

Ecosystem Response to the Removal of the Elwha River Dams



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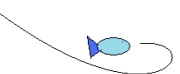
April 16, 2024

Groningen, The Netherlands

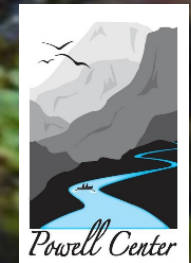
Elwha's Success: Maintaining and Building Partnerships



K. Denton & Associates, LLC



Shreffler Environmental

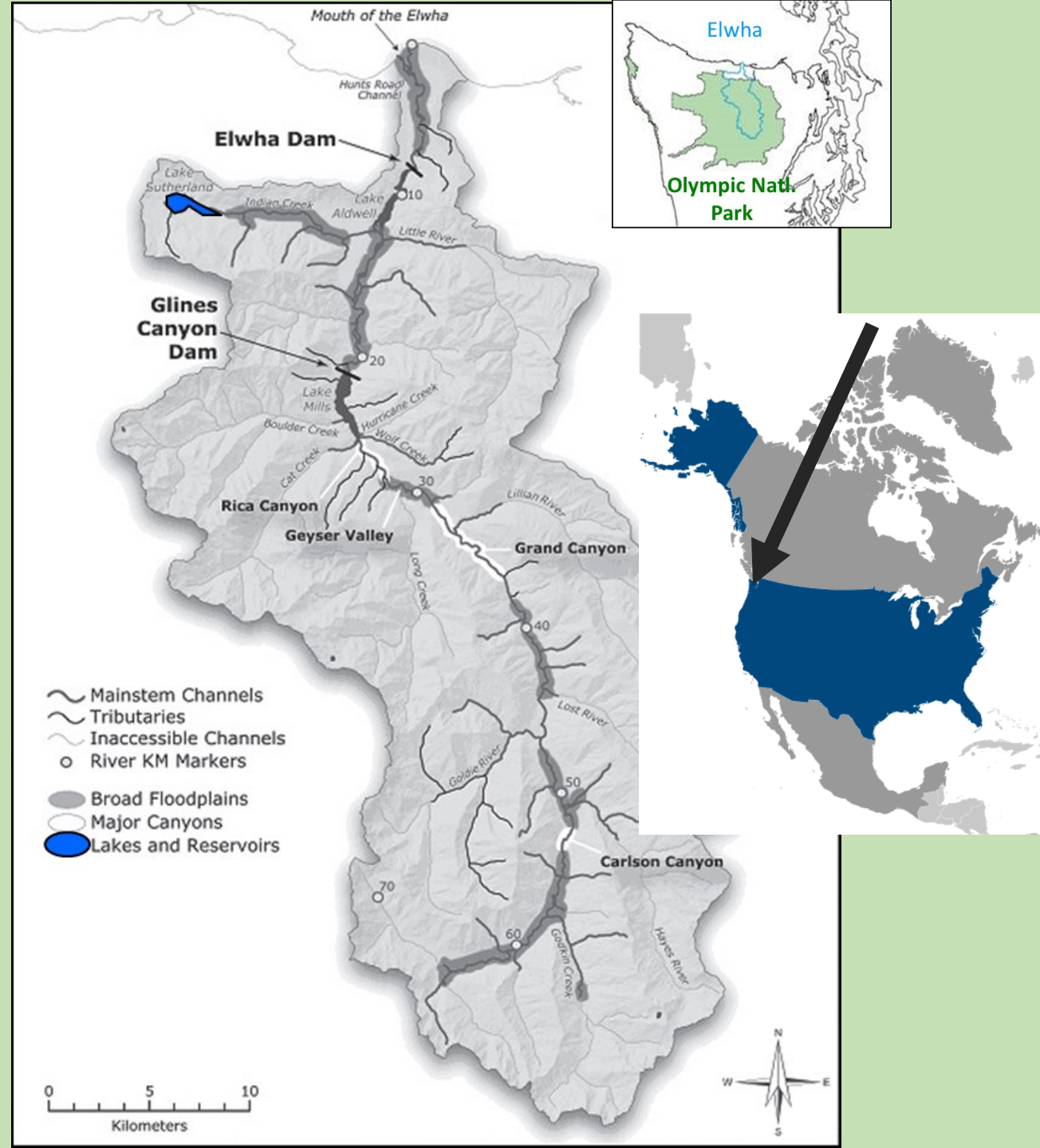


Today's Talk

- Elwha River Background
- Sediment release
 - A lot of sediment moved through the system relatively quickly (5 years)
- Fish Response
 - Story is just beginning after 10 years
 - All species of salmonids have reoccupied areas upstream of former dams
 - Increasing Populations
 - Increasing Life History Diversity
- Vegetation
 - Reservoir Surfaces, Natural Regrowth and Directed Plantings
- Wildlife Response
 - Benthic Invertebrates severely impacted by sediment release but quickly recovered
 - Salmon derived nutrients feeding wildlife upstream of the former dams
- Human Impacts
 - Fall of 2023: First tribal harvest of salmon since 2011

Elwha River Watershed Characteristics

- Largest Completed Dam Removal in the World
- 33 meter Elwha Dam @ RKM 8 Built: 1912
- 64 meter Glines Canyon Dam @ RKM 21, Built: 1927
- Short (72 KM) and steep (sea level to 1,370m)
- Permanent snowfield headwaters = lots of sediment



Elwha River Fishes

Coho salmon



Pink salmon



Chinook salmon



Steelhead



Chum salmon



Sockeye salmon



Eulachon



Bull trout

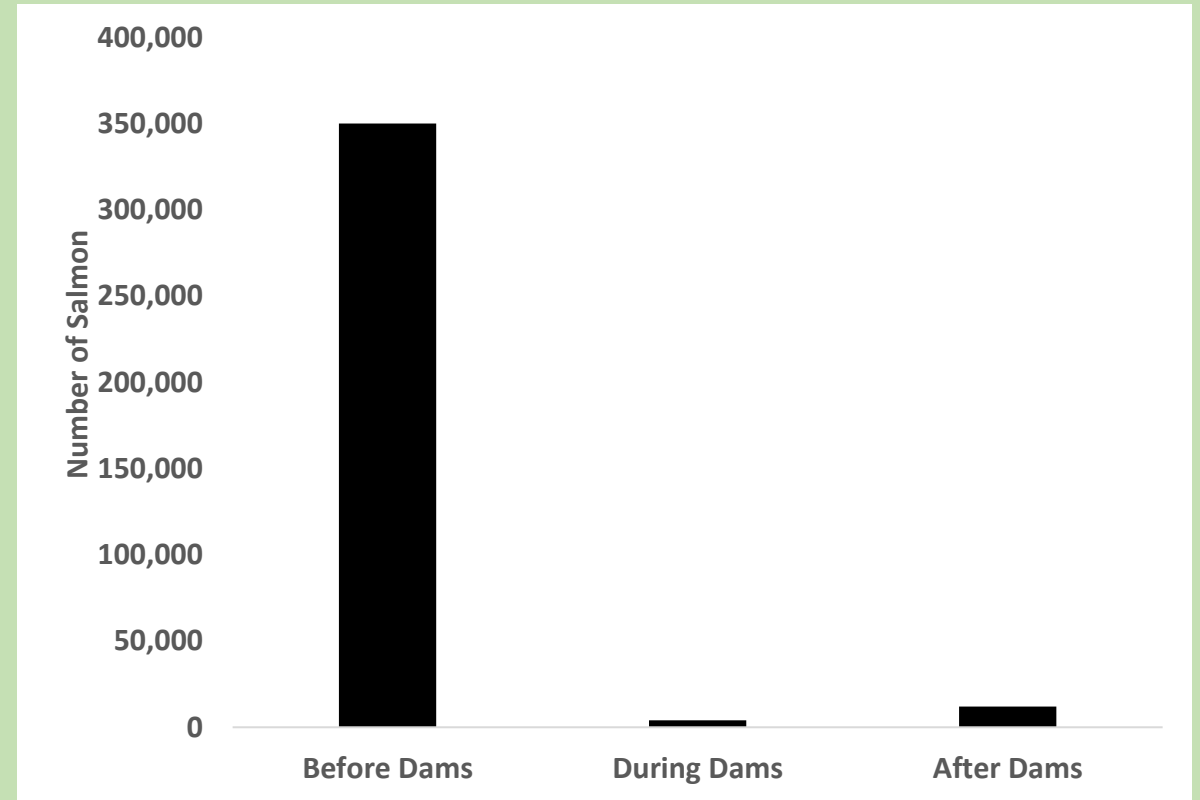
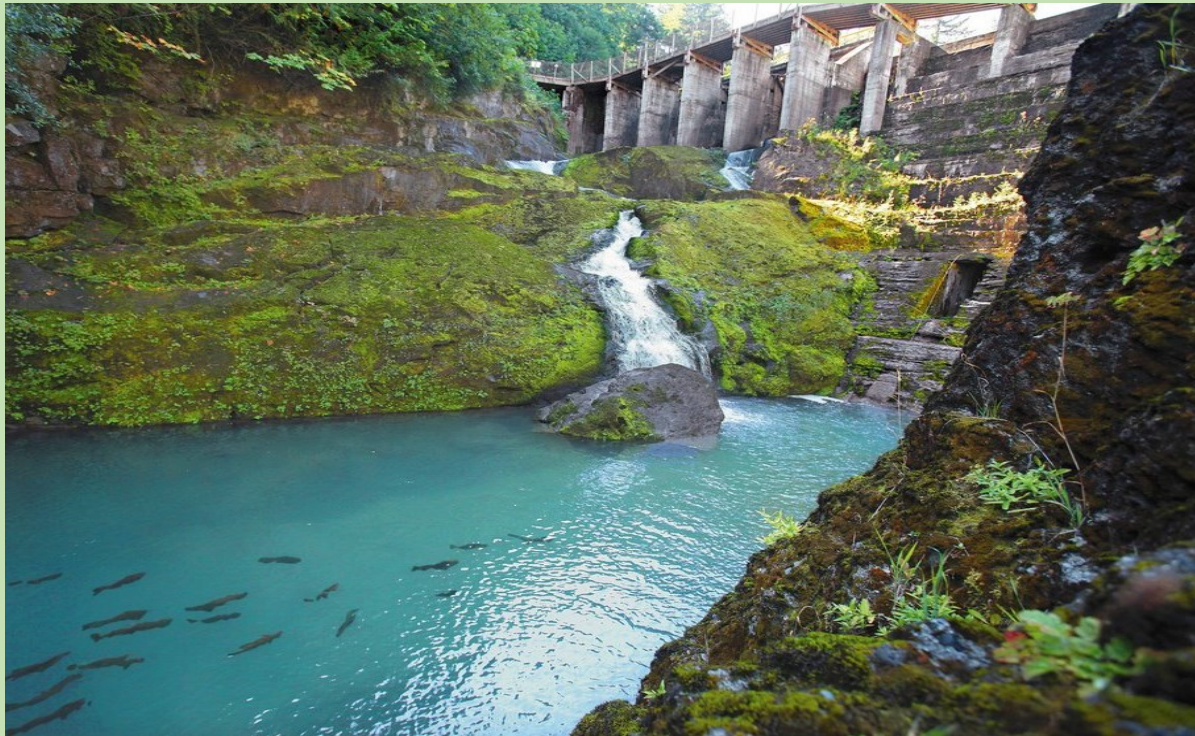


Pacific lamprey



Impacts of Dams to Elwha River Salmon Populations

98% Total Population Decline but Rebuilding

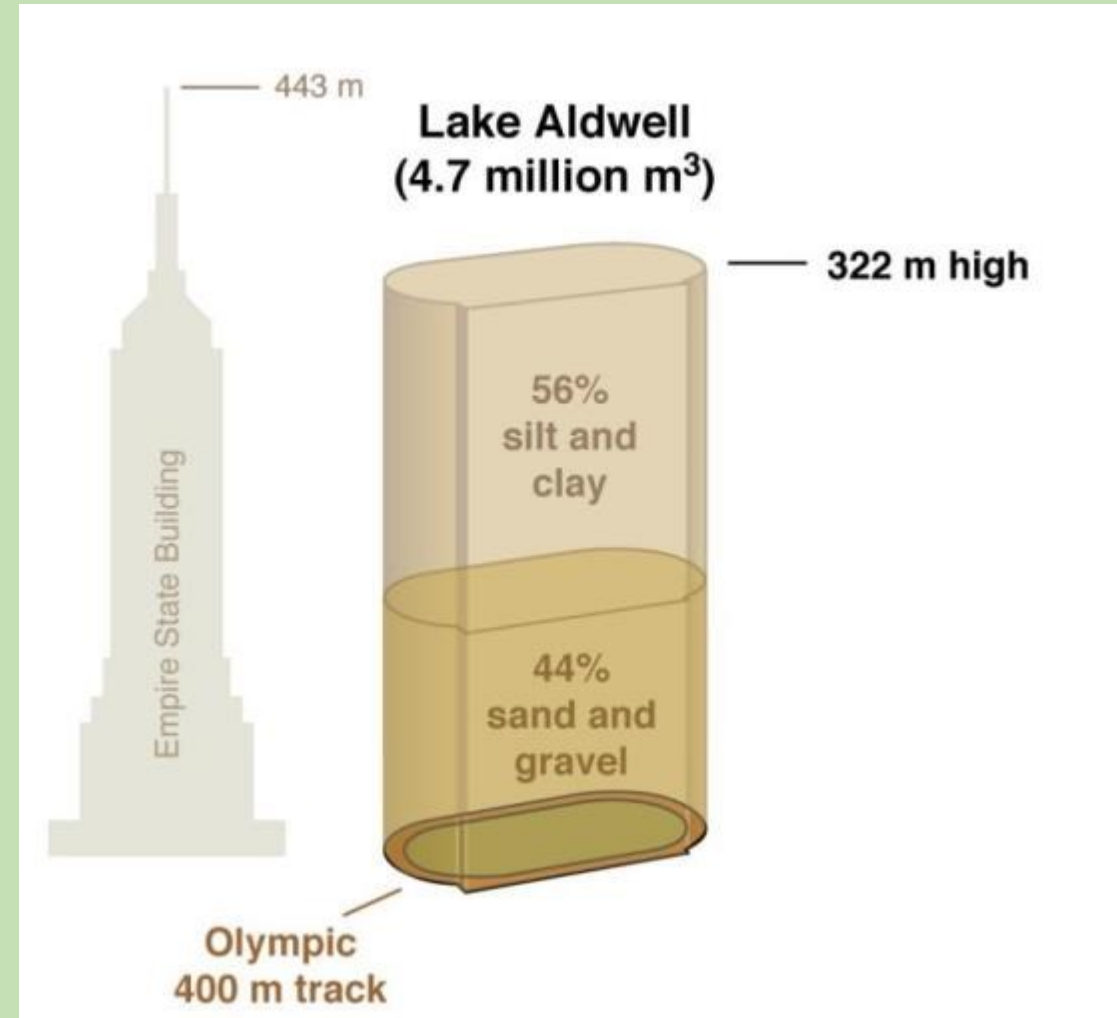


Pess et al. 2008
Pess et al. in Review

Elwha Dam removal



Elwha Webcams courtesy NPS



- Completed in 1912
- 33m concrete gravity dam

Glines Canyon Dam removal

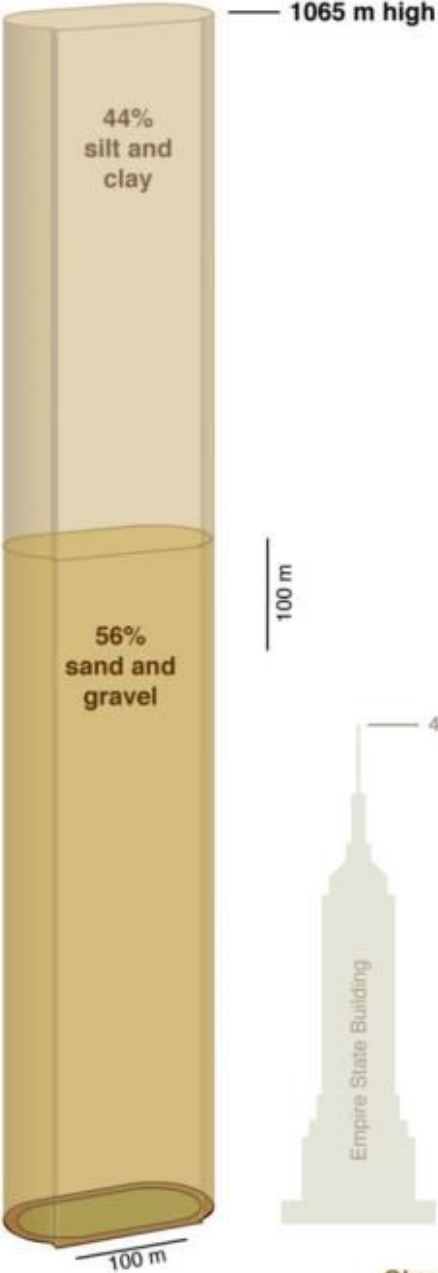
Before Dam Removal: September, 2011



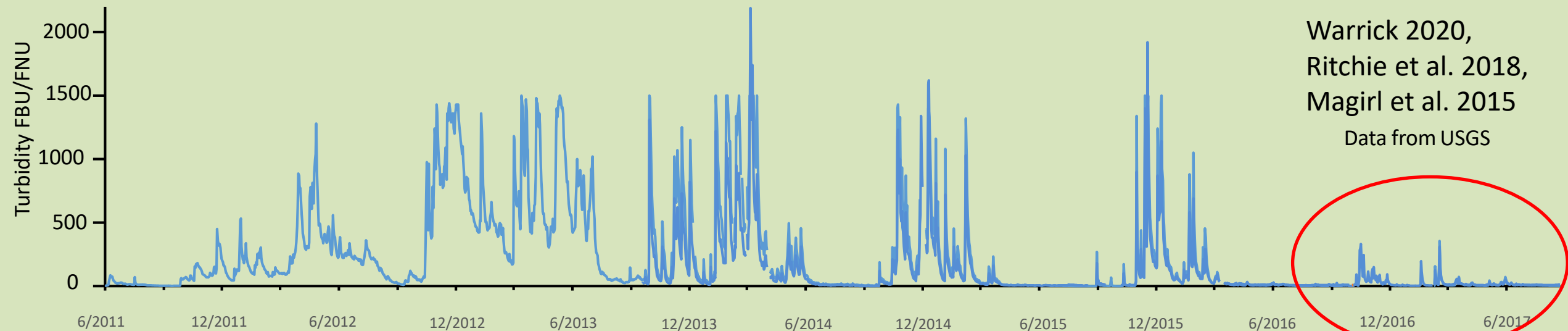
Elwha Webcams courtesy NPS

- Completed in 1927
- 64m concrete arch dam

Lake Mills
(15.6 million m³)



How did sediment supply change due to the dam removal?



How much sediment and where did it go?

~21 million m³ released

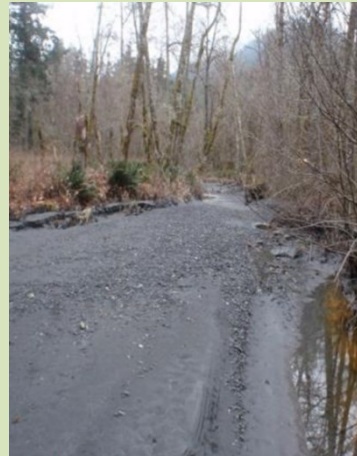


Ritchie et al. 2018

~7% stored in main stem



~3% stored in floodplain channels



~60% of sediment transported out



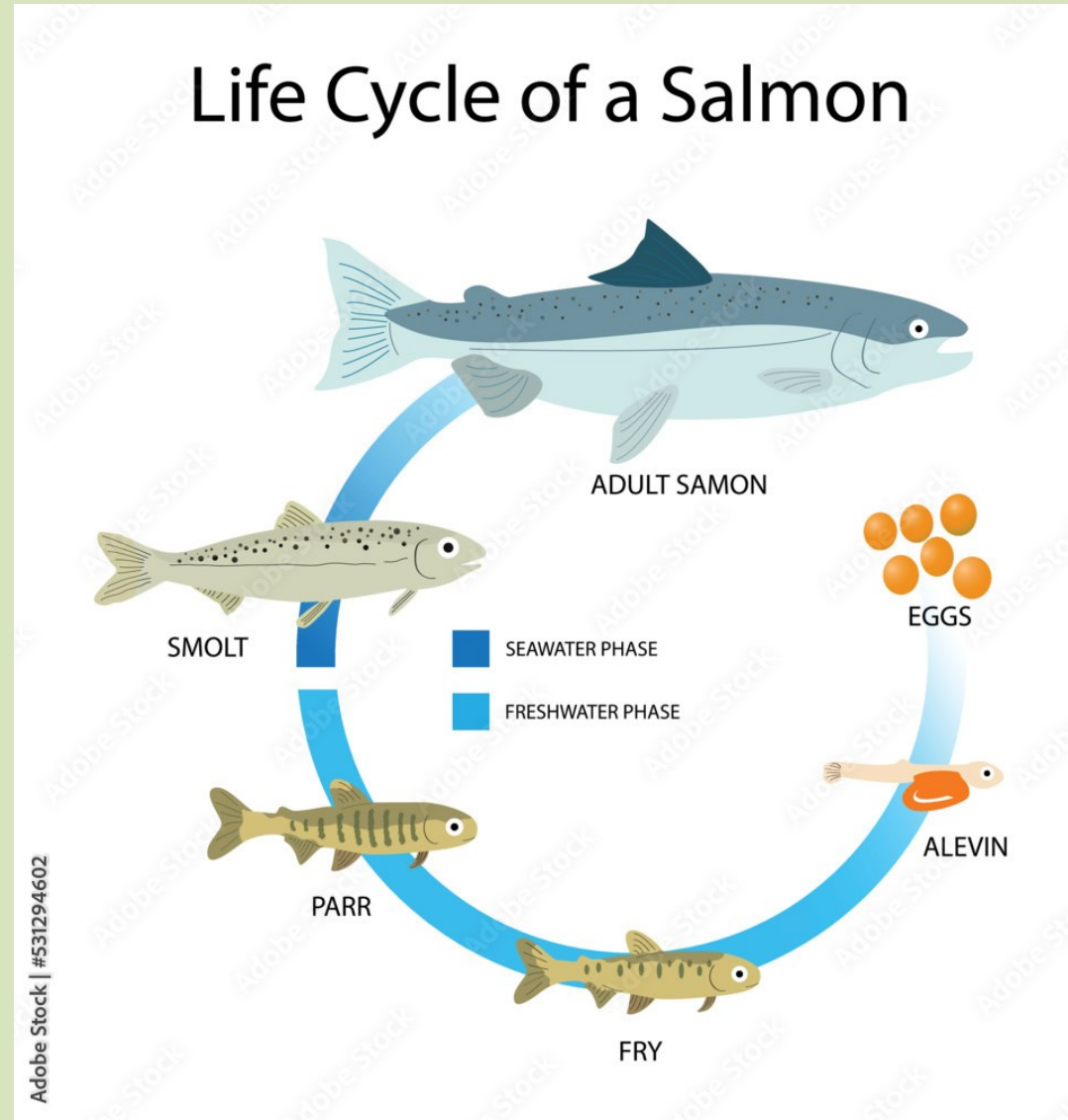
~29% deposited in nearshore



Dam removal improves shoreline for sand lance, surf smelt, flatfish, Dungeness crab, and other inverts



Changes in Elwha Fish Populations: But First.....



Changes in Elwha Fish Populations



Fish IN : Fish OUT
How Many?



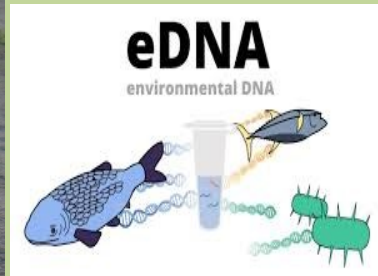
Smolt
Traps

SONAR

Distribution
Where do they Go?



Redd Surveys



eDNA
environmental DNA

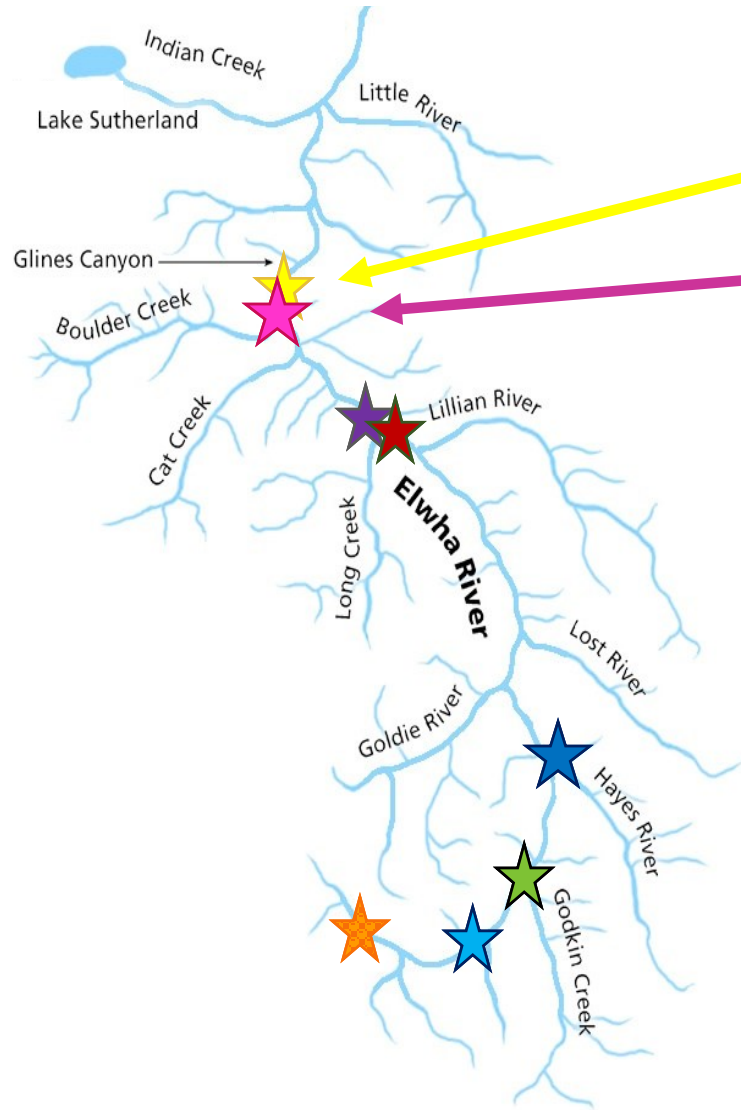


Snorkel Surveys



Radio Tracking

All species of salmon are now above the former Elwha dam locations



Chum-rkm 21.4



Pink-rkm 25.7



Coho-rkm 30.4



Sockeye-rkm 30.4



Chinook-rkm 57.8



Winter Steelhead-rkm 51.3

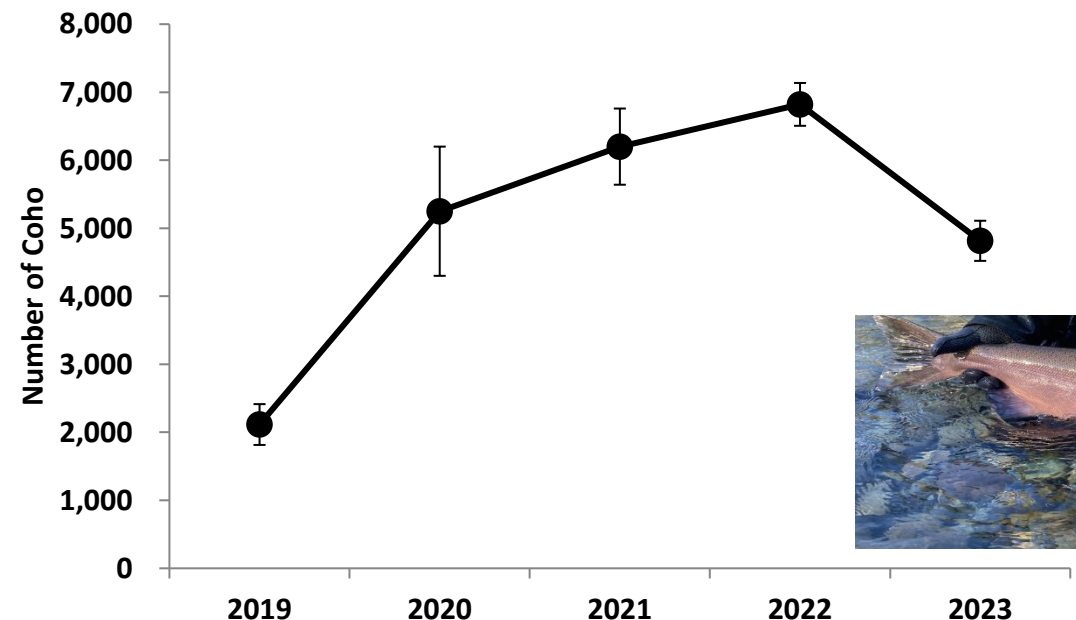
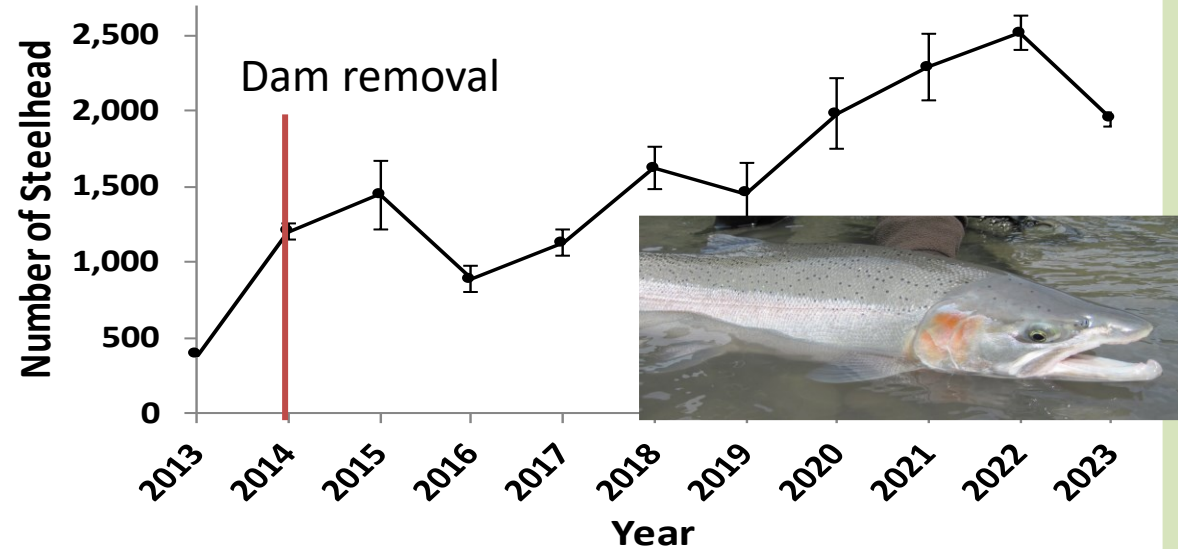
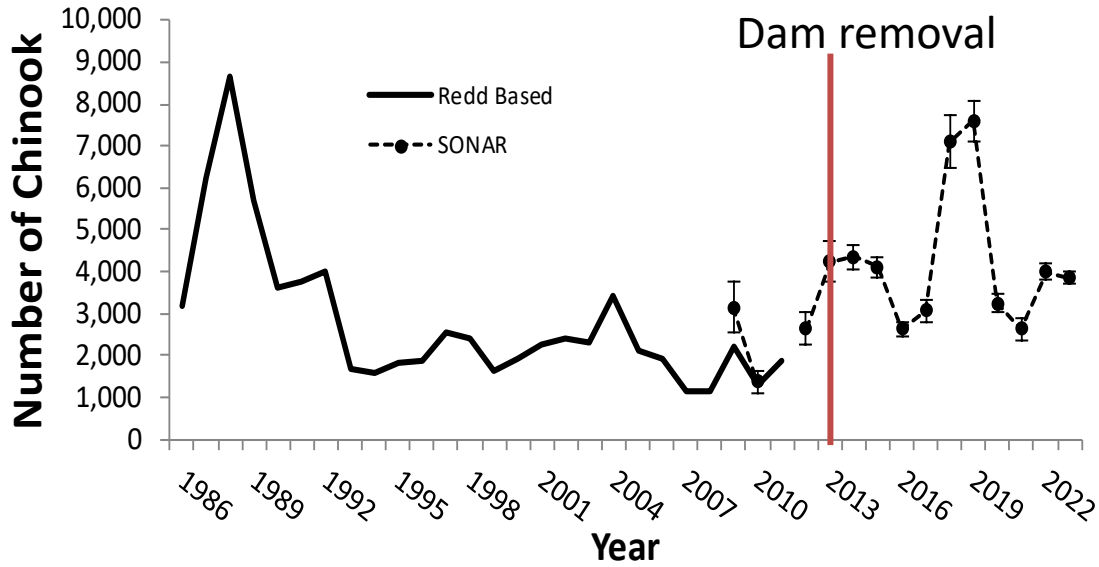
Summer Steelhead-rkm 63.3



Bull Trout-rkm 65.3

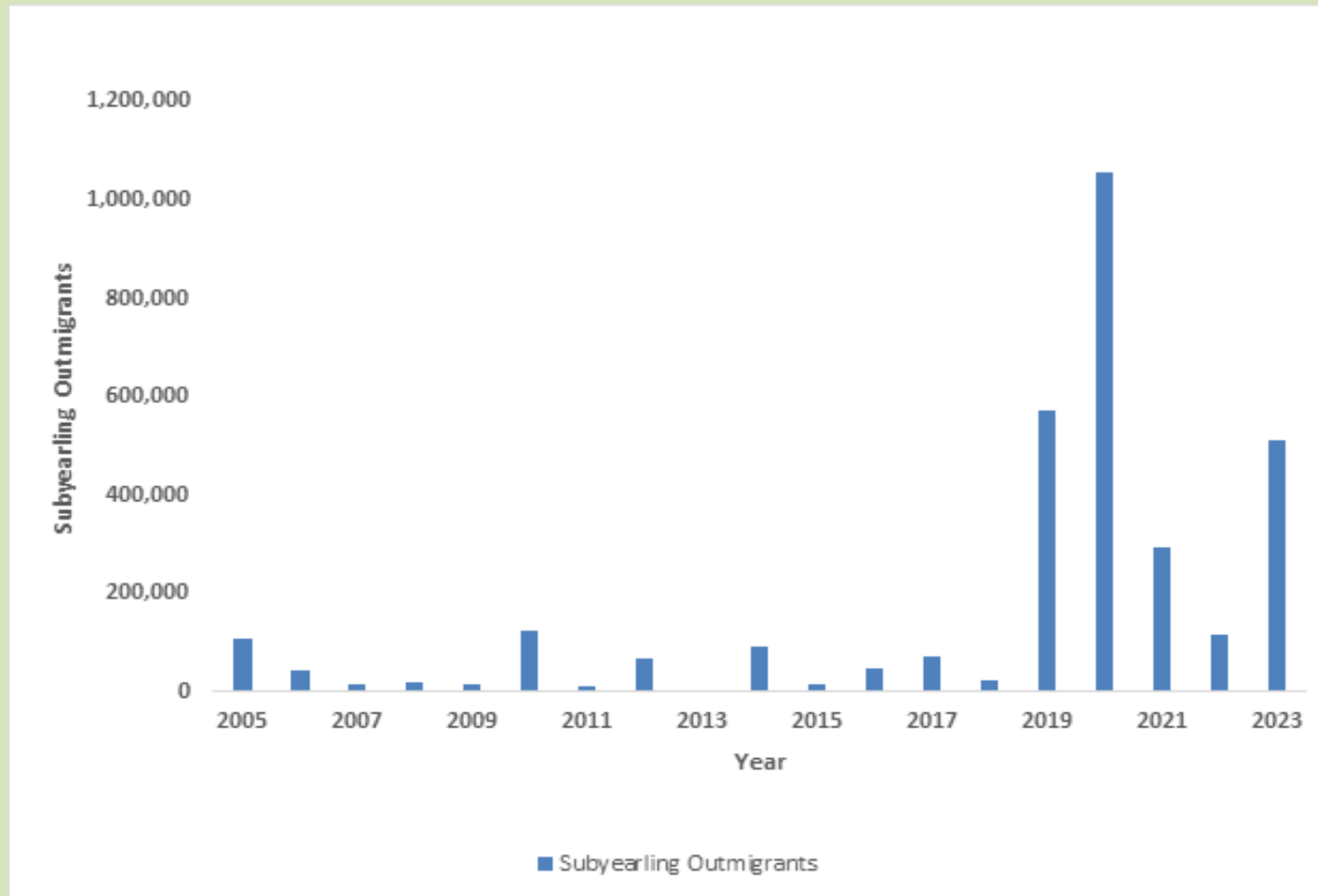
Brenkman et al. 2019,
Duda et al. 2021,
Pess et al. in review

Increasing Adult Abundance

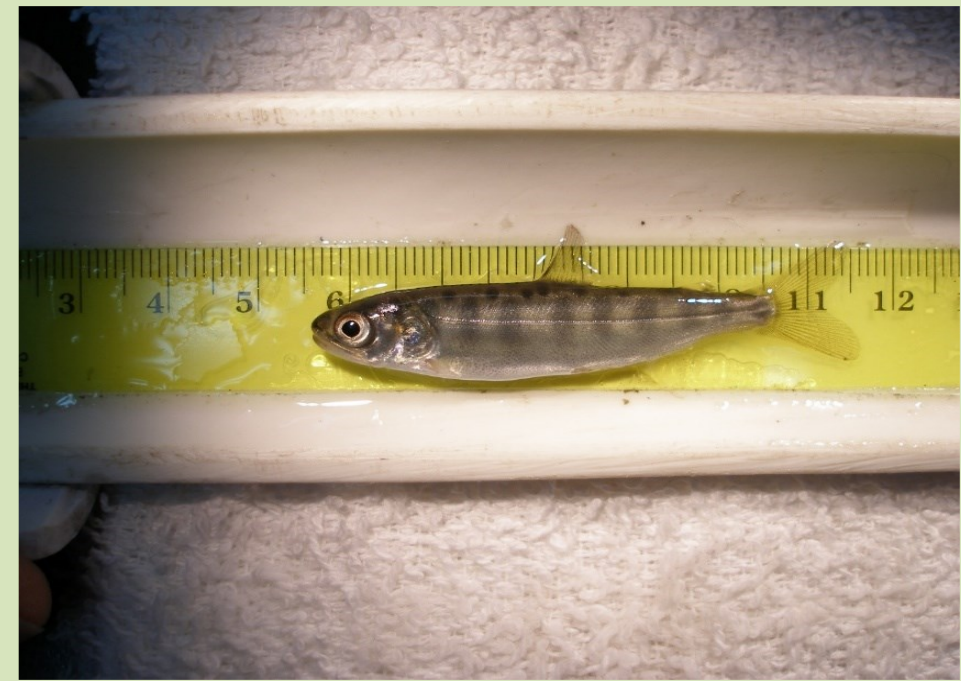


Denton et al. 2023
Pess et al. In Review

Increasing juvenile outmigrating Chinook salmon

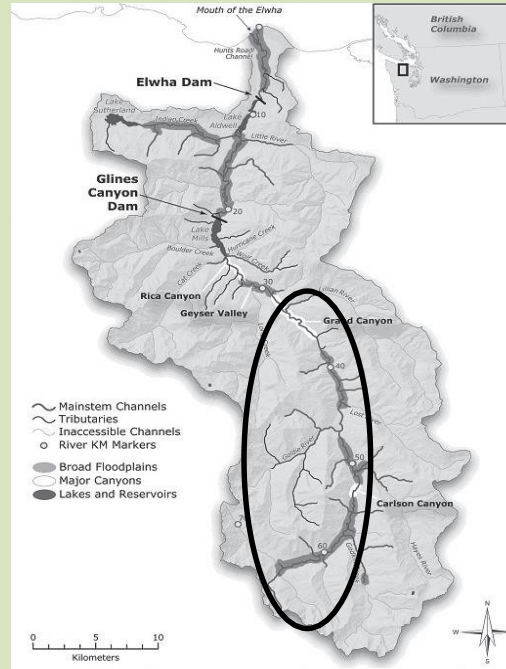
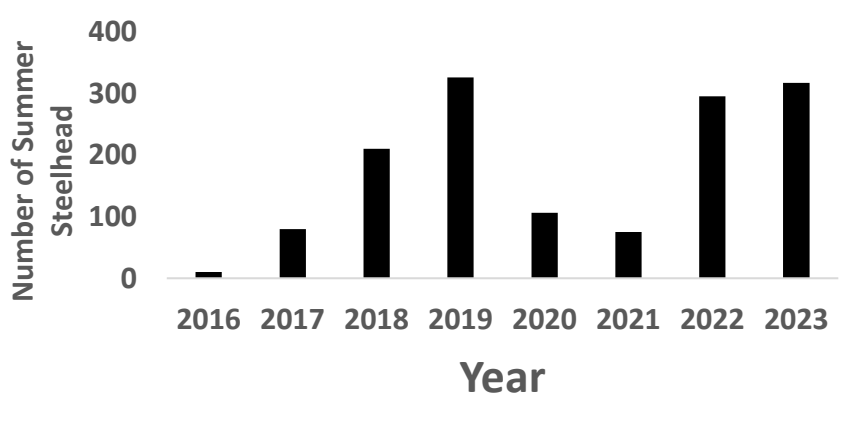


McHenry et al. 2023
Pess et al. In Review



Increased Life History Diversity

Summer Steelhead From
Upstream Resident Rainbow Trout



Bull Trout: Full river migrations
Brenkman et al, 2019



Fraik et al. 2021, Pess et al. In Review

Reemergence of Spring Chinook:
Genetic foundation is present and linked to entry timing.
McKinney et al. In Review





Sept 2012

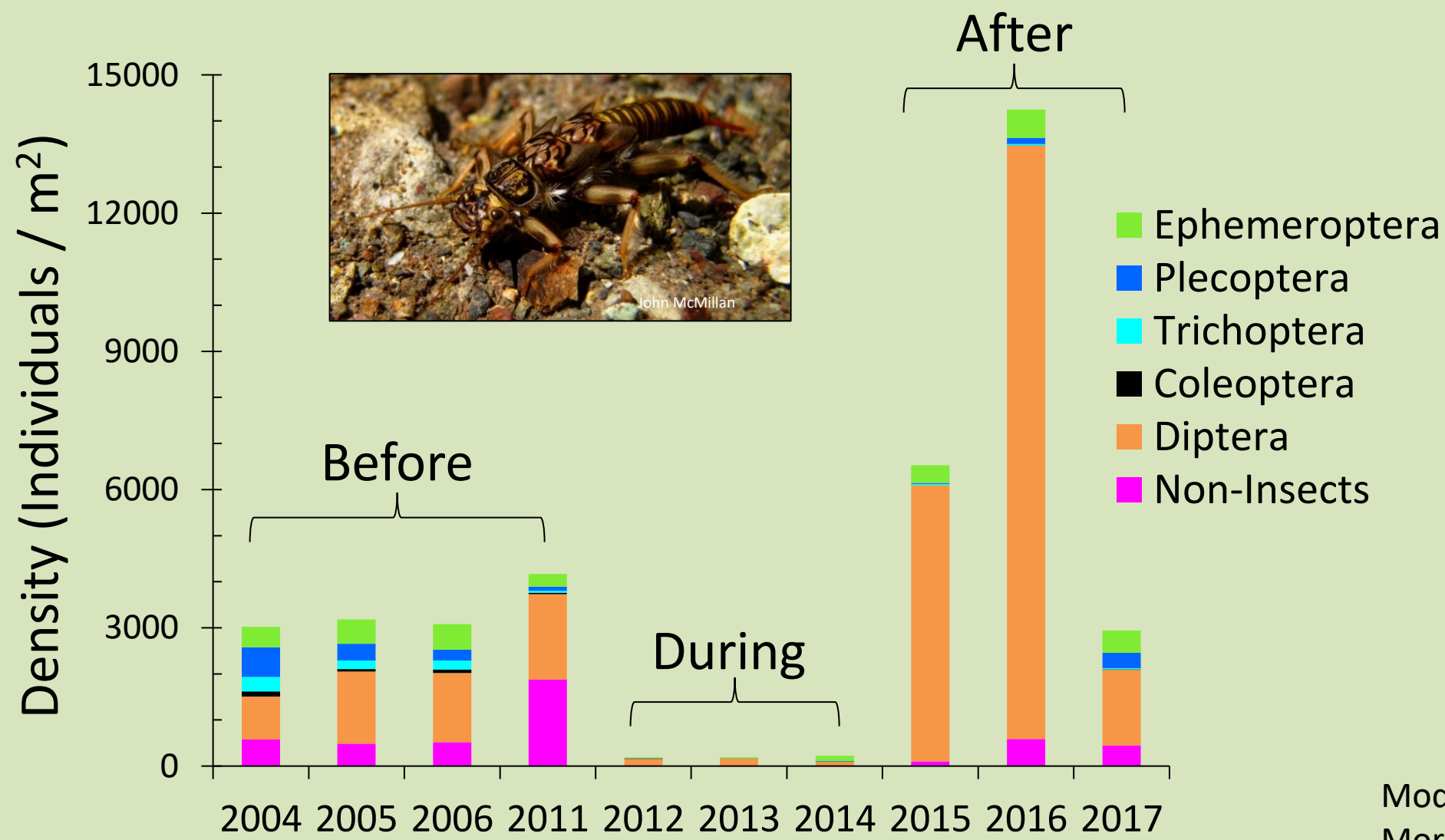
> 200 ha, > 400,000 plants, > 2,500 kg of seeds



April 2018

John Green

Changes to benthic invertebrate density below the Elwha River dams



Modified from Morley et al. 2020

Wildlife recolonization of former reservoirs



- Small mammal abundance and diversity increased with increased vegetation development
- Beavers have successfully recolonized both former reservoirs
- Deer and elk browse pressure is high but it has not impeded revegetation processes



- Dippers with access to salmon are attempting multiple broods



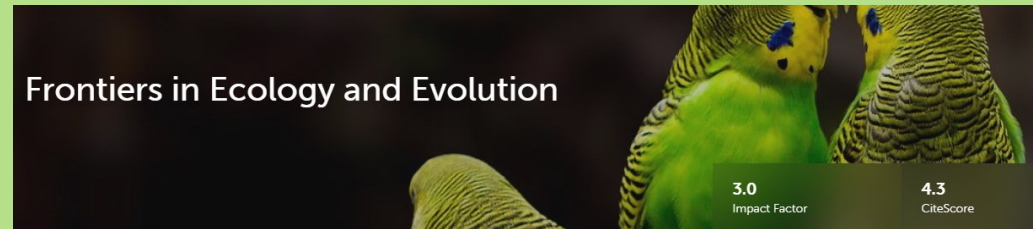
2023: First Harvest of Salmon on the Elwha since 2011

177 Coho kept by the Elwha Tribe for
Ceremonial and Subsistence
Purposes



Where to Find Additional Elwha Information

Zotero Bibliography



- Elwha Special Issue – online access
- 14 new Elwha papers published there
- More to come