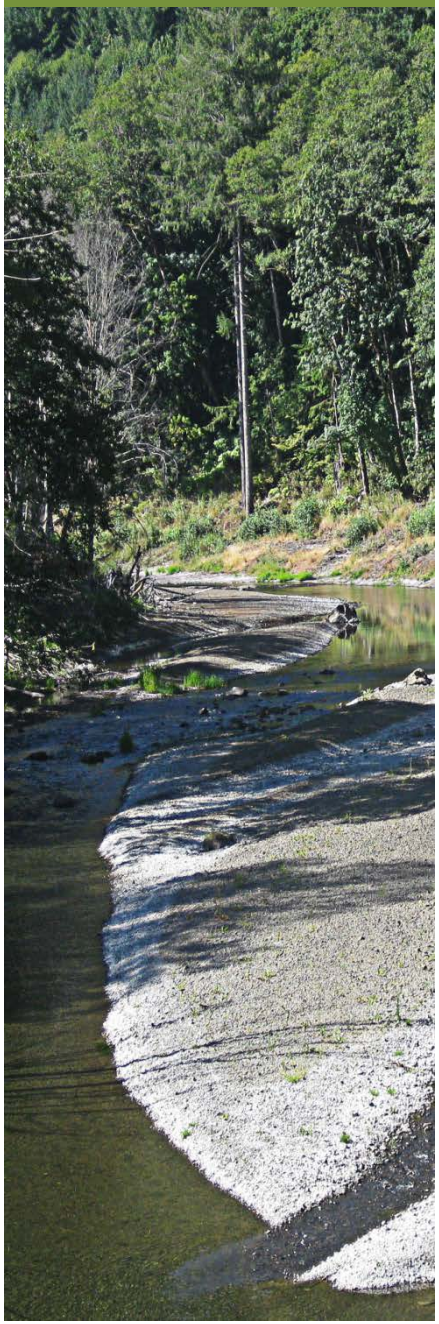
Chehalis Basin Strategy: Reducing Flood Damage and Enhancing Aquatic Species

Aquatic Species Enhancement Plan

Technical Committee Meeting
Olympia, Washington
May 7, 2014



Preliminary Results - Effects of Flood Retention Alternatives on Aquatic Species

- Background information and biological context
- Salmon
  - Ecosystem Diagnosis & Treatment (EDT) model results
  - Shiraz model results
- Other fish
- Non-fish
- Next steps

Background Information – Selected Species

- 24 key species modeled
  - Salmon (EDT and Shiraz) – 4
  - Other fish – 11
  - Non-fish – 7
  - Exotics – 2 (three additional species considered stressors)

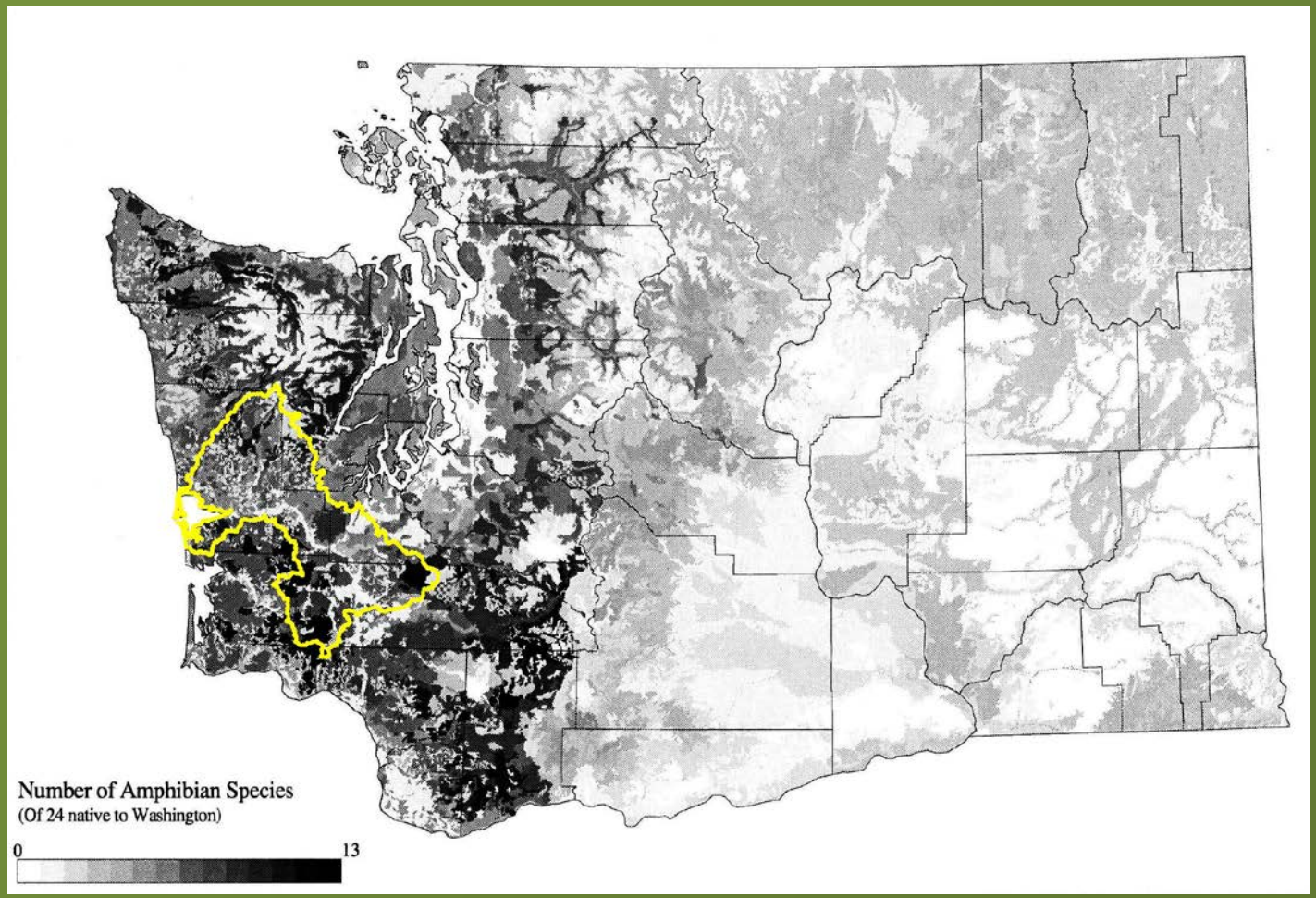
Background Information – Species Status

- ESA-listed species
  - Eulachon
  - Bull trout
- State species of concern
  - Olympic mudminnow
- Petitioned for ESA listing
  - Oregon spotted frog (August 2014)

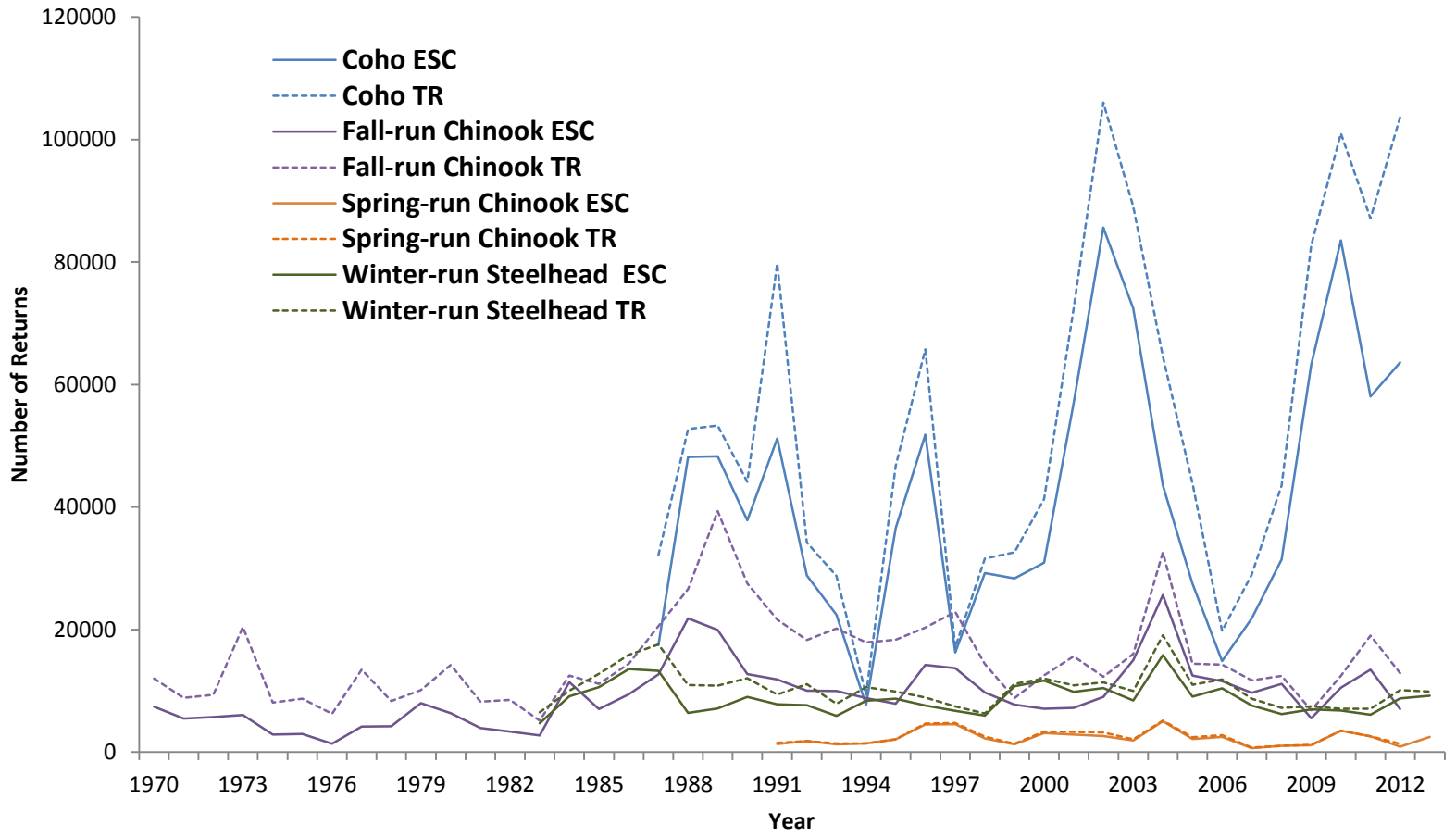
Background Information – Other Fish and Non-fish Species

- Historical and current population information very limited in Basin.
- Olympic mudminnow unique; center of distribution
- Chum salmon the exception; geo mean of total run size since 2003 = 25,116 fish (no clear trend)
- Highest species richness of amphibians in Washington State; also highest at risk in the state
- Potential Oregon spotted frog listing
- Most extensive floodplain off-channel habitats in Washington State; occupied by seven species of stillwater-breeding amphibians

Native Amphibian Species Richness



Background – Salmon Trends (WDFW Data)



Salmon – Geo Means of WDFW Spawner Index Data (2003–2012)

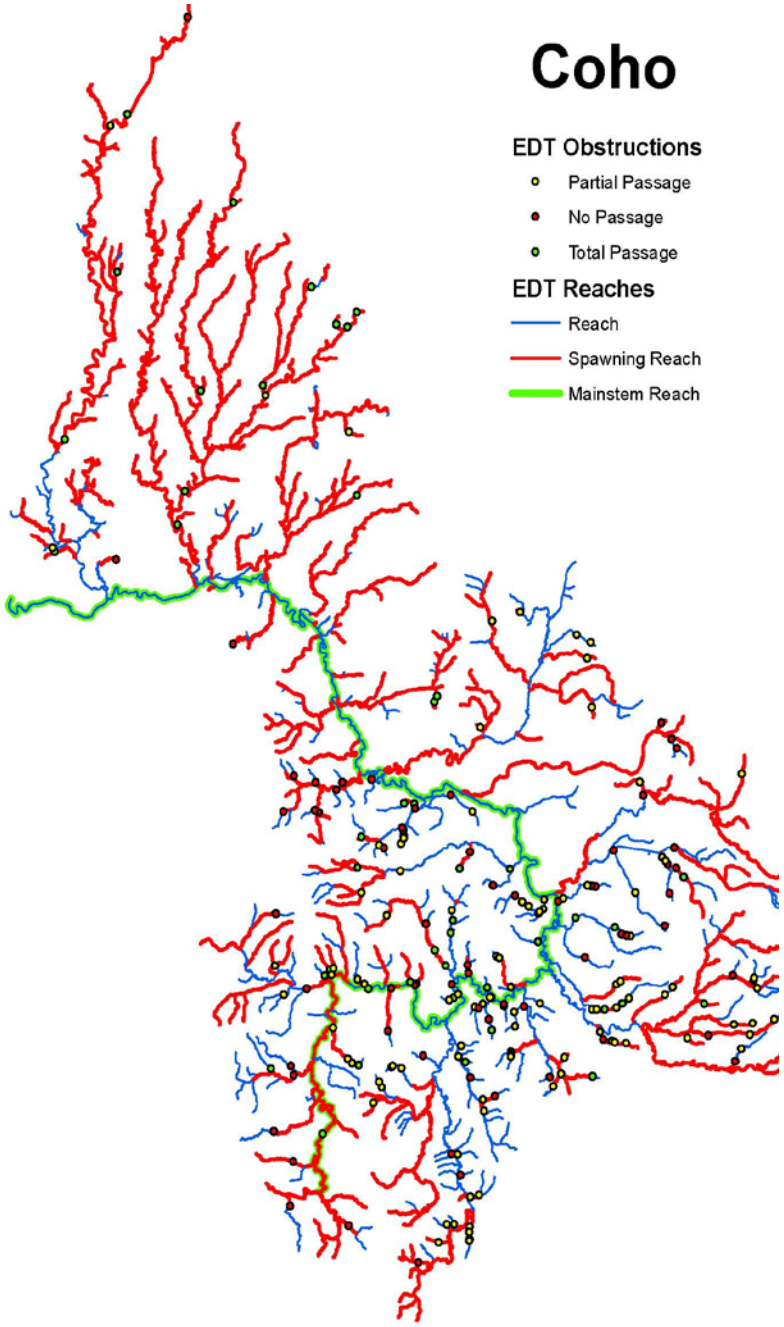
Species	Total Run	Escapement	Post-harvest Productivity (R/S)
Spring Chinook Salmon	1,933	1,766	0.9
Fall Chinook Salmon	14,165	11,264	1.0
Coho Salmon	58,567	42,039	1.1
Winter-run Steelhead	9,513	8,346	0.8

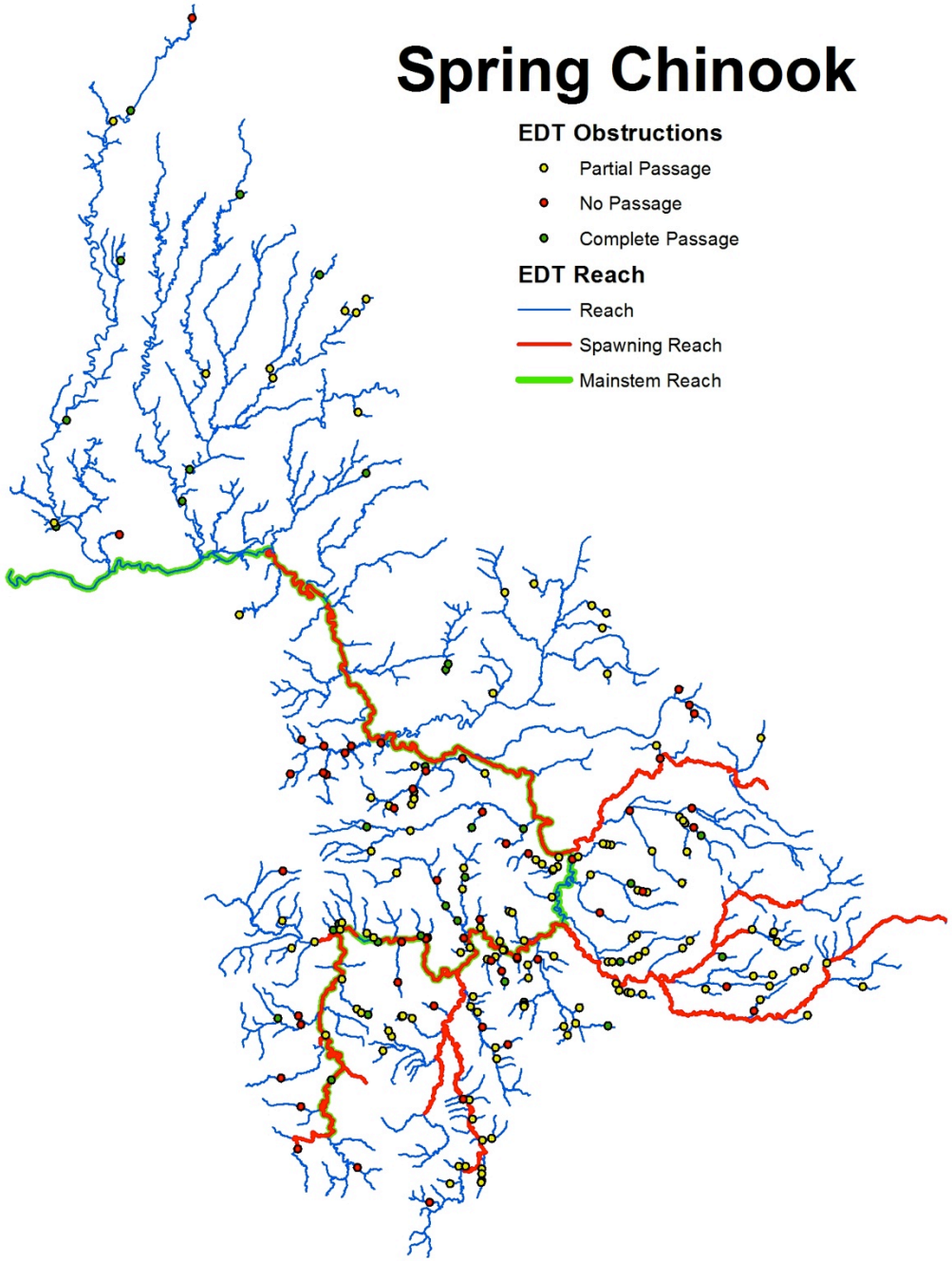
Salmon – Habitat Potential (EDT)

Species	Current	Intrinsic	Habitat Impairment
Spring Chinook Salmon	4,481	24,754	82%
Fall Chinook Salmon	21,713	44,652	51%
Coho Salmon	27,137	107,769	75%
Winter-run Steelhead	3,640	7,501	51%

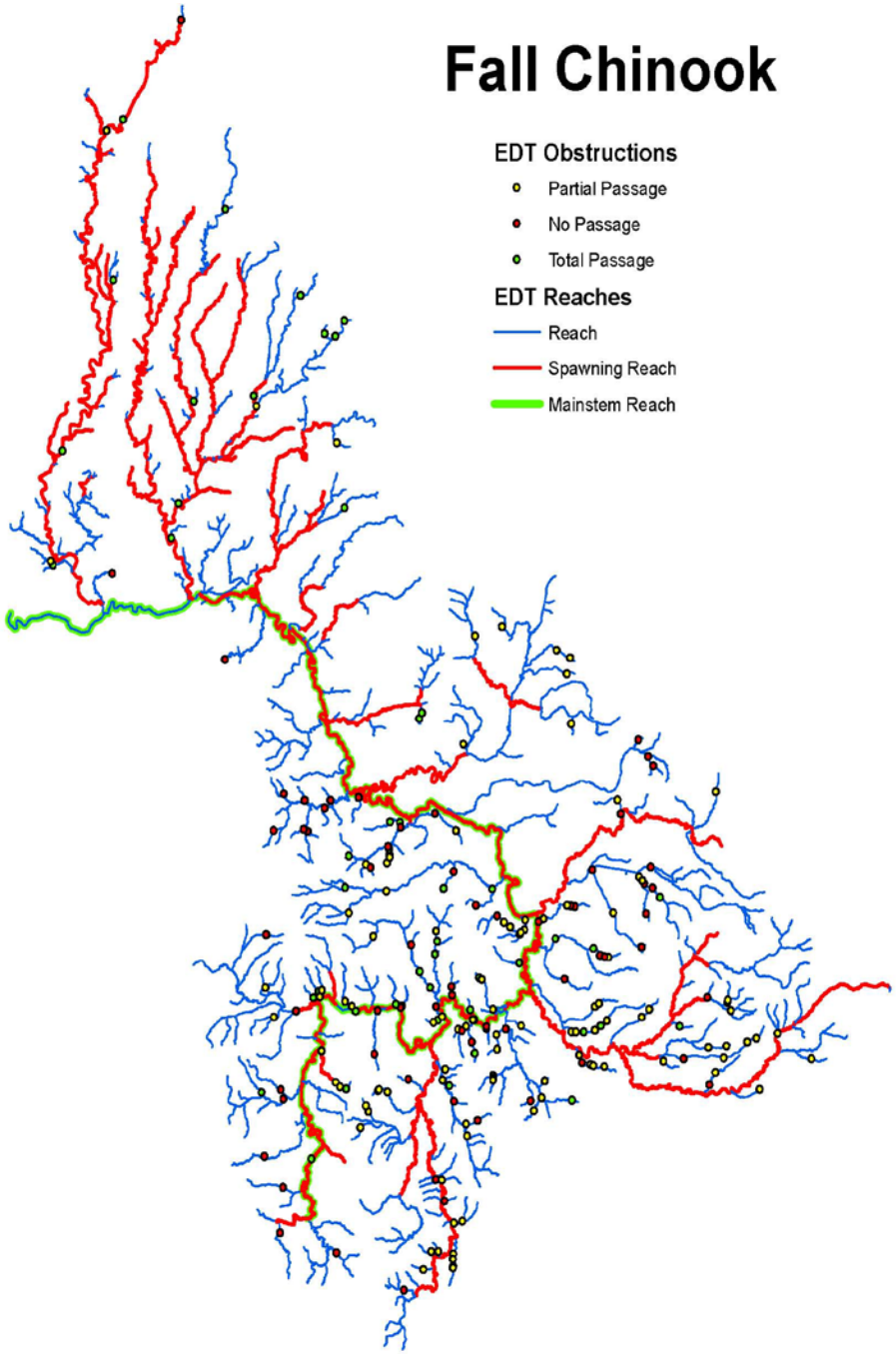
Salmon – VSP Attributes from EDT

Species	Productivity (returns/ spawner)	Capacity (fish)	Equilibrium Abundance (fish)	Diversity (proportion of successful life histories)
Spring Chinook Salmon	1.8	7,663	4,481	49.1%
Fall Chinook salmon	4.1	28,883	21,713	76.3%
Coho Salmon	4.8	33,277	27,137	71.1%
Winter-run Steelhead	8.6	4,102	3,640	72.8%

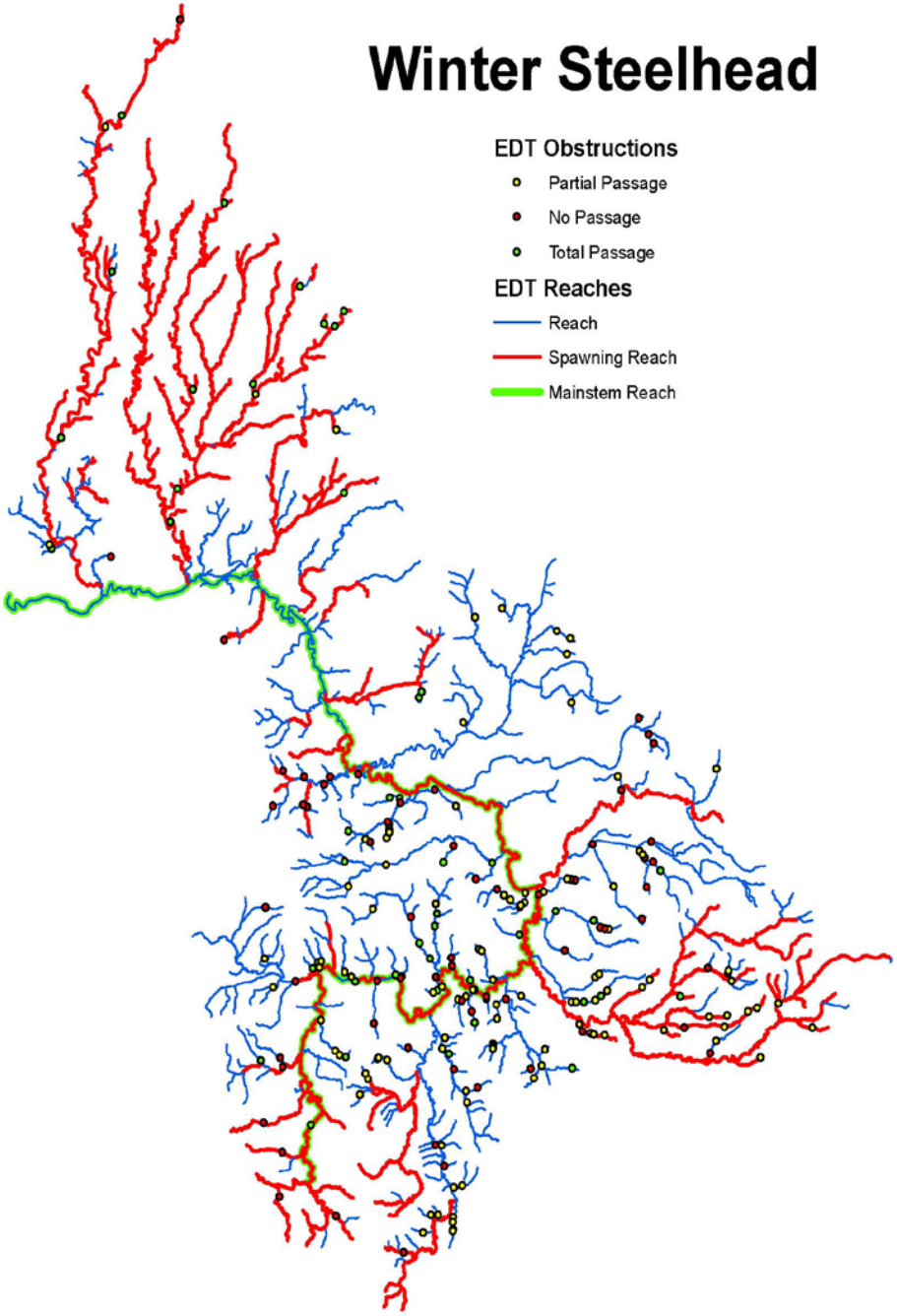

Coho
EDT Obstructions
Partial Passage
No Passage
Total Passage
EDT Reaches
Reach
Spawning Reach
Mainstem Reach


Spring Chinook
EDT Obstructions
Partial Passage
No Passage
Complete Passage
EDT Reach
Reach
Spawning Reach
Mainstem Reach

Fall Chinook



Winter Steelhead

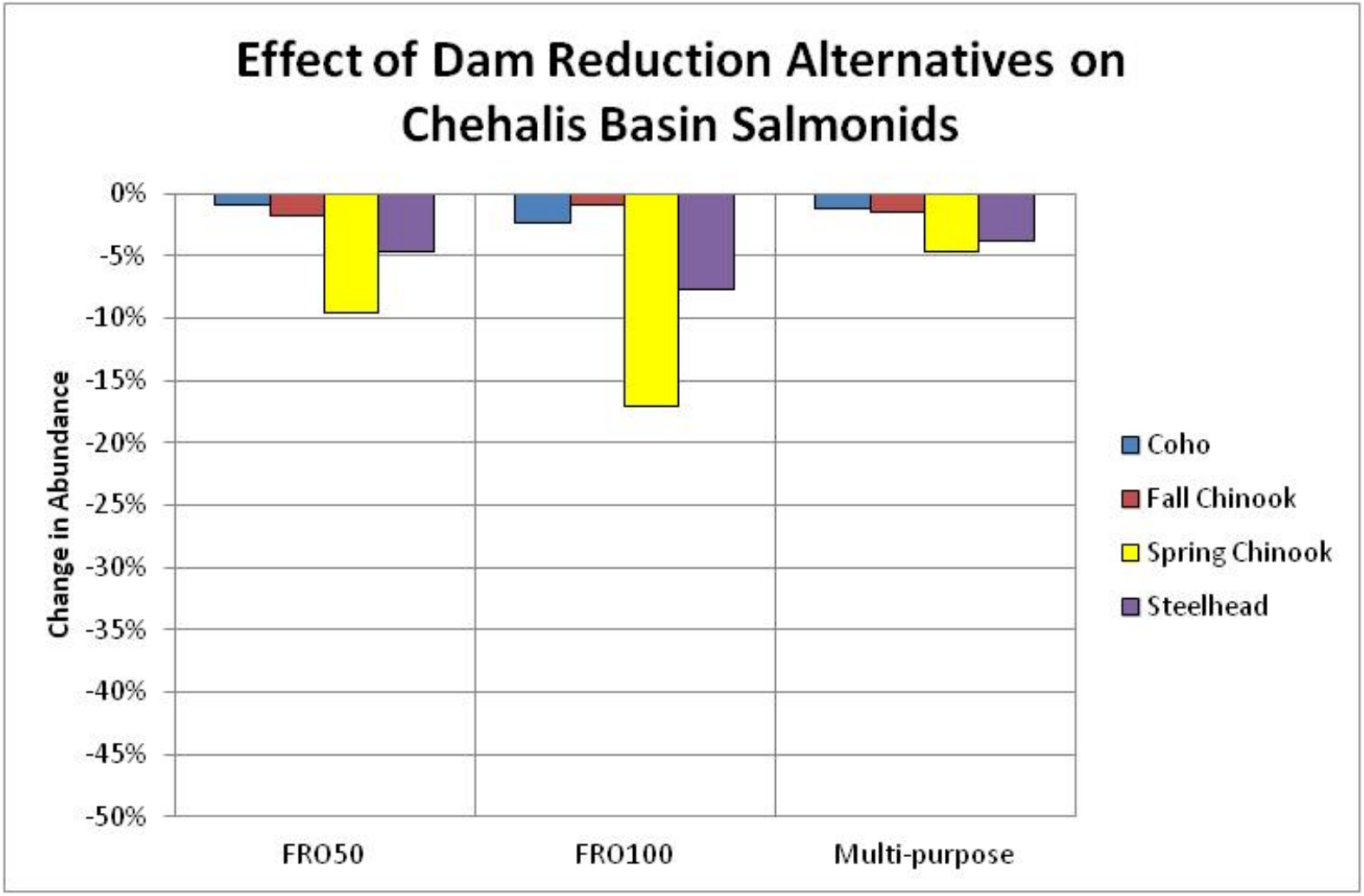


Salmon – Model Results

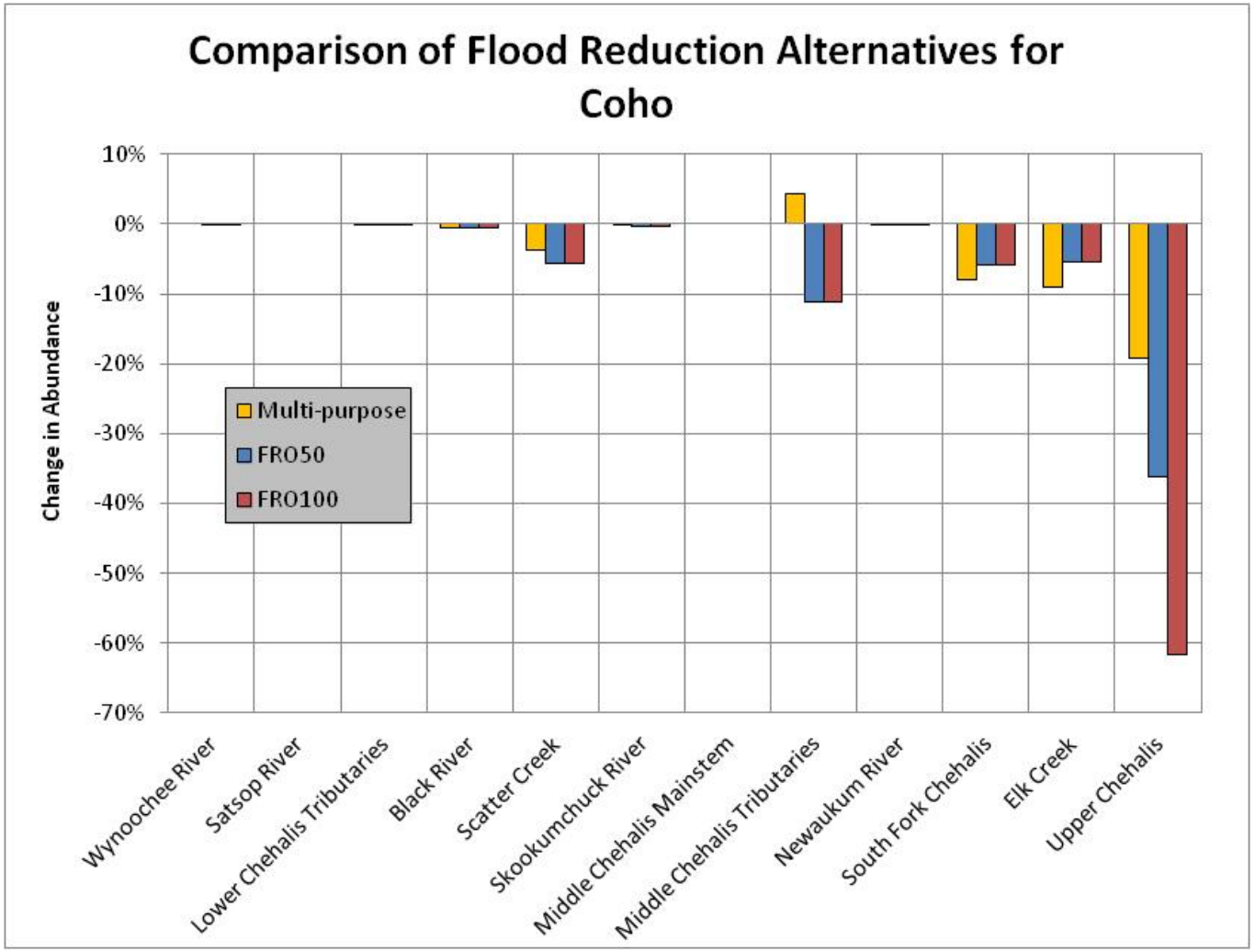
Flood Reduction Alternatives – EDT Modeling Assumptions

Scenario	Above Dam	Dam Passage	Below Dam
Multi-purpose	Inundated reaches converted to limnetic and littoral habitats ➔ juvenile rearing—no spawning	66% adult and juvenile passage	Reduction in bed scour; reduction in temperature; increased flow; reduction in floodplain habitat
FRO 100	100% of inundated reaches converted to migrational habitat➔ no spawning	92% adult and juvenile passage	Lesser reduction in bed scour; temperature unchanged; reduction in floodplain
FRO 50	50% of reaches converted to migrational habitat➔ some spawning	92% adult and juvenile passage	Lesser reduction in bed scour; temperature unchanged; reduction in floodplain

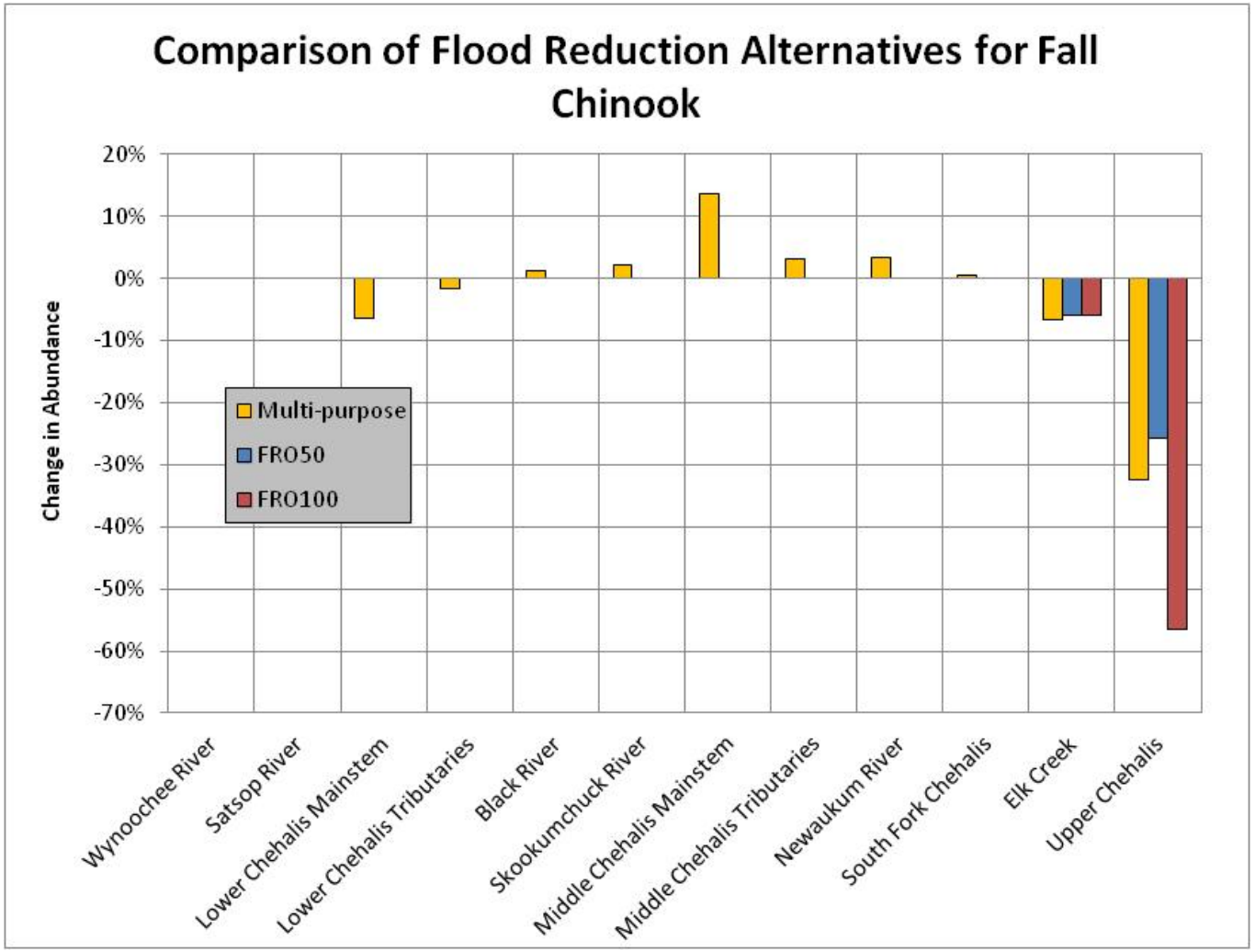
Basin-wide Effects of Dams (EDT)



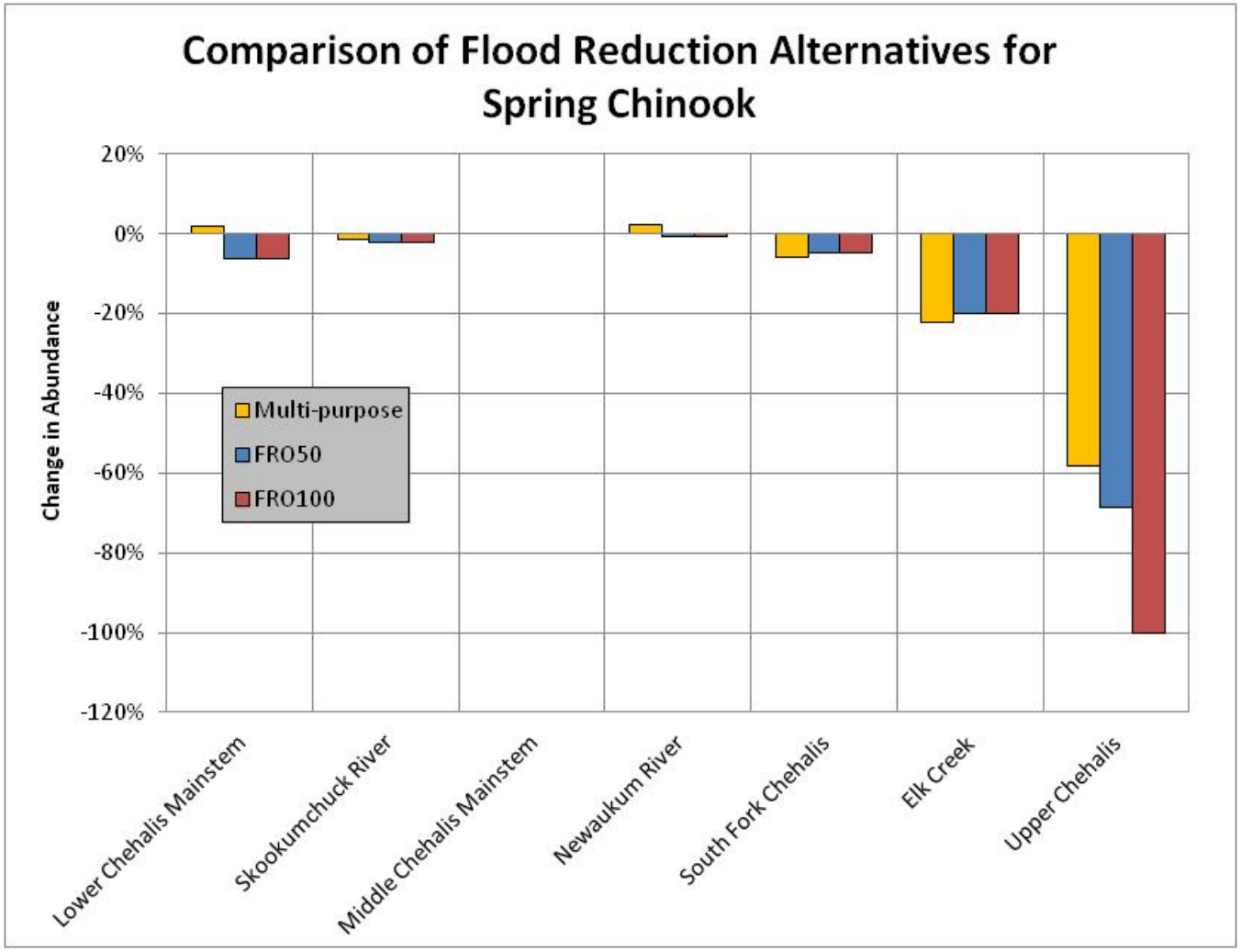
Coho Salmon Sub-population Effects (EDT)



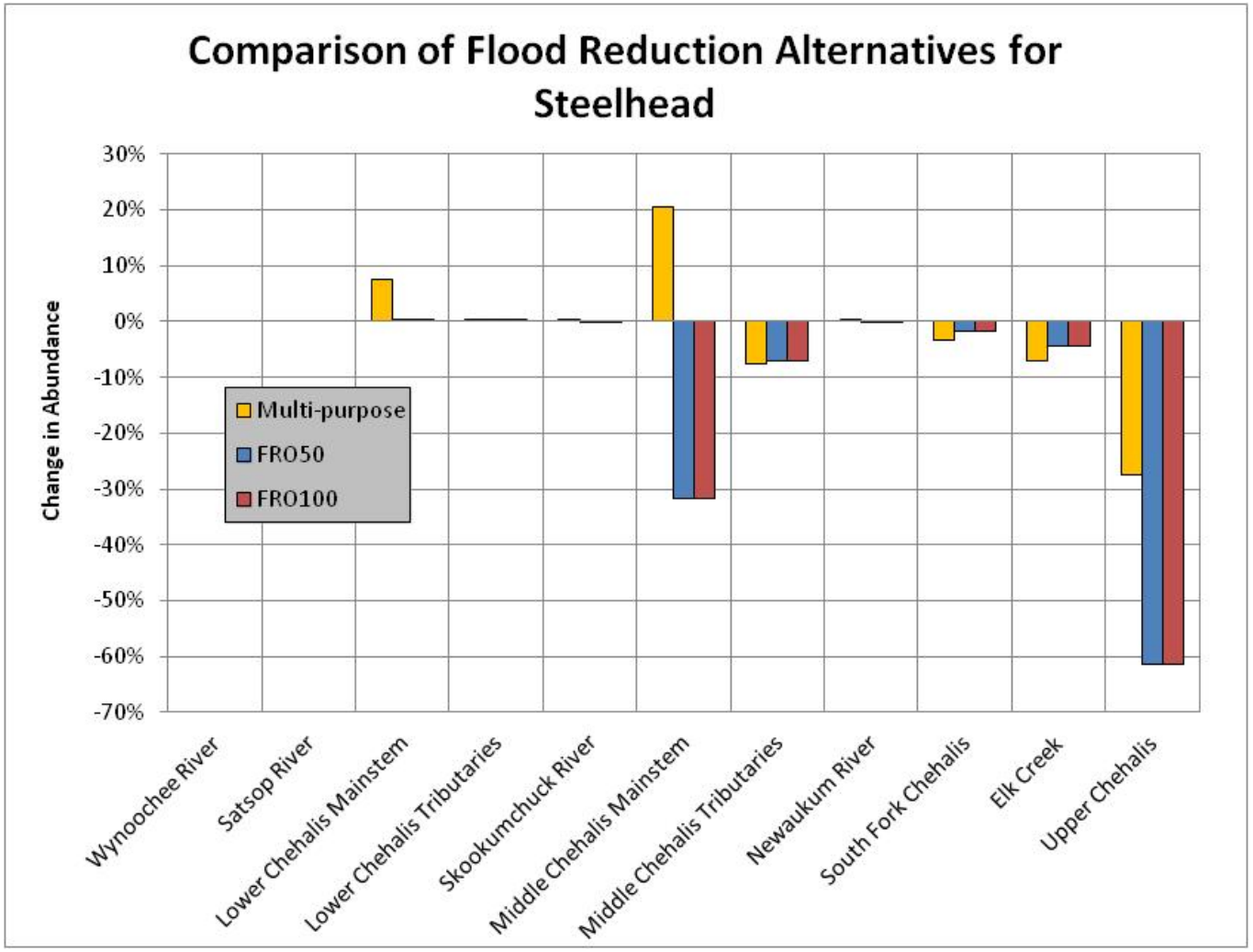
Fall Chinook Sub-population Effects (EDT)



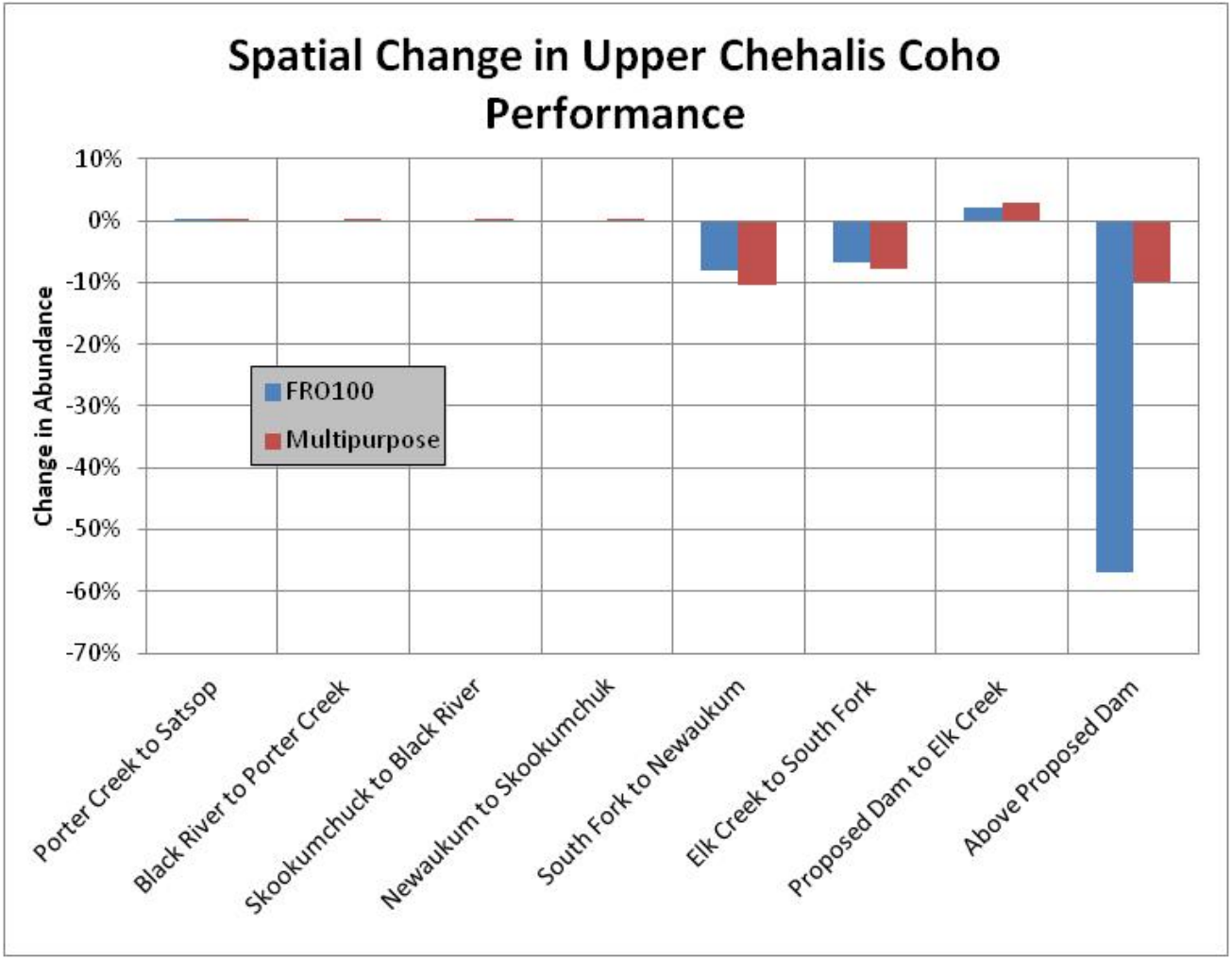
Spring Chinook Sub-Population Effects (EDT)



Winter Steelhead Sub-population Effects (EDT)



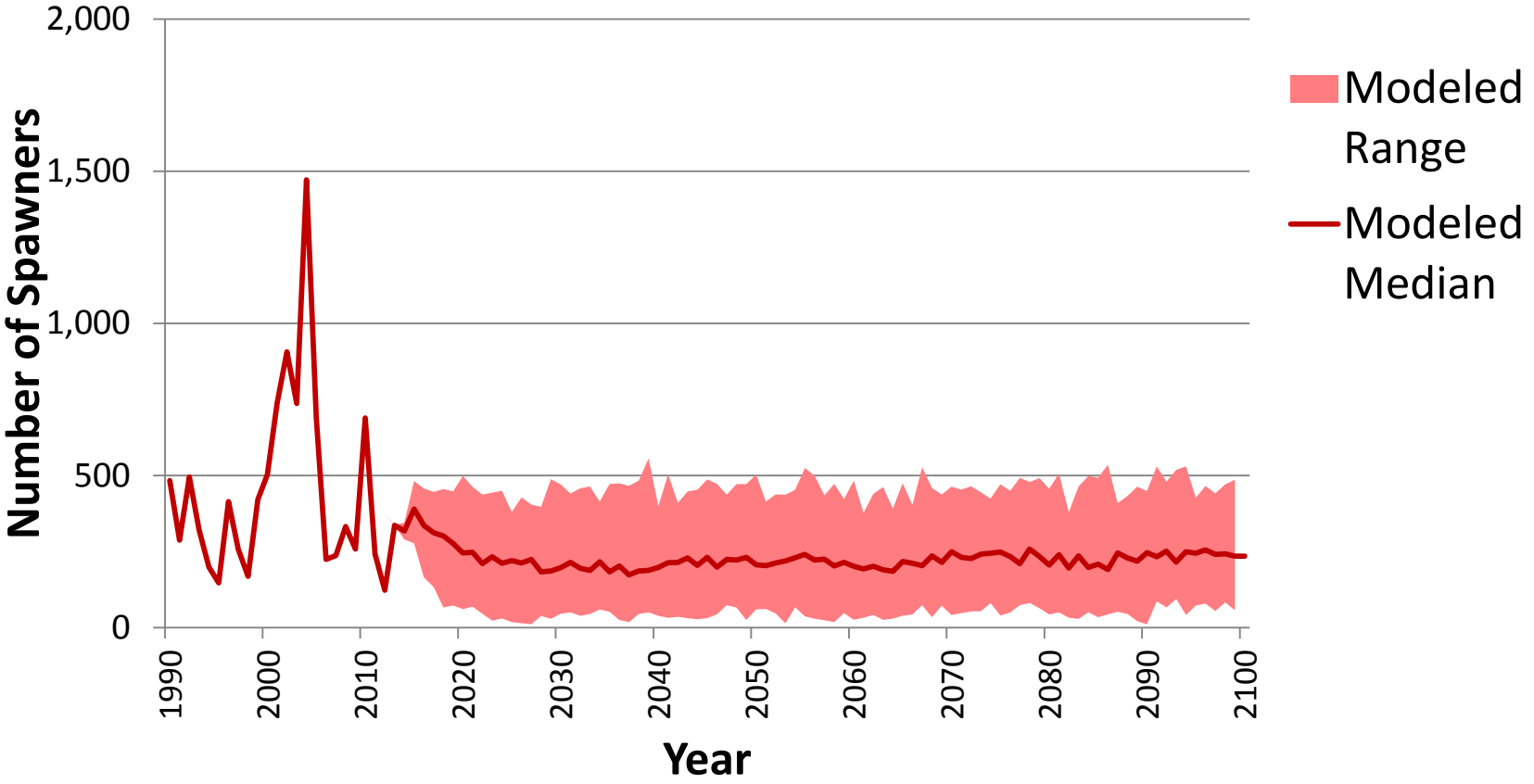
Spatial Changes in Upper Chehalis Coho Performance Under Flood Reduction Alternatives (EDT)



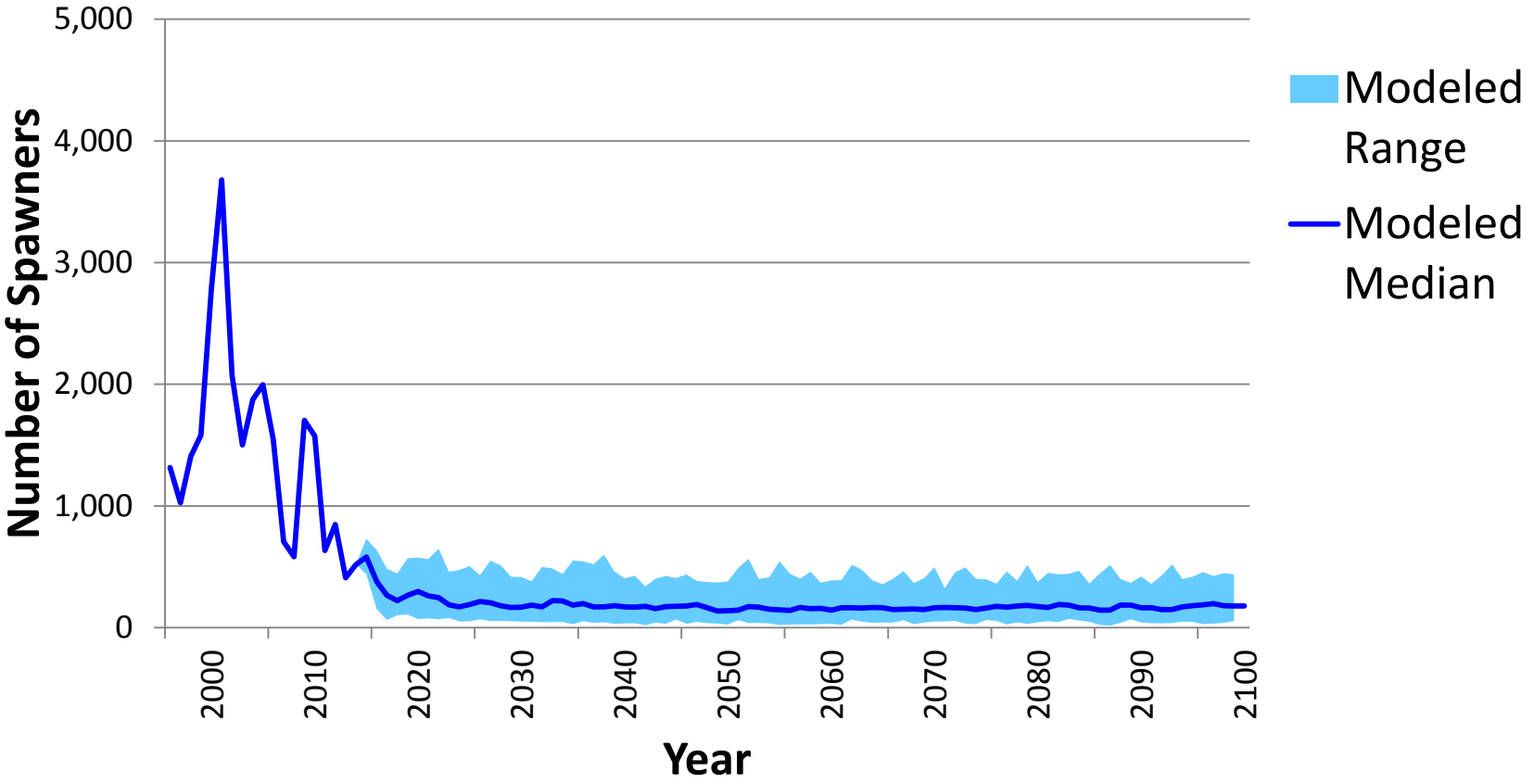
Shiraz Model Results (Mainstem Only)

- Evaluated Upper Chehalis Basin stocks:
  - Spring-run Chinook salmon
  - Coho salmon
  - Winter-run steelhead
- Purpose: Assess population responses over time
  - Trends
  - Variability
  - Risk

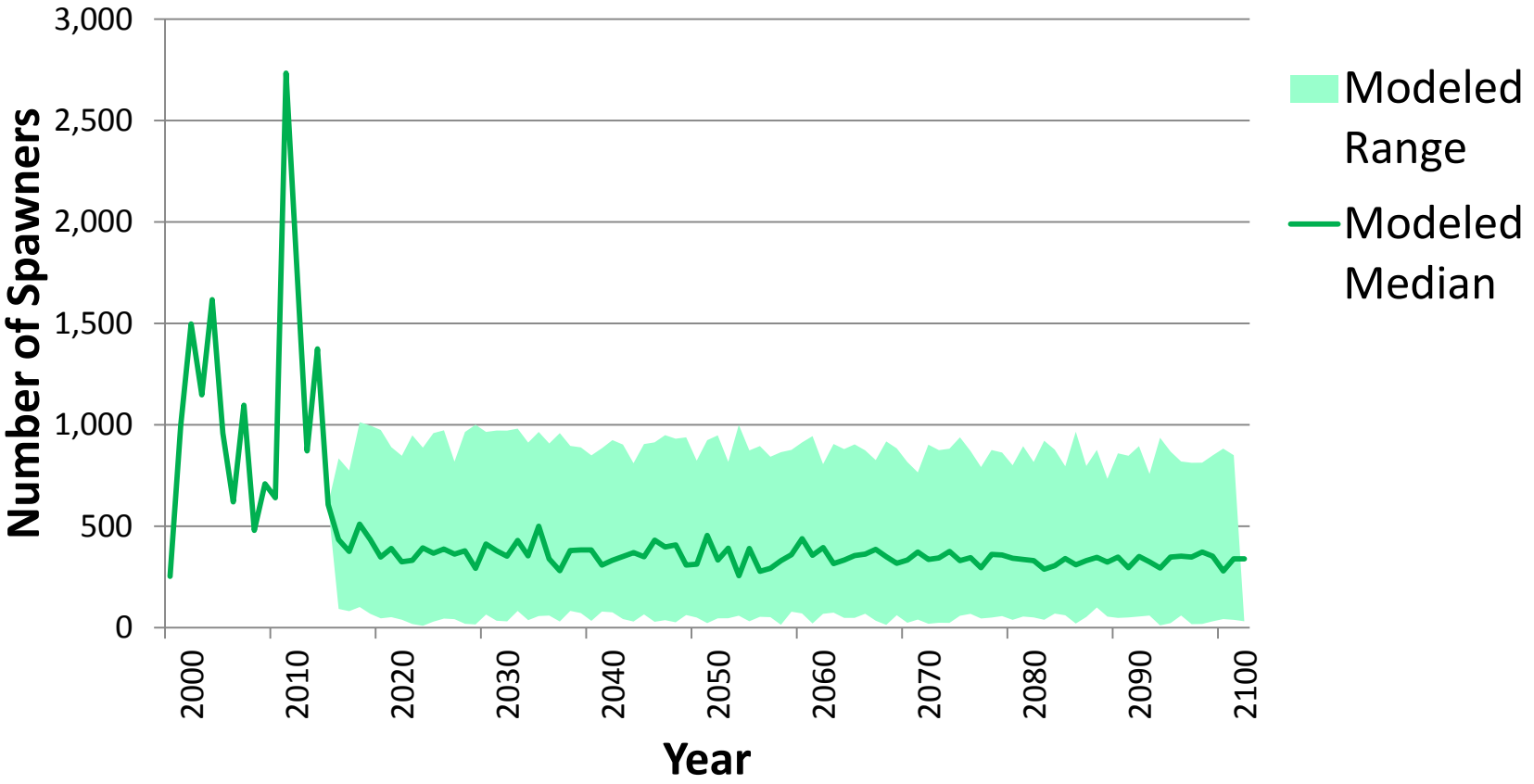
Spring-run Chinook Salmon – Flood Retention Only (Shiraz)



Winter-run Steelhead – Flood Retention Only (Shiraz)



Coho Salmon – Flood Retention Only (Shiraz)



Shiraz Results – Population Risk

- Range in estimated spawners decreased for all three species under dam alternatives
- Spring Chinook: highest estimated spawners under dam alternatives < median number existing conditions
- Winter steelhead: minimum estimated spawners under dam alternatives < minimum estimated under existing conditions (112 fish)
- Coho: Under existing conditions and Flood Retention Only, < 20 fish returned some years

Shiraz Model Results – Summary

- Response appears to be immediate
- Decreased variability over time
- Increased risk (i.e., lower lows)

Other Fish and Non-Fish

Other Fish and Non-fish Methods

- Baseline conditions and flood retention only were considered to be similar during summer (low flow) months when fish are most active; therefore, comparisons were made only with the multi-purpose facility
- In-channel habitat – PHABSIM was used to establish baseline conditions of weighted usable area (WUA)
- Off-channel habitat – correlatives were used to quantify the amount of off-channel habitat under both scenarios

Other Fish and Non-Fish In-channel Habitat – Baseline

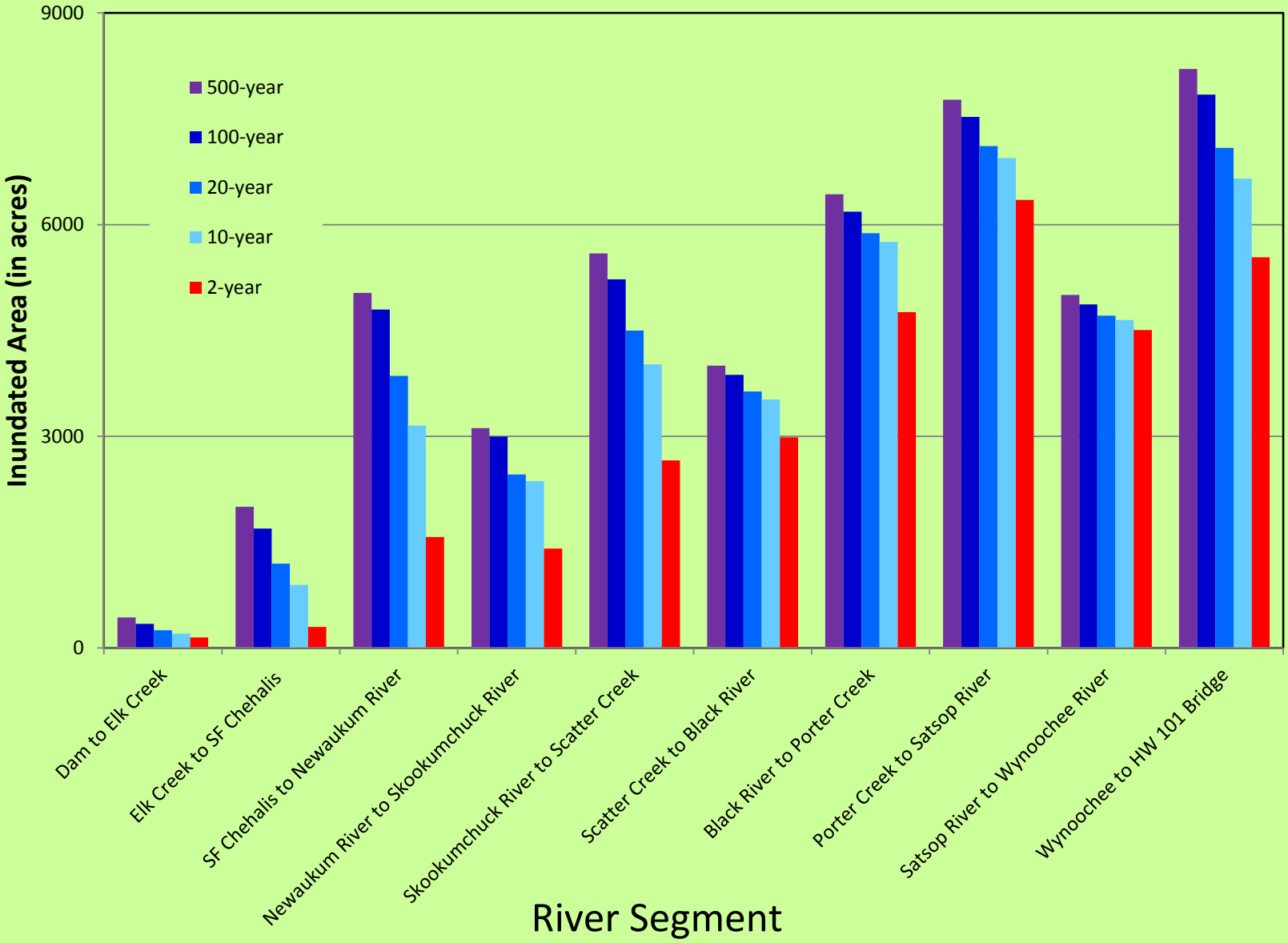
- Flows are more limiting in the upper basin than the lower basin
- Low flows during summer months appears to be a limiting factor for many species

In-channel Habitat Results Discussion

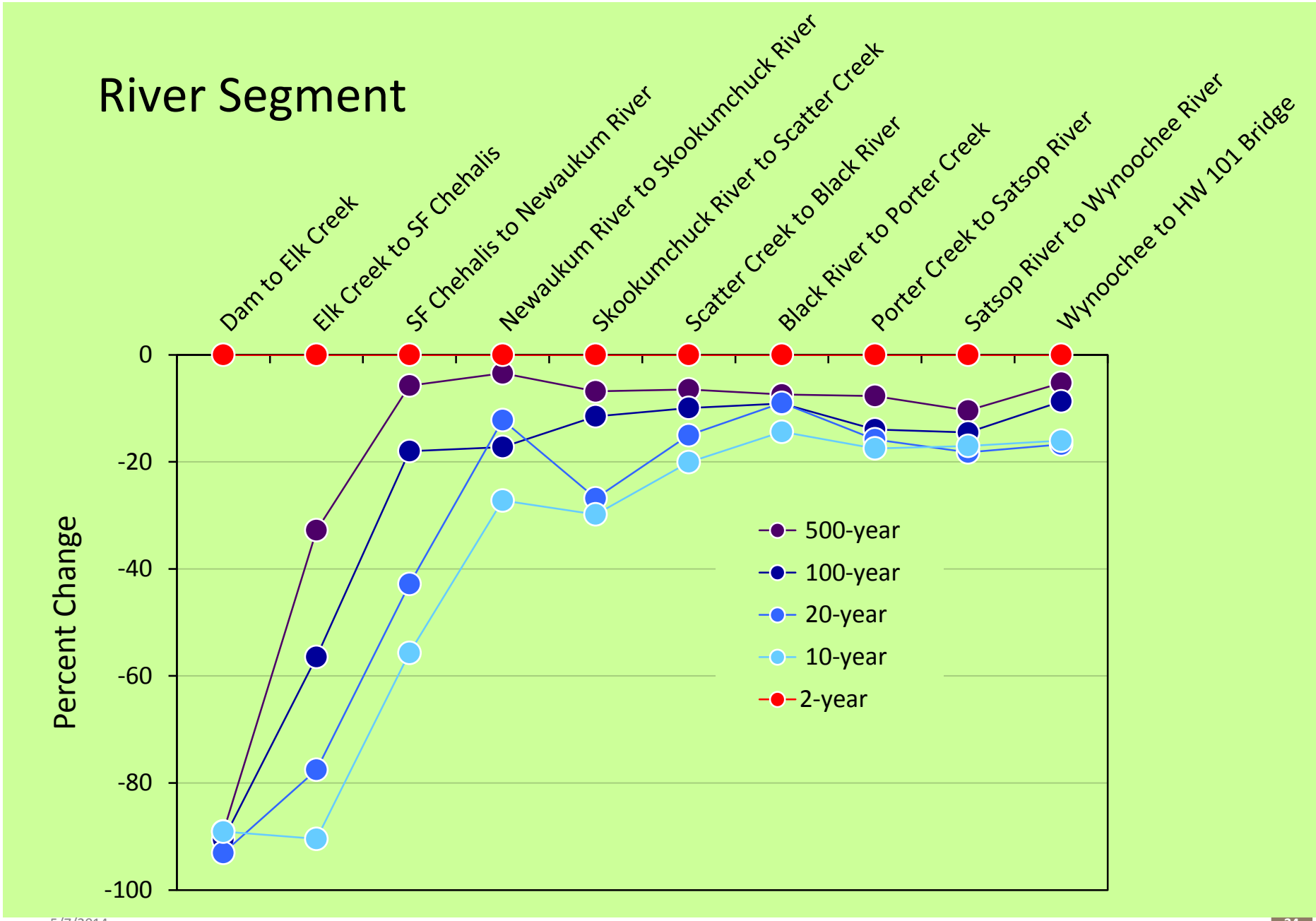
- Changes in flow resulted in both increases and decreases in WUA, depending on species and life stage
- Generally, rearing decreased for all species except whitefish, likely due to increased flows during summer months

Off-channel Habitat

- Looked at 2, 10, 20, 100, and 500 year flood events
- Compared inundated area (at least 0.1 foot) of baseline to dam
- 3 figures
  - Baseline inundation
  - Absolute change in inundation with dam
  - Relative (%) change in inundation with dam


9000
6000
3000
0
Inundated Area (in acres)
500-year
100-year
20-year
10-year
2-year
Dam to Elk Creek
Elk Creek to SF Chehalis
SF Chehalis to Newaukum River
Newaukum River to Skookumchuck River
Skookumchuck River to Scatter Creek
Scatter Creek to Black River
Black River to Porter Creek
Porter Creek to Satsop River
Satsop River to Wynoochee River
Wynoochee to HW 101 Bridge
River Segment


River Segment
Dam to Elk Creek
Elk Creek to SF Chehalis
SF Chehalis to Newaukum River
Newaukum River to Skookumchuck River
Skookumchuck River to Scatter Creek
Scatter Creek to Black River
Black River to Porter Creek
Porter Creek to Satsop River
Satsop River to Wynoochee River
Wynoochee to HW 101 Bridge
200
0
-200
-400
-600
-800
-1000
Absolute Change (in acres inundated)
500-year
100-year
20-year
10-year
2-year


River Segment
Dam to Elk Creek
Elk Creek to SF Chehalis
SF Chehalis to Newaukum River
Newaukum River to Skookumchuck River
Skookumchuck River to Scatter Creek
Scatter Creek to Black River
Black River to Porter Creek
Porter Creek to Satsop River
Satsop River to Wynoochee River
Wynoochee to HW 101 Bridge
0
-20
-40
-60
-80
-100
Percent Change
500-year
100-year
20-year
10-year
2-year

Off-channel Habitat Discussion

- Area of inundation generally increased closer to the mouth
- For 500, 100, and 20 year the reach with the greatest reduction in inundation was from the dam site to Elk Creek
- Inundation index generally decreases further downstream from the dam
- Dam effects are negligible for a 2 year flood

Summary – Salmon (EDT)

- Largest impact on spring-run Chinook and winter-run steelhead (basin scale)
- Largest change in abundance on Upper Chehalis sub-populations
  - Spring Chinook: 100% with FRO100 scenario; 70% with FRO50 scenario
  - Winter steelhead: 62% with FRO100 and FRO50
  - Coho: 62% with FRO100 scenario; 36% with FRO50 scenario
- Some positive effects on middle-to-lower river populations (fall-run Chinook, Winter-run steelhead and coho)

Summary – Salmon (EDT and Shiraz)

- General pattern between dam alternatives (EDT): Impacts from FRO100 > FRO50 > Multi-purpose alternative
- Temporal trends (preliminary)(Shiraz):
  - Response appears to be immediate
  - Decreased population variability over time
  - Stocks exposed to increased risk (i.e., lower lows)

Summary – Other Fish and Non-Fish In-channel Habitat

- Response varied with species thermal preferences (adaptations), life stage, location (reach)
- In general
  - Warm adapted species impacted by releases from multi-purpose dam
  - Cool adapted species benefit from releases from multi-purpose dam
- Low flows during summer months appear to be a limiting factor
- Increased summer flows may have a positive effect on some species
- Much more data is needed to determine in-channel effects on Other Fish and Non-Fish species

Summary – Other Fish and Non-Fish Off-channel Habitat

- Increase in inundation would have a positive effect and a decrease in inundation would have a negative effect on the off channel suite of species
  - Pacific lamprey juveniles, Olympic mudminnow, speckled dace, largescale sucker juveniles, riffle sculpin, reticulate sculpin and largemouth bass
  - Coastal tailed frog, Northern red-legged frog, Oregon spotted frog, Western pond turtle, North American Beaver
- Much more data is needed to determine off-channel effects on Other Fish and Non-Fish species

Next Steps

- EDT adjustments:
  - Incorporate WDFW mainstem habitat data
  - Incorporate tributary water temperature monitoring data
- Complete EDT analyses of climate change scenarios with dams

Next Steps

- Shiraz runs
  - Habitat degradation over time
- EDT and Shiraz:
  - Model iterations and discuss assumptions
- Other fish – no additional analyses
- Non-fish – no additional analyses
- Address technical review comments

Extra Slides

Fish-passage Survival Assumptions

SPECIES AND LIFE STAGE	MULTI-PURPOSE	FRO
Coho Adults	73.6%	88.2%
Coho Juveniles Upstream	61.8%	93.1%
Coho Juveniles Downstream	61.8%	93.1%
Fall Chinook Adults	73.6%	88.2%
Fall Chinook Juveniles Upstream	61.8%	93.1%
Fall Chinook Juveniles Downstream	61.8%	93.1%
Spring Chinook Adults	73.6%	88.2%
Spring Chinook Juveniles Upstream	61.8%	93.1%
Spring Chinook Juveniles Downstream	61.8%	93.1%
Steelhead Adults	73.6%	88.2%
Steelhead Juveniles Upstream	61.8%	93.1%
Steelhead Juveniles Downstream	61.8%	93.1%

500-year Flood Event

SEGMENT	500-YEAR		PERCENT CHANGE
	NO DAM	DAM	
Dam to Elk Creek	432	180	58
Elk Creek to SF Chehalis	1999	1442	28
SF Chehalis to Newaukum River	5032	4836	4
Newaukum River to Skookumchuck River	3114	3057	2
Skookumchuck River to Scatter Creek	5592	5393	4
Scatter Creek to Black River	4003	3938	2
Black River to Porter Creek	6432	6309	2
Porter Creek to Satsop River	7771	7662	1
Satsop River to Wynoochee River	5005	4953	1
Wynoochee to HW 101 Bridge	8206	8066	2

100-year Flood Event

SEGMENT	100-YEAR		PERCENT CHANGE
	NO DAM	DAM	
Dam to Elk Creek	340	167	51
Elk Creek to SF Chehalis	1692	905	47
SF Chehalis to Newaukum River	4796	4219	12
Newaukum River to Skookumchuck River	2997	2725	9
Skookumchuck River to Scatter Creek	5224	4930	6
Scatter Creek to Black River	3870	3783	2
Black River to Porter Creek	6183	6055	2
Porter Creek to Satsop River	7528	7364	2
Satsop River to Wynoochee River	4871	4818	1
Wynoochee to HW 101 Bridge	7844	7643	3

20-year Flood Event

SEGMENT	20-YEAR		PERCENT CHANGE
	NO DAM	DAM	
Dam to Elk Creek	250	156	38
Elk Creek to SF Chehalis	1195	499	8
SF Chehalis to Newaukum River	3855	2880	2
Newaukum River to Skookumchuck River	2458	2332	4
Skookumchuck River to Scatter Creek	4499	4007	2
Scatter Creek to Black River	3636	3539	3
Black River to Porter Creek	5877	5778	2
Porter Creek to Satsop River	7112	6992	1
Satsop River to Wynoochee River	4709	4672	2
Wynoochee to HW 101 Bridge	7089	6829	1

10-year Flood Event

SEGMENT	10-YEAR		PERCENT CHANGE
	NO DAM	DAM	
Dam to Elk Creek	204	155	24
Elk Creek to SF Chehalis	892	354	60
SF Chehalis to Newaukum River	3153	2275	28
Newaukum River to Skookumchuck River	2362	2104	11
Skookumchuck River to Scatter Creek	4021	3616	10
Scatter Creek to Black River	3521	3414	3
Black River to Porter Creek	5756	5614	2
Porter Creek to Satsop River	6941	6838	1
Satsop River to Wynoochee River	4647	4623	1
Wynoochee to HW 101 Bridge	6653	6474	3

2-year Flood Event

SEGMENT	2-YEAR		PERCENT CHANGE
	NO DAM	DAM	
Dam to Elk Creek	149	149	0
Elk Creek to SF Chehalis	296	297	0
SF Chehalis to Newaukum River	1571	1574	0
Newaukum River to Skookumchuck River	1407	1409	0
Skookumchuck River to Scatter Creek	2659	2660	0
Scatter Creek to Black River	2983	2984	0
Black River to Porter Creek	4762	4763	0
Porter Creek to Satsop River	6352	6352	0
Satsop River to Wynoochee River	4506	4506	0
Wynoochee to HW 101 Bridge	5536	5536	0