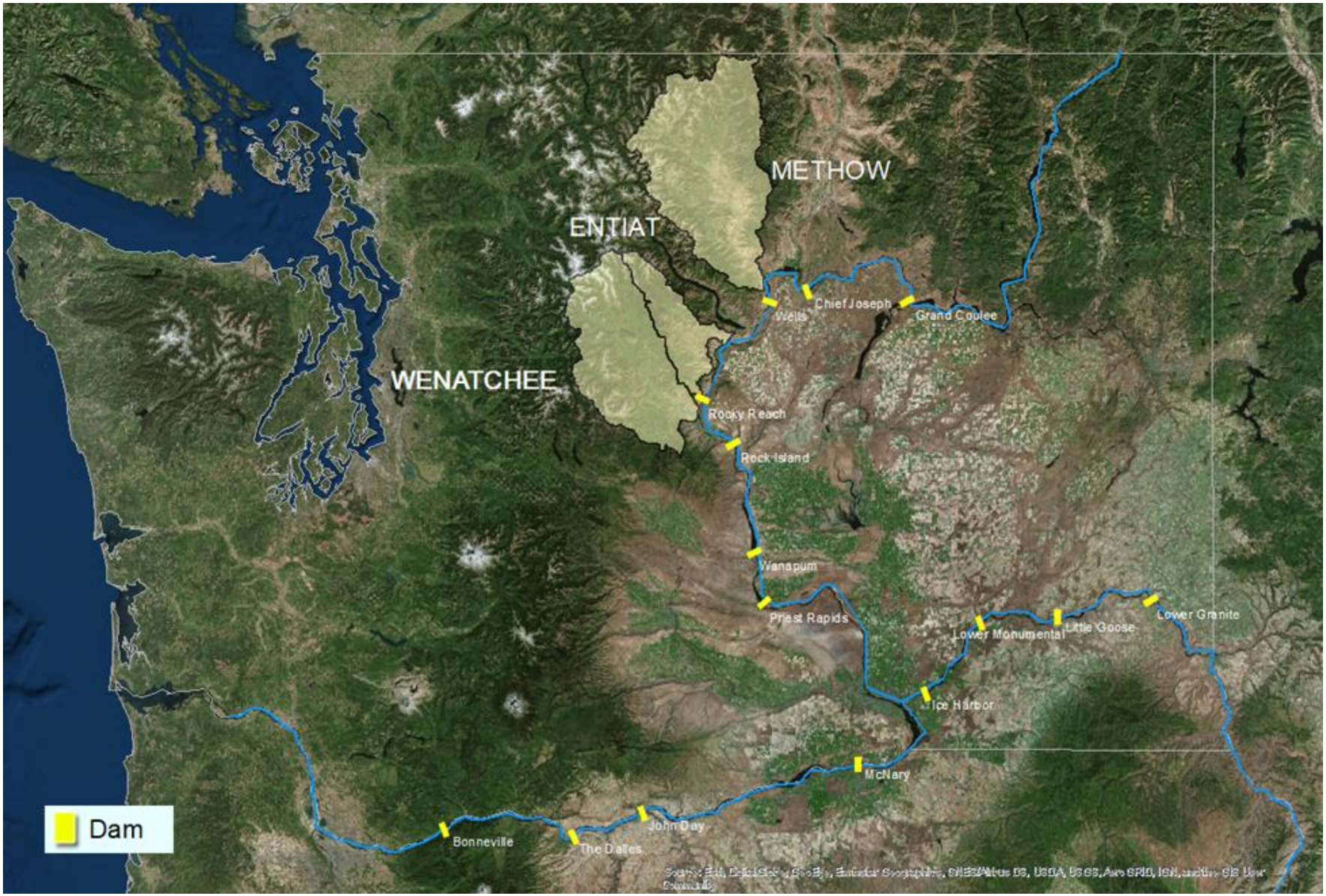
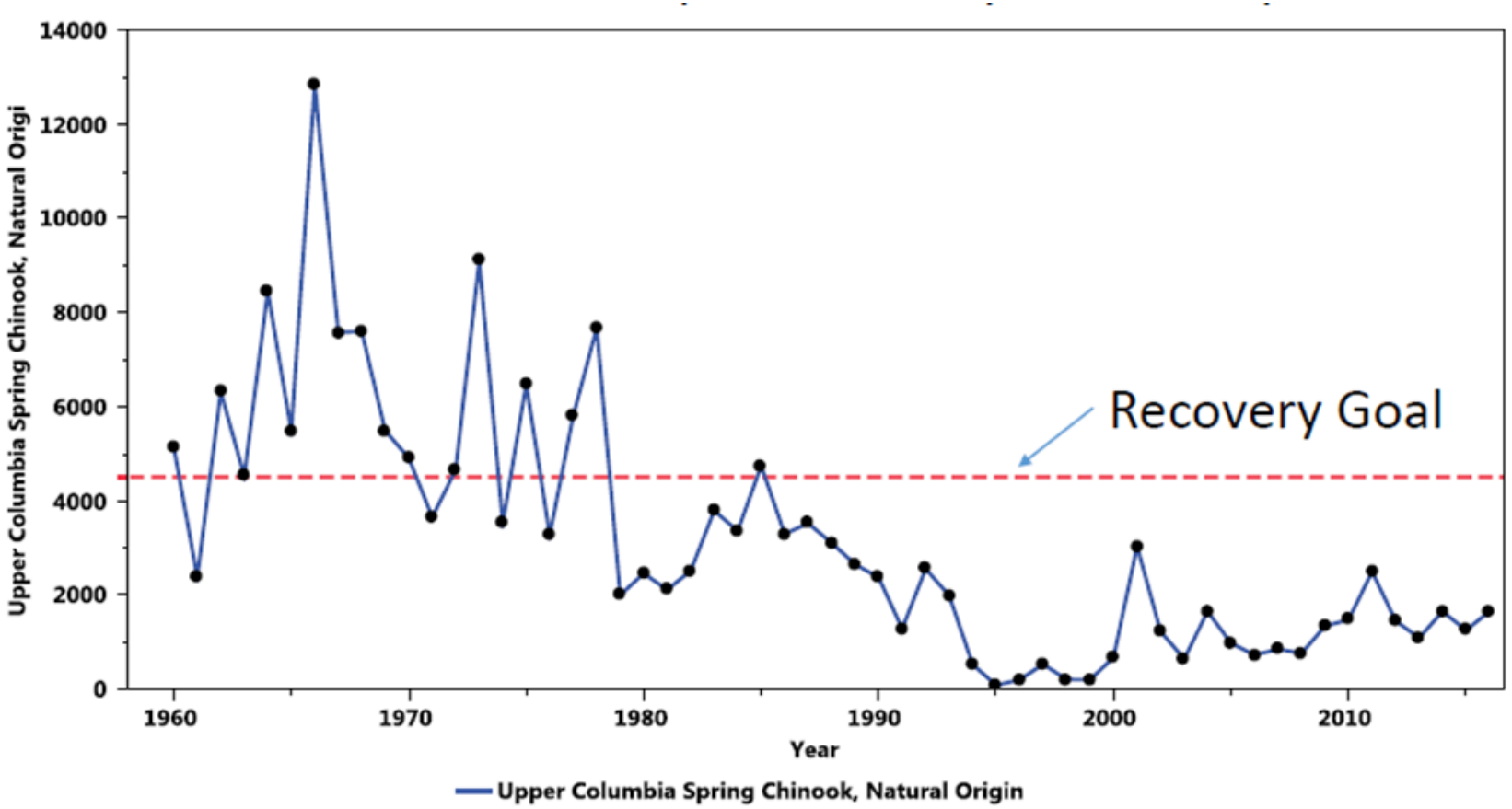
INDEPENDENT SCIENTIFIC ADVISORY BOARD

Review of Spring Chinook Salmon in the Upper Columbia River

ISAB 2018-1 FEBRUARY 9, 2018


METHOW
ENTIAT
WENATCHEE
Chief Joseph
Wells
Grand Coulee
Rocky Reach
Rock Island
Wanapum
Priest Rapids
Lower Monumental
Little Goose
Lower Granite
Ice Harbor
McNary
John Day
The Dalles
Bonneville
Dam


14000
12000
10000
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6000
4000
2000
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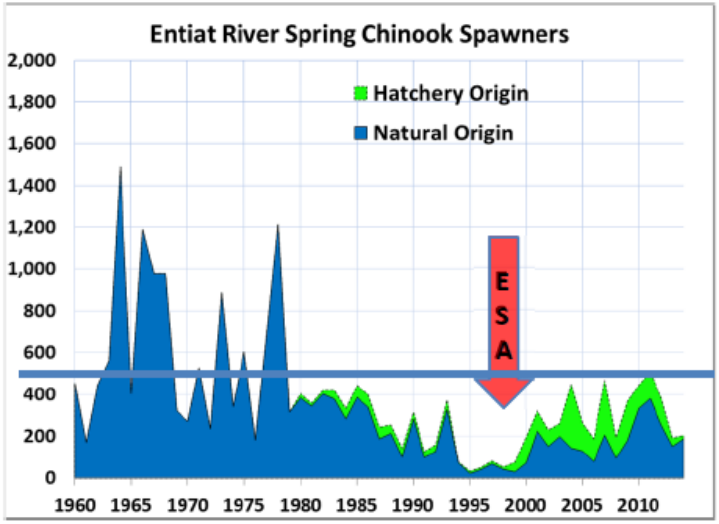
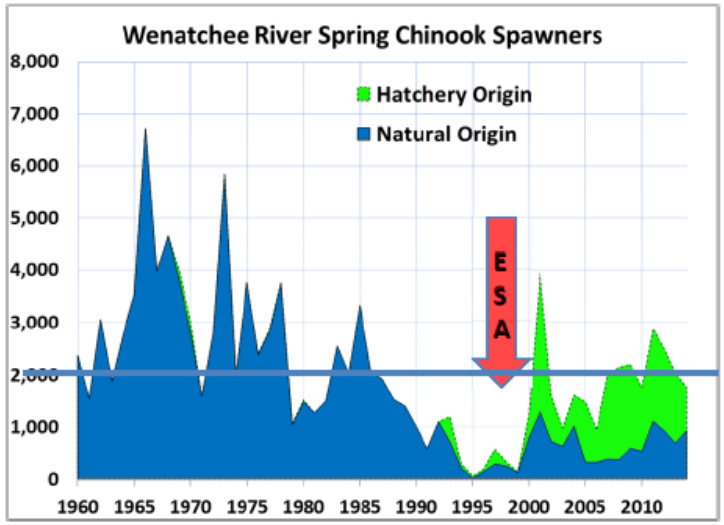
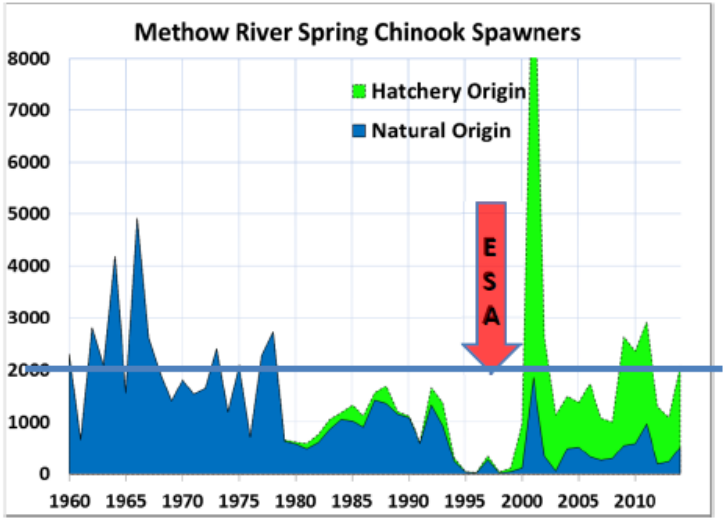
Upper Columbia Spring Chinook, Natural Origi
1960
1970
1980
1990
2000
2010
Year
Recovery Goal
Upper Columbia Spring Chinook, Natural Origin

Status Trends
Upper Columbia Spring Chinook Salmon





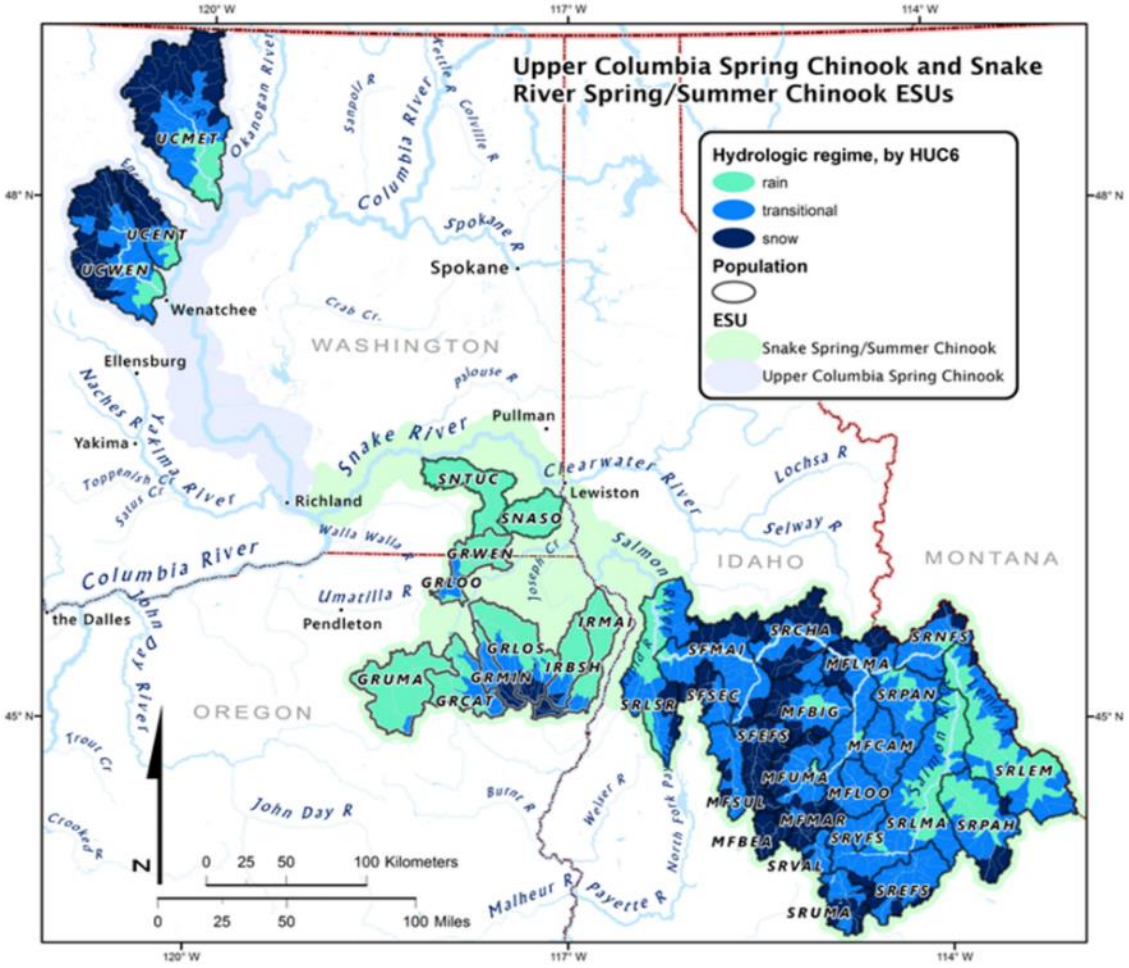


Graphs from Mike Ford, NOAA Fisheries

Major Questions

- Snake River spring Chinook vs UCR spring Chinook
- Limiting factors assessment
- Evidence of habitat improvement
- Prioritization of habitat recovery actions
- Adequacy of research, monitoring, and evaluation
- Life-cycle and habitat models
- Coordination

Upper Columbia River ESUs and Snake River ESUs



Spatial Diversity

Hydrologic regime

- Snow
- Transition
- Rain

Abundance

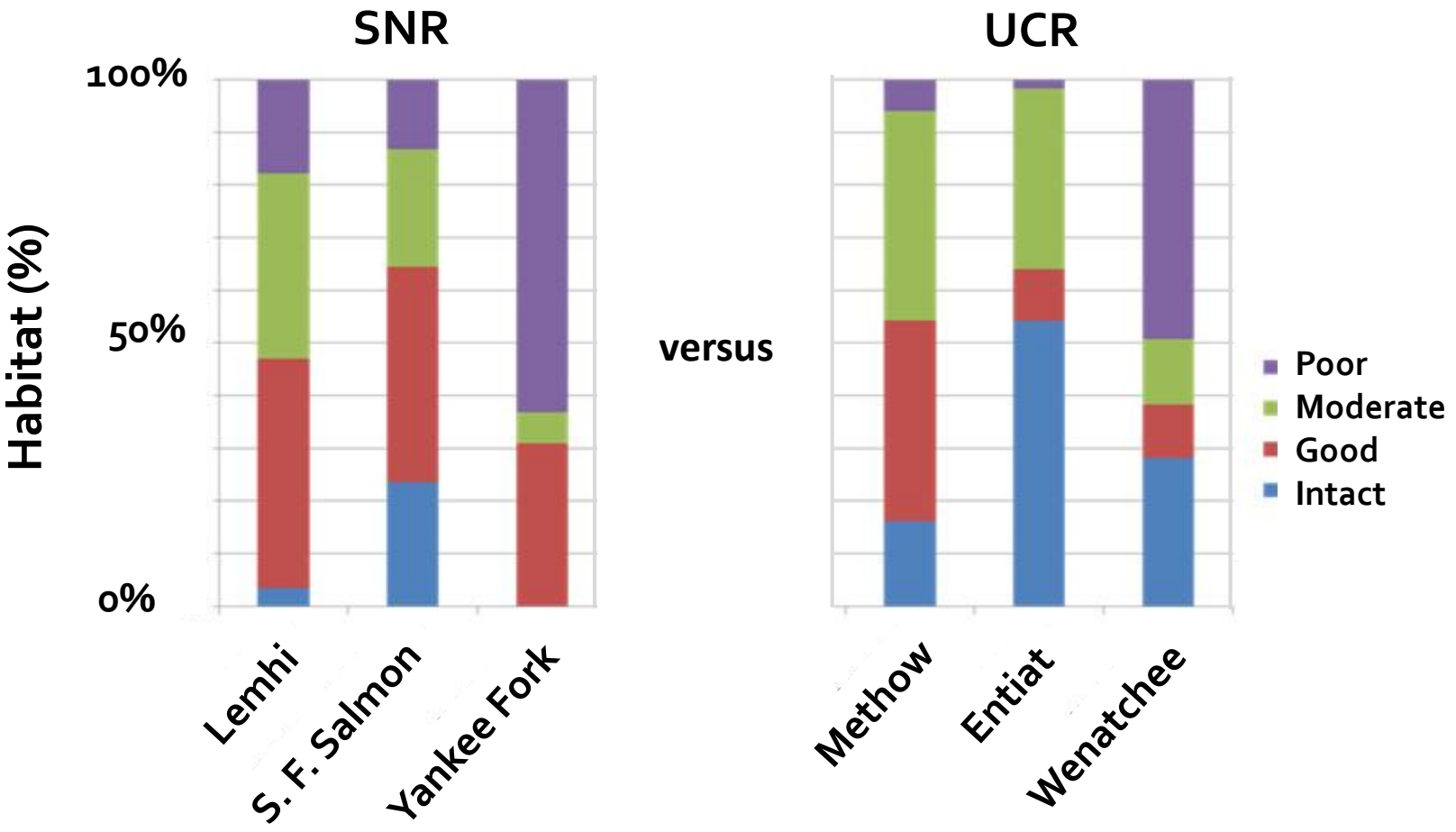
(2010 – 2014 versus 2005 – 2009)

	UCR	SNAKE
Number of populations	3	26
Average abundance	1,475	11, 347
Average change	74%	154%
Range	12% to 105%	-2% to 426%

Survival to Bonneville

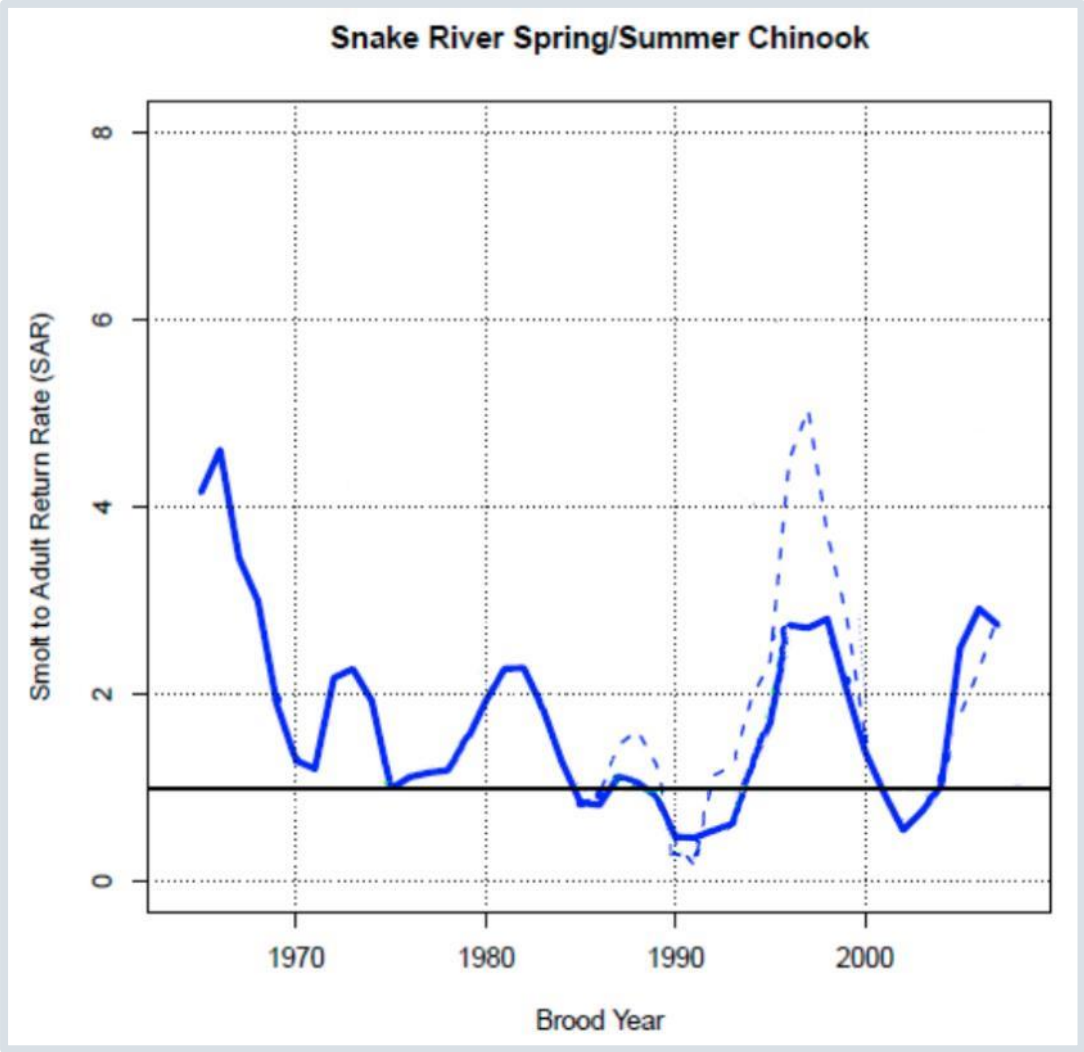
Smolt Survival					
ESU	Reach	Years	Probability (SE)	Hatchery-BON	
UCR	Hatchery-MCN	1999-2016	0.555 (0.012)		
	MCN-BON		0.809 (0.034)	0.449	**45%**
SNR	Hatchery-LGR	1993-2016	0.629 (0.012)		
	LGR-MCN		0.736 (0.013)	0.325	**33%**
	MCN-BON		0.703 (0.021)	(ISAB)	

Geomorphic conditions based on CHaMP analyses



From M. Ford, NOAA Fisheries, data from C. Jordan

Smolt – Adult Return Rates (SARs)

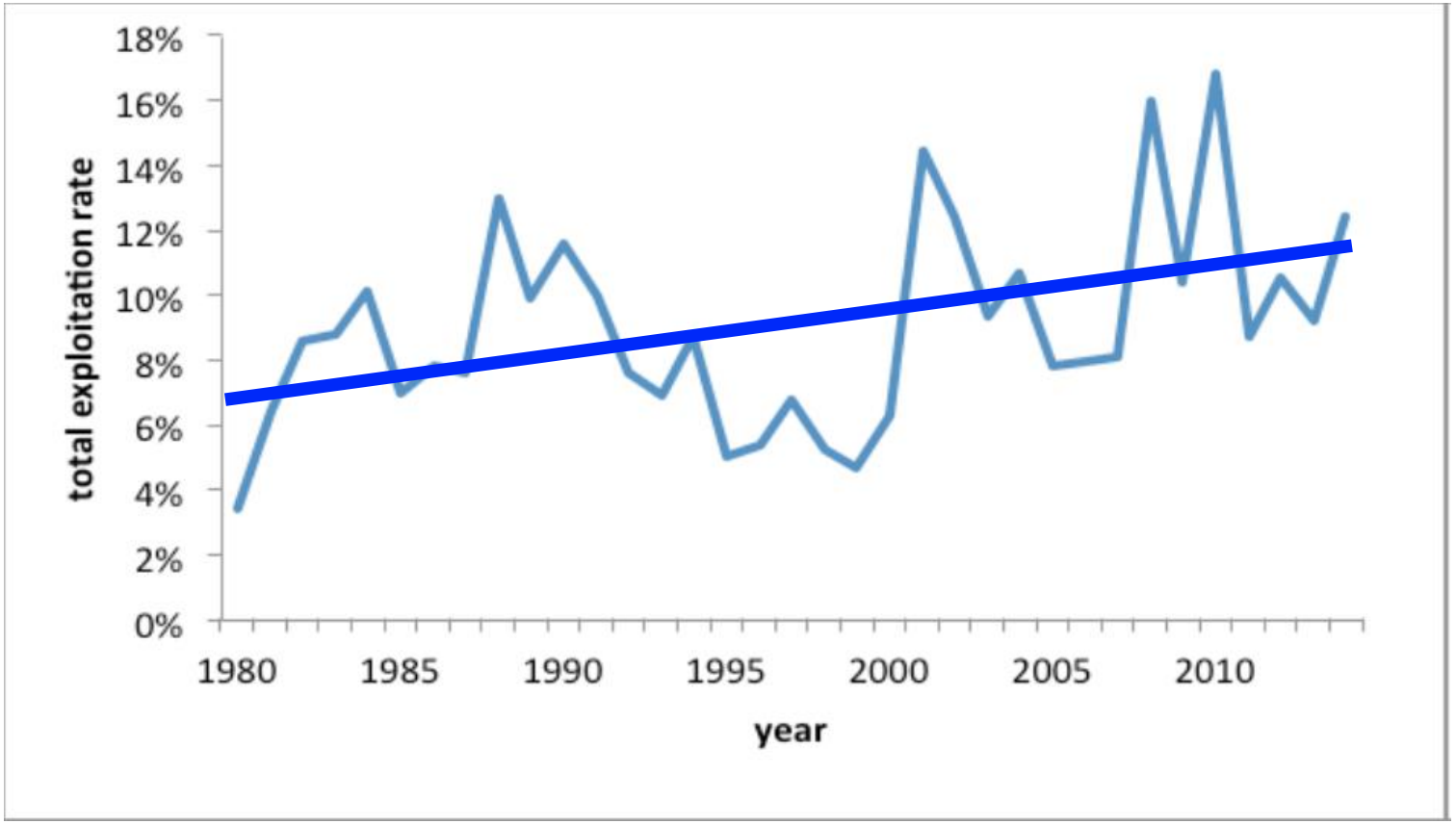


SNR sp/sum Chinook

UCR spring Chinook

3-year moving average

Total Harvest Rate



Average 10%

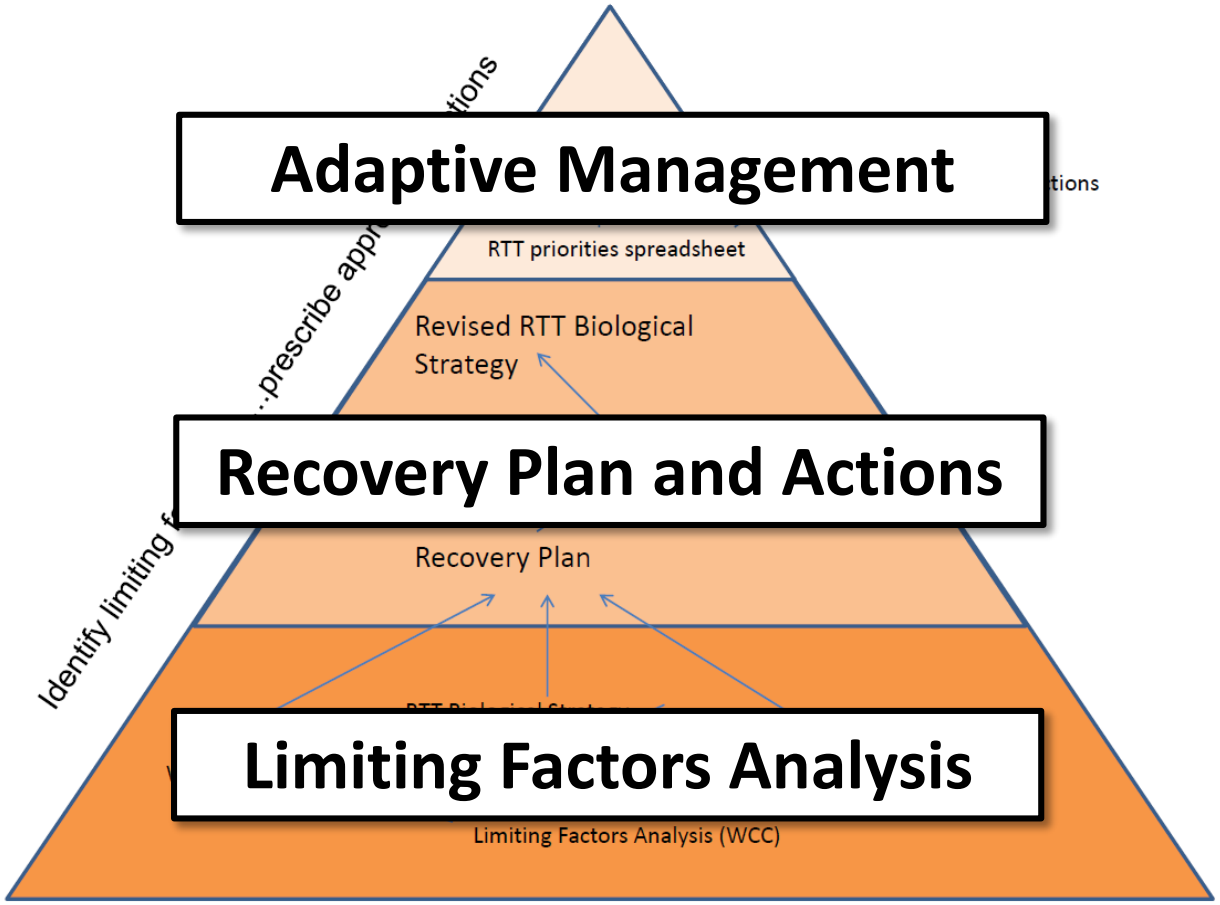
NWFSC, 2015

Limiting Factors

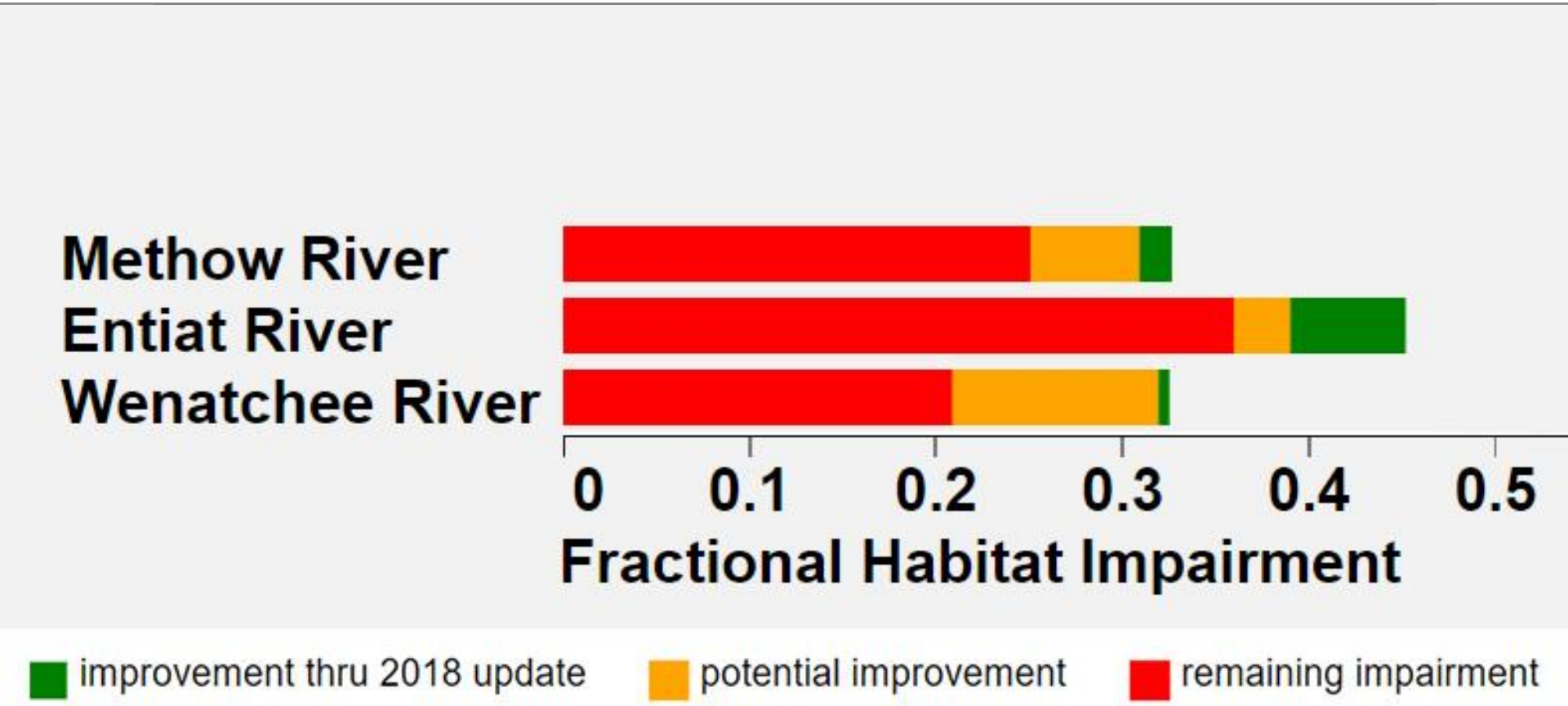
Limiting Factors

- Scientific principles and methods for identifying factors limiting the recovery of Upper Columbia spring Chinook salmon are generally sound.

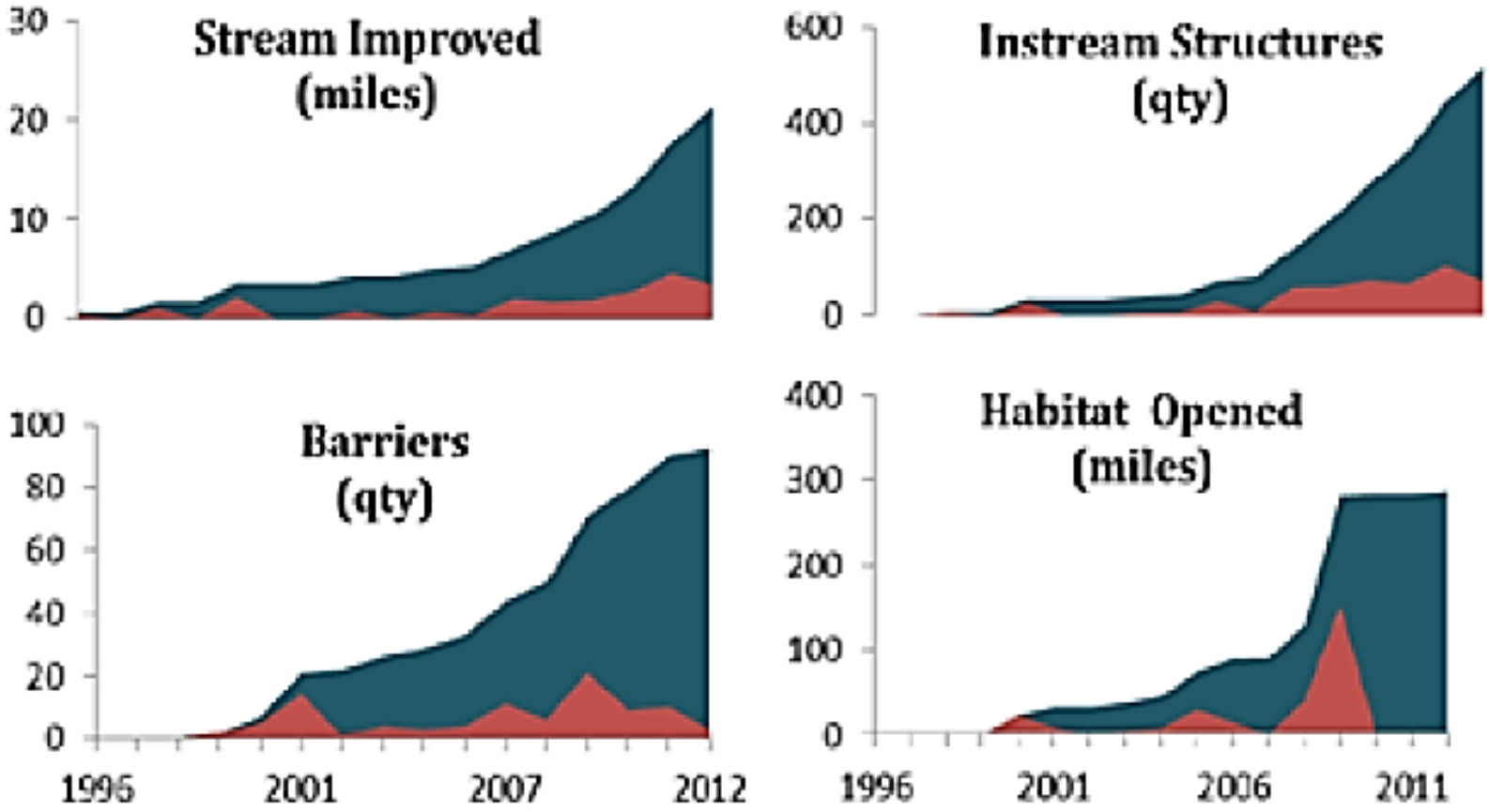
Limiting Factors



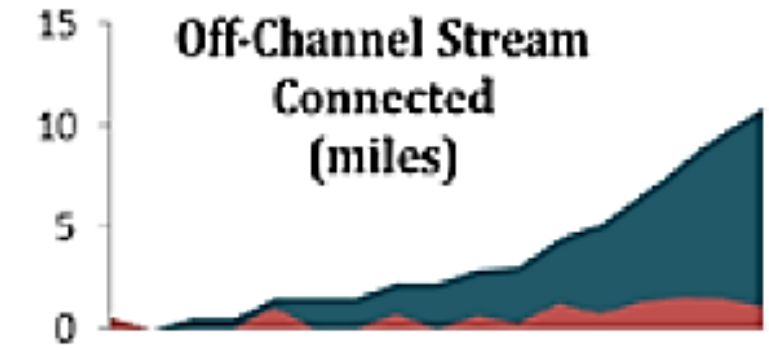
UCR Habitat Impairment

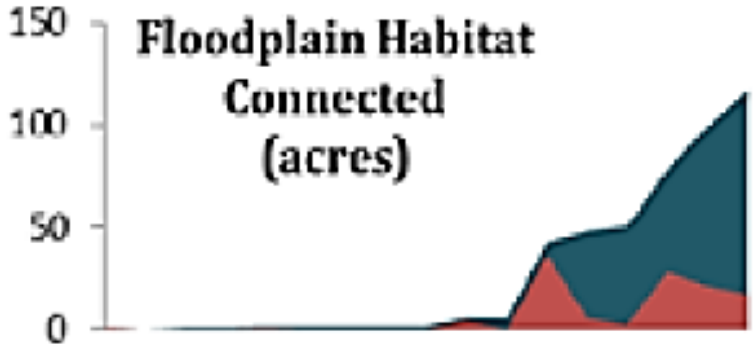


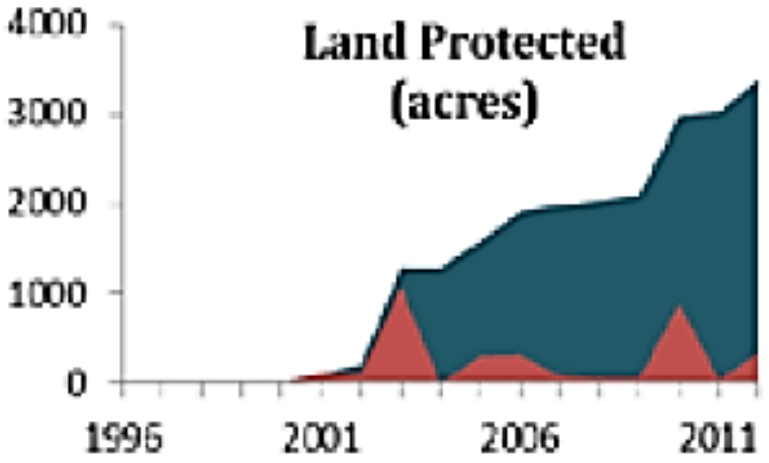
Tracking Progress

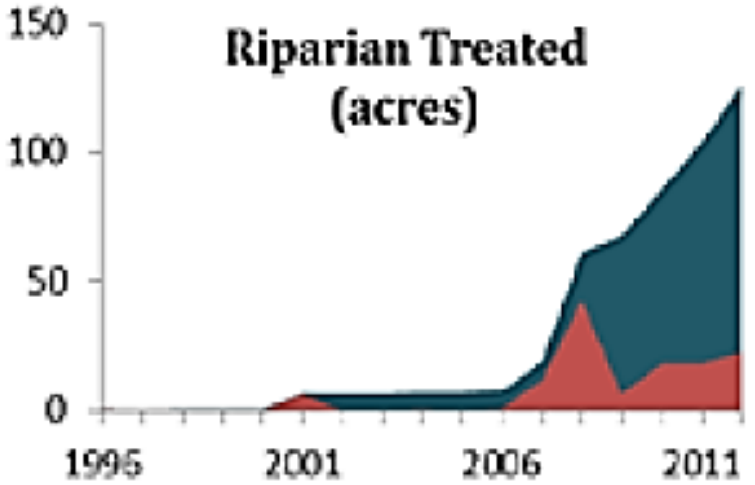


Tracking Progress

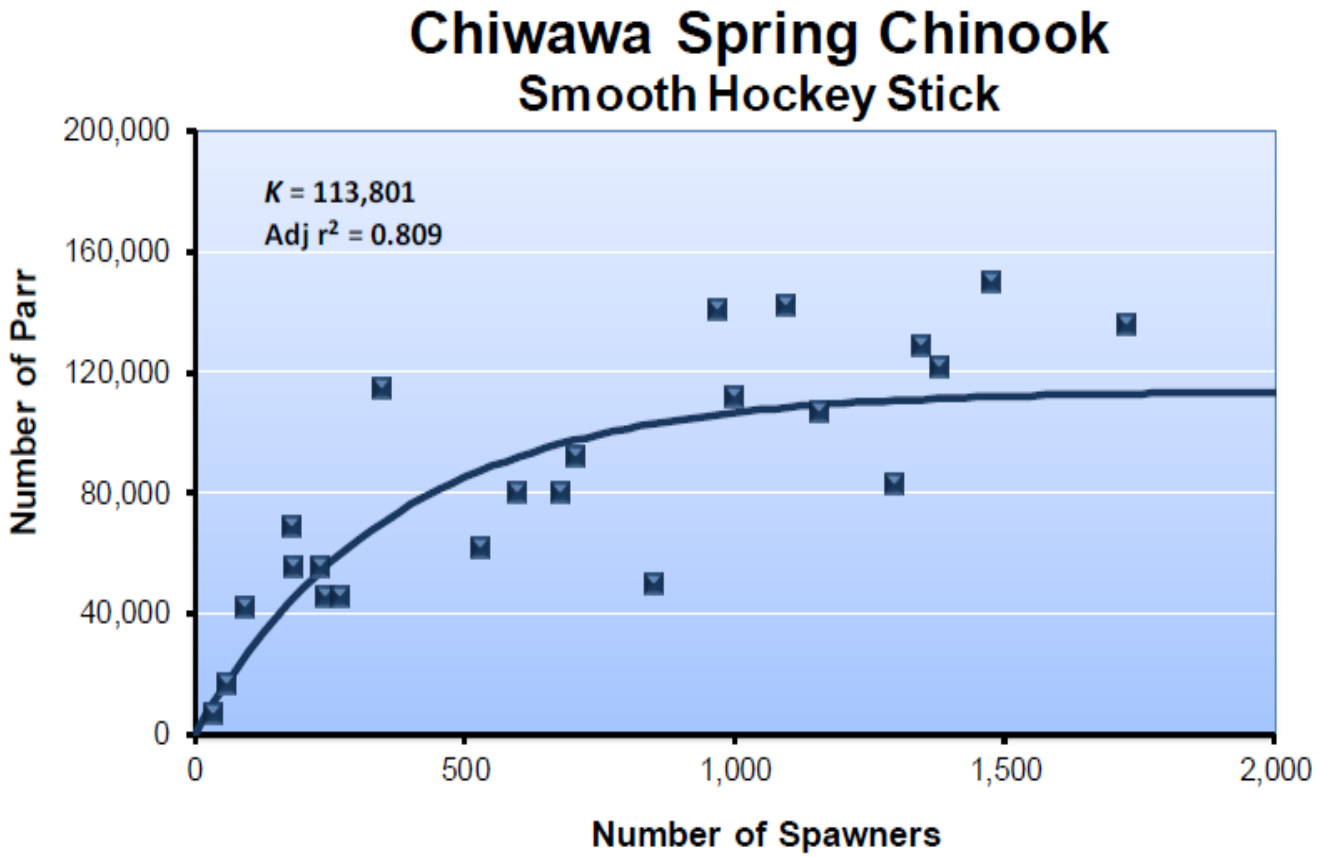




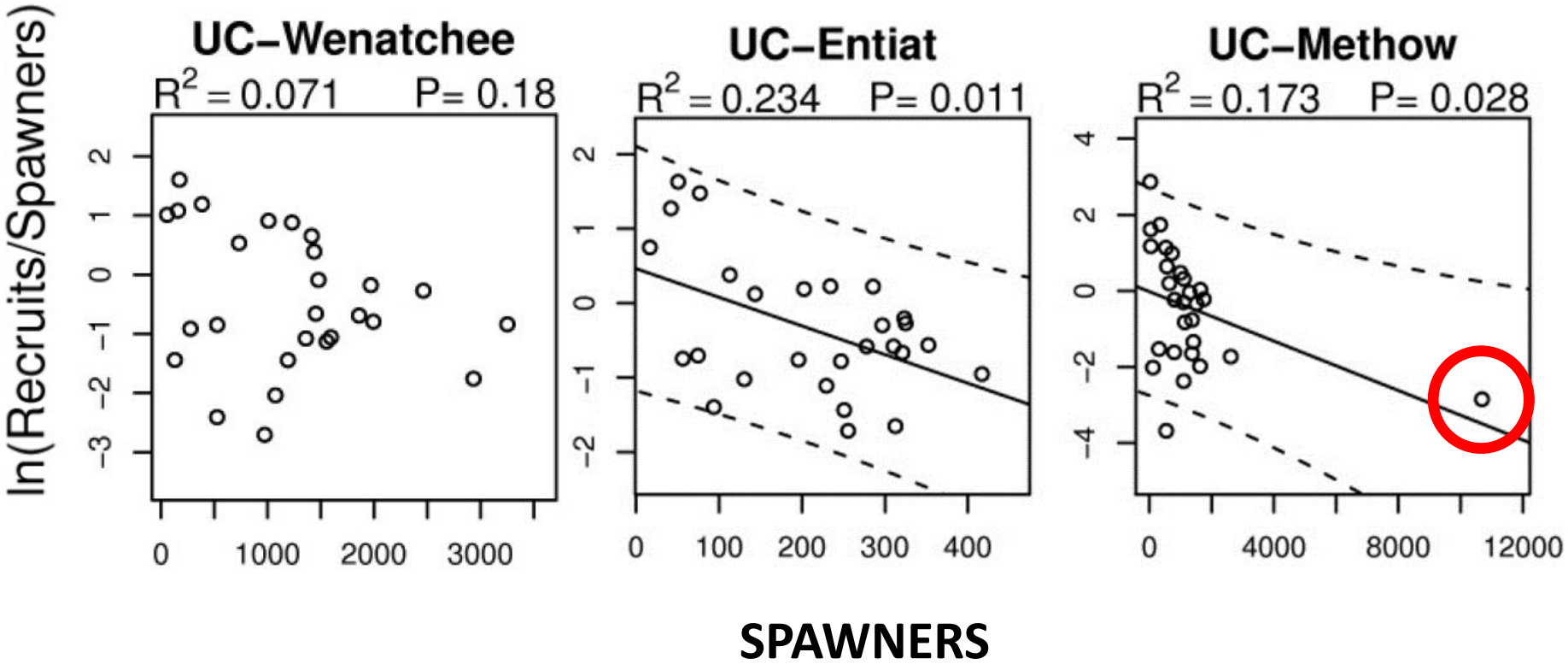




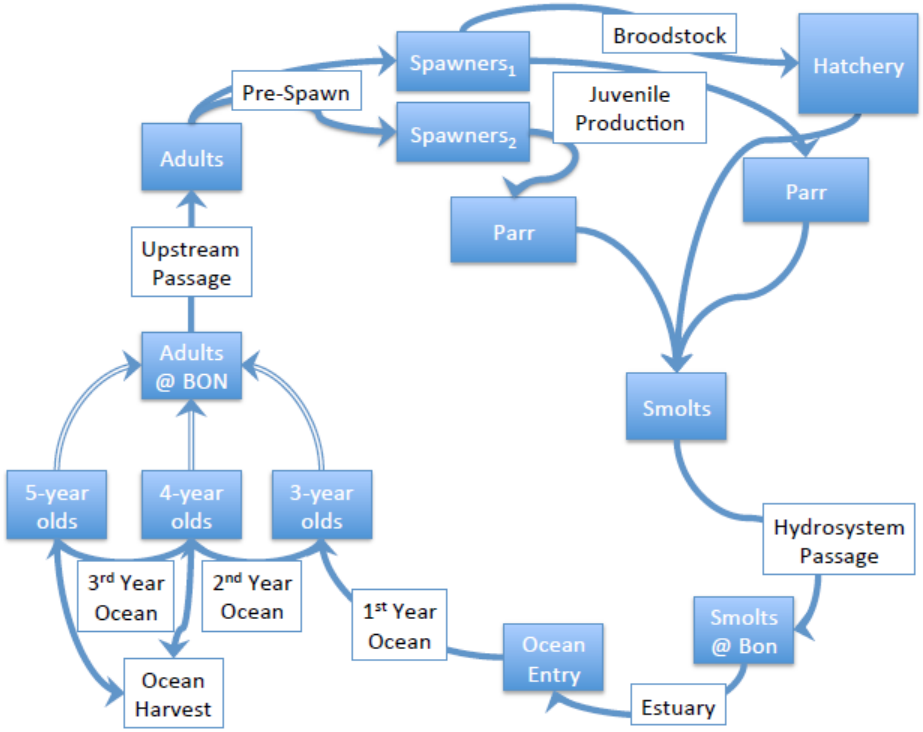
Density Dependence

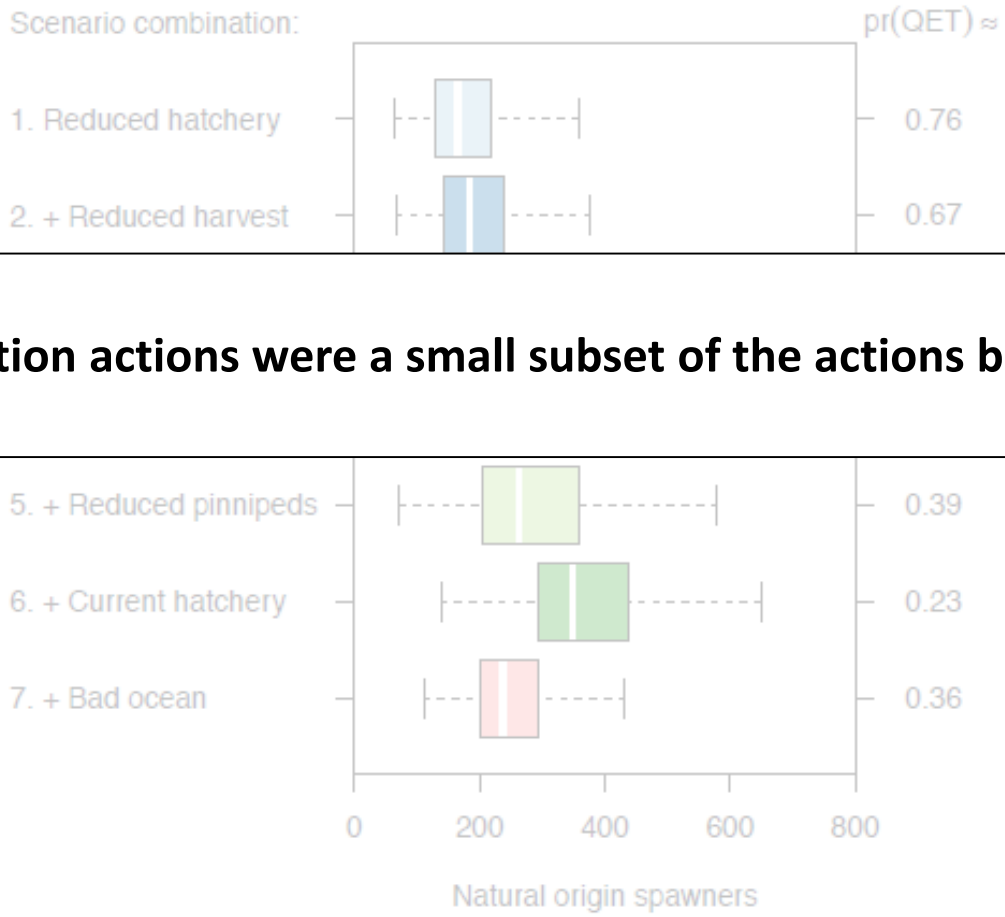


Density Dependence



Wenatchee Life-Cycle Model

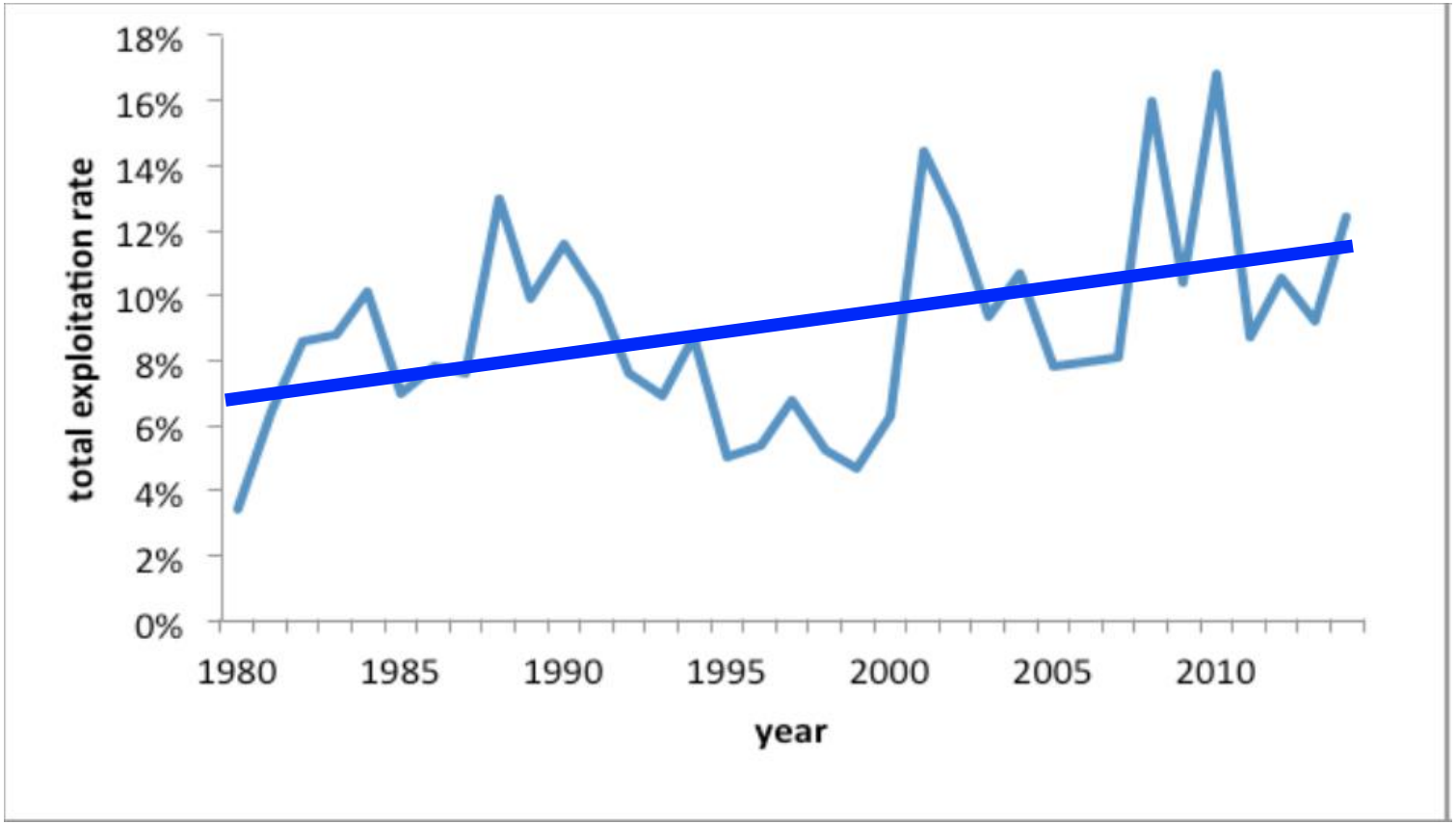




Habitat restoration actions were a small subset of the actions being implemented

Hydrosystem

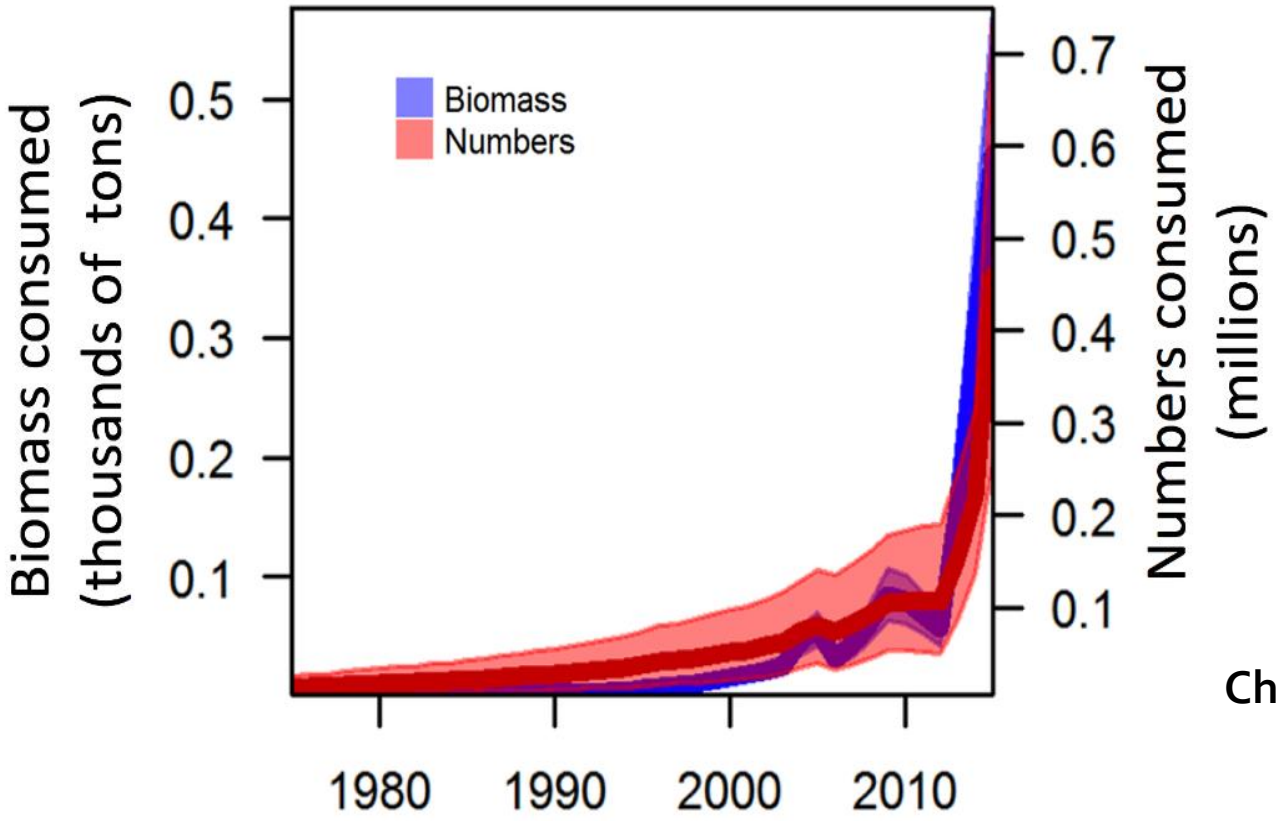
Harvest



Average 10%

NWFSC, 2015

Pinniped Predation



Chasco et al. 2017

Temporal trends in marine mammal predation of Chinook salmon
Mark Sorel/NOAA Northwest Fisheries Science Center

Are pinnipeds potentially significant source of mortality for UCR spring Chinook?

Yes, but population-specific estimates of impacts not available.

Can the effect of pinniped predation be quantified?

Yes, but more tagging studies and coast-wide bioenergetics/life-cycle modeling are needed.

Pinniped Predation

The ISAB recommends proceeding with the pinniped recommendations listed in the 2016 Five-Year Upper Columbia Status Report of NOAA Fisheries:

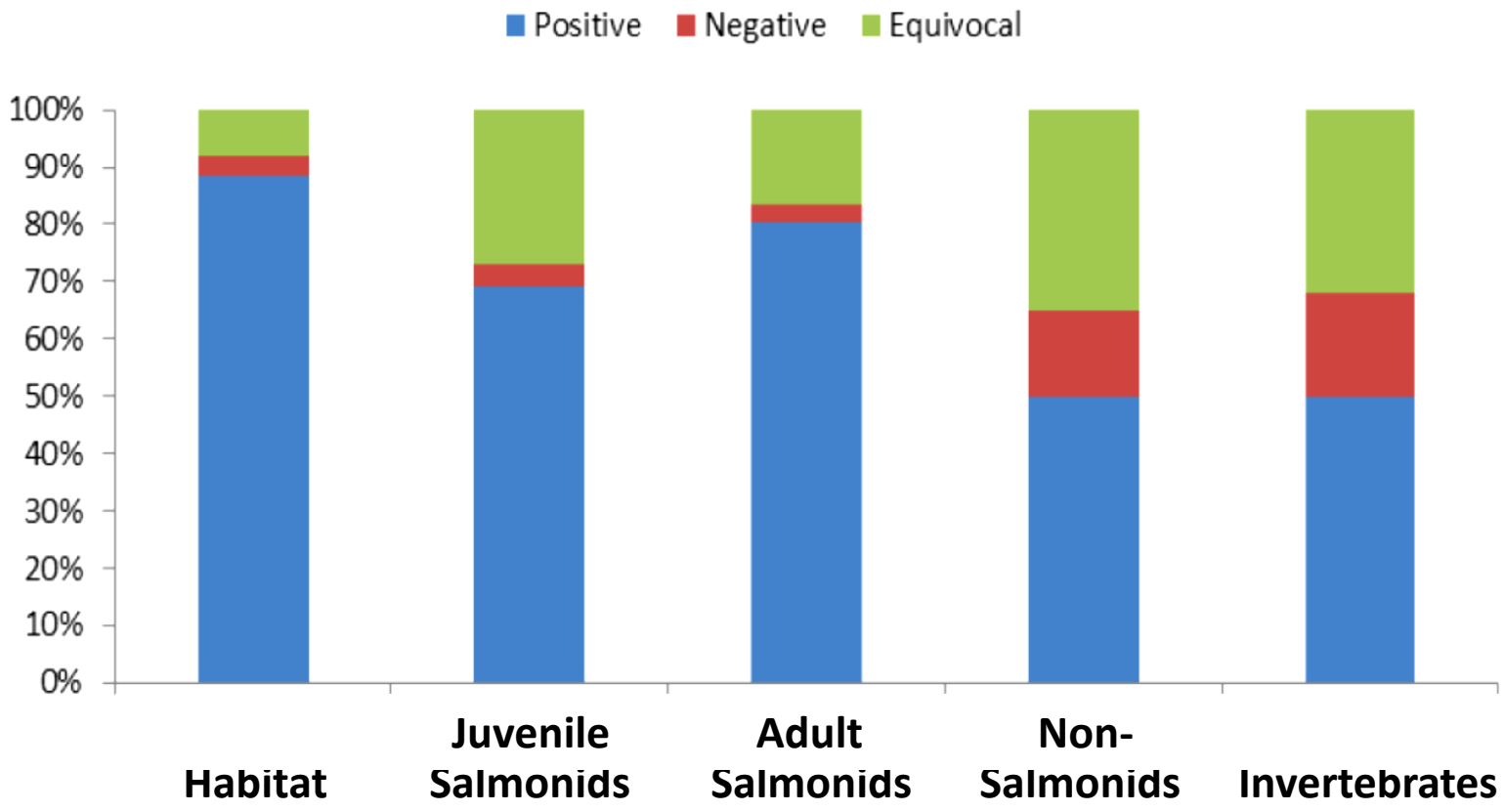
- Expand monitoring to assess interactions between pinnipeds and listed species
- Maintain predatory pinniped management actions at Bonneville Dam
- Complete the life-cycle/extinction risk modeling
- Expand research on survival and run timing for adult salmonids in the Columbia River estuary and lower Columbia River

Habitat Action Effectiveness

Is there evidence that past projects have improved habitat for this ESU?

- Removing barriers to connectivity
- Reconnecting floodplains, side channels, and off-channel habitats
- Restoring habitat complexity using log or boulder structures
- Increasing streamflow
- Managing fine sediment
- Restoring nutrients
- Controlling nonnative species

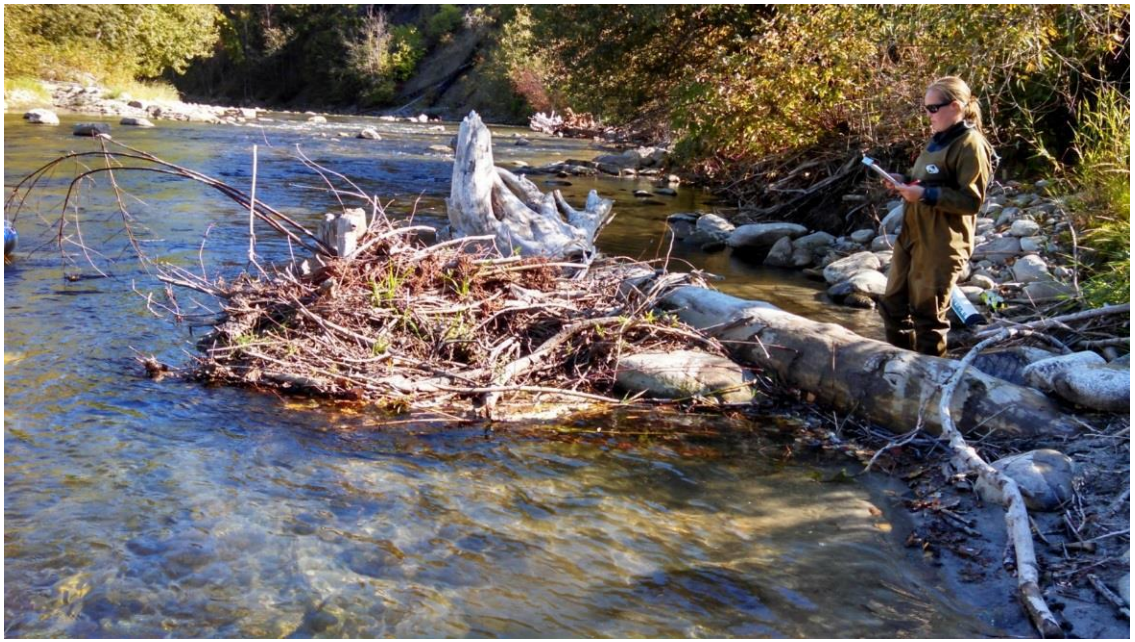
Effectiveness of wood structures



Restoring habitat complexity using log or boulder structures

Higher numbers of juvenile Chinook during early and mid-summer

Higher total abundance, not just moved fish around



Polivka et al. 2015

Sample Design

For Before and After studies, adding **1 year** of pre-treatment measurements increased the power to detect differences more than including up to **100 years** of post-treatment data (O'Neal et al. 2016).

Evidence for Effectiveness

- Habitat protection
- Removing barriers
- Reconnecting floodplains and side channels
- Increasing habitat complexity

Prioritization

Are habitat recovery actions being prioritized and sequenced strategically, given existing knowledge and data gaps?

Prioritization Based on Cost Effectiveness

- The procedure for characterizing costs and effectiveness is simplistic and the results are weighted such that they have little or no influence on project priorities.

- The ISAB recommends using a transparent, quantitative cost-effectiveness analysis of each proposed project.

RME

Is a research, monitoring, and evaluation (RME) framework in place that can adequately address the questions above?

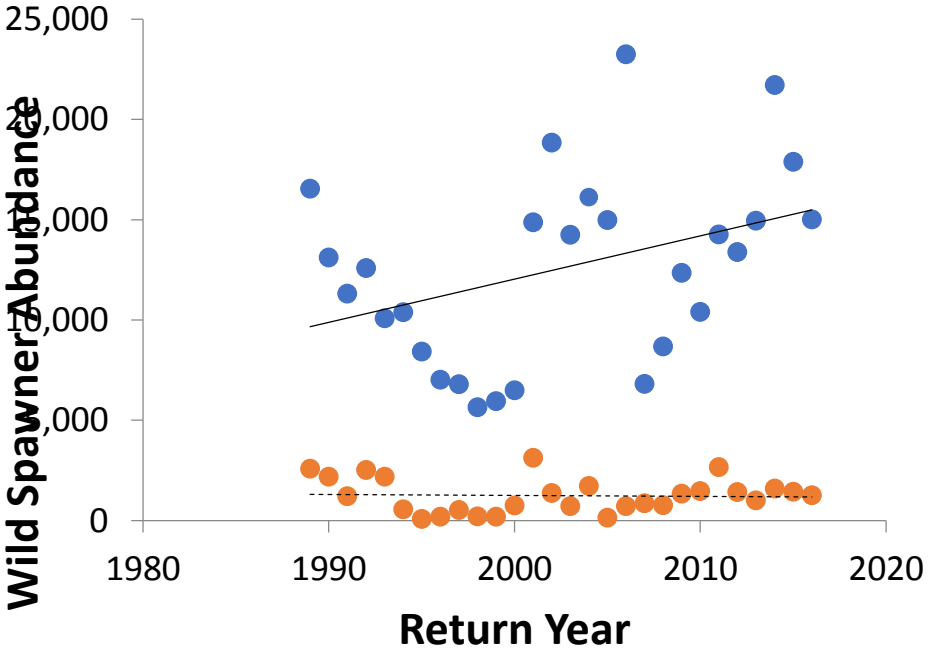
RME

- Methods of the UCSRB's Regional Technical Team, public utility districts, and regional fisheries agencies **are generally appropriate and can be used to answer questions** about effects of hatcheries and the hydrosystem.
- Currently, the RME Plan does not encompass all Hs and their related working groups.
- The ISAB recommends developing an integrated RME Plan that encompasses all Hs and the Upper Columbia's related working groups.

More wild summer than spring Chinook: Why?

Answers & analyses from UCR researchers

Photo by Michael Humling, USFWS



Graph & data from Andrew Murdoch, WDFW

Spring vs. Summer Chinook

Examining Differences at the Adult and Juvenile Stages in Freshwater Habitats

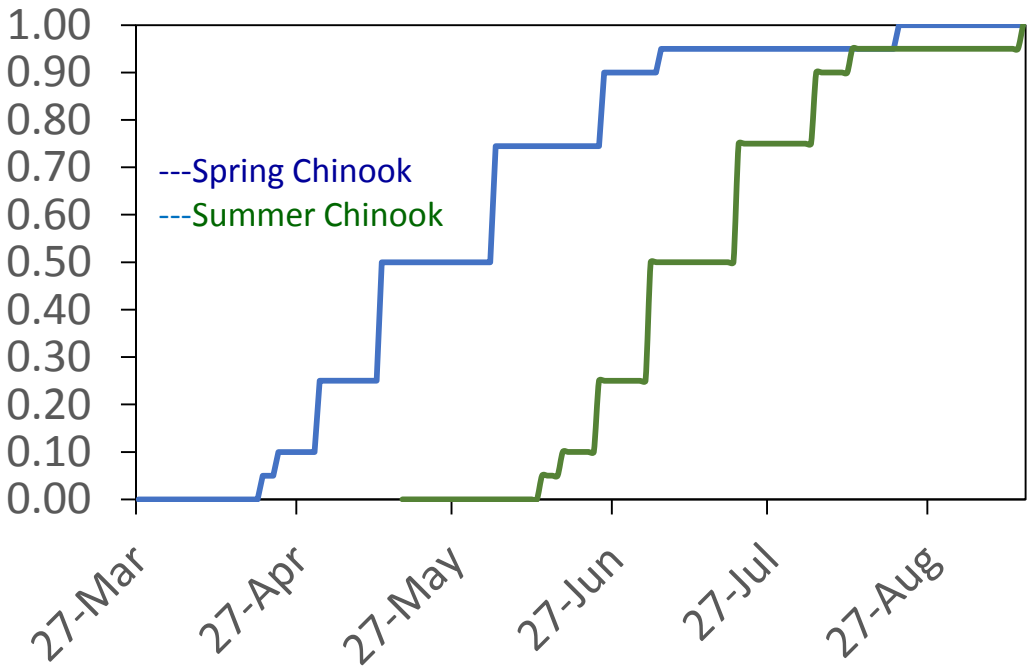
Photo courtesy of Greer Maier UCRSRB

Photo NOAA-Fisheries

Arrival Timing at Bonneville Dam

Average Cumulative %

% of Run	Spring	Summer	Difference in Days
5	Apr 20	Jun 13	54
25	May 1	Jun 24	54
50	May 13	Jul 4	52
75	Jun 4	Jul 21	47
90	Jun 25	Aug 5	41



Graph & data from Andrew Murdoch, WDFW

Seasonal Affects On Adult Chinook Transit Times
In The Lower River

Residency In The Lower River	
Date	**Transit Time**
Late Mar	**30 to 40 Days**
Mid Jun	**5 to 10 Days**

Data from Sorel et al. 2017

Survival in the Lower River

by Arrival Timing

Timing	Population	Survival	
		2010-12	2013-15
Early	**Methow**	**69 - 81%**	**50 – 70%**
Intermediate	**Entiat**	79 – 88%	67 – 85%
	Wenatchee		
Late	**Imnaha**	84 – 92%	83 – 92%
	Lostine		

Photo: Spokesman.com

Data from Sorel et al. 2017

Adult Transit Times & Survival

In the Mainstem

(McNary to Rock Island 293 Rkm)

Race	Mean Travel Time (days)	Mean Survival
Spring	**9**	**74%**
Summer	**5**	**81%**

Data from Andrew Murdoch, WDFW

Pre-Spawning Mortality

Photo from: Oceanmdx,skyscrapercity.com

Holding Location	50% Arrival Date	Mean Survival
Spring Chinook Upper River Refuges	Early to Mid May	54%
Summer Chinook Main River Pools	Mid July	85%

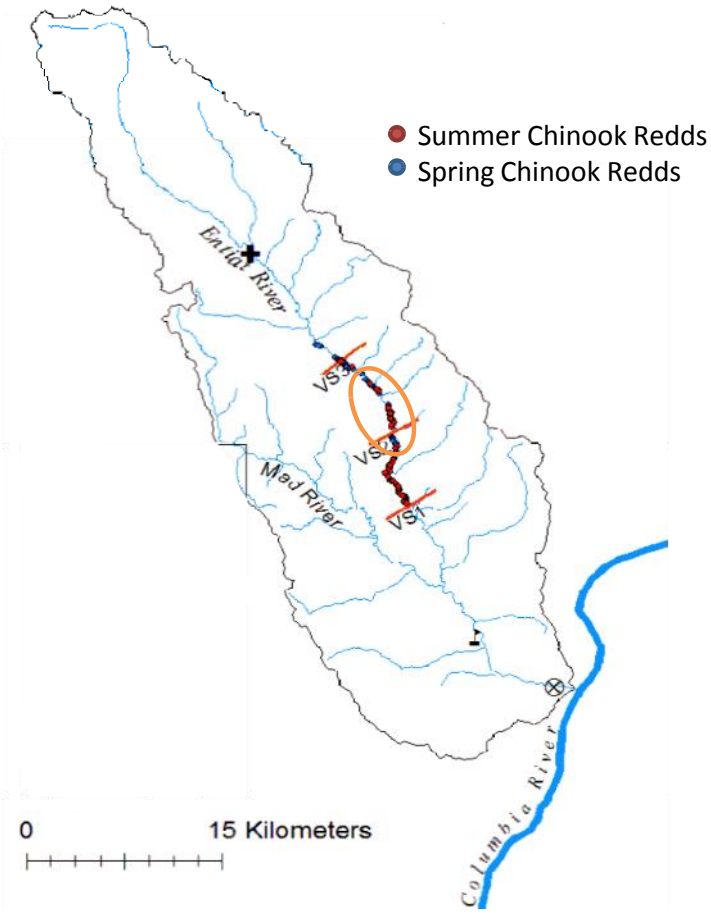
Data from Andrew Murdoch, WDFW

Influence of Hatchery Spawners
(1989 – 2016)

Photo: Mike Cushman, Cascadia Conservation District

River	Race	pHOS	pNOB	PNI
Wenatchee	Summer	14%	92%	0.87
	Spring	45%	55%	0.55
Methow	Summer	33%	74%	0.69
	Spring	57%	37%	0.39

Data from Andrew Murdoch, WDFW



Redd Superimposition & Hybridization
(Entiat Subbasin)

- ~19% Superimposition: Summers on Springs
- ~14% Possible Hybridization
- >3.2% Juvenile Hybrids Detected

Data & Map from: Tom Desgroseillier et al., PPT 2017, USFWS

Summary of Adult Differences
(Springs Compared to Summers)

- Higher pinniped predation
- Lower mainstem survival
- Lower pre-spawning survival
- Greater potential for hatchery domestication
- Subject to redd Superimposition
  - Redd superimposition could be a factor in the Wenatchee & Methow

Differences Between Juvenile Spring & Summer Chinook

Juvenile Life History Strategies

Photo: Togiak National Wildlife Refuge USFWS

Juvenile Life History	Summer Chinook	Spring Chinook
Sub-Yearling To Estuary		
Spring	✓	-
Summer	✓	-
Fall	✓	-
Winter	-	-
Yearlings to Estuary		
Spring-- from Reservoirs	✓	Few
Spring-- from Natal Subbasin	✓	✓

Data from Desgroseillier et al. 2017 PPT

Emigration Timing of Chinook from the Wenatchee River into the Columbia River

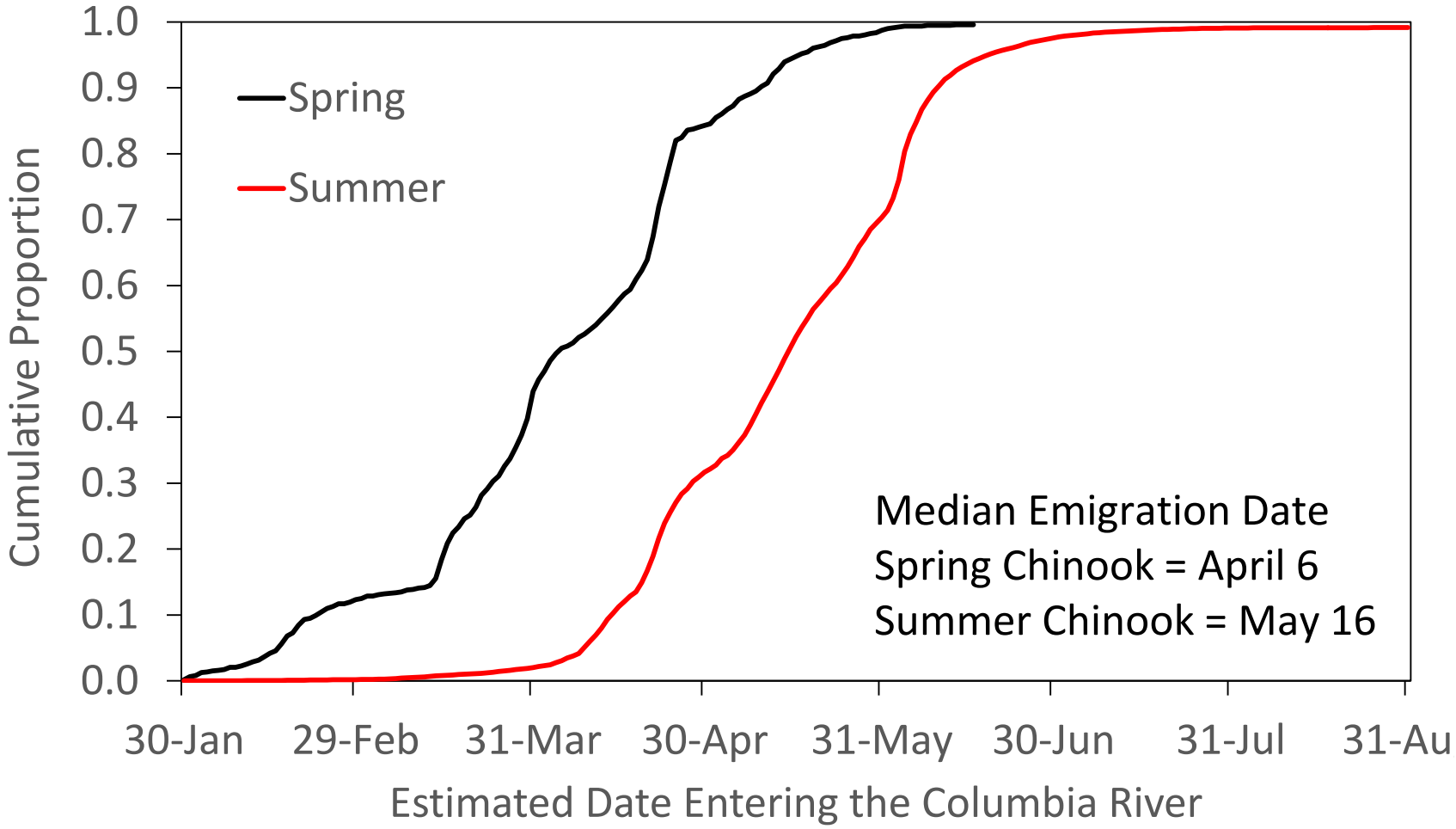


Figure from Andrew Murdoch, WDFW

Summary of Juvenile Differences
(Springs Compared to Summers)

- Less life history diversity
- Narrower time span and range in body sizes at estuary entrance
- Smaller % of mainstem out-migration during spill regime
- Increased susceptibility to avian predation due to larger size
- Subject to capacity and survival bottlenecks in tributaries due to longer tenure in upper Columbia subbasins

Research Monitoring & Evaluation
(hatchery questions)

Wells Hatchery

- Have past and ongoing hatchery programs affected the fitness of UCR spring Chinook?
- Are current supplementation programs providing demographic benefits?
- Can the present RM&E program answer the above questions?

Data and analyses from Murdoch et al. 2011 and Hillman et al. 2017

Priest Rapids Rearing Channel

Research Monitoring & Evaluation
(hatchery questions)

- Can the present RM&E program answer questions about current hatchery effects and demographic benefits?

- Yes, a comprehensive RM&E program is in place with an adaptive management component.

Research Monitoring & Evaluation
(speculations on past hatchery effects)

1899 State Hatchery Upper Wenatchee
Photo from Wahle and Pearsons 1984

- Have past hatchery programs affected the fitness of UCR spring Chinook?

- **Productivity** (R/S)
  - Initial decrease due to out-of-basin transplants
- **Abundance**
  - Broodstock mining
- **Genetic diversity** was likely altered via:
  - Broodstock mining
  - Straying
  - Use of out-of-basin stocks

Research Monitoring & Evaluation
(speculation on past hatchery effects)

Leavenworth Hatchery 1940

http://usfwspacific.tumblr.com/post/127730300805

- Have past hatchery programs affected the fitness of UCR spring Chinook?

- **Spatial structure** was likely reduced by:
  - Straying of hatchery fish
  - Broodstock mining
  - Transplants of out-of-basin stocks
    - Grand Coulee Fish Maintenance Project
    - Importation of lower river stocks
  - Homogenization of in-basin stocks

Research Monitoring & Evaluation
(current hatchery effects on genetics)

Methow Hatchery

Photo: Grant County PUD

Genetic Differences

Pre-Supplementation v. Post-Supplementation

Methow & Wenatchee

- No change in genetic diversity
  - Allelic richness
  - Heterozygosity
- No change in Effective Population Size
- Straying is reducing genetic differences among Methow, Chewuch & Twisp stocks in the Methow
- Large amount of geneflow among Chiwawa, Nason, and White River stocks in the Wenatchee

Research Monitoring & Evaluation

(current hatchery effects on demographics when compared to Reference Streams)

Demographic Effects of Supplementation		
Population Attribute	**Methow**	**Wenatchee**
Overall Abundance	No Change	No Change
Wild Abundance	No Change	No Change
Productivity (R/S)	No Change	No Change

Models

Are the life-cycle and habitat models for the Upper Columbia ESU useful for identifying, prioritizing, and evaluating restoration actions?

Models

- In general, the life-cycle models will be useful to investigate the relative impacts of restoration actions.

- Life-cycle models can be used to scale up management actions to larger spatial (entire river and ocean) and temporal scales (full life cycle).

Models

- At this point, the models are useful for ranking the relative benefit of management actions at the population level but may not perform well when predicting the exact benefits.

- The life-cycle models should be continually refined and improved.

Coordination

- The UCSRB has developed a useful process for coordinating recovery actions.

- Currently, there is no process for integrating the separate coordinating committees and working groups across the three subbasins.

- The ISAB encourages the UCSRB and the tribal, state, federal agencies and the public utility districts to develop a systematic, collective process for coordinating actions, monitoring, and decision-making.


QUESTIONS