Steelhead response to the removal of the Elwha River Dams

Pacific Coast Steelhead Management Conference

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Walla Walla, WA

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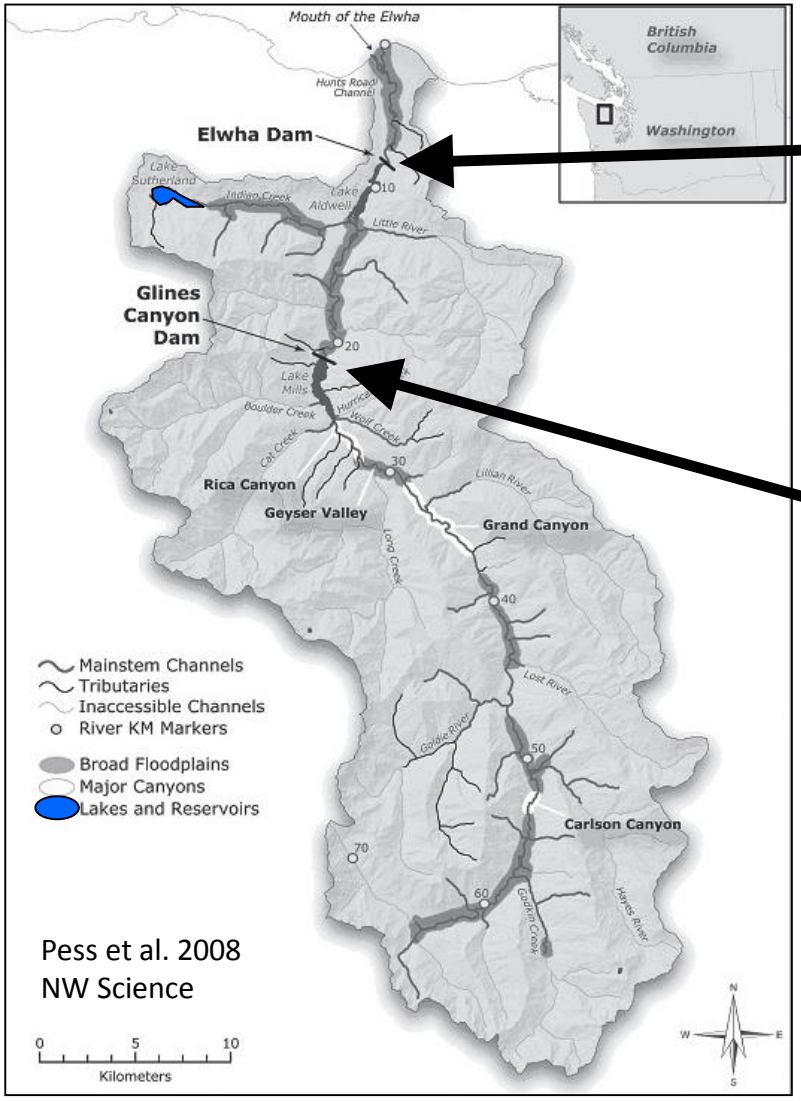
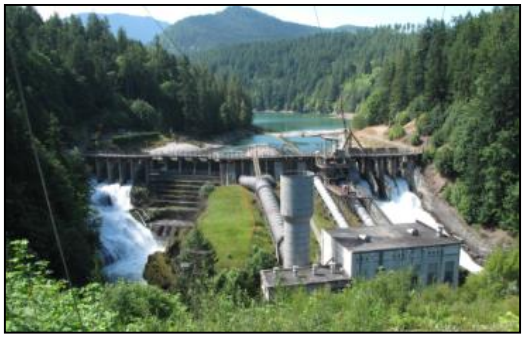
Elwha River

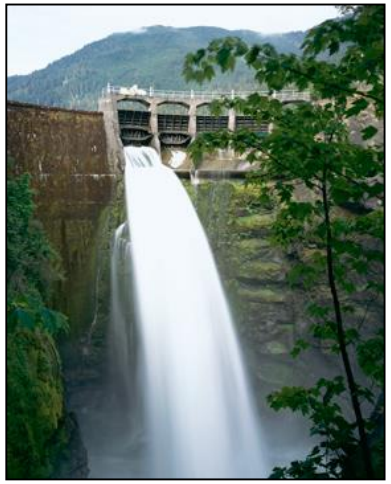


833 km^2 watershed

Elwha Dam
- built 1913
- 32 m tall
- River km 8



Glines Canyon Dam
- Built 1927
- 64 m tall
- River km 21



115 km of habitat upstream of Elwha Dam site


Photo montage compiled by George Pess
Photos from NPS time lapse camera


May 12 14 08:32:59
Photo montage compiled by George Pess
Photos from NPS time lapse camera

Sediment release

- 21 million m^3 of sediment stored in former reservoirs
  - 16 million m^3 in Lake Mills (upstream of Glines)
  - 5 million m^3 in Lake Aldwell (upstream of Elwha)

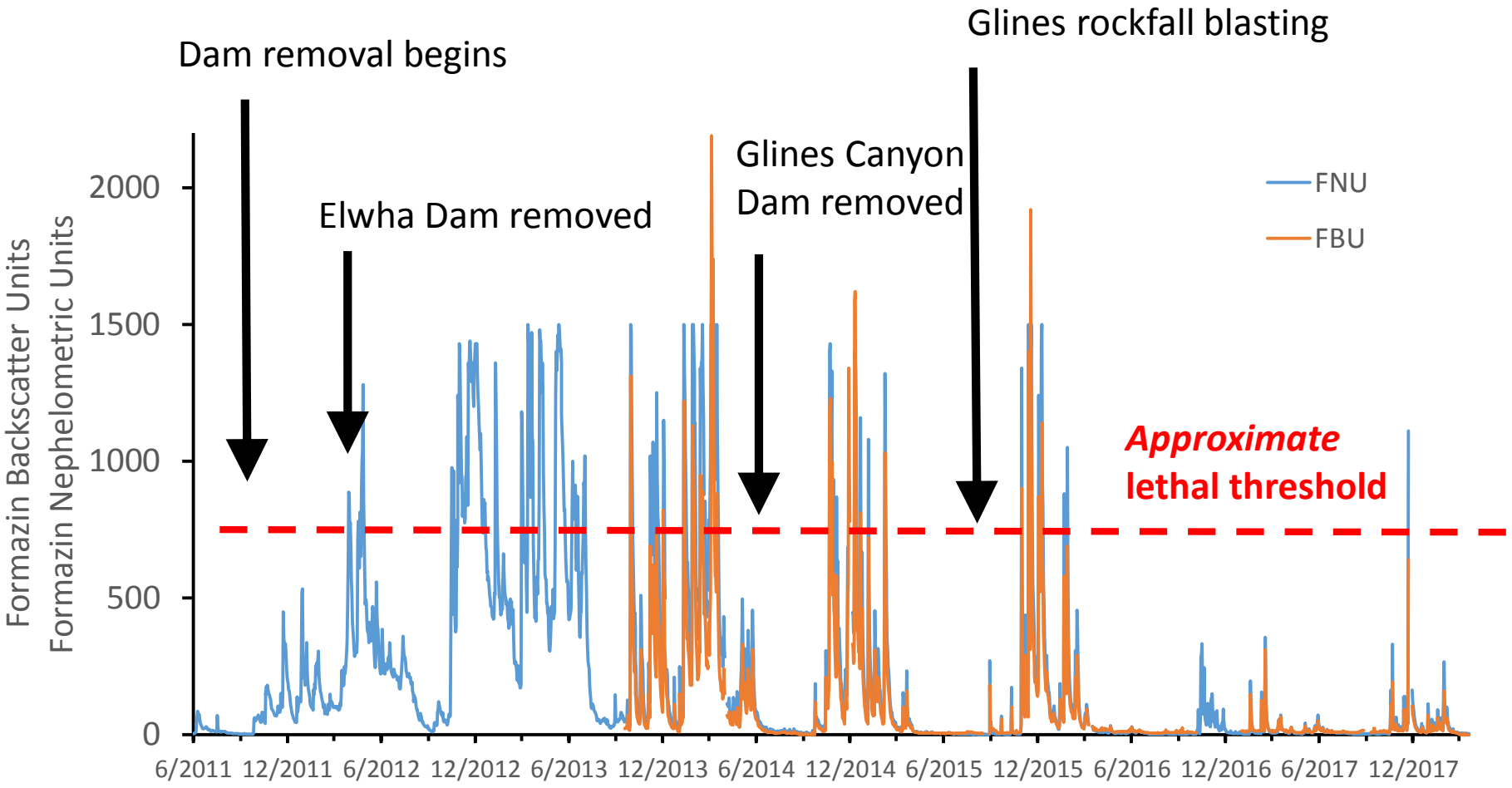
- Approximately two-thirds evacuated from former reservoirs
  - 90% delivered to coastal habitats
  - Pools filled, 1.0 – 1.5 m increase in river channel height downstream of dams during peak of sediment wave

- At this point, erosion from reservoirs mostly complete

- Greatest remaining impact to salmon habitat in floodplain channels, not mainstem

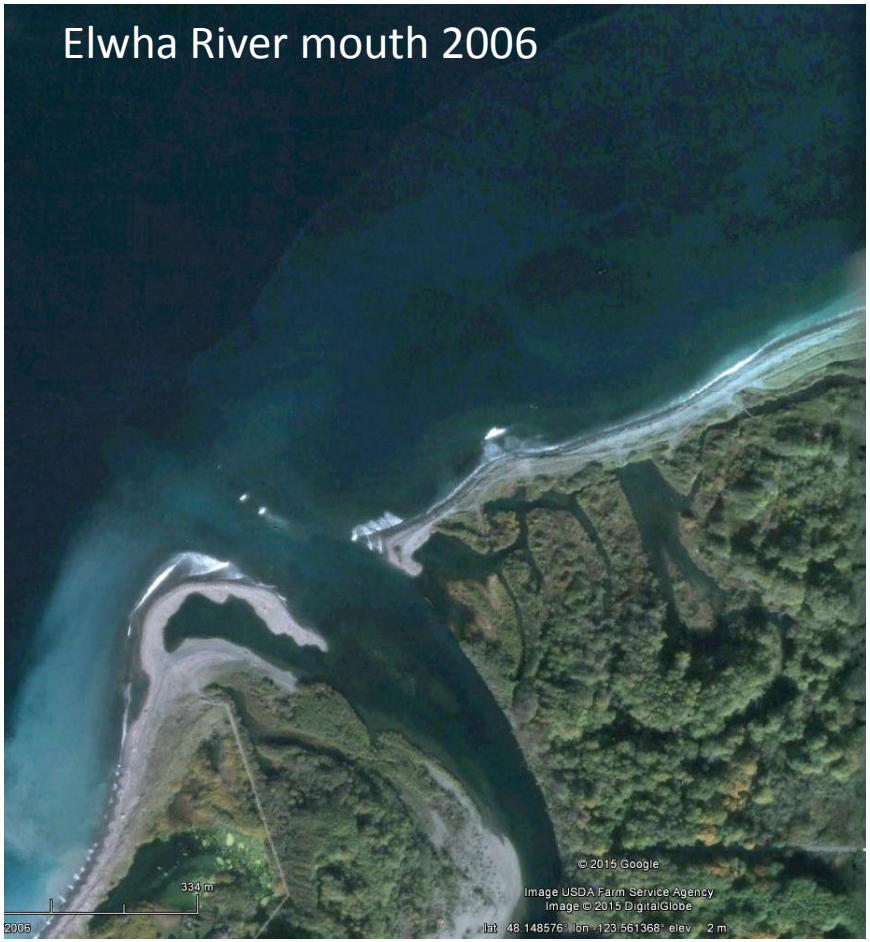
Lake Mills reservoir, Aug 28 2014
Andy Ritchie, NPS/USGS

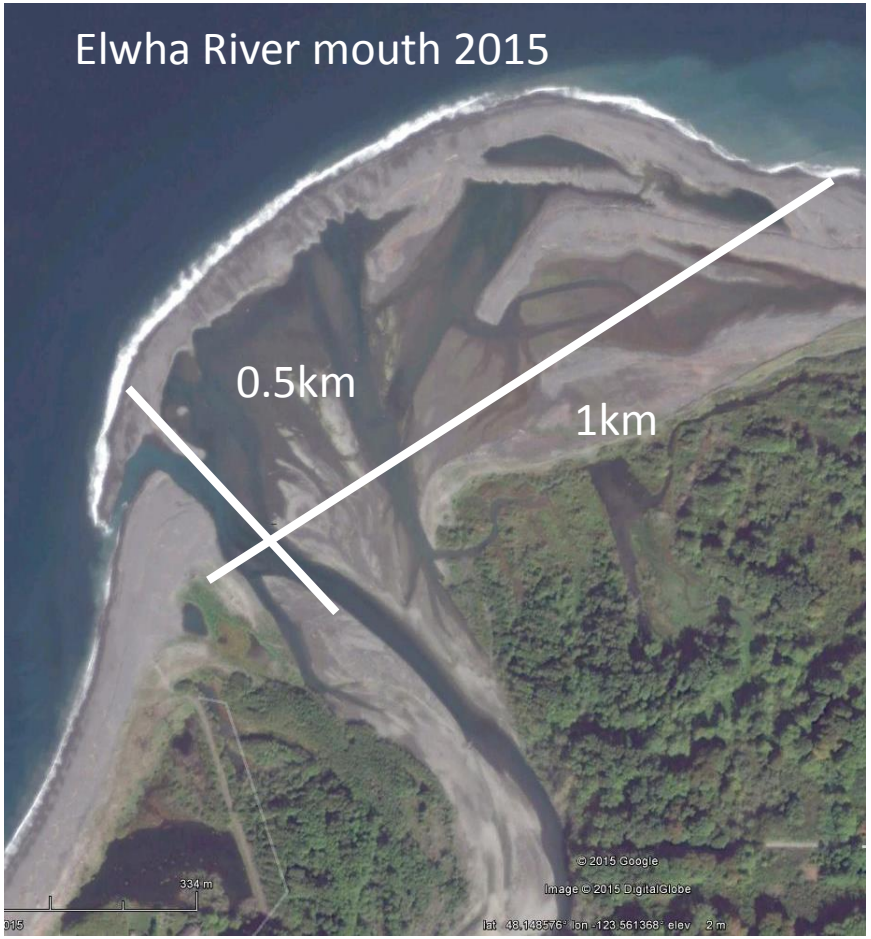
Turbidity



Data from USGS

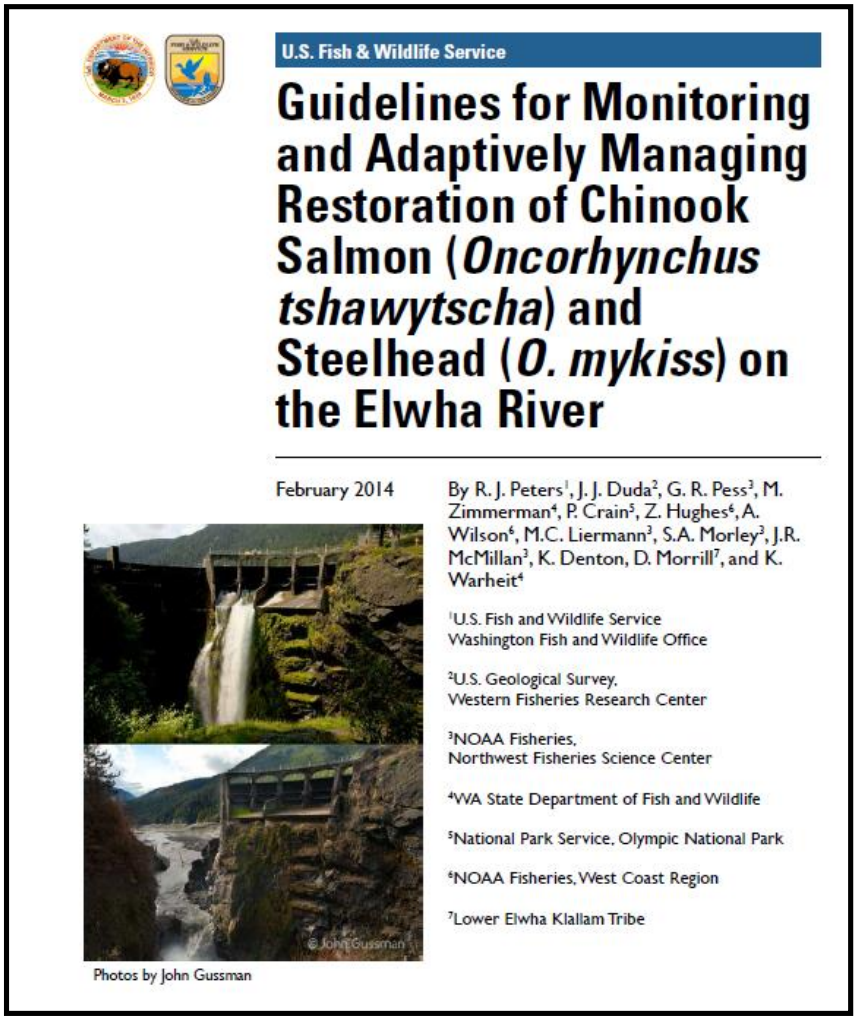
Elwha River mouth, estuary & nearshore





Slide courtesy of George Pess, NOAA

Monitoring and Adaptive Management



U.S. Fish & Wildlife Service

Guidelines for Monitoring and Adaptively Managing Restoration of Chinook Salmon (*Oncorhynchus tshawytscha*) and Steelhead (*O. mykiss*) on the Elwha River

February 2014

By R. J. Peters[1], J. J. Duda[2], G. R. Pess[3], M. Zimmerman[4], P. Crain[5], Z. Hughes[6], A. Wilson[6], M.C. Liermann[3], S.A. Morley[3], J.R. McMillan[3], K. Denton, D. Morrill[7], and K. Warheit[4]

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[7]Lower Elwha Klallam Tribe

Photos by John Gussman

1. Preservation
Prevent extinction when river conditions at times are lethal to fish

2. Recolonization
Ensure continual access to habitat above former dam sites with some successful spawning

3. Local Adaptation
Promote evolution of traits advantageous for natural river, increase life history diversity

4. Viable Natural Population
Self-sustaining natural population productive enough to withstand harvest without hatchery supplementation

Triggers dictate movement between phases

Species: Steelhead
Oncorhynchus mykiss

	PHASE	Preservation	Recolonization	Local Adaptation	Viable Natural Population
	GOALS	Prevent extinction and preserve the existing genetic and life history diversity of native salmonid populations until fish passage is restored and water turbidity is determined to be non-lethal to fish in the river	Salmonids are continually accessing habitats above the old dam sites with some fish successfully spawning and producing smolts	Maintain or increase life history diversity of natural-spawning populations through local adaptation to the Elwha River ecosystem until minimum levels of spawner abundance, productivity, and distribution are met	Ensure that self-sustaining and exploitable population levels continue once desired values for all VSP and habitat parameters have been met and hatchery programs are no longer needed for protection, recovery, or exploitation
Abundance	Natural Spawners	<196	>196 or <969	>969 or <2,619	>2,619
Weir, Sonar, foot and boat surveys, aerial surveys	Spawner Escapement duration	4 yrs	4 yrs	4 yrs	4 yrs
Managing for pHOS	pNOS (natural-origin spawner)	*	0.90	1.0	1.0
Otoliths, CWT, Scale samples	pHOS(proportion hatchery-origin spawner)	*	0.10	0	0
Productivity	#Juvenile migrants/female	75	75	75	75
Weir, Sonar, Spawner Surveys, Smolt trap, otoliths, cwt, harvest	# Pre-fishing recruits/spawner (h+n)	>1.0	> 1.0	> 1.0	> 1.0
	#Spawners/spawner (h+n)	>1.0	> 1.0	> 1.0	> 1.0
	#Pre-fishing recruits/spawner (n)	*	*	*	*
	#Spawners/spawner (n)	*	>1.0	>1.0	~1.0
	Productivity trend	4 yrs	4 yrs	4 yrs	4 yrs
Spatial Distribution	Extent	Above Elwha Dam: 9% intrinsic poetntial	Above Elwha Dam: 37% of Intrinsic Potential	Above Glines Canyon Dam: 74% of Intrinsic Potential	100% of Intrinsic Potential
Spawner Surveys, Radio-telemetry, Snorkel Surveys	Barriers	No migration barriers exist below Elwha Dam	No 'artificial' migration barriers exist in Aldwell reach	No 'artificial' migration barriers exist in Mills reach	No 'artificial' barriers exist within intrinsic Potential
Diversity	Entry timing variance	n/a - data collection	0.5 days/yr	0.5 days/yr	0.5 days/yr
Sonar, spawner surveys	Entry timing	Fish returning in February	Fish returning in January	Fish returning in December	No change from previous

Elwha hatchery steelhead program

- **Goal:** conservation of Elwha native steelhead population
- Current program is integrated broodstock management
- Eggs and fry collected 2005 – 2011, raised to reproductive maturity and spawned in captivity
- Currently switching from captive broodstock to adult returns to river
- Production goal = 175,000 age-2 smolts
    - Average release 2011 – 2016 = 141,935 smolts
    - Release site located at river km 3

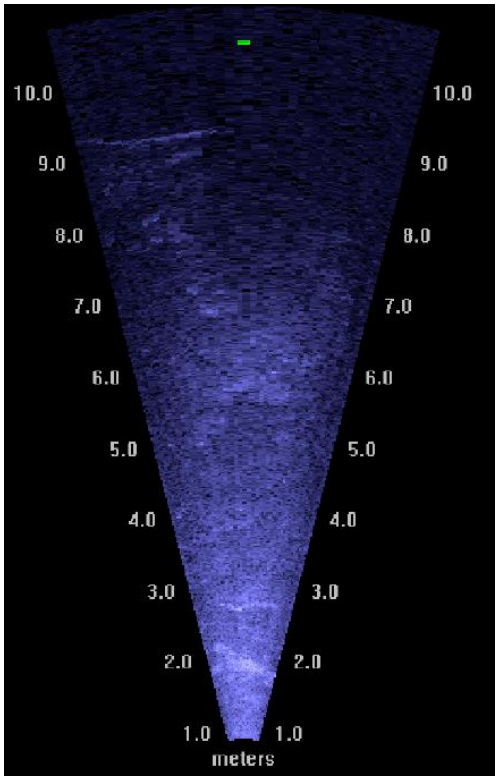
Photo: John Mahan

Sources:
Lower Elwha Klallam Tribe 2012
Steelhead Hatchery Genetic Management Plan (HGMP)

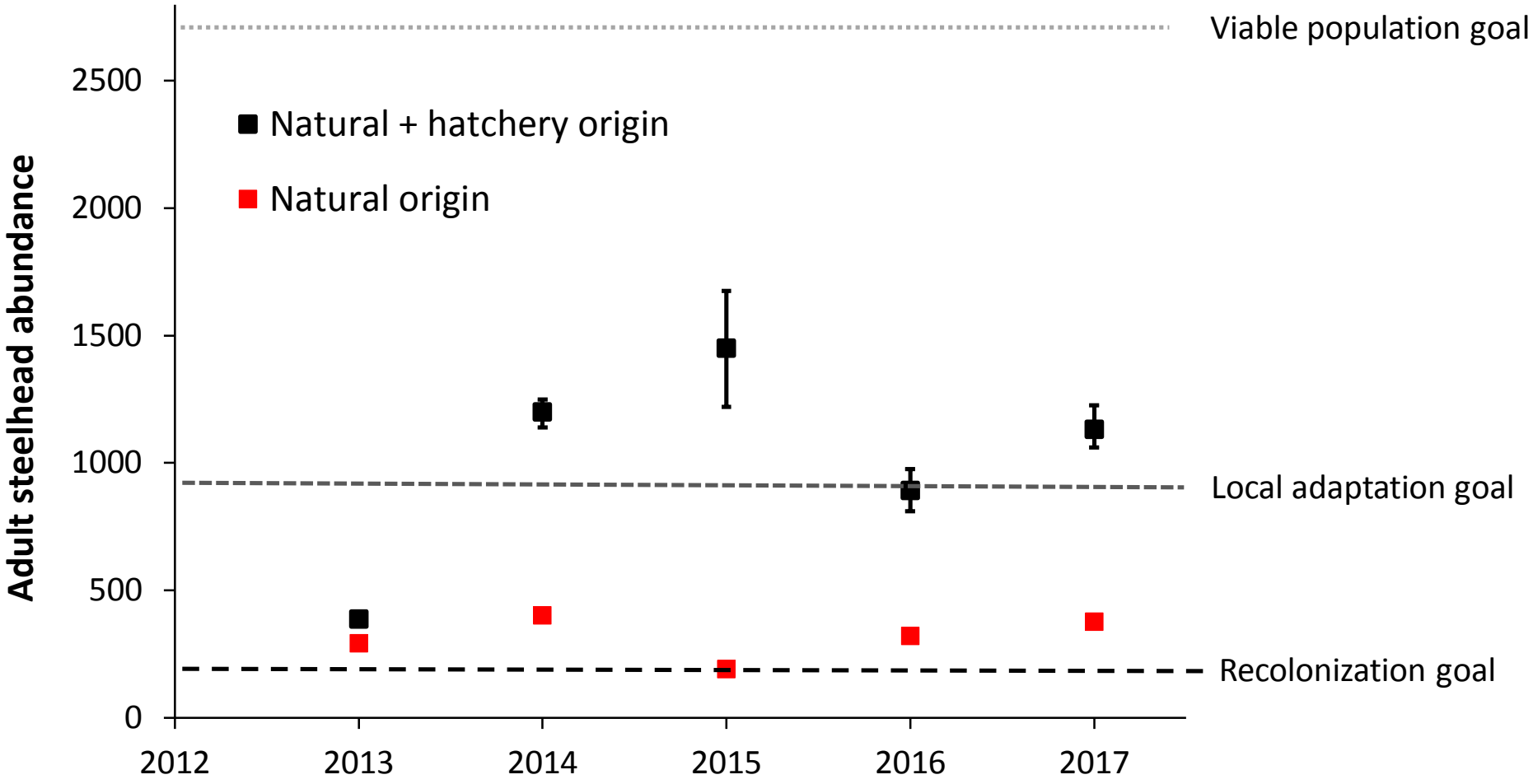
Lower Elwha Klallam Tribe HGMP Annual reports

Abundance

Estimate abundance using SONAR



Steelhead SONAR abundance estimate



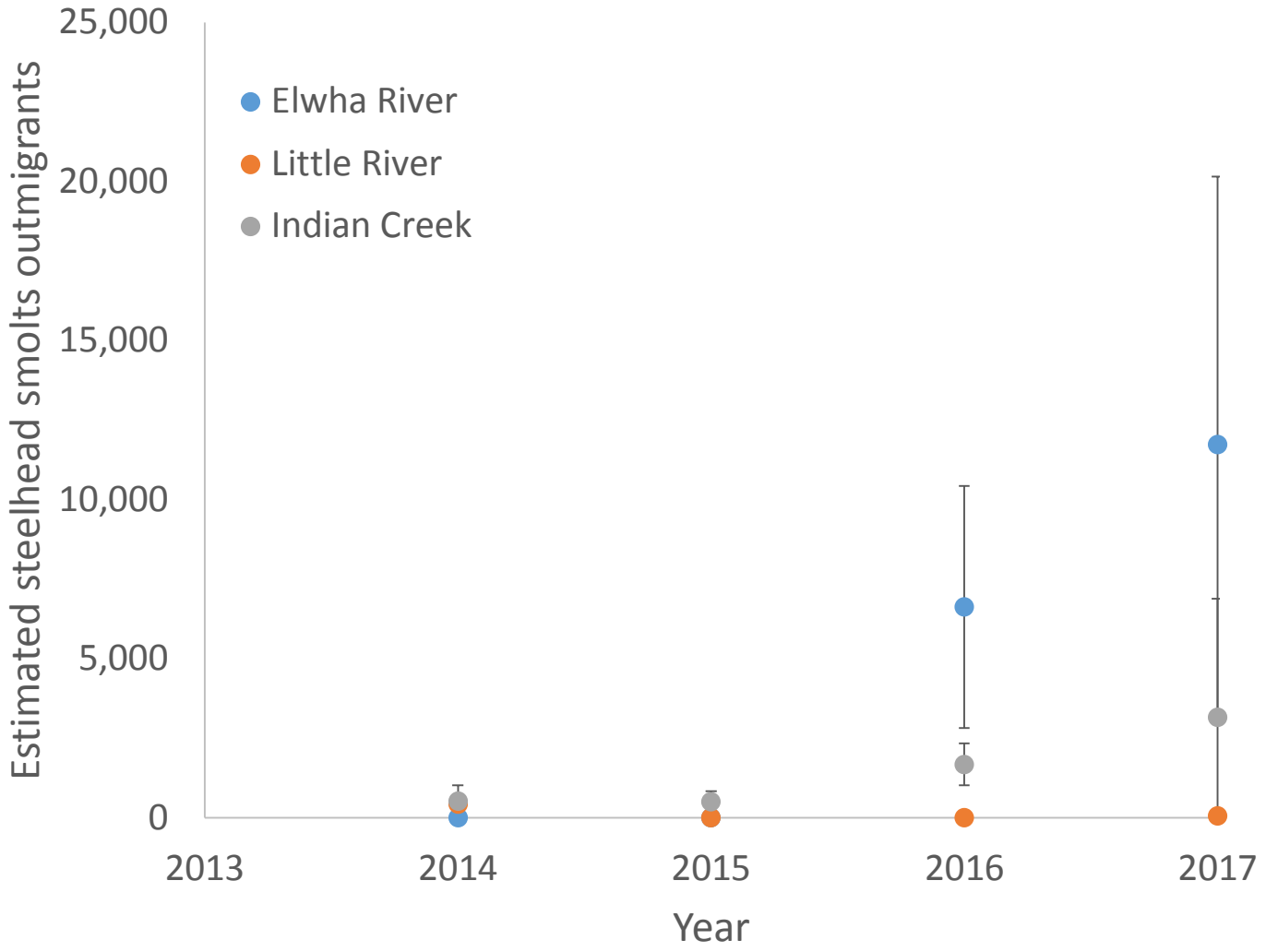
Information for hatchery and natural origin steelhead was taken during species composition collections. The intent of species composition was not designed to estimate such proportions but is more of an indicator.

Productivity

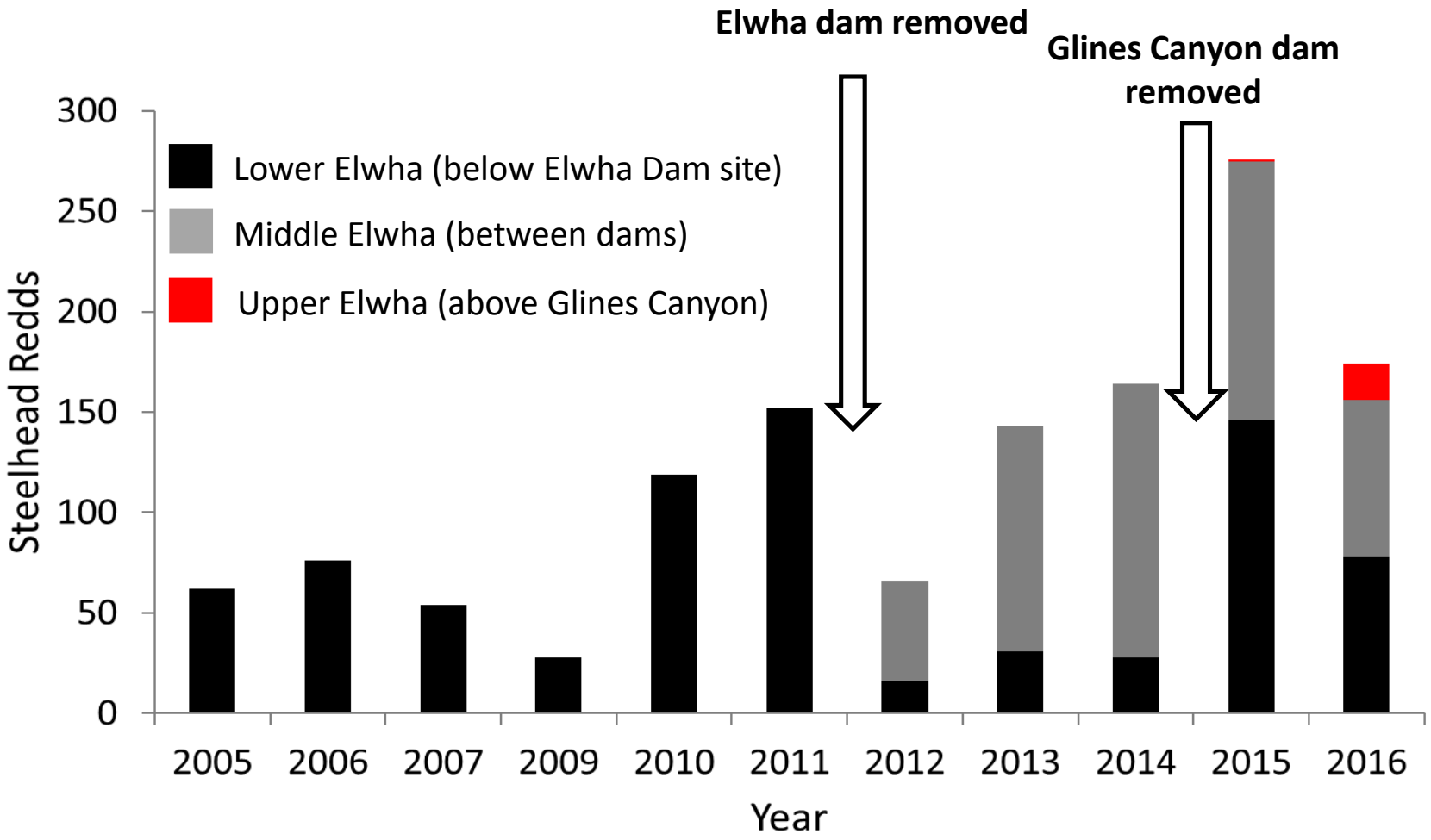
Elwha River screw trap locations

Smolt Productivity

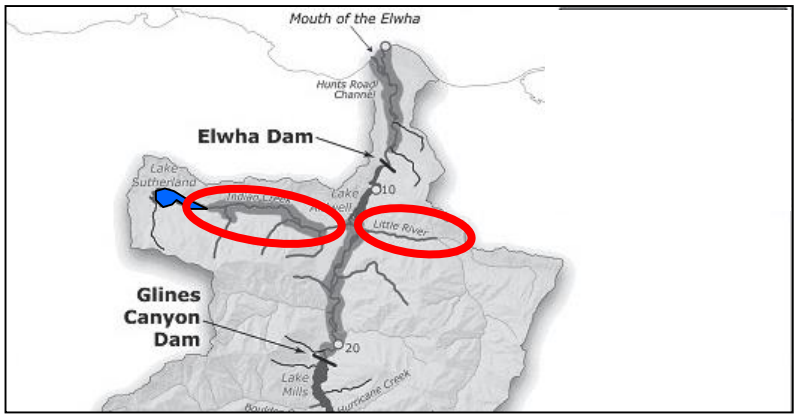
Elwha River, Indian Creek, & Little River Steelhead smolts



Spatial distribution



Natural and Assisted Recolonization



Year	Indian Creek		Little River	
	Fish relocated	Redds	Fish relocated	Redds
2012	11	9	35	43
2013	0	24	88	47
2014	0	36	59	73
2015	0	6	0	36
2016	34	7	0	28
2017	0	16	0	37

Data source: McMillan et al. 2018
Summary of 2017 winter steelhead surveys in the Elwha River

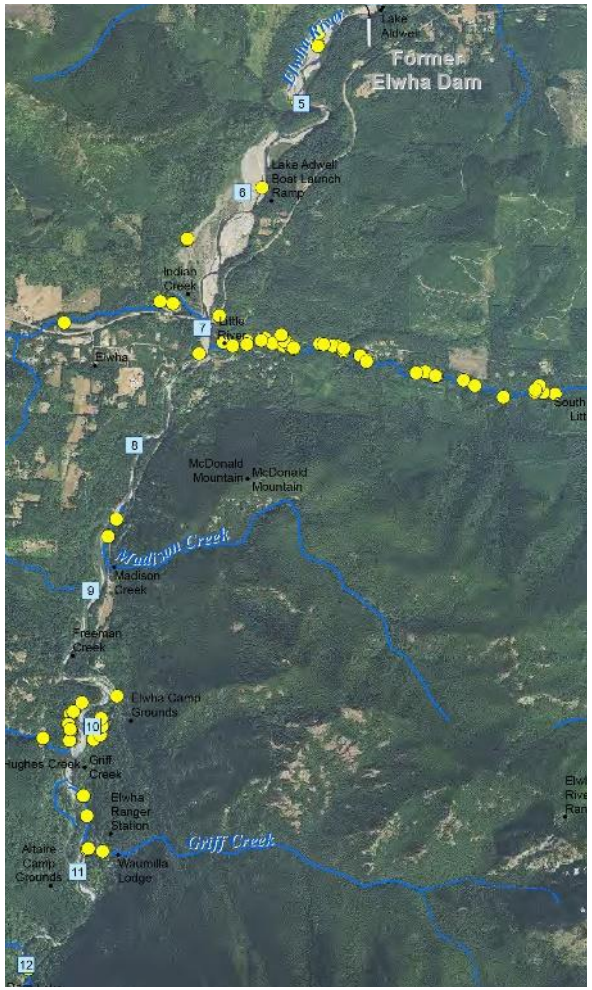
Note – 25% of Indian Creek and 98% of Little River are surveyed for spawners. Number of redds is not representative of the total number of spawners in each creek

Spatial distribution

Steelhead spawning distribution 2016

Mouth to Elwha Dam

Elwha Dam to Glines Canyon



Upstream of Glines Canyon

Source: McMillan et al 2017

Spatial distribution of hatchery mark rates

Year	River km	Hatchery-origin	Natural-origin
Lower Elwha below hatchery	0 - 3	202	28
Lower Elwha above hatchery	3 - 8	33	14
Middle Elwha	8 - 21	6	11
Upper Elwha	21 +	0	3

Photo: Sam Brenkman

- Netting from SONAR and radio telemetry projects
- Data represent all encounters 2014 – 2017
- Information for hatchery and natural origin steelhead was taken during species composition collections. The intent of species composition was not designed to estimate such proportions but is more of an indicator.

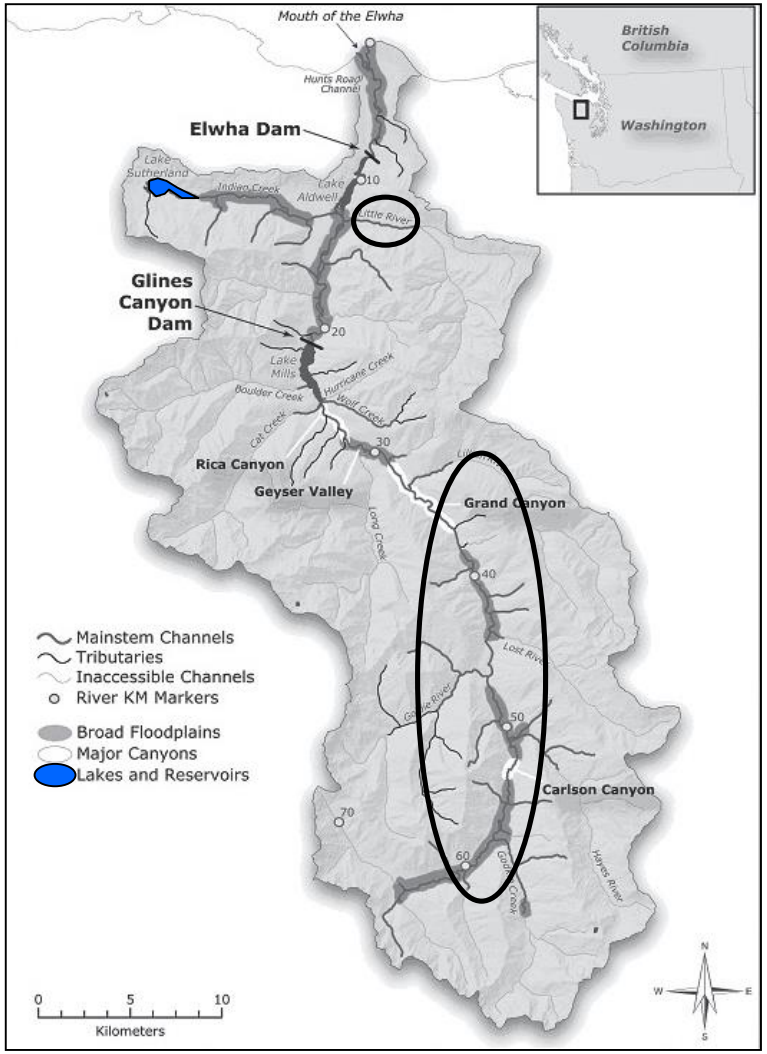
Former Glines Canyon Dam rockfall blast September/October 2015

Photos courtesy of Andy Ritchie , NPS

Diversity

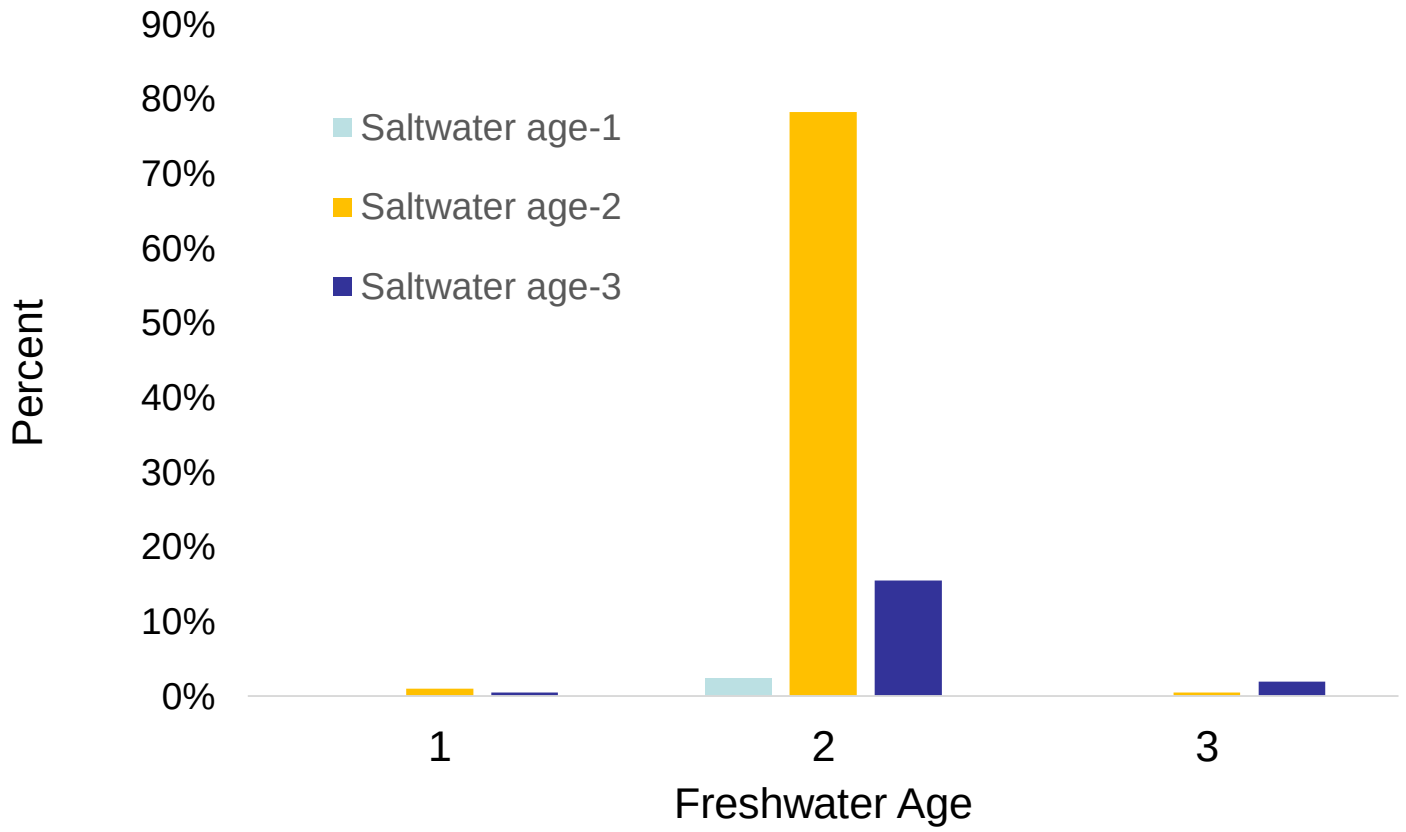
Summer run steelhead observations

- Summer steelhead first observed in newly accessible habitat Oct 2013
- N = 72 counted during backcountry snorkel survey in September 2017 covering approximately 20 river km



Diversity

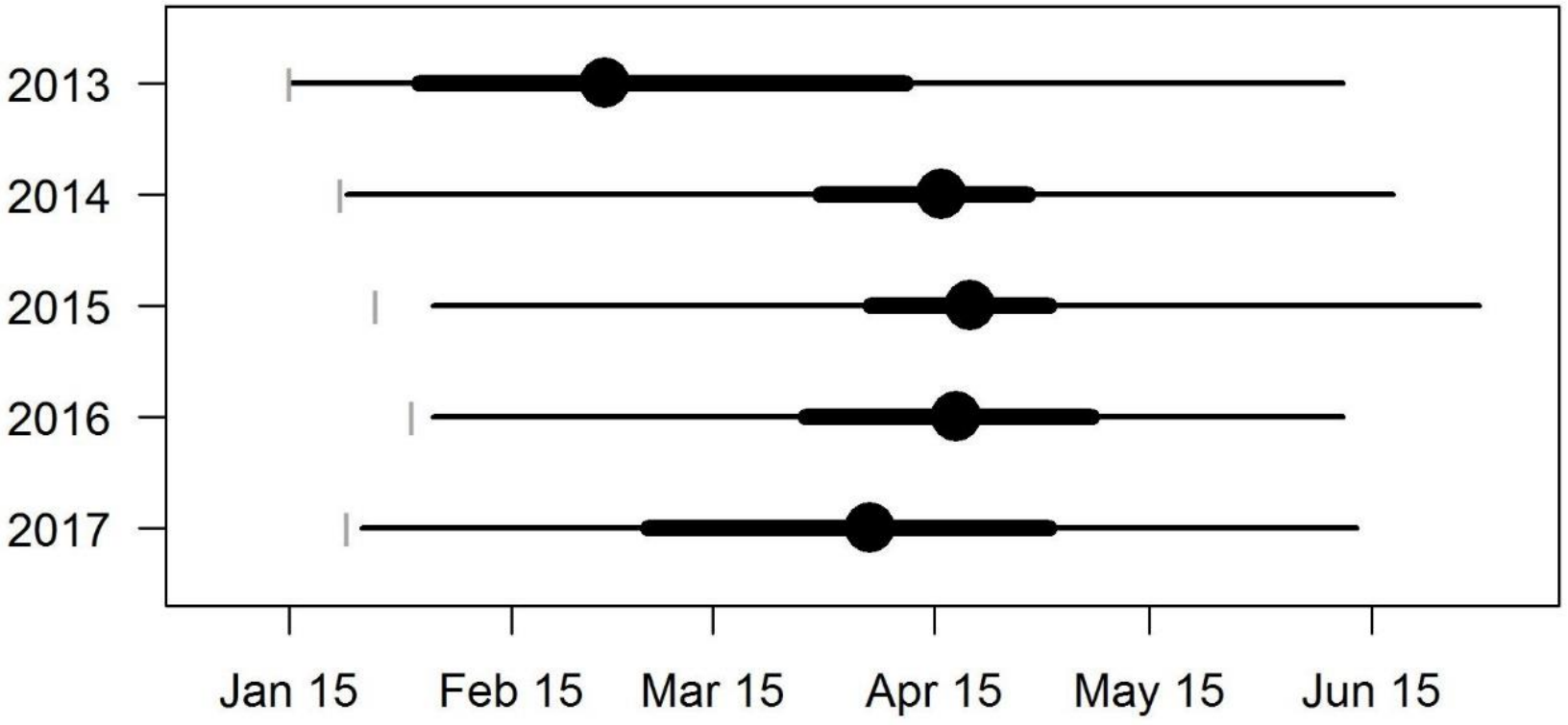
Age structure determined from N = 207 adult steelhead



N = 9 distinct anadromous life history forms, accounting for repeat spawners

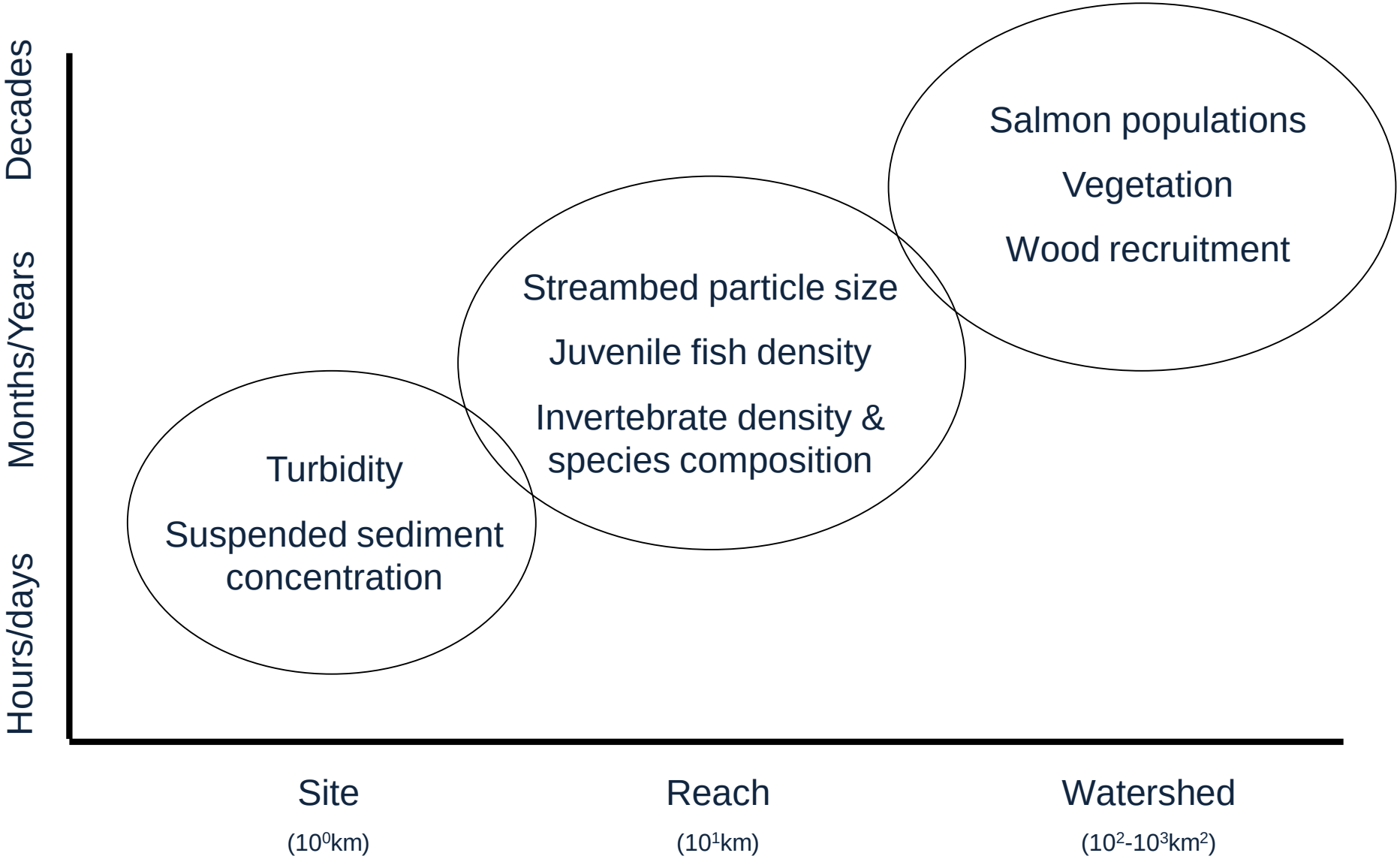
Diversity

Winter-run entry timing



Source:
Denton et al. 2018
2017 SONAR Annual Report

How long will recovery take?



Outlook for the future

- **Encouraging signs:** fish accessing areas upstream of dams, massive physical disturbance tapering off
- Steelhead populations far short of long term recovery goals
- First step is to ensure colonists reach newly accessible spawning and rearing habitats
- Interagency collaborative monitoring effort intended to adaptively manage Elwha fish populations
- Unique opportunity for salmon recovery

Thank you