Washington Department of FISH and WILDLIFE

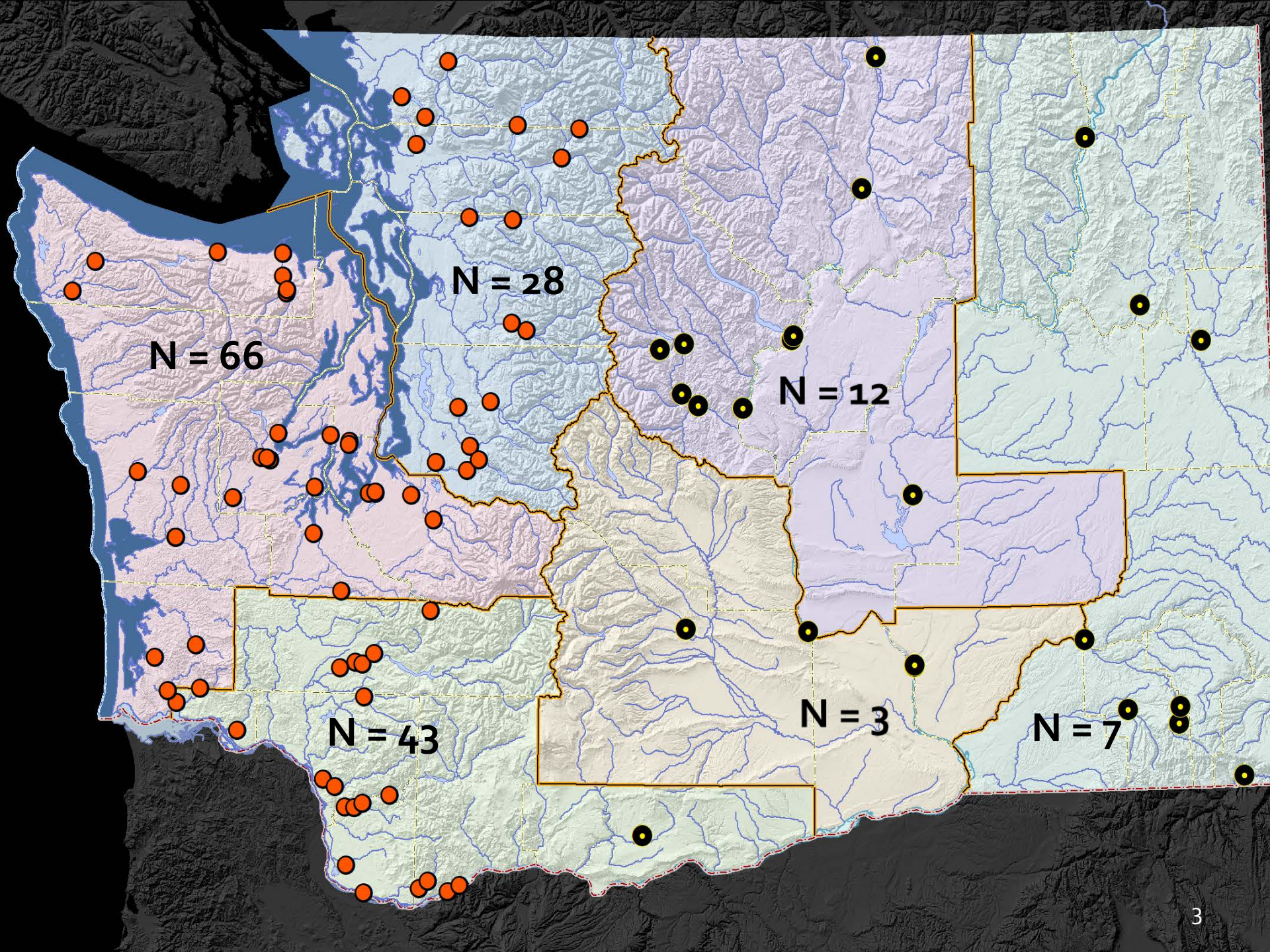
Hatchery and Fishery Reform Policy Review

April 9, 2020

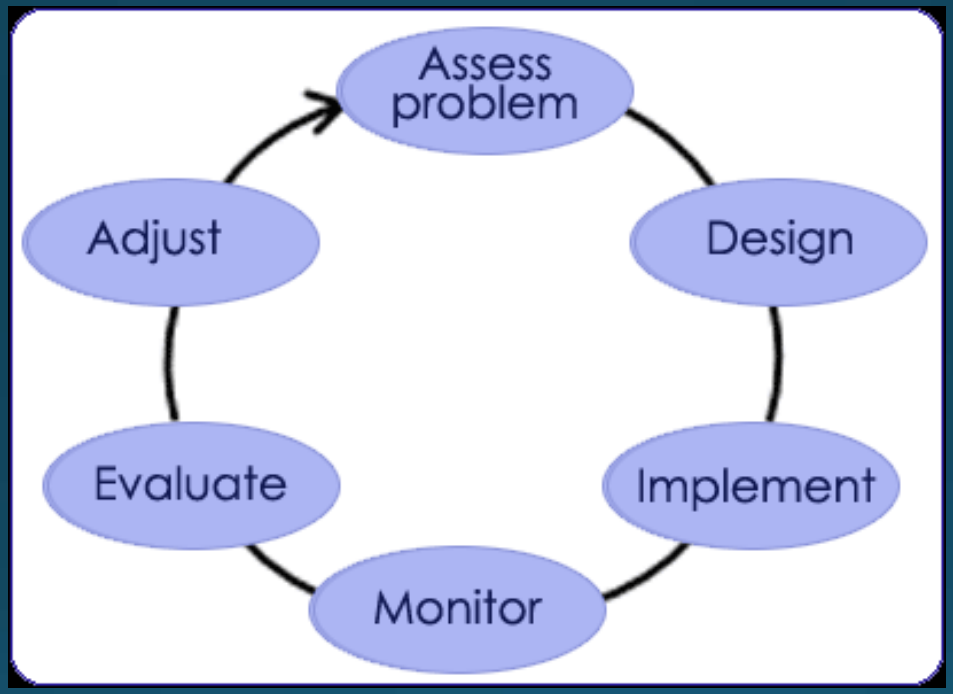
Photo credit: Patrick Hulett (WDFW)

Presentation Outline

- Implementation of Policy C-3619 guidelines.
  - 1st step – Assess implementation of reform actions (e.g., using weirs to reduce pHOS)
  - Stoplight chart
- Effectiveness monitoring in the natural environment
  - 2nd step – Conduct statistical analysis (e.g., BACI)
  - Missing data that prevented Statewide performance assessment
- Recommendations
  - Hatchery effectiveness monitoring

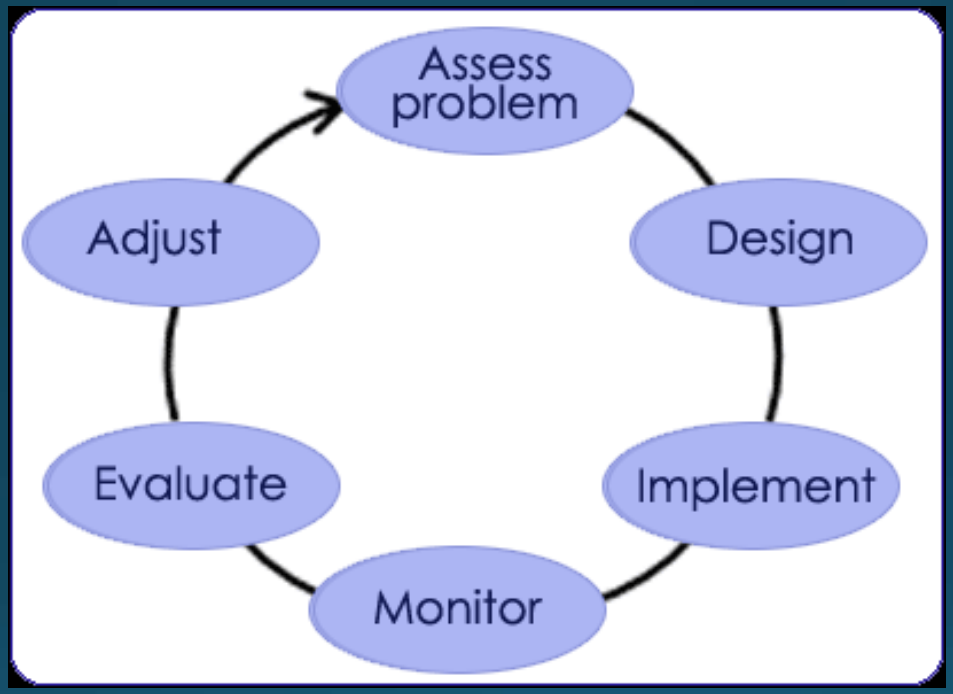

N = 66
N = 28
N = 12
N = 43
N = 3
N = 7

Adaptive Management



Adaptive Management

(Beguiling simple in form so hard in practice)



"…..promote the achievement of hatchery goals through adaptive management based on a structured monitoring, evaluation and research program" – Guideline 1 #C-3619

To learn best about the results of our actions - adaptive management

Did we implement the action?

Did the action achieve expected outcomes?

Did management actions in the watershed result in a *fish population* response

Sequential questions with increasing complexity and cost

Product: Hatchery and Fishery Reform Assessment Report

Product: Compare observed PNI to goal

Product: The only Chinook examples in WA
Methow
Wenatchee
Tucannon
Upper Yakima

Hatchery Reform Terminology

pHOS: proportion of naturally spawning fish that are hatchery-origin

pNOB: proportion of hatchery broodstock that are natural-origin

PNI: proportionate natural influence $\frac{\text{pNOB}}{\text{pNOB + pHOS}}$

0 % or low PNI indicates predominantly hatchery influence

100% or high PNI indicates predominantly natural influence

Assessment of Policy Implementation

- Evaluate how well the department has implemented the 11 Policy Guidelines
- This review will be displayed in the form of a report card, with a summary report that examines data in a more detailed format

Policy Guideline			Progre
1		Use the principles, standards, and recommendations of the Hatchery Scientific Review Group (HSRG) to guide the management of hatcheries operated by the Department. b. In particular, promote the achievement of hatchery goals through adaptive management based on a structured monitoring, evaluation, and research program.	
	1.a	Develop Clear, Specific, Quantifiable Harvest and Conservation Goals for Natural and Hatchery Populations within an "All H" Context	R,Y,G
	1.b	Design and Operate Hatchery Programs in a Scientifically Defensible Manner	R,Y,G
	1.c	Monitor, Evaluate and Adaptively Manage Hatchery Programs	R,Y,G
2		The Department will prioritize and implement improved broodstock management (including selective removal of hatchery fish) to reduce the genetic and ecological impacts of hatchery fish and improve the fitness and viability of natural production working toward a goal of achieving the HSRG broodstock standards for 100% of the hatchery programs by 2015.	R,Y,G
3		Develop watershed-specific action plans that systematically implement hatchery reform as part of a comprehensive, integrated (All-H) strategy for meeting conservation and harvest goals at the watershed and Evolutionarily Significant Unit (ESU)/Distinct Population Segment (DPS) levels. Action Plans will include development of stock (watershed) specific population designations and application of HSRG broodstock management standards. In addition, plans will include a time-line for implementation, strategies for funding, estimated costs including updates to cost figures each biennium.	R,Y,G
4		Externally mark all Chinook, coho and steelhead artificial production that is intended to be used for harvest except as modified by state-tribal agreements or for conservation or research needs.	R,Y,G
5		Secure necessary funding to ensure that Department-operated hatchery facilities comply with environmental regulations for passage facilities, water intake screening, and pollutant control systems.	R,Y,G
6		Implement hatchery reform actions on a schedule that meets or exceeds the benchmarks identified in the 21st Century Salmon and Steelhead Framework.	R,Y,G
7		Provide an annual report to the Fish and Wildlife Commission on progress of implementation.	R,Y,G
8		Develop, promote and implement alternative fishing gear to maximize catch of hatchery-origin fish with minimal mortality to native salmon and steelhead.	R,Y,G
9		Seek funding from all potential sources to implement hatchery reform and selective fisheries.	R,Y,G
10		Define "full implementation" of state-managed mark selective recreational and commercial fisheries and develop an implementation schedule.	R,Y,G
11		Work with tribal co-managers to establish network of Wild Salmonid Management Zones (WSMZ) across the state where wild stocks are largely protected from the effects of same species hatchery programs. The Department will have a goal of establishing at least one WSMZ for each species in each major population group (bio-geographical region, strata) in each ESU/DPS. Each stock selected for inclusion in the WSMZ must be sufficiently abundant and productive to be self-sustaining in the future. Fisheries can be conducted in WSMZ if wild stock management objectives are	R,Y,G

Report Card

Report Card	Definition	Percent of Implementation
	Full or nearing full implementation	76% - 100%
	Good progress towards full implementation	51% - 75%
	Some progress towards full implementation	26% - 50%
	Little to no progress towards full implementation	0% - 25%

Example (Use local broodstock)

Metric	Region						Total
	1	2	3	4	5	6	
Programs	7	12	3	28	43	66	159
Local Brood	5	11	3	26	36	63	139
%	71	92	100	93	84	89	87
Assessment							


Hatchery Reform


Fishery Reform


Risks and Benefits


Reporting and Funding

Hatchery Reform Guidelines
(Suspended guidelines)

1. Use the principles of the HSRG

- Develop Clear, Specific, Quantifiable Harvest and Conservation Goals for Natural and Hatchery Populations within an "All H" Context
- Design and Operate Hatchery Programs in a Scientifically Defensible Manner
- Monitor, Evaluate and Adaptively Manage Hatchery Programs

Hatchery Reform Guidelines
(Suspended guidelines)

1. Use the principles of the HSRG

- Develop Clear, Specific, Quantifiable Harvest and Conservation Goals for Natural and Hatchery Populations within an "All H" Context

HSRG Recommendation	Metric
1. Express conservation goals relative to population's biological significance, viability and recover phase with triggers	60%
2 Express harvest goals in terms of specific fisheries	0%
3. Ensure programs goals are coordinated and compatible with those for other populations that might be affected.	?
Mean	30%

Hatchery Reform Guidelines
(Suspended guidelines)

1. Use the principles of the HSRG

- Design and Operate Hatchery Programs in a Scientifically Defensible Manner

HSRG Recommendation	Metric
4. Identify the purpose of the hatchery program	100%
5. Explicitly state assumptions relative to goals (AHA, PCD risk, Geneflow)	68%
6. Selected broodstock management strategy based on goals (mechanisms for segregation)	76%
7. Size program based on goals under an All H strategy (stray rates)	66%
10. Self sustaining local broodstock (importing broodstock)	87%
11. Coordinate hatchery programs to account for effects on other (non-WDFW) programs and populations (AHA, PCD Risk, Stray matrix)	46%
13. Maximize survival of hatchery fish (SARs)	67%
Mean	73%

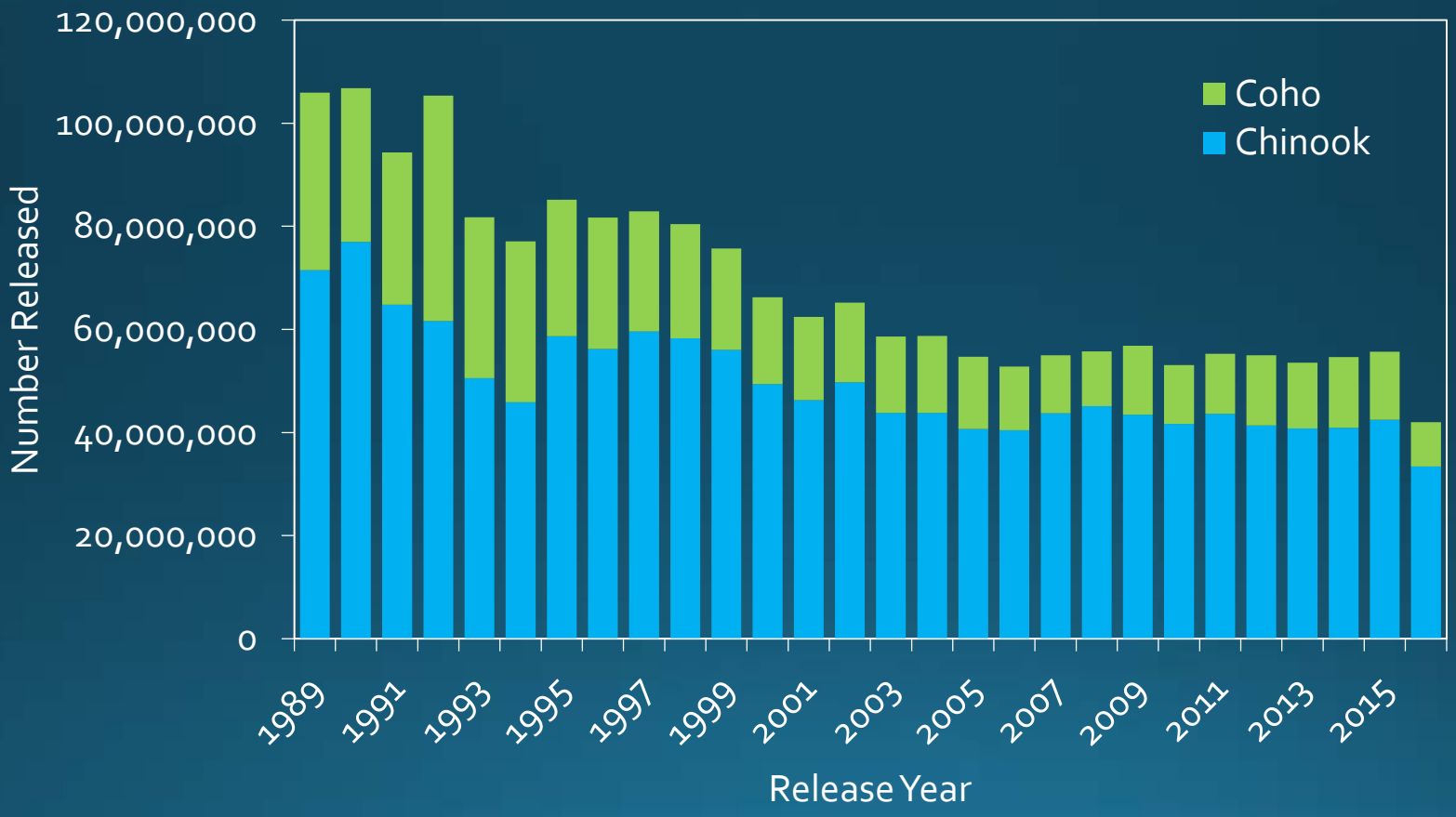
Hatchery Reform Guidelines
(Suspended guidelines)

1. Use the principles of the HSRG

- Monitor, Evaluate and Adaptively Manage Hatchery Programs

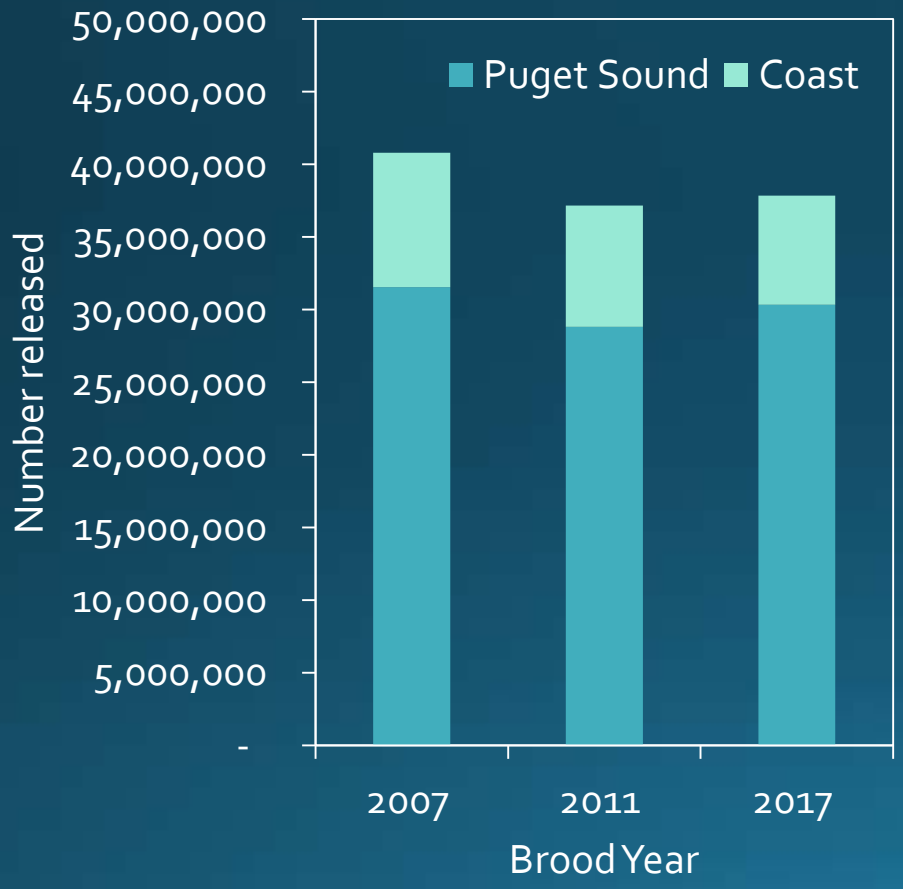
HSRG Recommendation	Metric
15. Prioritize research on quantifying factors affecting RRS and fitness	75%
16. Adaptively manage hatchery programs (M & E programs)	44%
17. Discontinue or modify if risk outweigh benefits (programs changes related to risk have occurred in every region)	100%
Mean	73%

All Releases (WDFW and Others) of Chinook and Coho in Puget Sound Release Years 1989-2016



C-3619 Hatchery Reductions

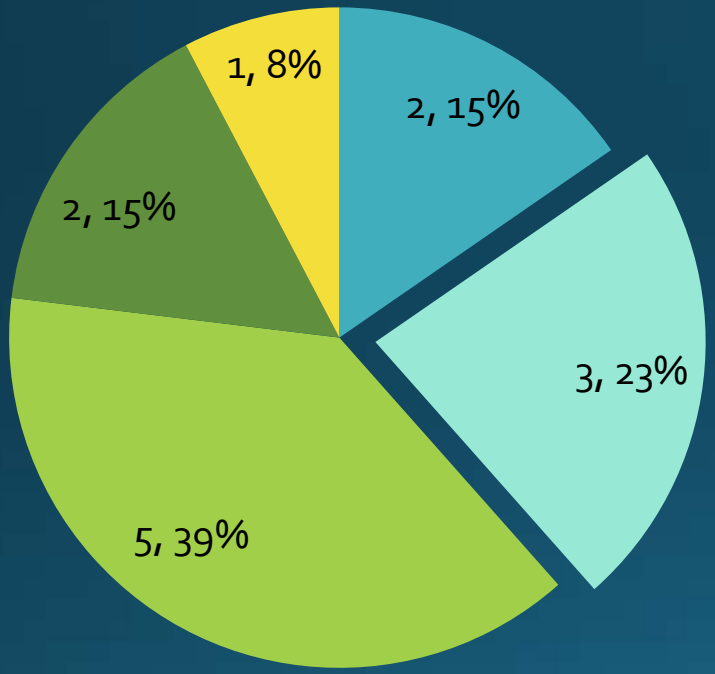
Chinook Salmon



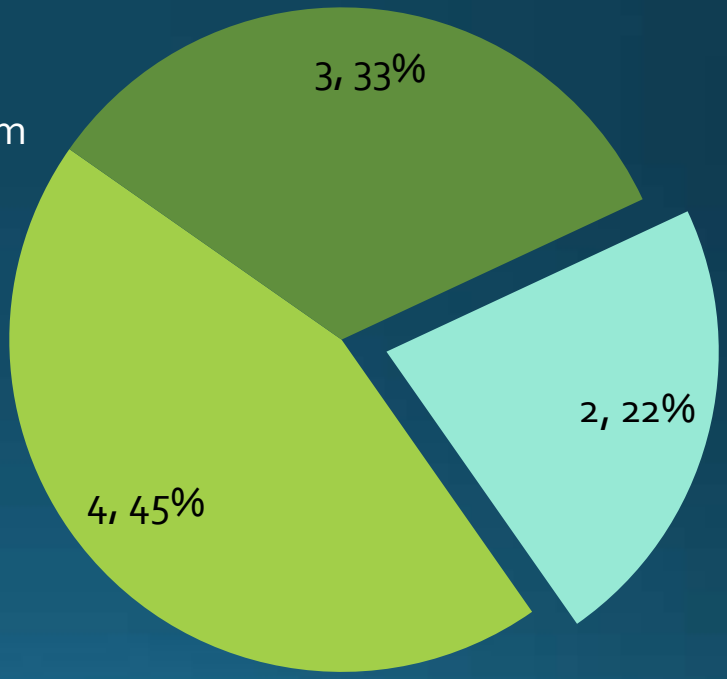
- Western WA Chinook releases declined 7% between 2007 and 2017 for various reasons
- Columbia River Chinook releases are based on multiple agreements including ESA, US v. OR, FERC/PUD mitigation and Mitchell Act

Western WA Chinook Salmon

Decrease (N=13)



Increase (N=9)



- Net loss of 100k due to hatchery reform
- Net loss of 1.65M due Willapa Bay Policy

Hatchery Reform Guidelines
(Suspended guidelines)

2. Improve broodstock management to reduce ecological and genetic impacts of hatchery fish; achieve 100% HSRG standards by 2015.

- Progress made, but uncertainty in pHOS remains; low natural fish abundance

HSRG Recommendation	Metric
8. Manage harvest, broodstock and spawning escapement to meet HSRG standards	73%

- Improved estimates pHOS, but managing pHOS is still problematic
- Lack of natural origin fish has prevented higher pNOB
  - Poor ocean conditons

Hatchery Reform Guidelines
(Suspended guidelines)

3. Develop watershed action plans (i.e., All-H Approach)
   - AHA and HGMPs (Surrogate metric, not an action plan)

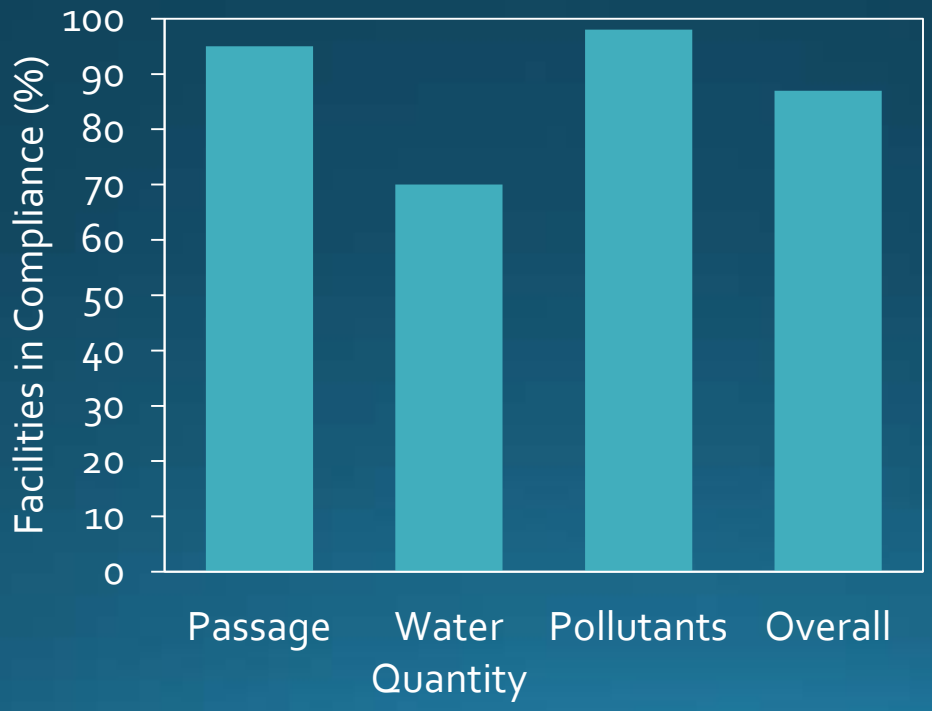
HSRG Recommendation	Metric
14. Regularly review goals and performance of programs in an "all-H" context.	81%

- HGMPs are not required for some coastal programs
- Reviewed upon renewal (R1-3)
- Action plans require co-management and stakeholder agreement plus funding
- Represents a paradigm shift in how we manage hatcheries, harvest and habitat.

Hatchery Reform Guidelines
(Hatchery benefits or risk)

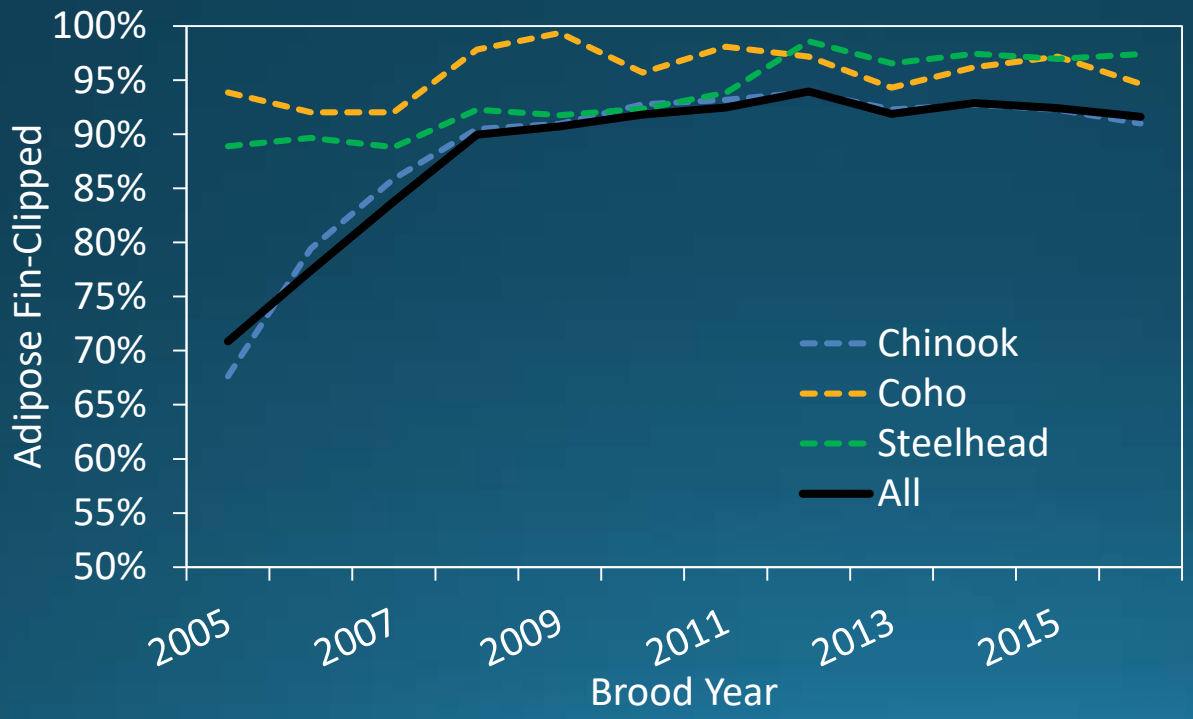
5. Hatchery facility compliance

- Good progress, some outstanding issues related to water quality or passage



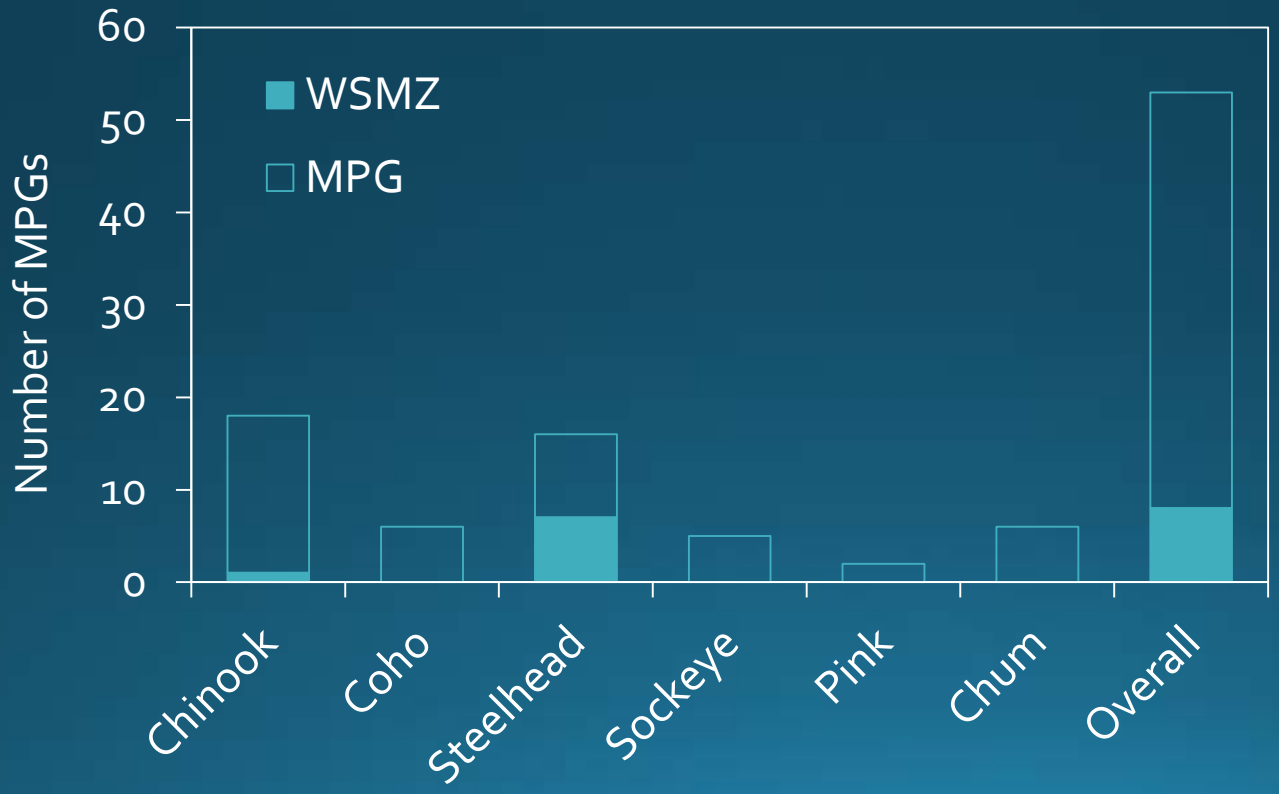
Hatchery Reform Guidelines
(Hatchery benefits or risk)

4. Externally mark all Chinook, coho, and steelhead
   - All programs but one.
     - Priest Rapids Hatchery Fall Chinook (>3M not marked)



Hatchery Reform Guidelines
(Hatchery benefits or risk)

11. Wild Salmonid Management Zones
    - 7 steelhead, 1 fall Chinook or 15% complete



Guideline 11: WSMZ
(Qualitative steelhead comparison)

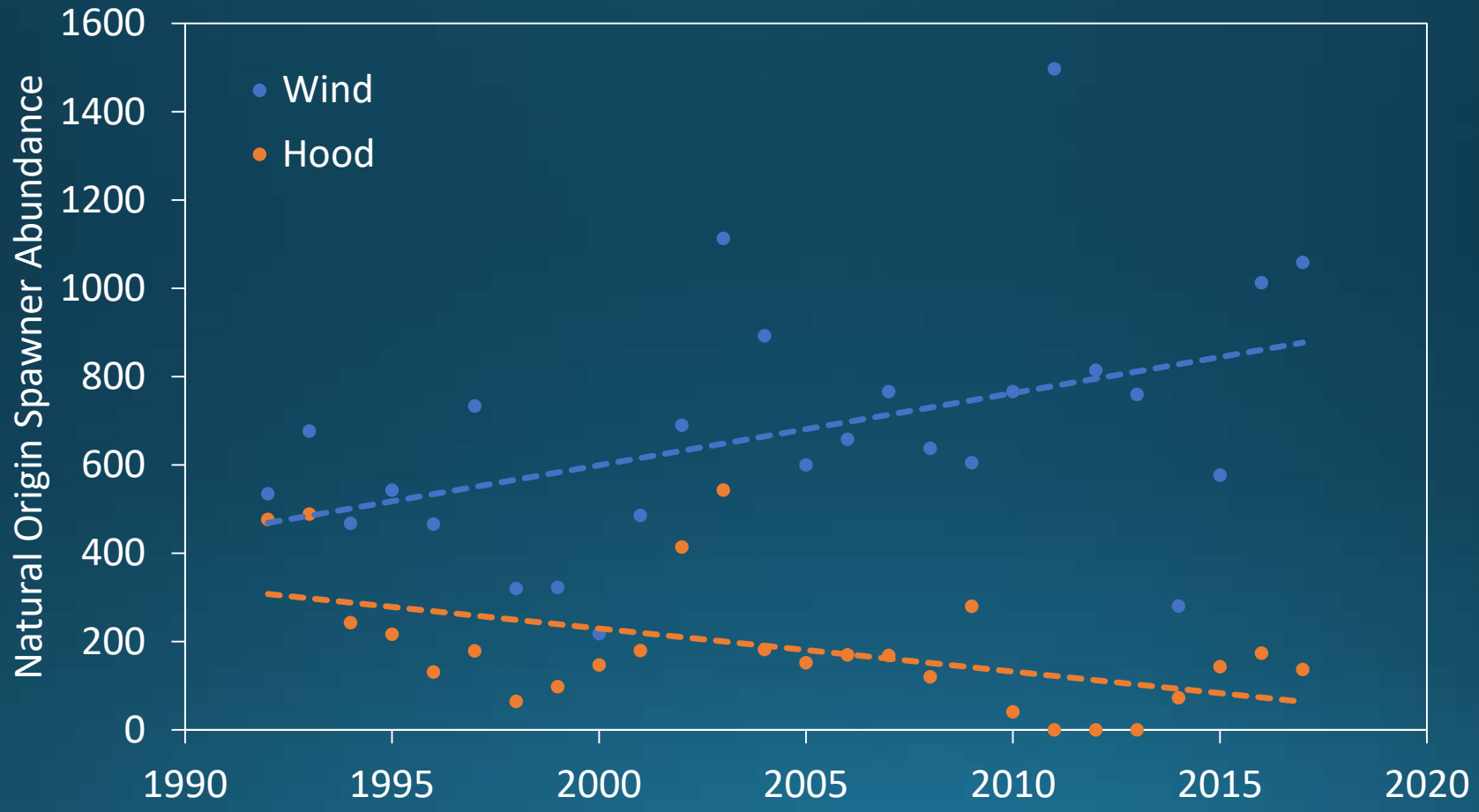
- Wind River (rkm 251) vs. Hood River (rkm 273)
- Similar out of basin effects
  - Bonneville Dam
- Similar in-basin effects
  - Dam removed in 2009 or 2010
- High quality abundance time series
- Mean pHOS (1992-2017)
  - Wind <0.01; Hood = 0.46 (0 – 0.88)

Guideline 11: WSMZ
(Qualitative Comparison)

- Correlation is not causation
- Risk from hatchery fish in the Wind River is near zero (i.e., higher VSP score)
- Few WSMZ examples exist because similar data sets don't exist.
- No decrease in fishing effort (e.g., EF Lewis)
- Hatchery summer steelhead are no longer released in the Hood River.

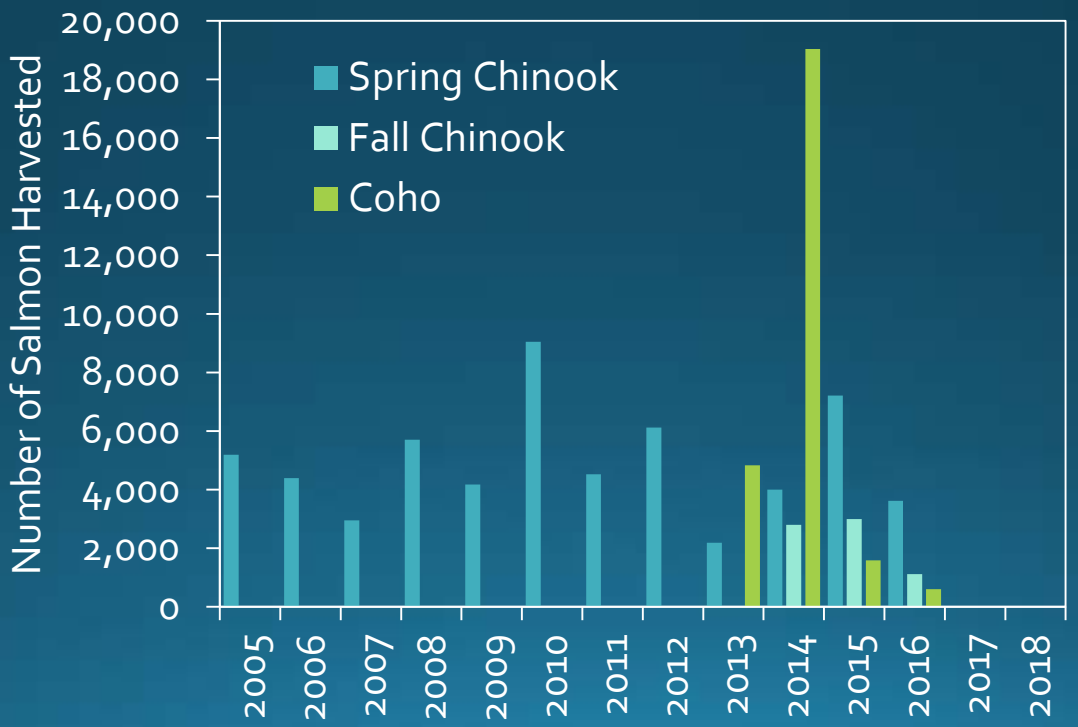
Guideline 11: WSMZ

(Data Source: Stream Net)



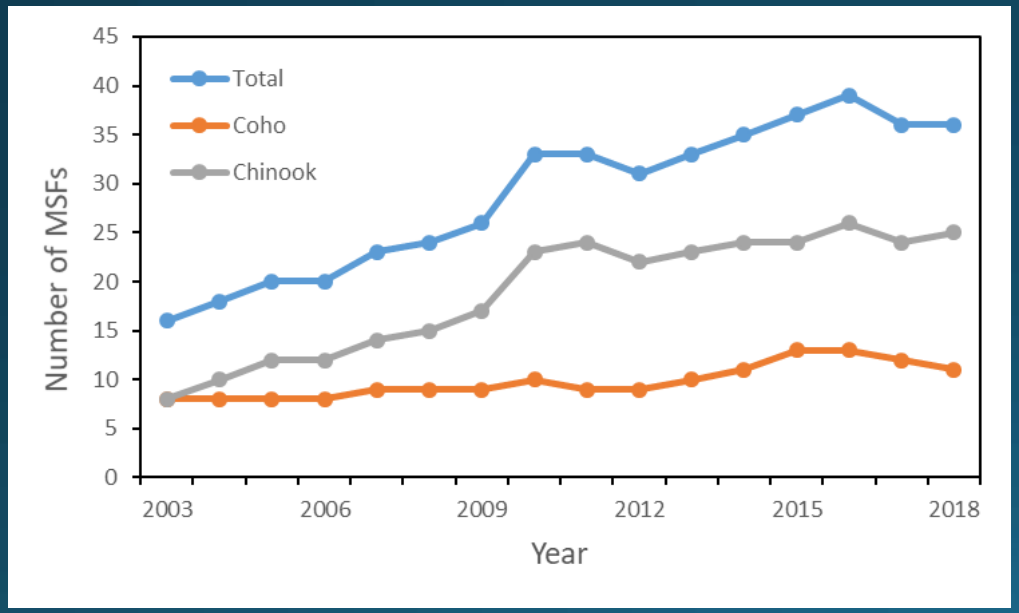
Fishery Reform Guidelines

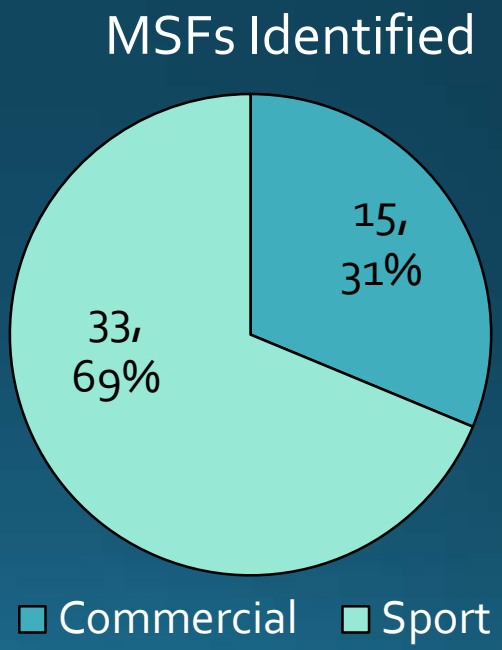
8. Alternative Gear
   - Gear developed but indirectly mortality relatively high
   - Promoted in Lower Columbia and Coast
   - Implementation was limited due to low abundance and cost
   - Overall



Fishery Reform Guidelines

10. Mark Selective Fisheries
    - Plan not defined, but MSFs peaked in 2016





C-3619 Fishery Changes

- Fisheries have not been directly affected by this policy, positively or negatively.
- Generally, mixed stock fisheries are not impacted by a change in a single program release goals.
- Overall changes in abundance (e.g. ocean conditions) and ESA impacts typically drive fishery openers and closures.

Hatchery Reform Guidelines
(Reporting/funding)

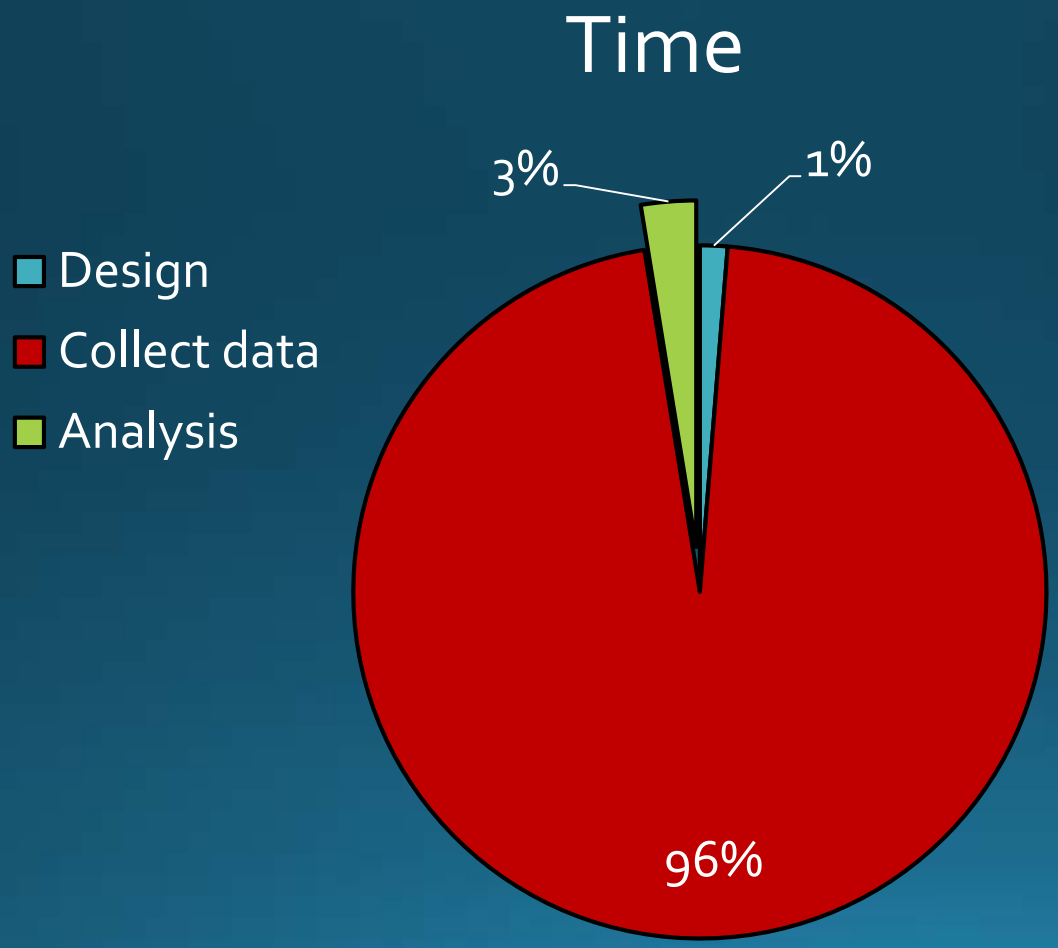
6. Implement hatchery reform consistent with 21St Century Salmon and Steelhead benchmarks
   - Redundant 2020 benchmarks

7. Report on implementation to FWC
   - Last comprehensive report in 2012

9. Seek funding to implement reform (Since 2007)
   - Hatchery Reform $64M
     - $5.3M annually or $1.5M/facility or $124k/facility/year

   Fishery Reform $33M ($13M CRSSE)

Monitoring in the Natural Environment



To learn best about the results of our actions - adaptive management

Did we implement the action?

Did the action achieve expected outcomes?

Did management actions in the watershed result in a *fish population* response

Sequential questions with increasing complexity and cost

Product: Hatchery and Fishery Reform Assessment Report

Product: Compare observed PNI to goal

Product: The only Chinook examples in WA
Methow
Wenatchee
Tucannon
Upper Yakima

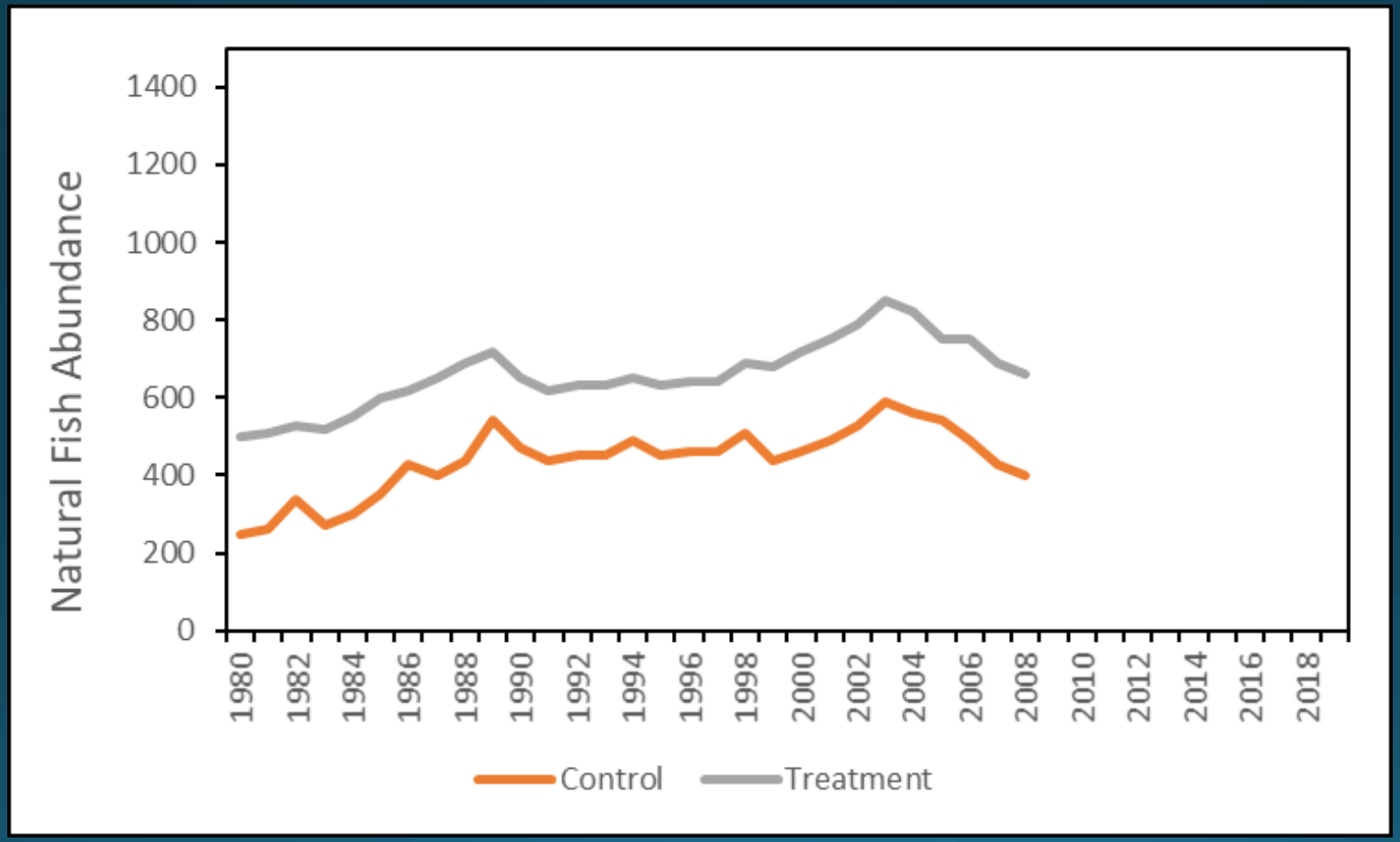
Reform Actions and Effectiveness Monitoring

- What is purpose of hatchery reform?
  - Goal: Minimize potential adverse impacts of hatcheries on natural populations while providing sustainable fisheries
- M & E programs are designed to evaluate the effectiveness of the entire hatchery program.
  - A specific action (e.g., pHOS = 0.3) will be data intensive
  - Meta-analysis approach or conduct population-level experiments with explicit hypotheses

Hatchery Effectiveness Monitoring

- Detecting change in a natural population that is attributed to a specific management action is challenging.
- Requires proper study design where the treatment effect (i.e., hatchery fish) is not confounded
  - BACI or Before-After-Control-Impact
  - Few published fishery or hatchery examples
    - Vendetti et al. 2018 – Upper Snake Chinook
    - Fast et al. 2015 – Upper Yakima Chinook
    - Berejikian and Van Doornik 2018 – Hood Canal steelhead
  - Bayesian hierarchal time-series model
    - Scheuerell et al. 2015 – Upper Snake

Before-After-Control-Impact Design



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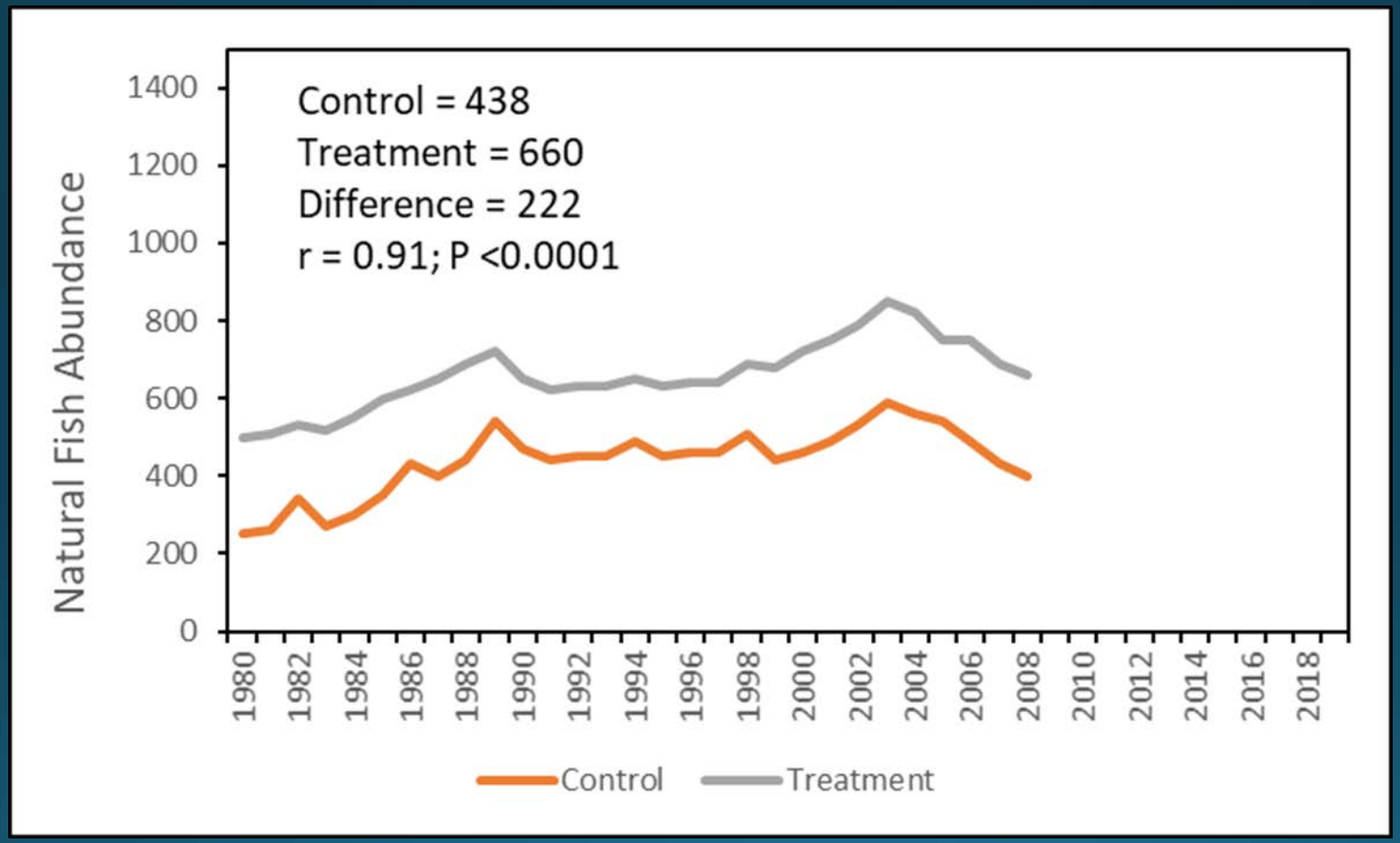

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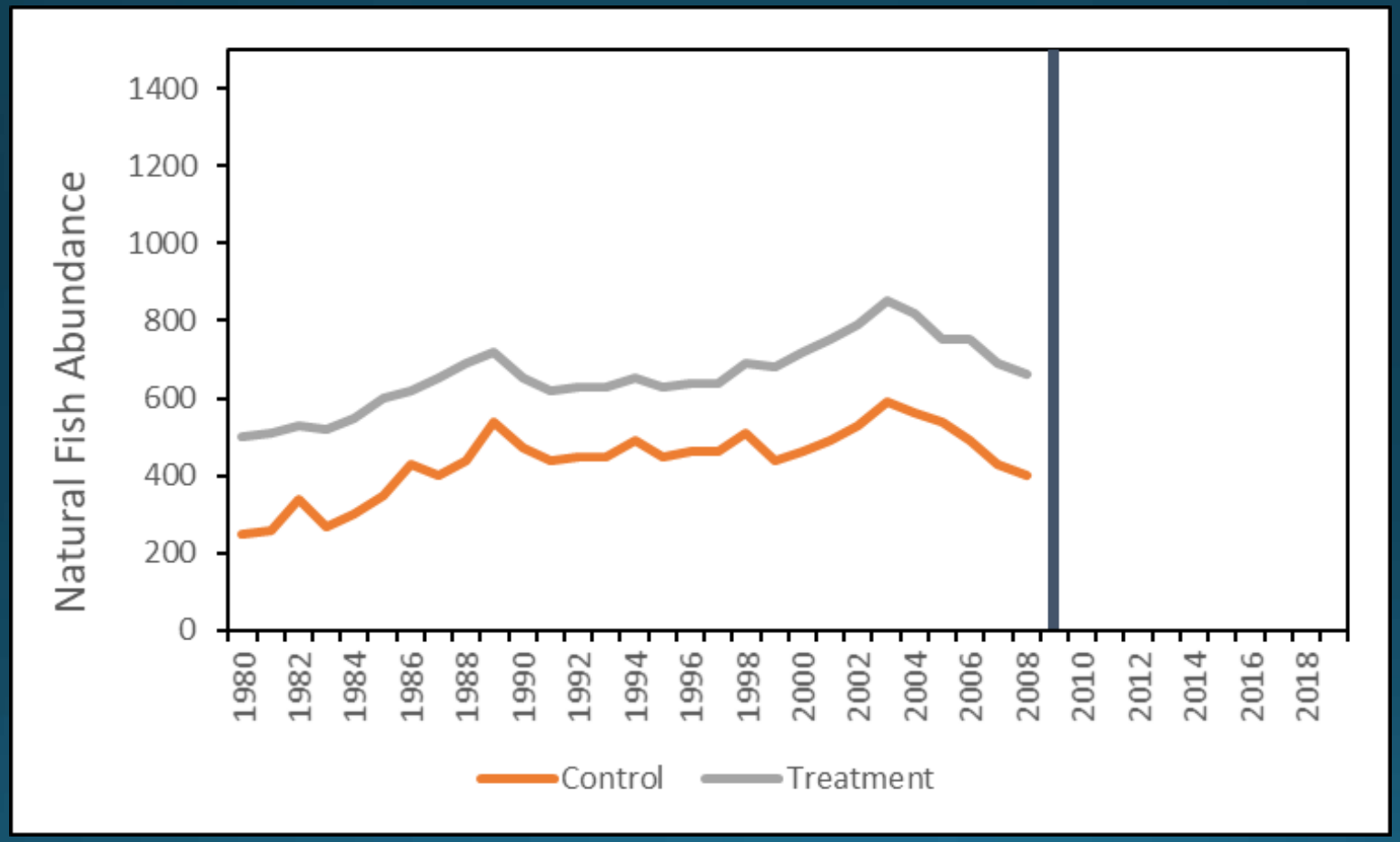

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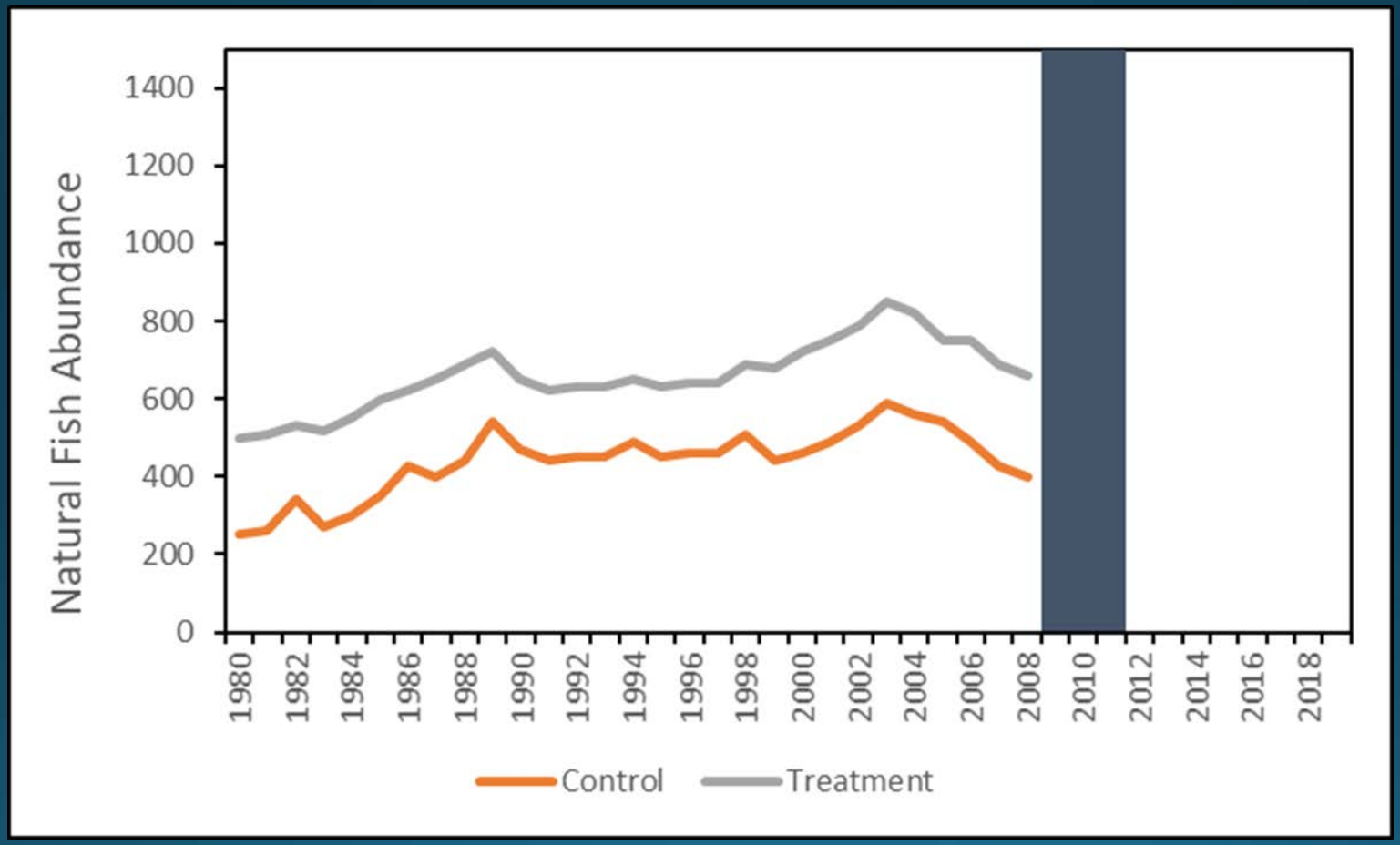

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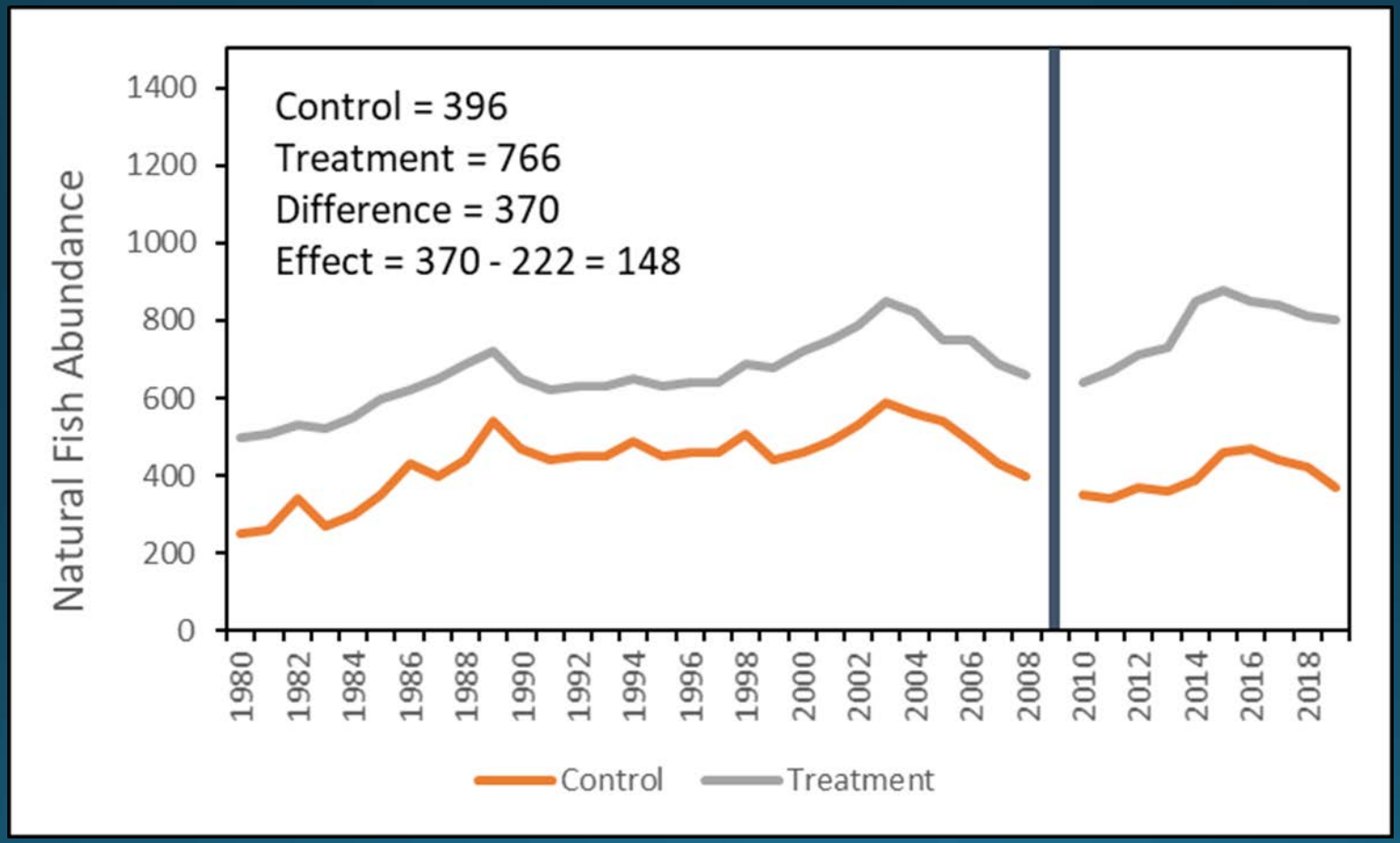

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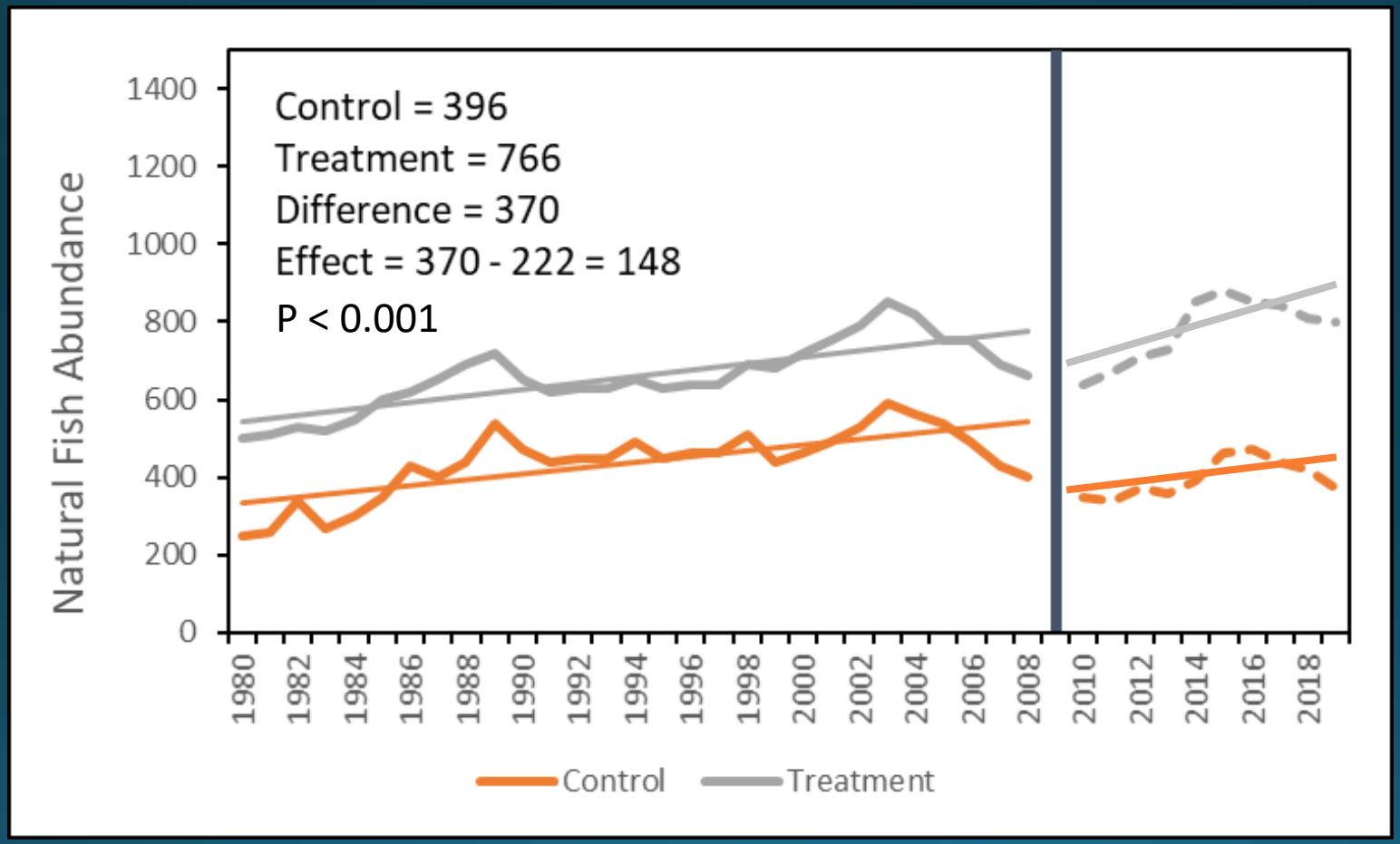
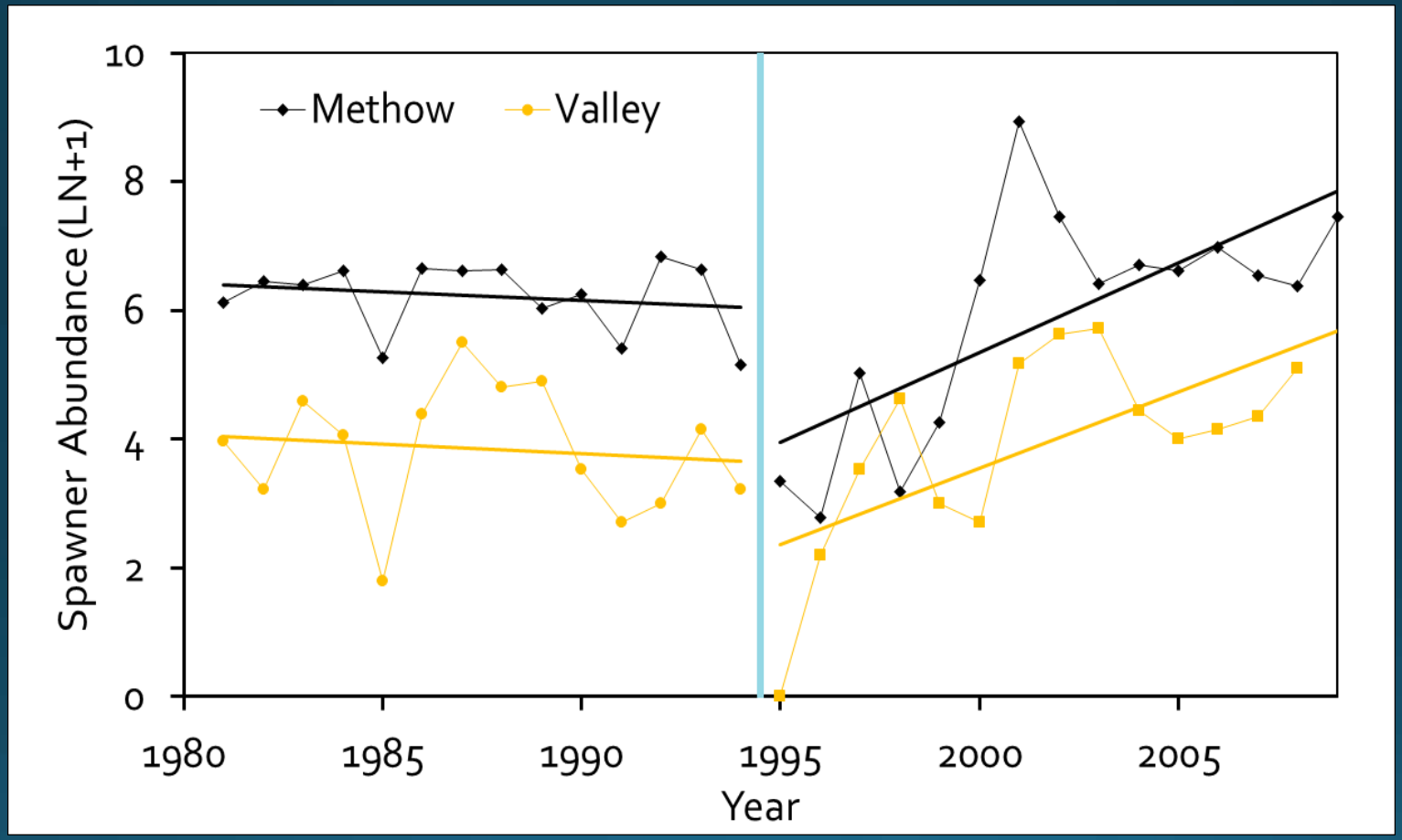


Methow Spring Chinook

(Control = Valley Creek, ID)



Lessons Learned

1. Implementing reform actions is complicated and takes time

   - Variability in implementation across the state is large (e.g., funding, co-management, FERC, Mitchell Act)

   - Effectiveness of implementation is uncertain
     - For example, weirs to control pHOS in SW WA achieved their goals only 5% of the of the time (T. Buehrens, WDFW)

Lessons Learned

1. Implementing reform actions is complicated and takes time
2. Requires a proper study design (e.g., BACI or other statistical approach)

- Ideally with multiple control populations
  - Columbia = Upper Snake
  - Coastal WA = Coastal OR?
  - Puget Sound = Western BC ?

Lessons Learned

1. Implementing reform actions is complicated and takes time
2. Requires a proper study design (e.g., BACI or other statistical approach)
3. No "Before" period due to lack of mass marking prior to 2008.

- High uncertainty in pHOS
  - Much less of an issue in Columbia Basin (except for Fall Chinook)

Lessons Learned

1. Implementing reform actions is complicated and takes time
2. Requires a proper study design (e.g., BACI or other statistical approach)
3. No "Before" period due to lack of mass marking prior to 2008.
4. The "After" period is too short (assuming we had a "Before" period)
   - Detectable effect size decreases with time
   - 15-30 years in both before and after periods

Effectiveness Monitoring Recommendations

1. Statewide Comprehensive Hatchery Monitoring and Evaluation Program

   - Most programs do not have a comprehensive M & E program
     - Hatchery environment (hatchery survival)
     - Natural environment (hatchery performance/level of integration)
     - Analytical framework (hypotheses testing)

   - Where programs do exist they are regional, species or program specific

   - Uncertainties in hatchery impacts also confound habitat effectiveness monitoring programs

Effectiveness Monitoring Recommendations

2. Establish program specific goals
   - How we measure success

3. Assess current population viability
   - Establish consistent methodology to set triggers for phases of recovery

4. Establish more WSMZs
   - Eliminates genetic risk from hatchery fish (except strays)
   - Monitor natural variability in abundance for future hatchery and habitat action effectiveness

5. Improve estimates of spawner abundance and pHOS
   - Critically important metrics

Effectiveness Monitoring Recommendations

6. Conduct a multi-generational relative reproduce success study on fall Chinook Salmon
   - 70% of all fish released from WDFW hatcheries are fall Chinook Salmon
   - Fall Chinook Salmon are underrepresented in literature

7. Develop robust study designs to evaluate hatcheries /reform actions
   - *A priori*, not *post hoc*.
   - Ensures results are scientifically defensible (and transferable)

8. Reevaluate CWT release goals
   - CWT groups are a powerful monitoring and research tool

Washington Department of FISH and WILDLIFE

Questions?

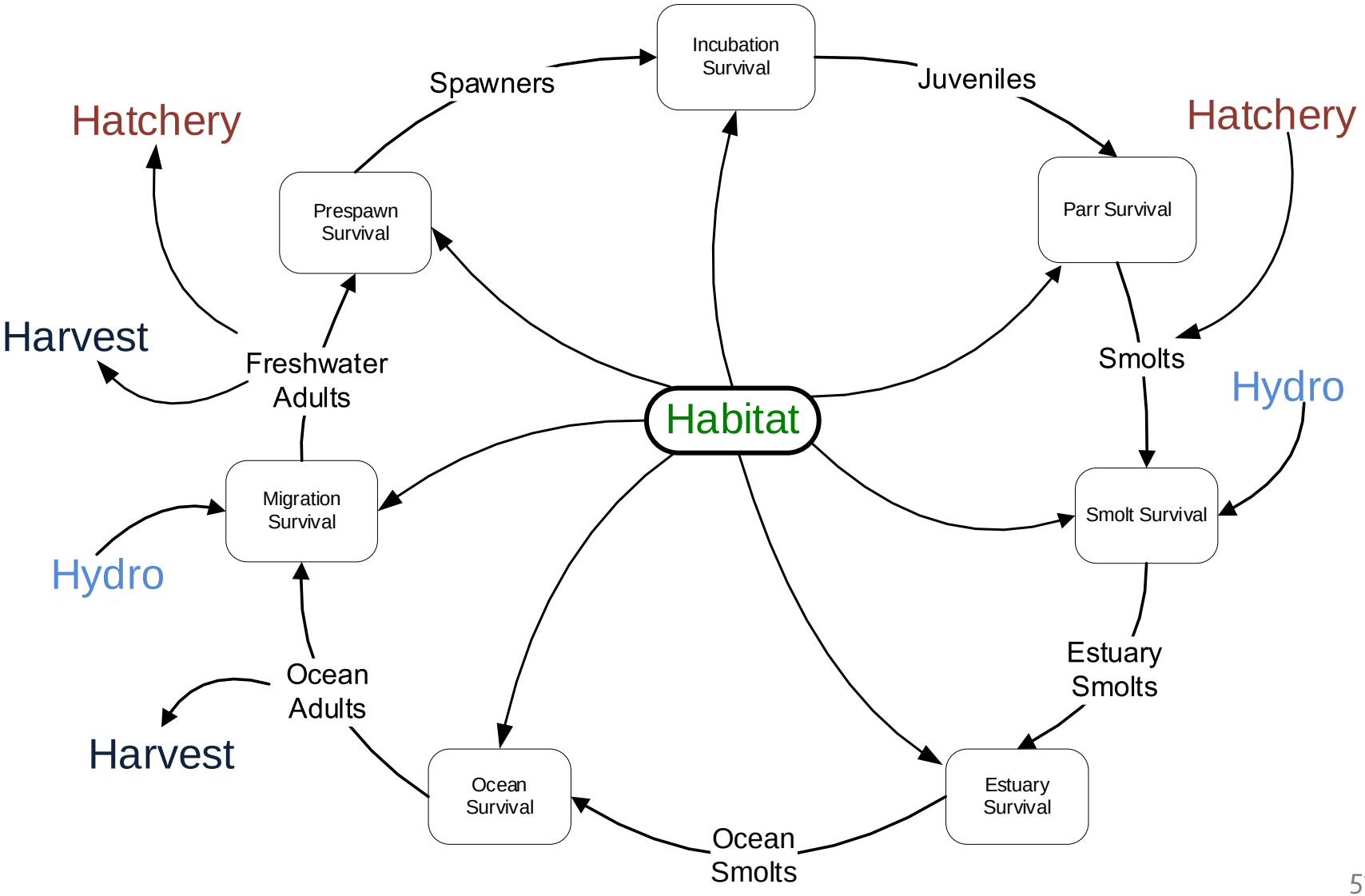
Photo credit: Patrick Hulett (WDFW)

Additional FWC Guidance
(Dec 13 Memo)

- Where has the first policy guideline been strictly applied and what happened?
  - Upper Yakima Spring Chinook (quantitative)
- Where has the first policy guideline been not applied and what happened?
  - Snake River Fall Chinook (qualitative)
  - Chiwawa Spring Chinook (quantitative)
  - Tucannon Spring Chinook (quantitative)

ALL-H Approach

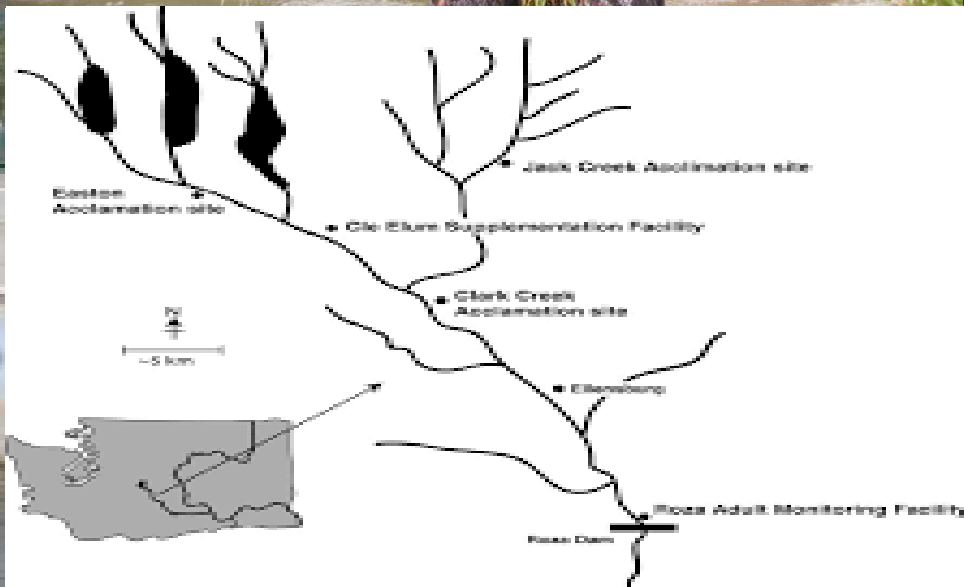
(Habitat, Hydro, Hatcheries and Harvest)



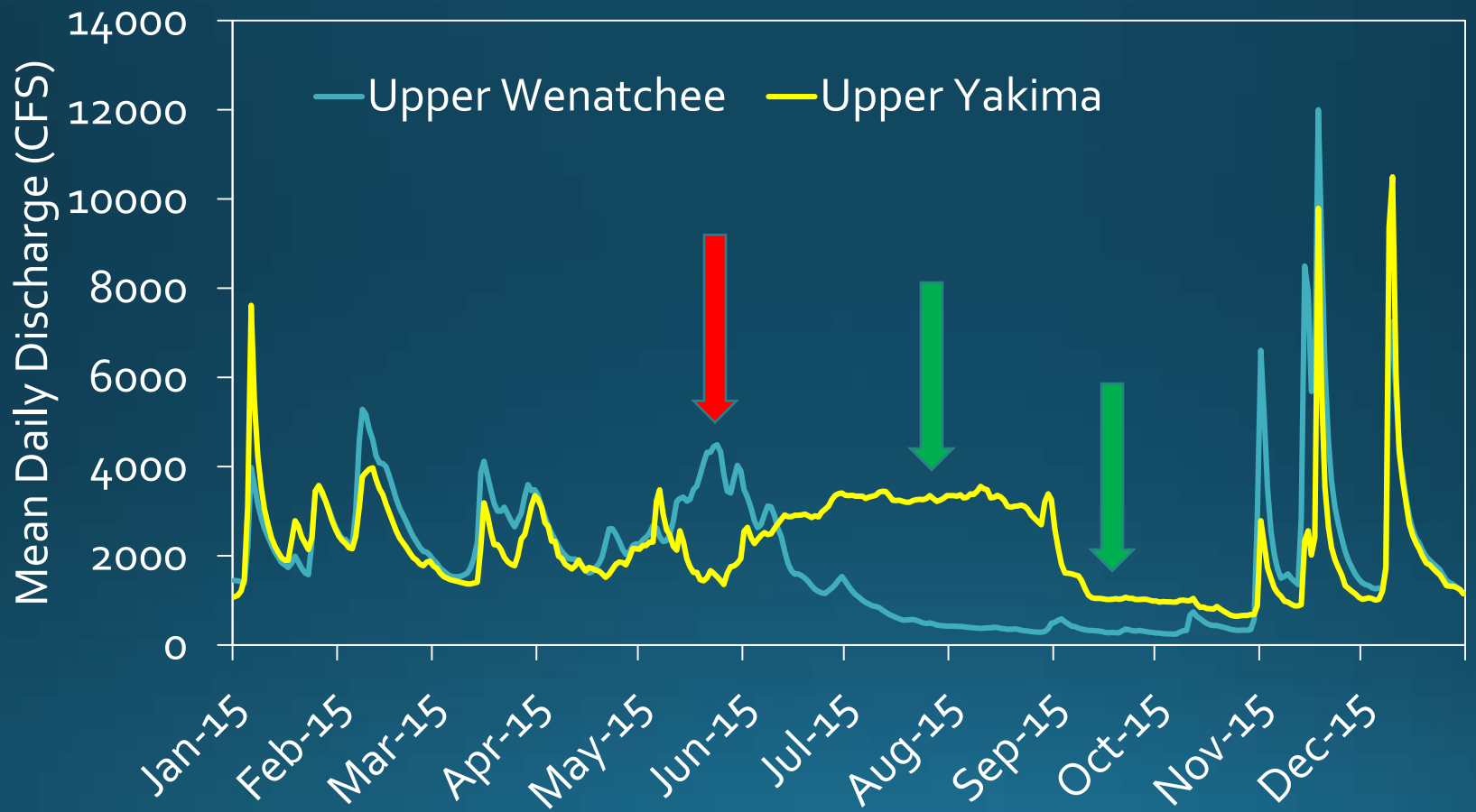
Chinook Case Studies

Population	ALL - H	pHOS	pNOB	PNI	BACI
SR Fall Chinook	HIGH	0.68	0 -0.3	0.12	NO
Chiwawa Spring	LOW	0.48	0.58	0.56	YES
Tucannon Spring	MOD	0.52	0.37	0.59	YES
Yakima Spring	HIGH	0.54	1.0	0.66	YES

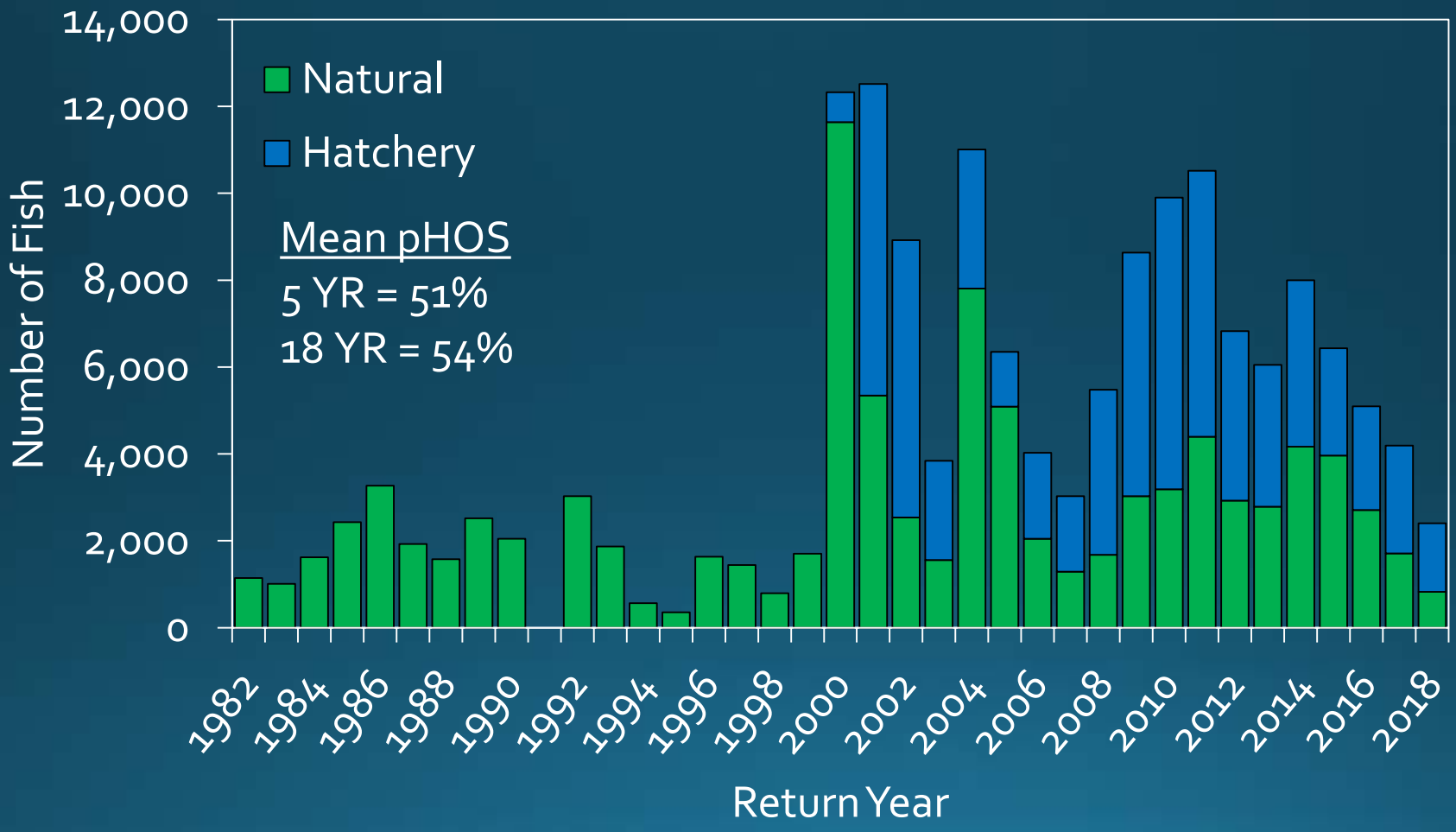
Upper Yakima Spring Chinook



Natural vs. Managed Hydrograph



Upper Yakima Spring Chinook
(Roza Dam Counts)



Upper Yakima Spring Chinook (Fast et al. 2015)

- Yakima Klickitat Fisheries Project
  - YN is lead entity and hatchery operator
  - All data courtesy of YN (Bill Bosch)
- Washington's "test of supplementation"
  - Best case scenario (e.g., Johnson Creek)
  - Non-listed population
    - Increase natural origin fish abundance
    - Increase harvest opportunities
  - Comprehensive RME program (BPA funded)
    - Naches serve as control population
  - Over 31 peer-review articles on this pop.

Upper Yakima Spring Chinook
(Fast et al. 2015)

- Program strictly follows BMPs (i.e., HSRG)
- Years of planning/modeling before construction
- Release goal 810k (mean = 742k since 1999)
  - 3 acclimation sites
- 100% natural origin broodstock
  - Supplementation line (Yakima natural origin)
  - Hatchery line (Yakima hatchery origin)
- Naches River is control population (wild line)
- Multi-generational RRS Study (In progress)

BACI (Upper Yakima vs. Naches)

A Synthesis of Findings from an Integrated Hatchery Program after Three Generations of Spawning in the Natural Environment

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National Marine Fisheries Service, Environmental and Fisheries Sciences Division, 2725 Montlake Boulevard East, Seattle, Washington 98112, USA

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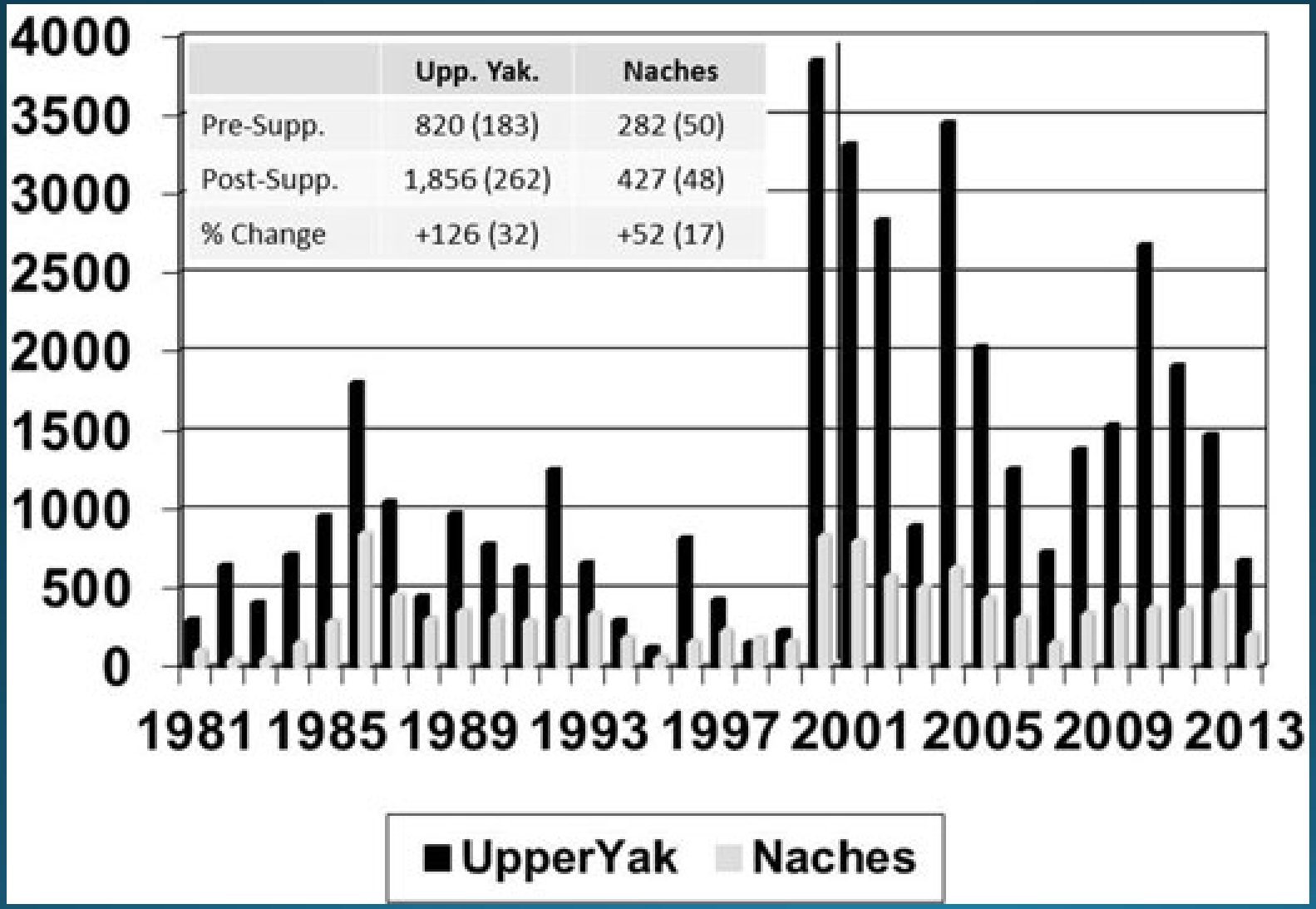
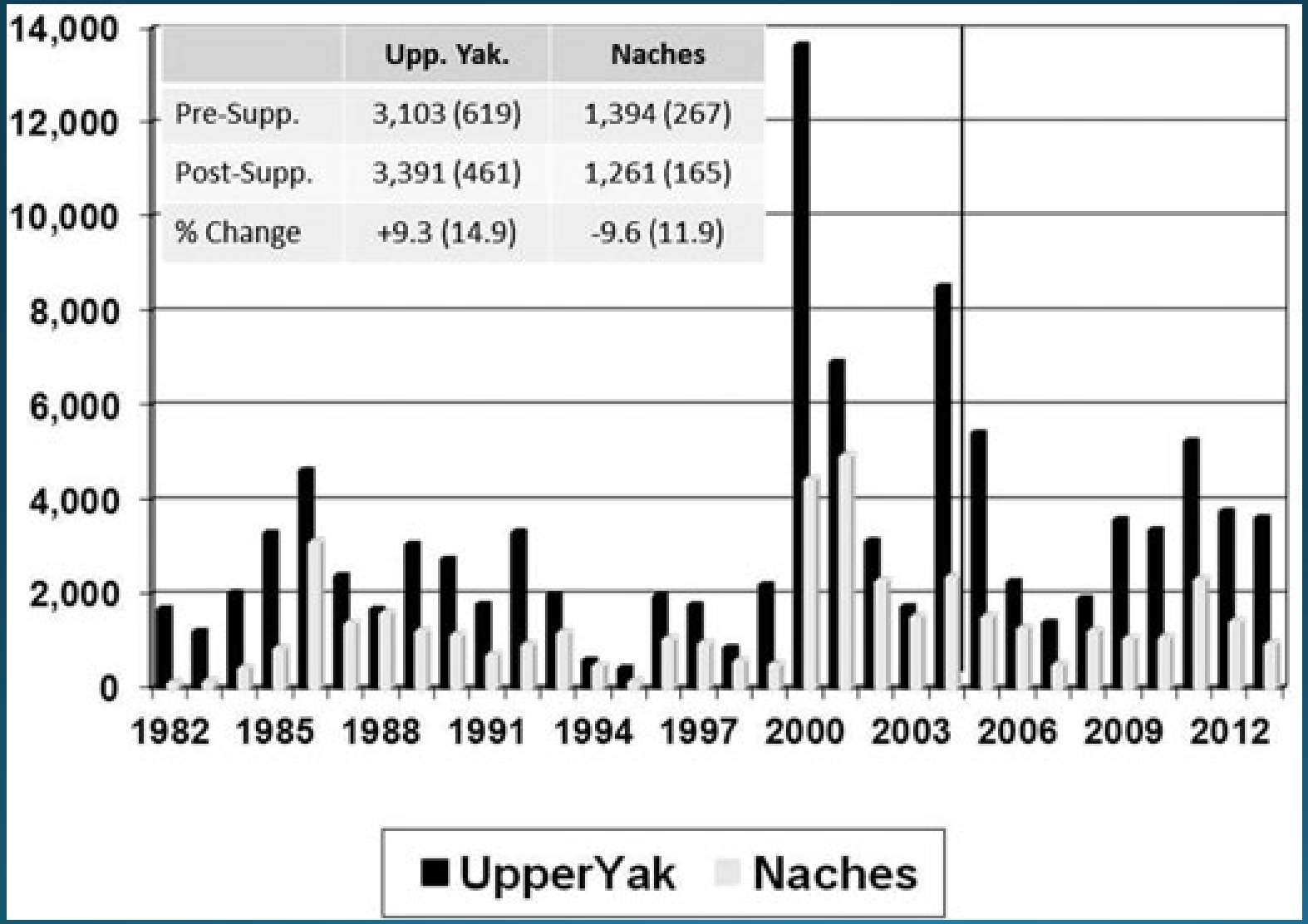
- Redd Abundance (spawner)
- Natural origin fish abundance
- In-basin harvest rates

Upper Yakima Spring Chinook
(Goal: Increase Redd Abundance*)

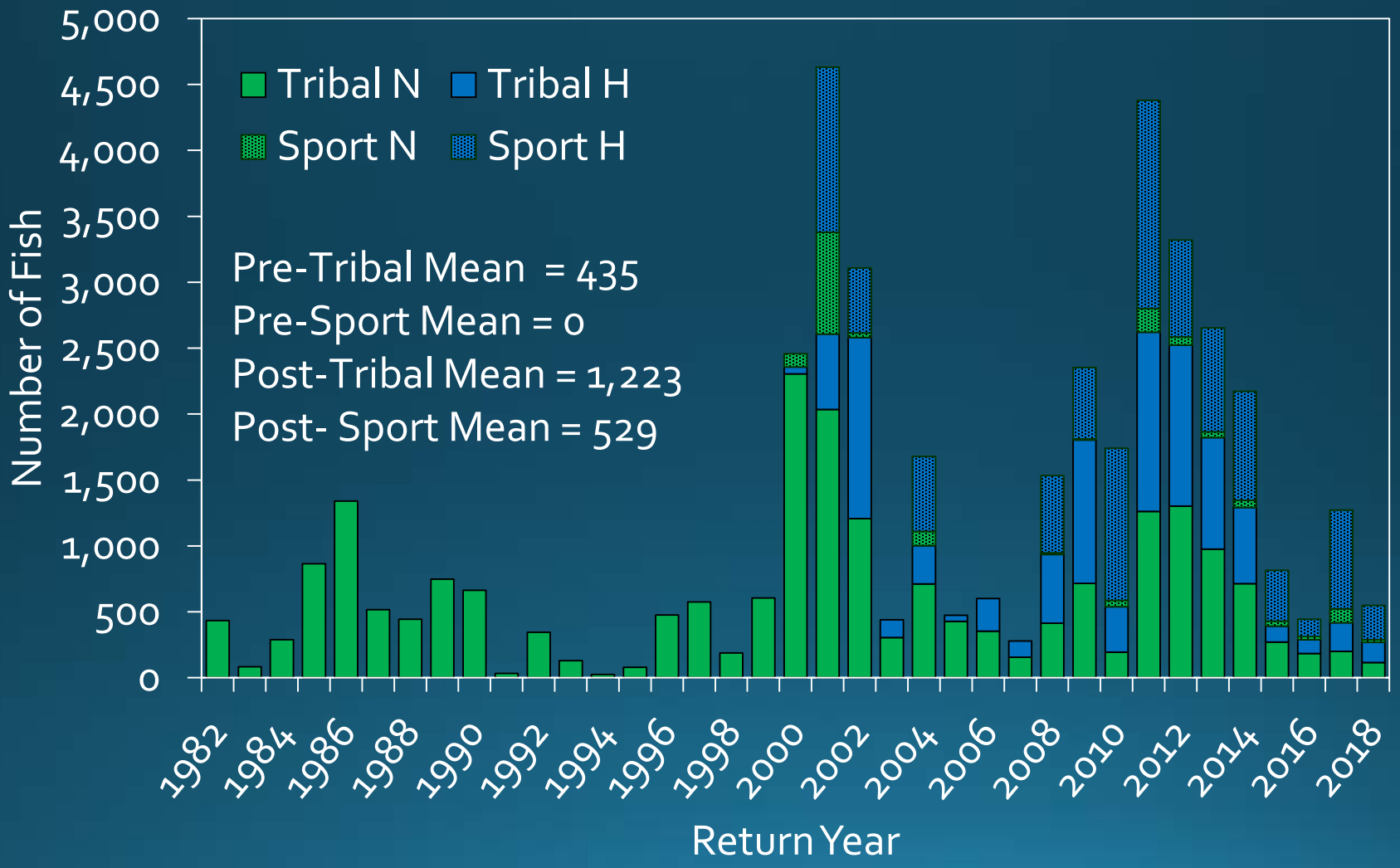


	Upp. Yak.	Naches
Pre-Supp.	820 (183)	282 (50)
Post-Supp.	1,856 (262)	427 (48)
% Change	+126 (32)	+52 (17)

Upper Yakima Spring Chinook
(Goal: Increase NOR Abundance)



Upper Yakima Spring Chinook
(Goal: Increase Harvest*)

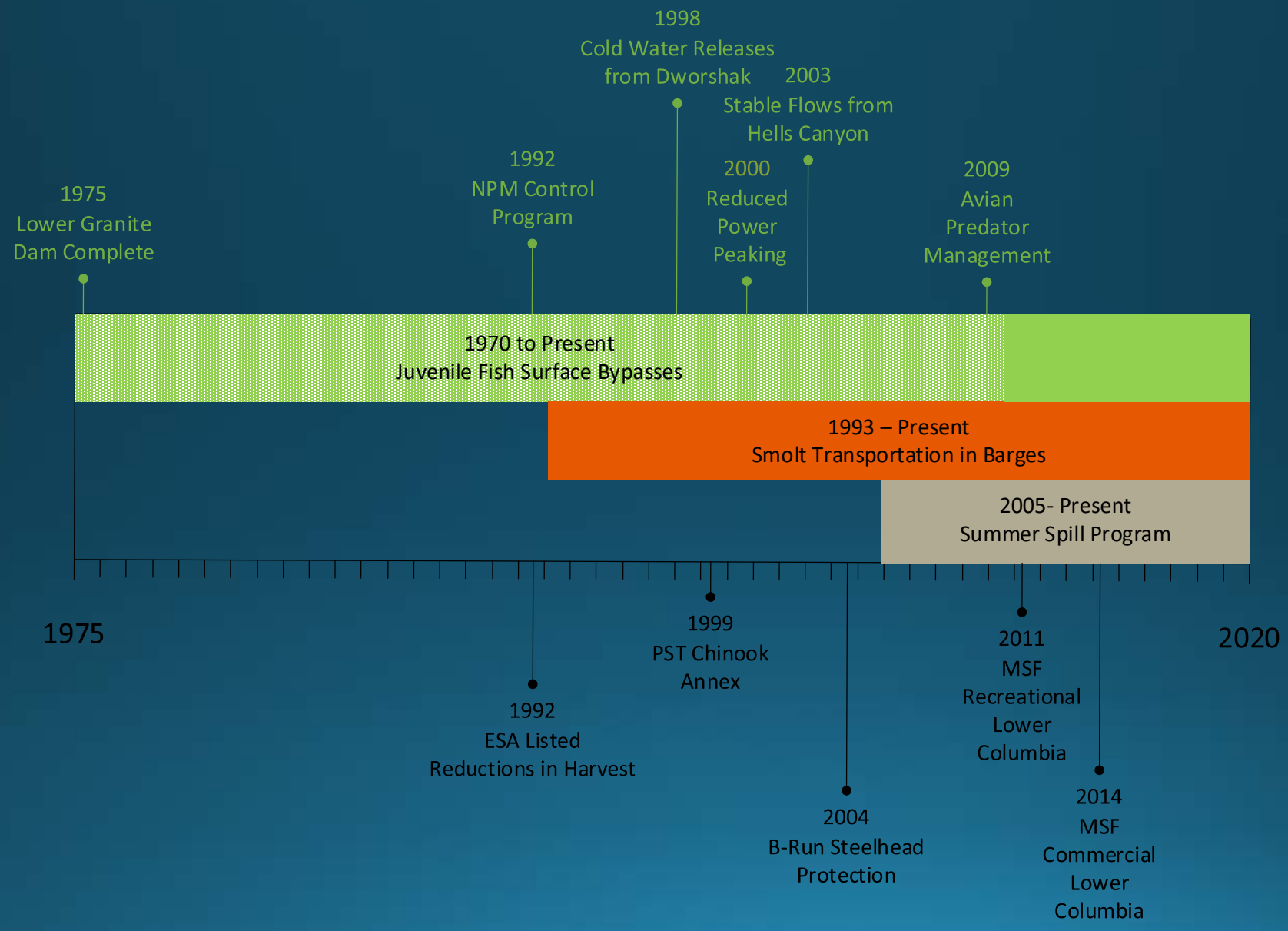


Snake River Fall Chinook

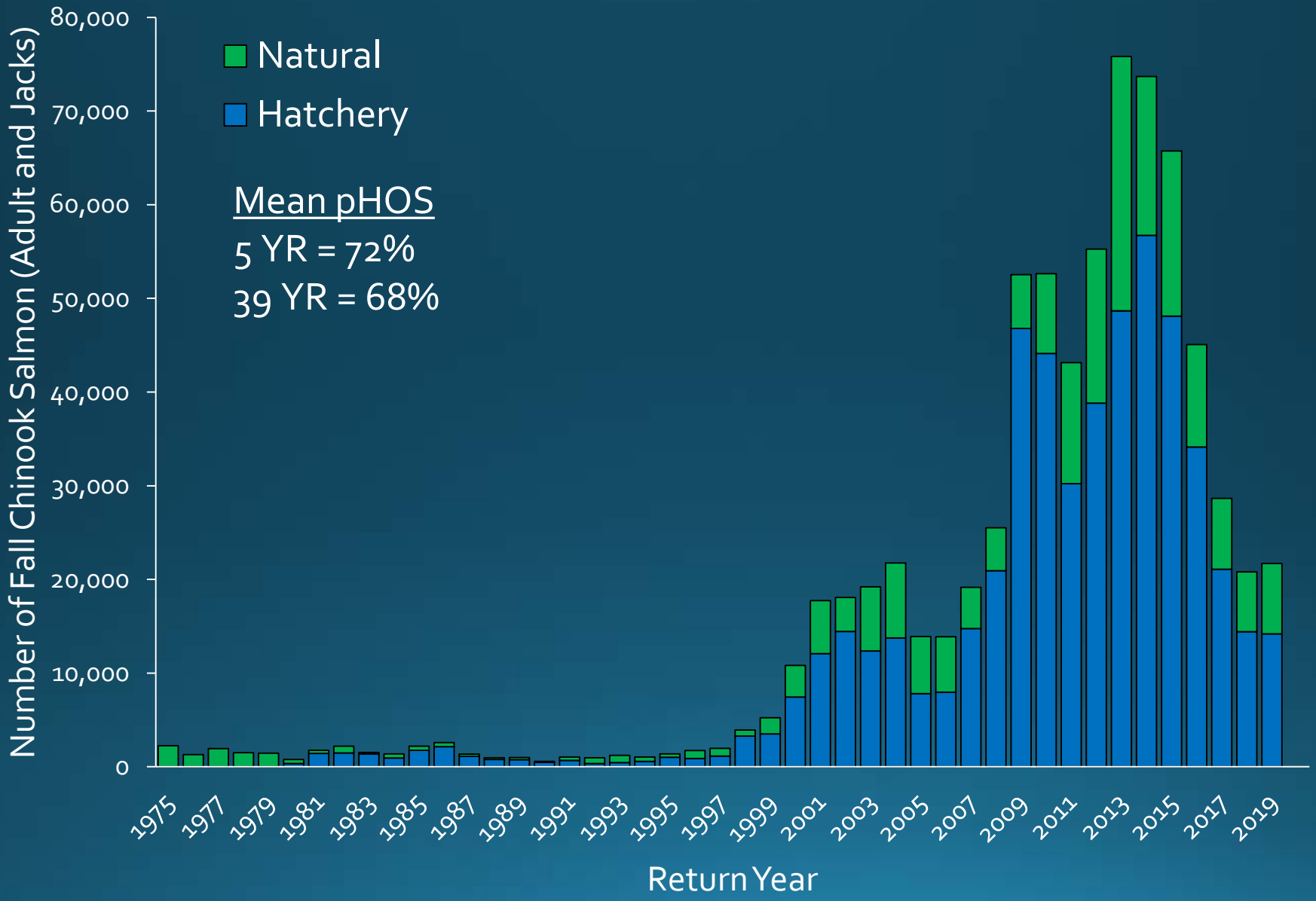
Snake River Fall Chinook

- One population in the ESU
- Snake River is used for all life stages
- An "All-H" approach has been implemented for decades
- Effectiveness of each H-action has not be quantified in terms of adult natural origin fish abundance
- Accurate estimates of hatchery fish abundance are relatively recent (2007 BY) through PBT.
- Data provided by WDFW Snake River Lab and LSRCP

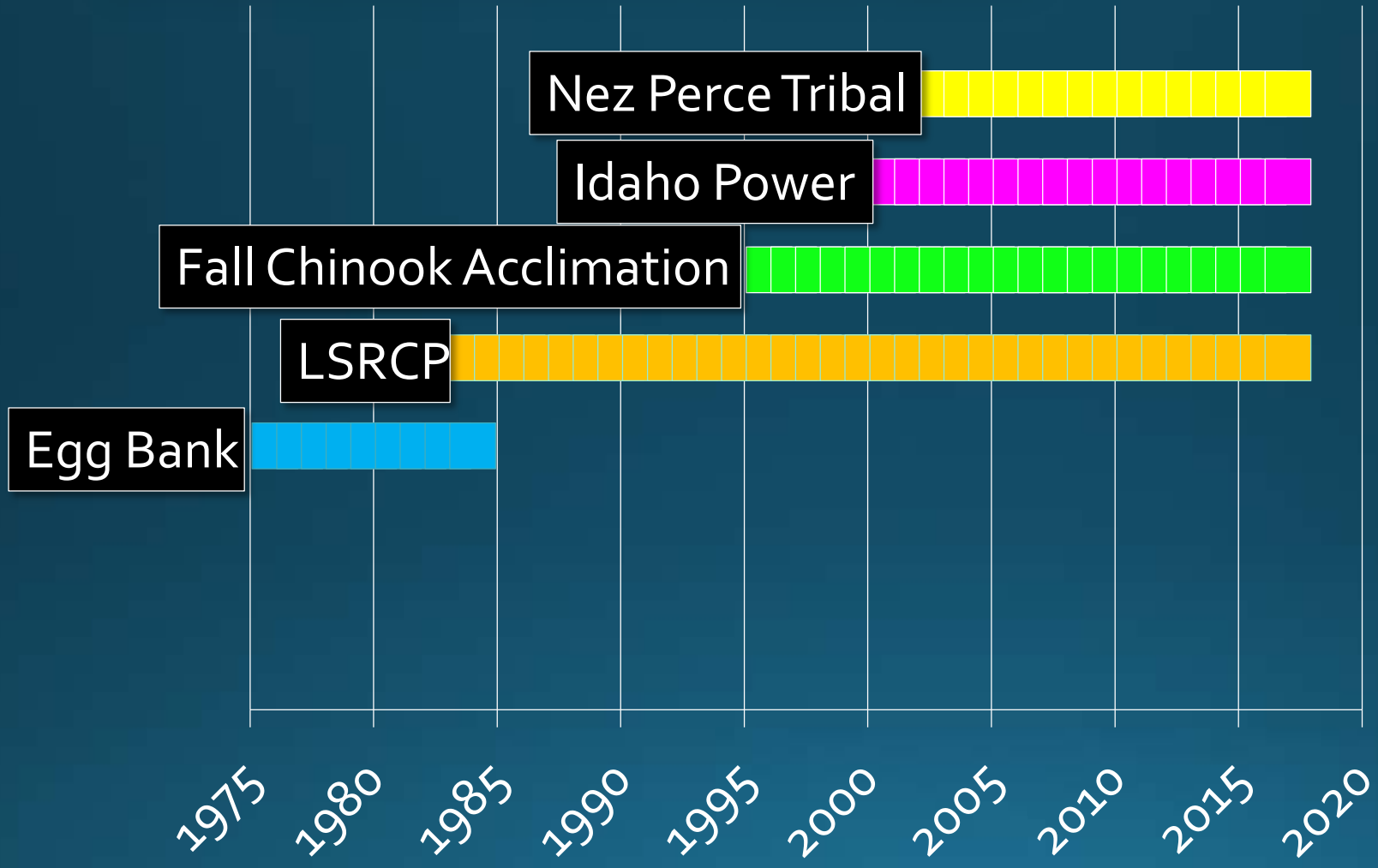
The other 3 H's



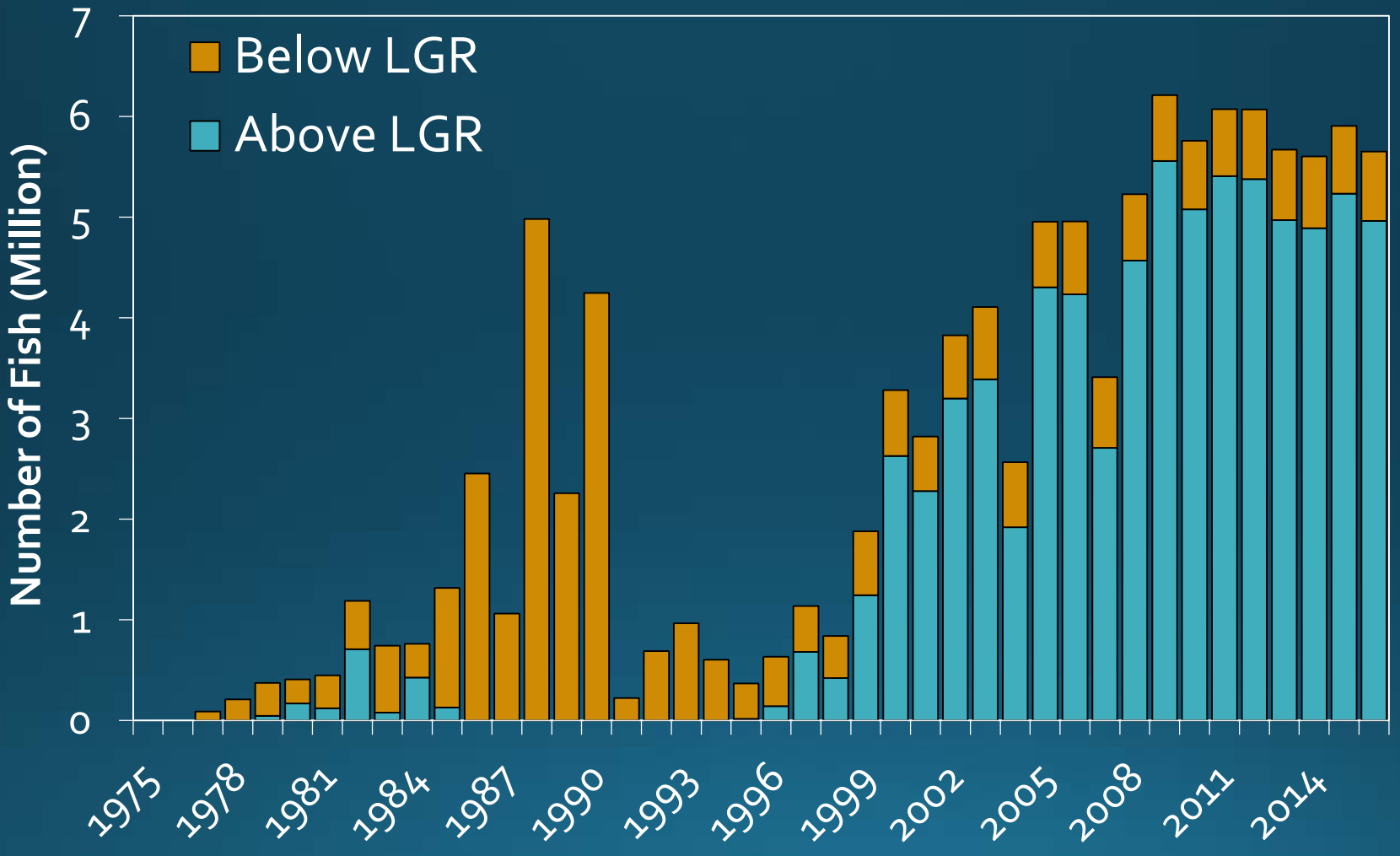
Snake River Fall Chinook – Return to Lower Granite Dam



Production Programs and Facilities



Release Location in Snake River Basin



All-H Integration
(A success story…..almost)

- Egg bank program preserved this population
- Adaptive management (aka hatchery reform)
  - Shift release locations from Lyons Ferry FH to areas of natural production
  - Increase pNOB through PBT of hatchery broodstock (5 yr mean ~ 0.3)
  - Consistent high pHOS (5 yr mean = 72%)
- Hydro, harvest, habitat actions each had a major role in the current status (i.e., viable) but must reach highly viable.
  - Focused on all life stages (migration, spawning, incubation and rearing, and migration)
- Recovery Scenario still undecided.
  - PNI > 0.67 in Natural Production Emphasis Areas

Chiwawa Spring Chinook

Background

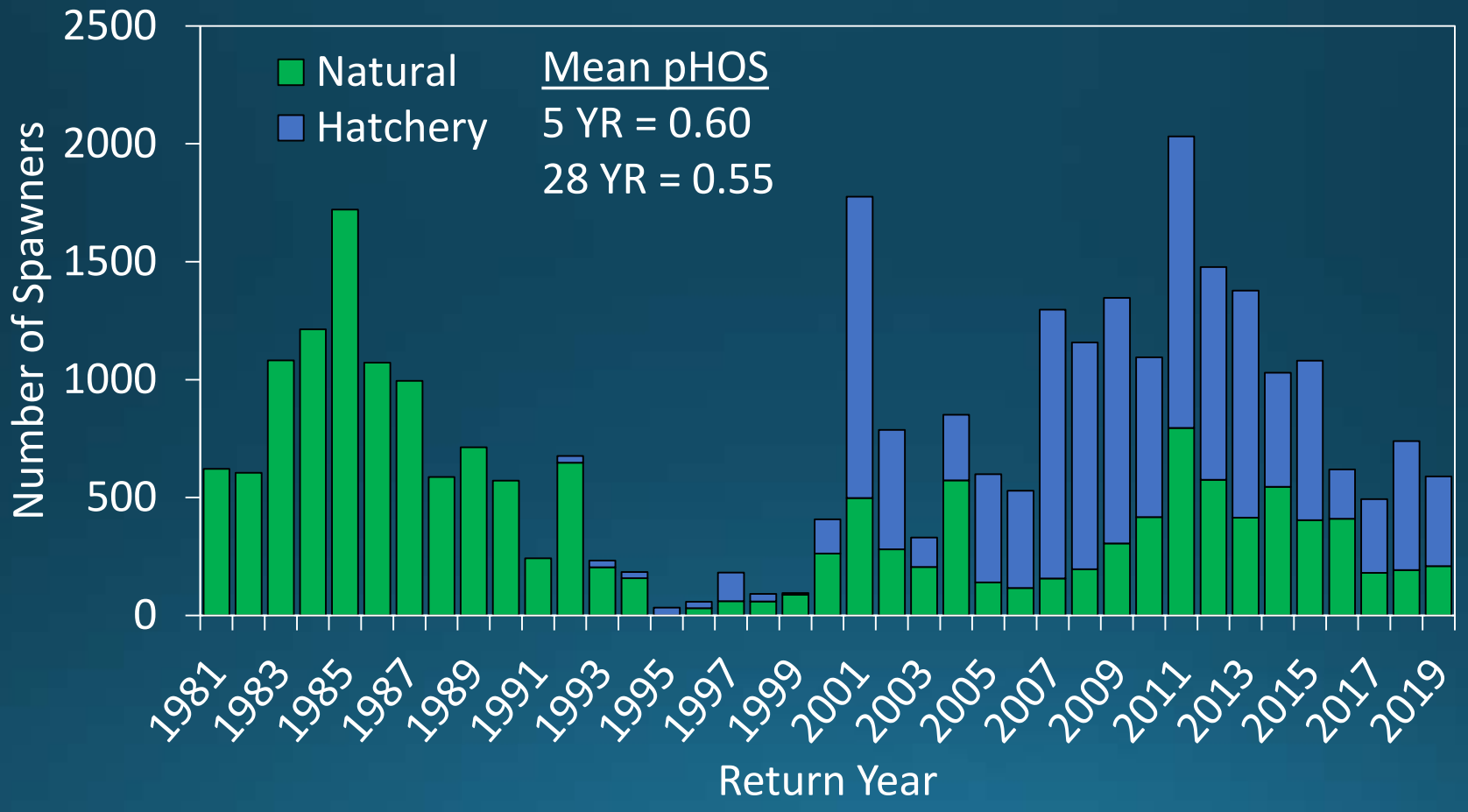
- Program began in 1989 and is mitigation for "unavoidable" smolt mortality at Rock Island Dam
- Funded by Chelan PUD; operated by WDFW
- Comprehensive M & E program including effectiveness
  - 2010 Effectiveness Analysis Complete (Hillman et al. 2011)
  - 2020 Effectiveness Analysis *In Progress*
- Relative Reproductive Success Study funded by BPA
  - WDFW/NOAA joint project
  - Multi-life stage
  - Multi-generational
- Data provided by WDFW Supplementation Research Team

Habitat Restoration

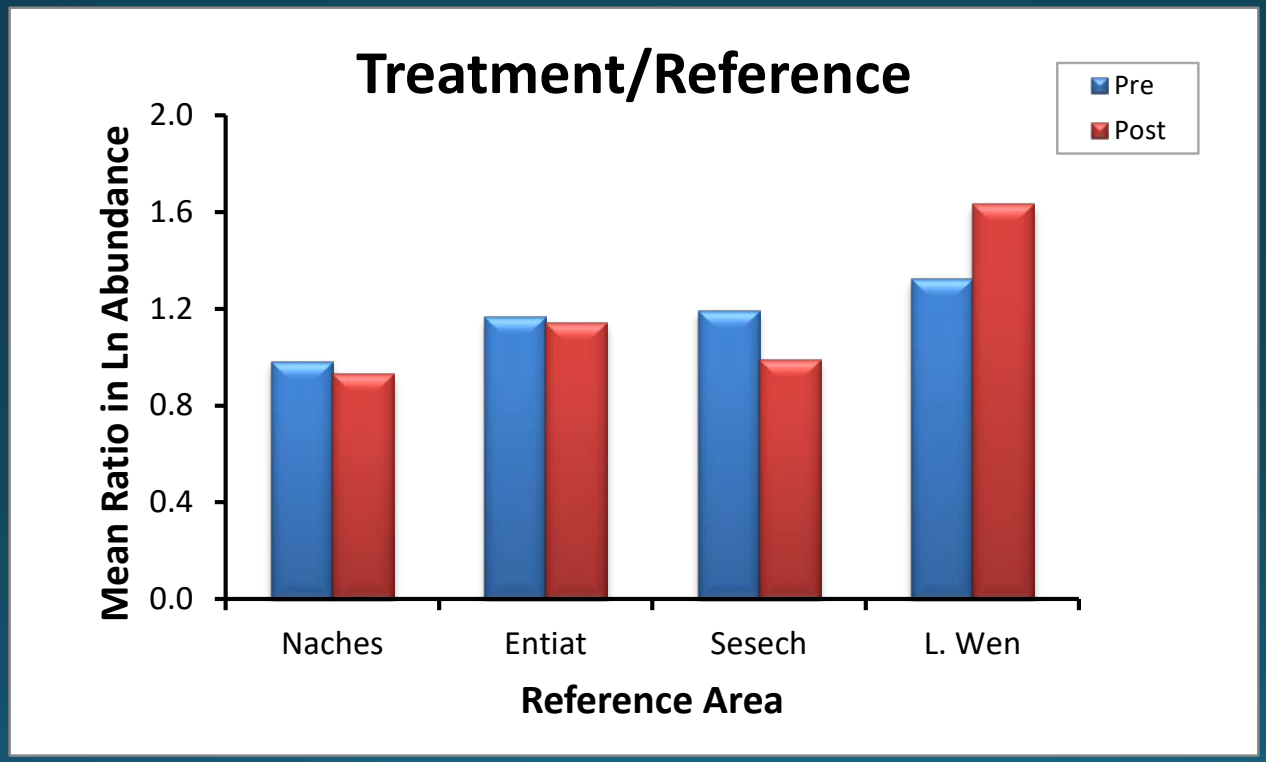
- Upper Columbia Biological strategy ranks Chiwawa River…
  - High for protection
  - Last for restoration
- No projects in upper Wenatchee River (i.e. overwintering parr)

- "Pristine" as it gets in the Upper Columbia

Chiwawa Spring Chinook

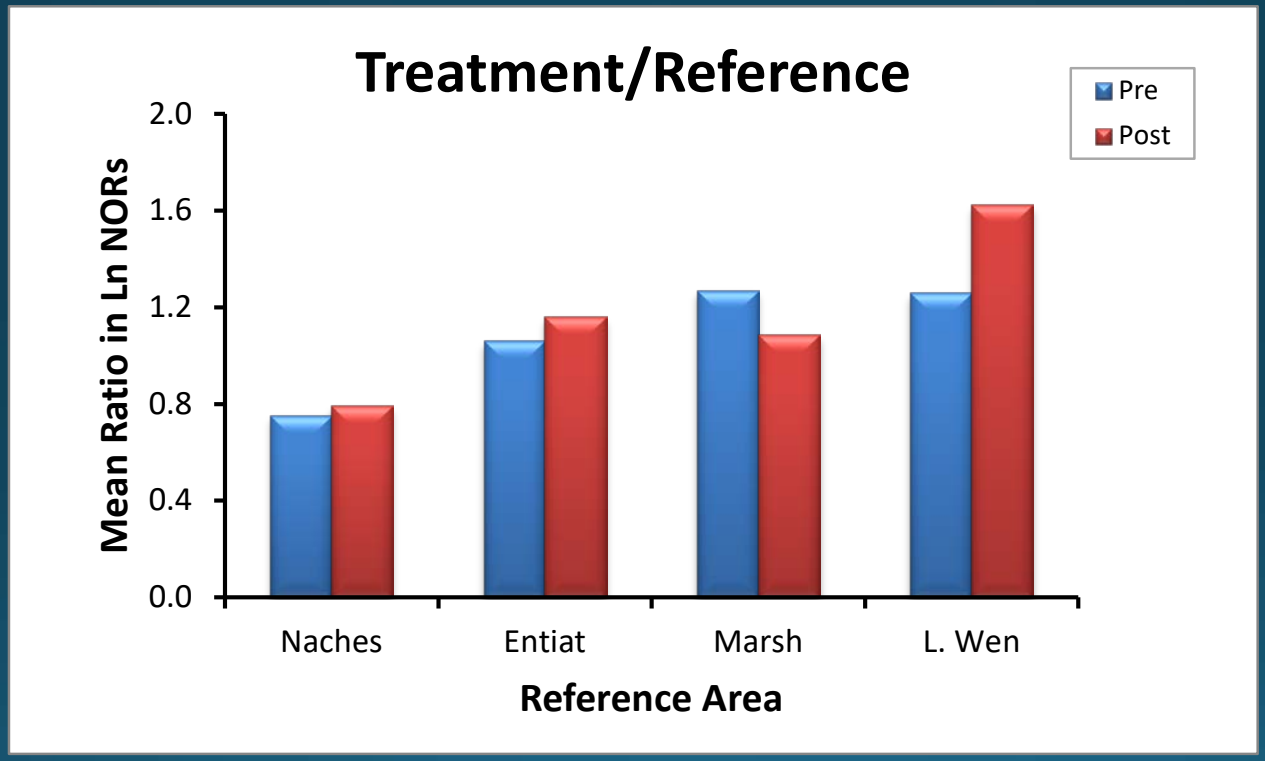


Spawning Escapement
(2010 BACI Hillman et al. 2011)



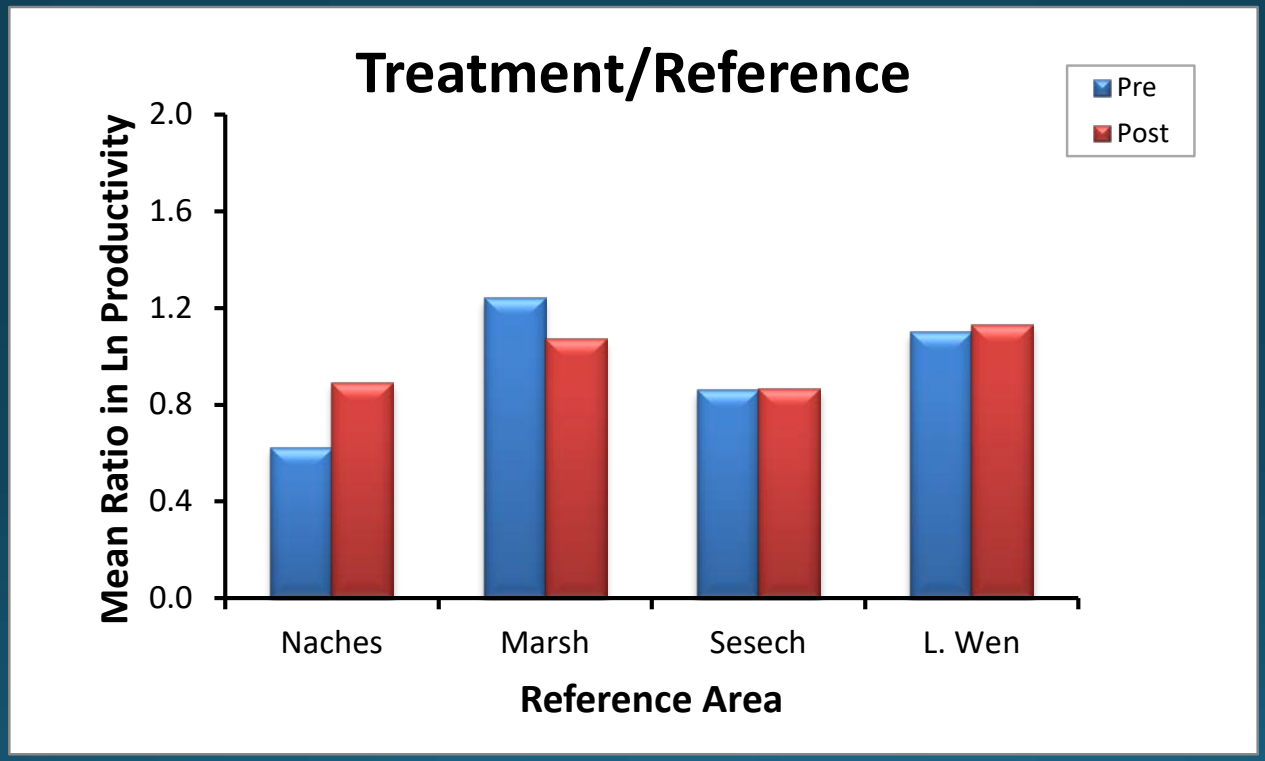
No Significant Increase in Abundance

NORs
(2010 BACI Hillman et al. 2011)



No Significant Increase in NORs

Productivity (R/S)
(2010 BACI Hillman et al. 2011)



No Significant Decrease in Recruits/Spawner

Chiwawa Summary

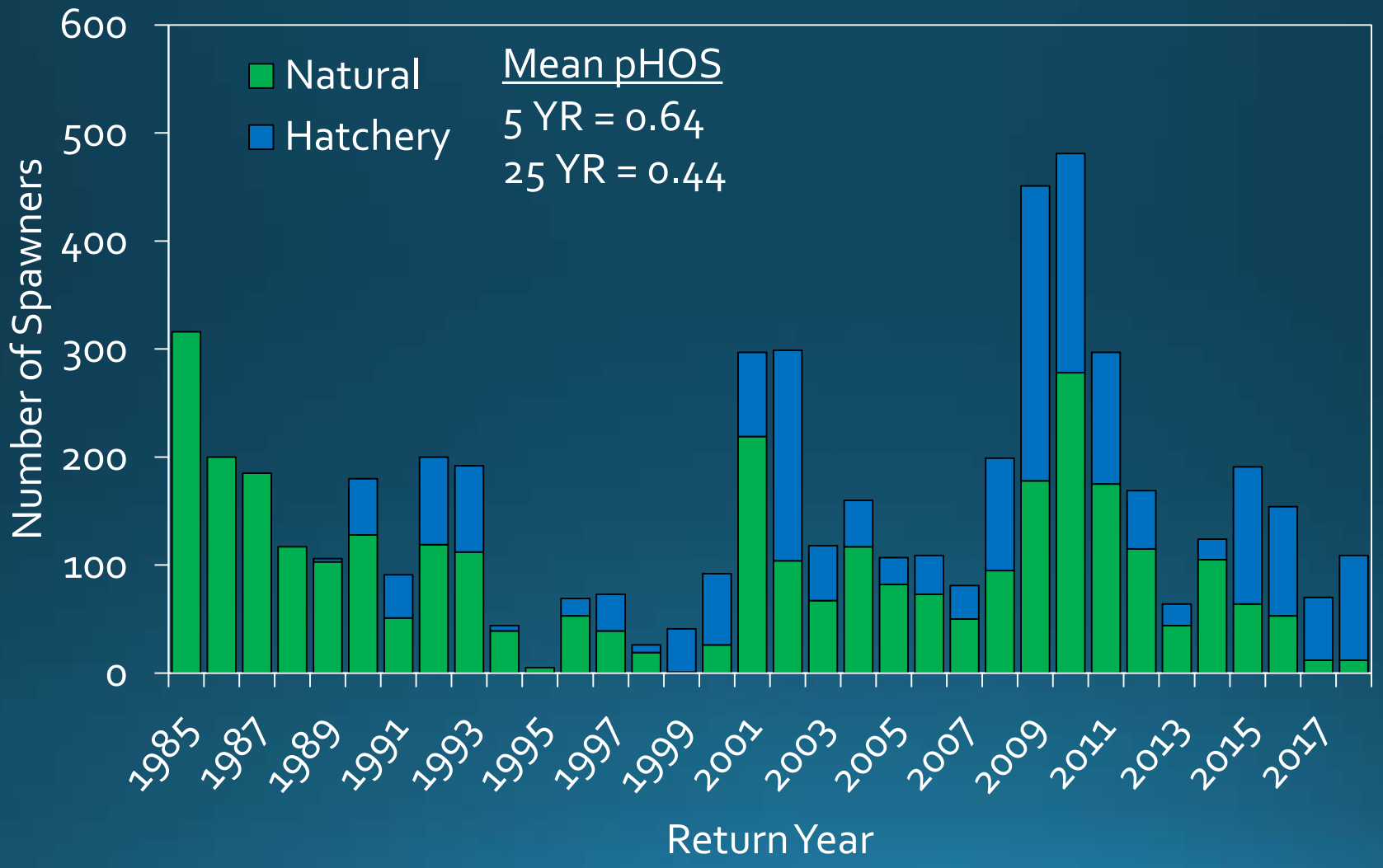
- Little to none "All-H integration"
- Hatchery fish are mitigation
- Harvest impacts already minimal
- No directed habitat projects
- No detectable difference in population status

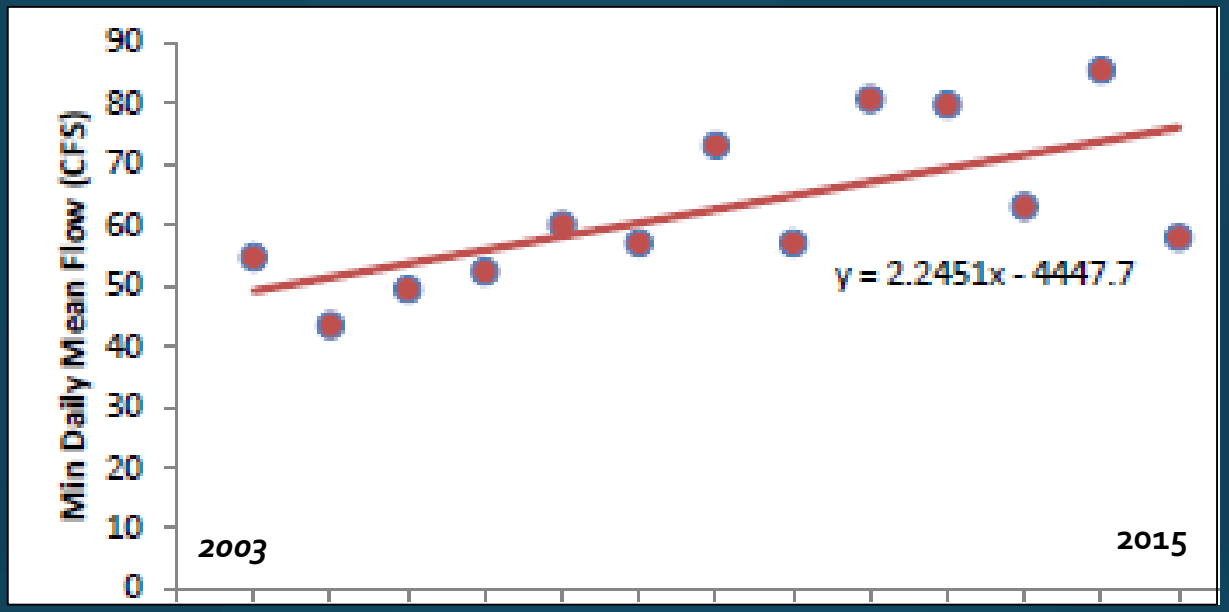

Tucannon Spring Chinook

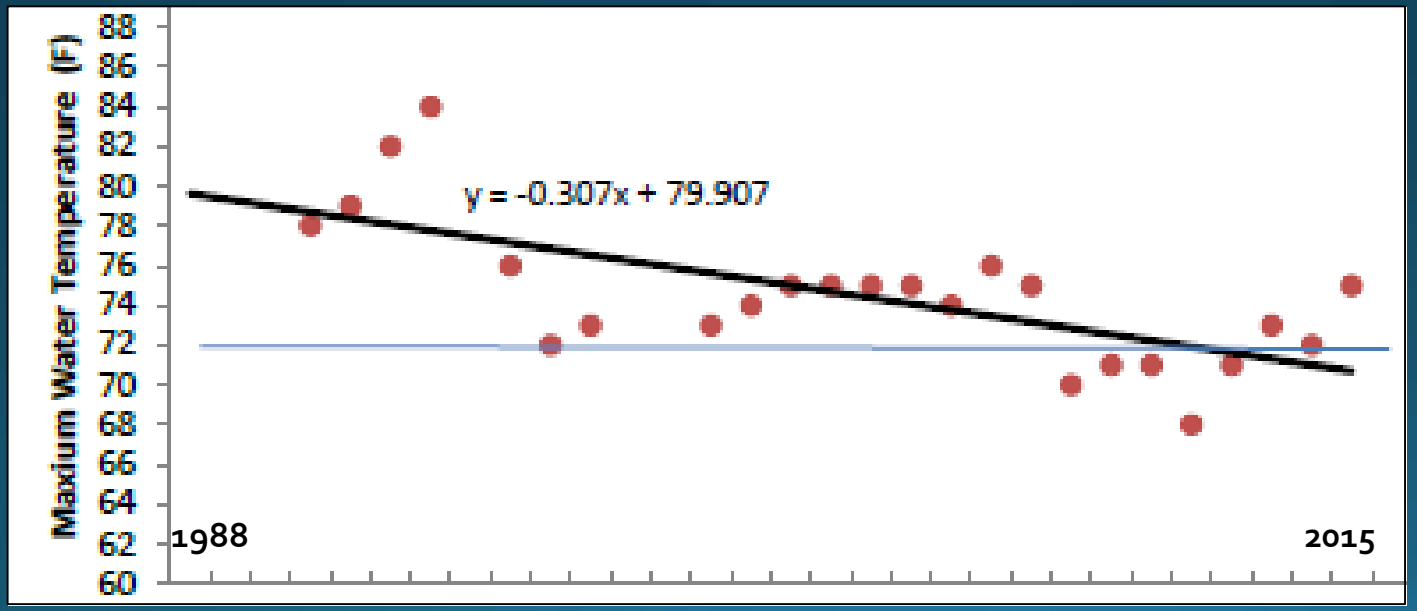
Background

- Program began in 1985 as part of Lower Snake River Compensation Program
- Converted from harvest to conservation program after ESA listing in 1992
- Captive broodstock program released smolts 2002 - 2008
- Current release goal = 225K yearling smolts
- Data provided by WDFW Snake River Lab (Mike Gallinat and Joe Bumgarner)
- Alf Haukenes (WDFW) conducted BACI analysis

Tucannon Spring Chinook




Min Daily Mean Flow (CFS)
90
80
70
60
50
40
30
20
10
0
y = 2.2451x - 4447.7
2003
2015


Maxium Water Temperature (F)
88
86
84
82
80
78
76
74
72
70
68
66
64
62
60
y = -0.307x + 79.907
1988
2015

Tucannon Summary

Metric	Method	Big Creek	Loon Creek	Secech River	Valley Creek	Bear Valley Creek	Lemhi River
Spawner abundance	T-R	N.S.	S +	S -	-	-	-
	T/R	N.S.	N.S.	S -	-	-	-
NOR Abundance	T-R	N.S.	N.S.	S -	N.S.	N.S.	N.S.
	T/R	N.S.	N.S.	S -	N.S.	N.S.	N.S.

- No significant increase in spawner abundance
- No significant increase in natural fish abundance
- Similar to Chiwawa and Methow spring Chinook results

- Most major habitat changes occurred in the last 10 years and may simply take longer to observe/detect benefits.

- Scheuerell et al. 2015 found hatchery effect on NORs of 0.032 (-0.21, 0.27)

Conclusions

- Identification **AND** improvement of survival bottlenecks is required in order to observe expected hatchery benefits (Vendetti et. al 2018).
  - Snake River fall Chinook and Upper Yakima spring Chinook
- Why lack of hatchery benefits in Chiwawa and Tucannon populations (i.e., mechanism is unknown)?
  - Habitat still limiting?
  - Cumulative negative hatchery effect?
- Additional population-level experimentation is needed
  - Populations contrasting existing studies (i.e., following HSRG)
- Uncertainties do remain
  - Multiple treatment effects (hatchery or habitat, not both)
  - Long-term genetic effects
    - Will Upper Yakima or Johnson Creek results persist over the next 25 years?


Questions?