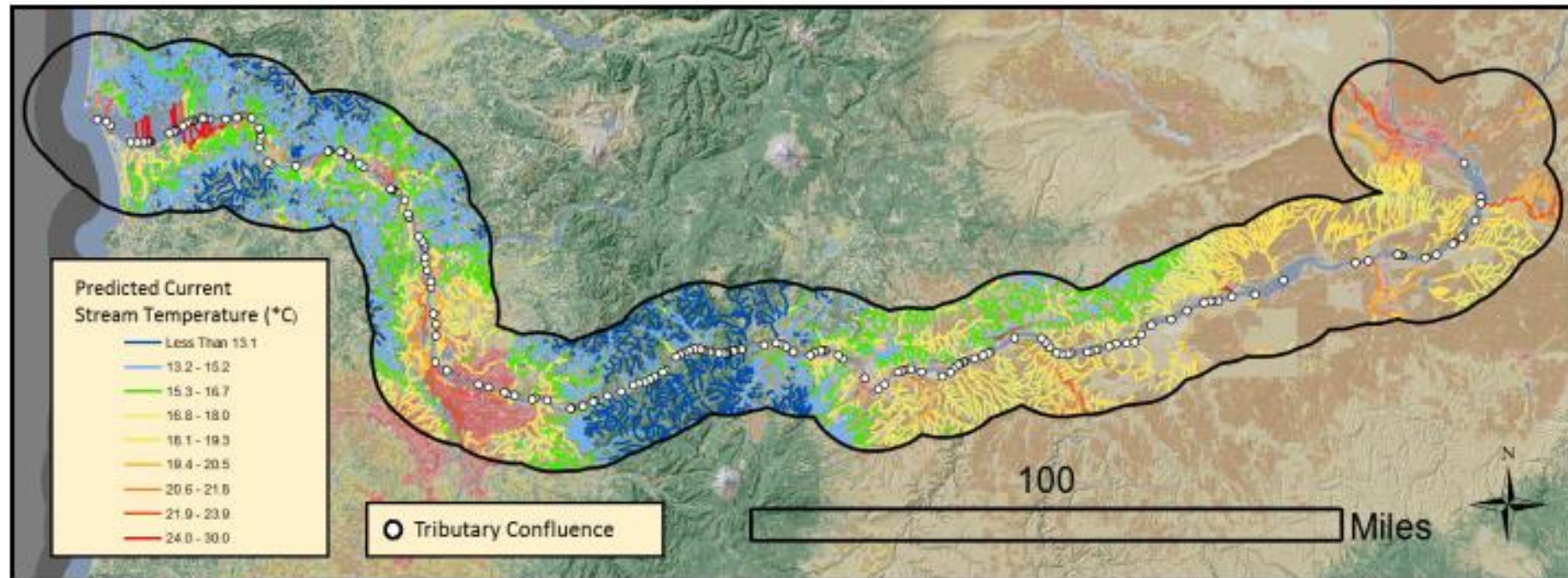
Columbia River Cold Water Refuges: A Synopsis of the EPA 2021 Report

Dr. Charlene Hurst
Columbia River Management Unit Lead, Fish Program



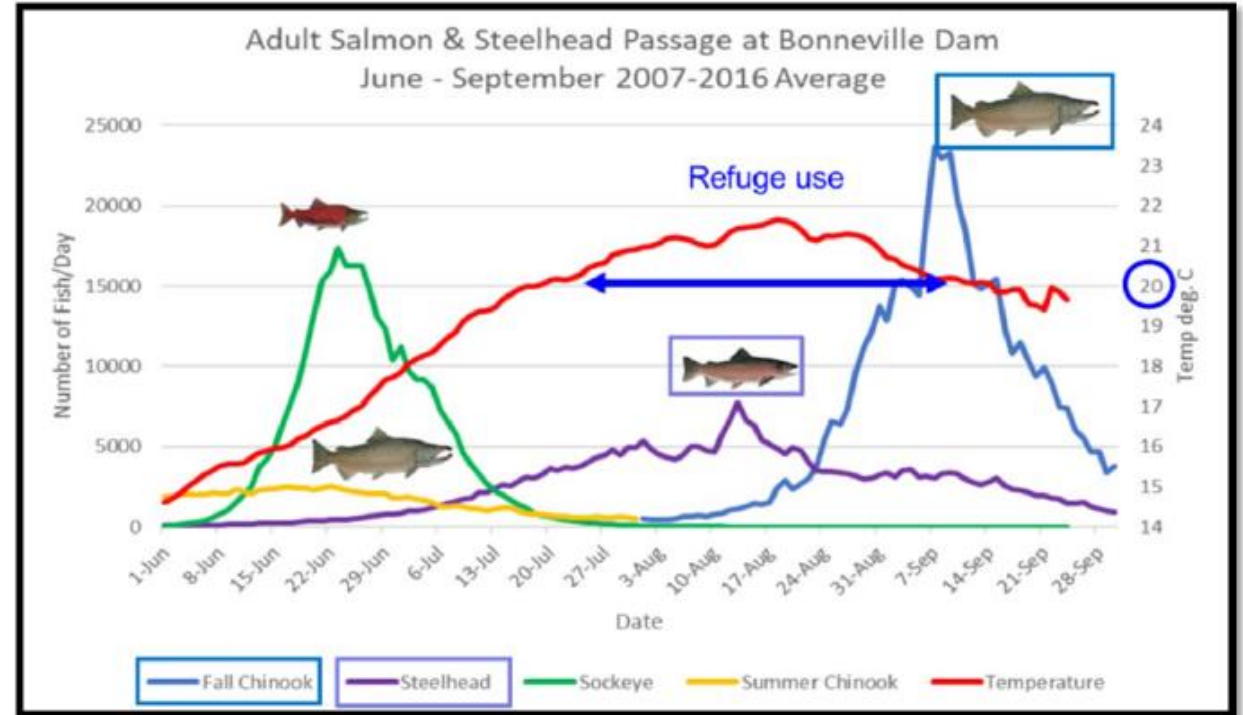
What are Cold Water Refuges?

- In the mainstem Columbia River, average August water temperatures are between 21-22°C
- As they migrate upriver, many salmon and steelhead move into areas of cooler water for temporary relief, called *cold water refuges*.
- These refuges are found where cooler tributaries flow into the river



Why are Cold Water Refuges Important?

- Benefit fish by reducing prolonged exposure to high river temperatures, which can increase disease risk, stress, loss of energy reserves, mortality risk, and decrease spawning probability.
- Adult steelhead and fall Chinook salmon use refuges the most because they migrate when temperatures are warmest
 - Steelhead begin using CWRs at 19°C and above for potentially weeks
 - Fall Chinook begin using CWRs at 21°C and above for typically a few days
 - Sockeye salmon do not appear to use refuges
 - Summer Chinook may use refuges for just a few hours
- High use of Bonneville reservoir CWR:
 - Steelhead = late-July through mid-September
 - Fall Chinook = late August through mid-September

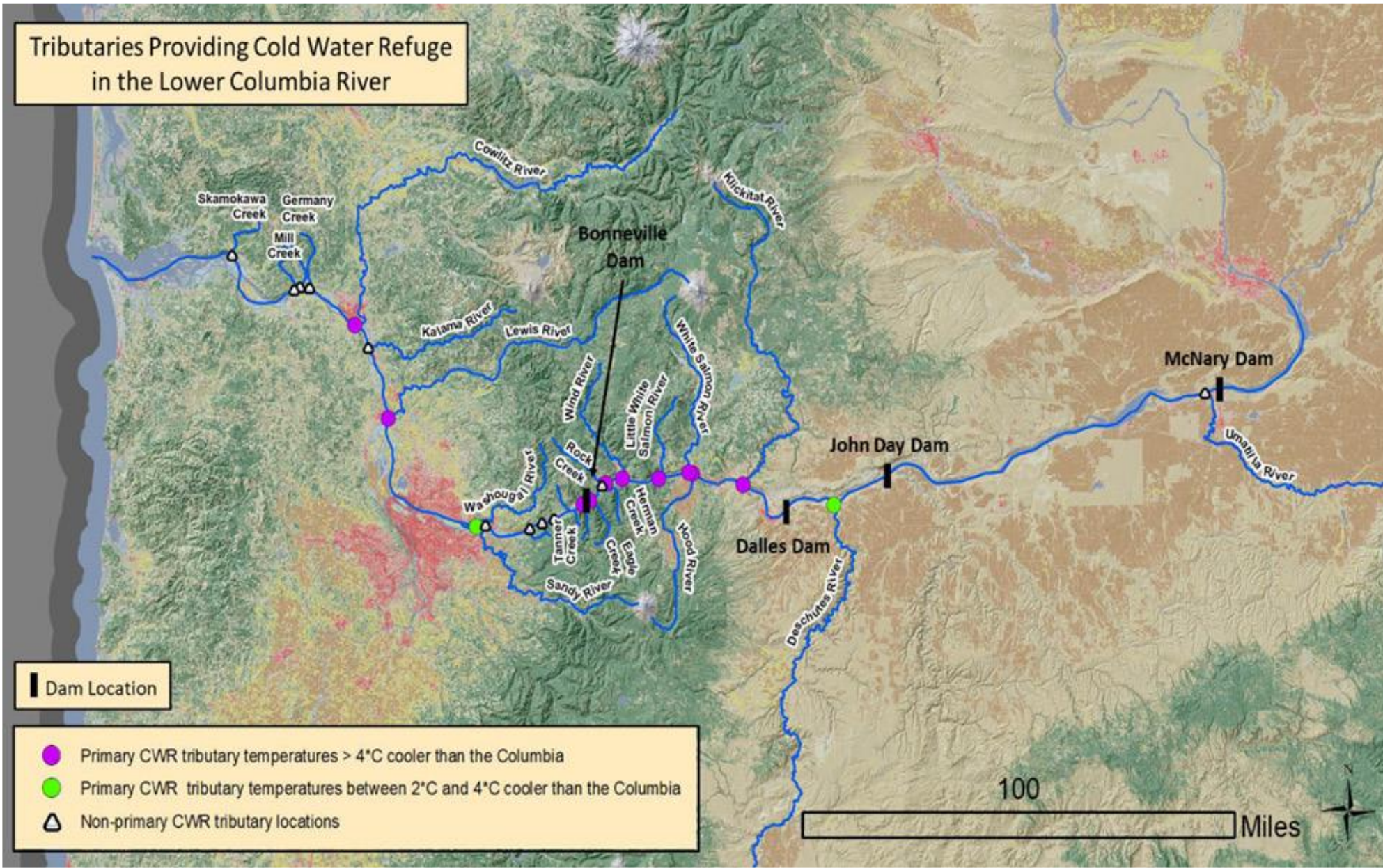


Cold Water Refuges

- EPA (2021) identified 23 cold water refuges
 - CWR for each tributary are in and/or near the confluence with the Columbia River.
- 12 primary CWR tributaries
 - known or presumed to be used by steelhead and fall Chinook
 - constitute 98% of CWR volume in the Lower Columbia River
- Remaining 11 other tributaries are smaller, and have limited information on fish use



Tributaries Providing Cold Water Refuge in the Lower Columbia River



Characteristics of the 12

- Features that keep the tributaries relatively cool
 - Glacier fed, cold headwater source
 - Significant groundwater inflows
 - High percentages of forested areas that minimize solar heating
 - Upstream storage dams that release cool water from deep within the storage reservoir
- Sediment build-up at the confluence with the Columbia River that may:
 - Impede salmon and steelhead access to the CWR
 - Fill deep pools preferred by fish
 - Create shallow areas more susceptible to solar warming



Focus on WA Refuges

| Tributary Name | River Mile | August Mean Mainstem temperature (DART) | August Mean Tributary Temperature (NorWeST) | August mean Temperature Differences | August Mean Tributary Flow | Total CWR Volume >2 °C Δ |
|--|------------|---|---|-------------------------------------|----------------------------|--------------------------|
| Cowlitz River | 65.2 | 21.3 | 16.0 | 5.4 | 3634 | 1,554,230 |
| Lewis River | 84.4 | 21.3 | 16.6 | 4.8 | 1291 | 613,455 |
| Wind River | 151.1 | 21.2 | 14.5 | 6.7 | 293 | 105,220 |
| Little White Salmon River (Drano Lake) | 158.7 | 21.2 | 13.3 | 7.9 | 248 | 1,108,661 |
| White Salmon River | 164.9 | 21.2 | 15.7 | 5.5 | 715 | 153,529 |
| Klickitat River | 176.8 | 21.4 | 16.4 | 5.0 | 851 | 222,029 |



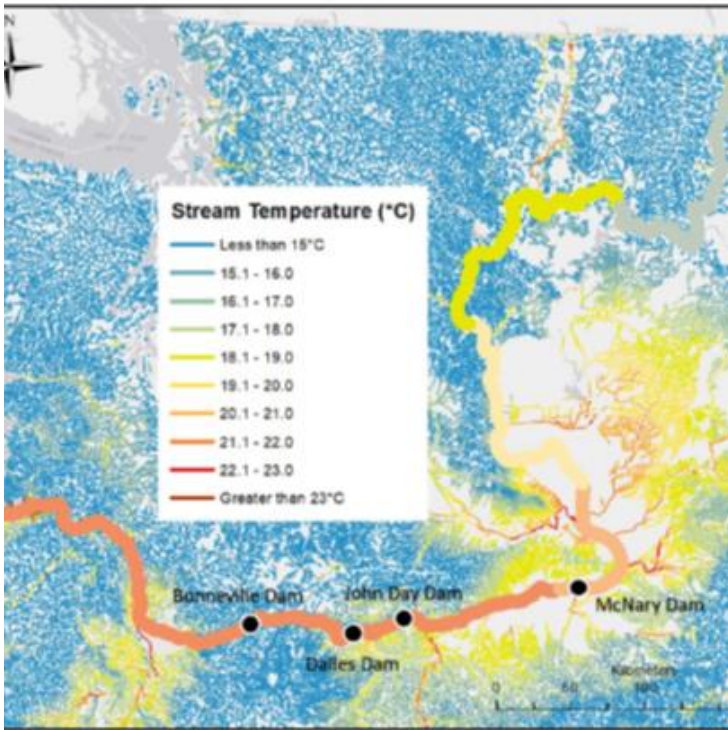
What does the EPA Report Say about Fishery Impacts?

Some studies have found that migration success to the spawning tributaries (Keefer et al. 2009) or from the Dalles to McNary dams (NMFS 2017) for steelhead (wild and hatchery) that used CWR was less than for steelhead that did not use CWR

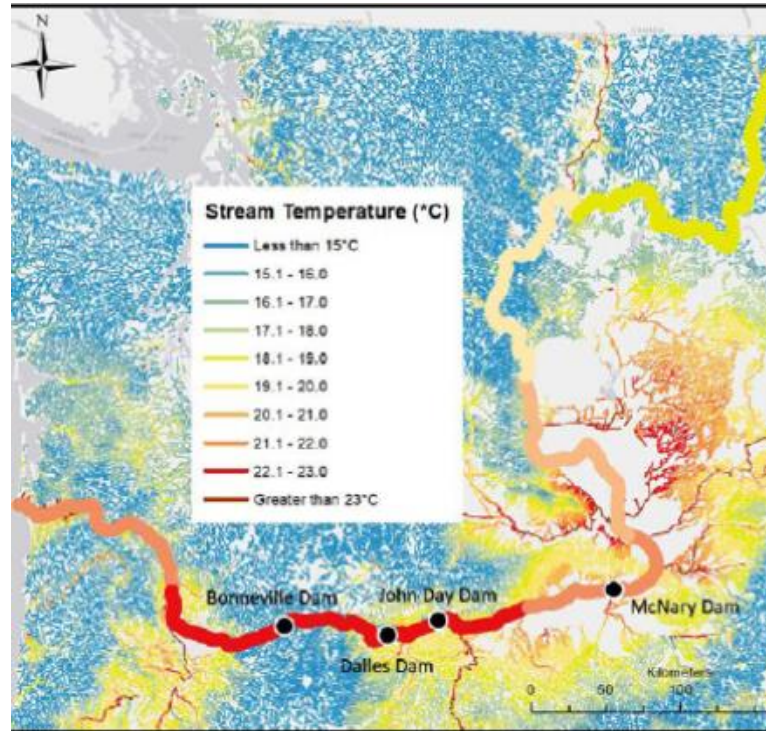
- Could be associated with fishery impacts in CWR
- Juveniles barged downstream have a higher rate of straying and lower adult survival rates – not all steelhead in CWR are equal
- Fish that use CWR may be more susceptible to warm temperatures and may have higher mortality in the mainstem
- More sophisticated studies needed to determine cause and effect



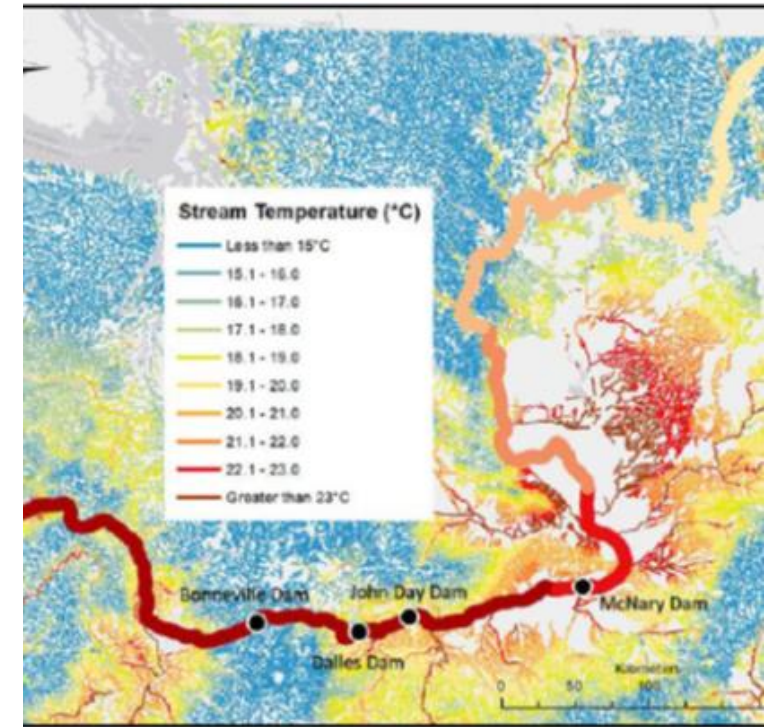
Current (August)



2040 (August)



2080 (August)



Thermal blockages for salmon and steelhead with insufficient access to quality CWR may be the largest single threat to the persistence of Columbia River salmon and steelhead in the 21st century.

WDFW recommended that the EPA consider aggressive actions to:
Limit increases in water temperatures in CWR

Limit or reverse increases in water temperatures in the mainstem Columbia and Snake rivers and their tributaries





Questions?

