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

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Cle Elum Spring Chinook
Supplementation and Research Facility

Goals

- Increase:
  - Harvest opportunity
  - natural production
- Maintain :
  - ecosystem function
- use research to:
  - improve hatchery practices
  - address critical uncertainties

Regional Assessment of Supplementation Project (1992)

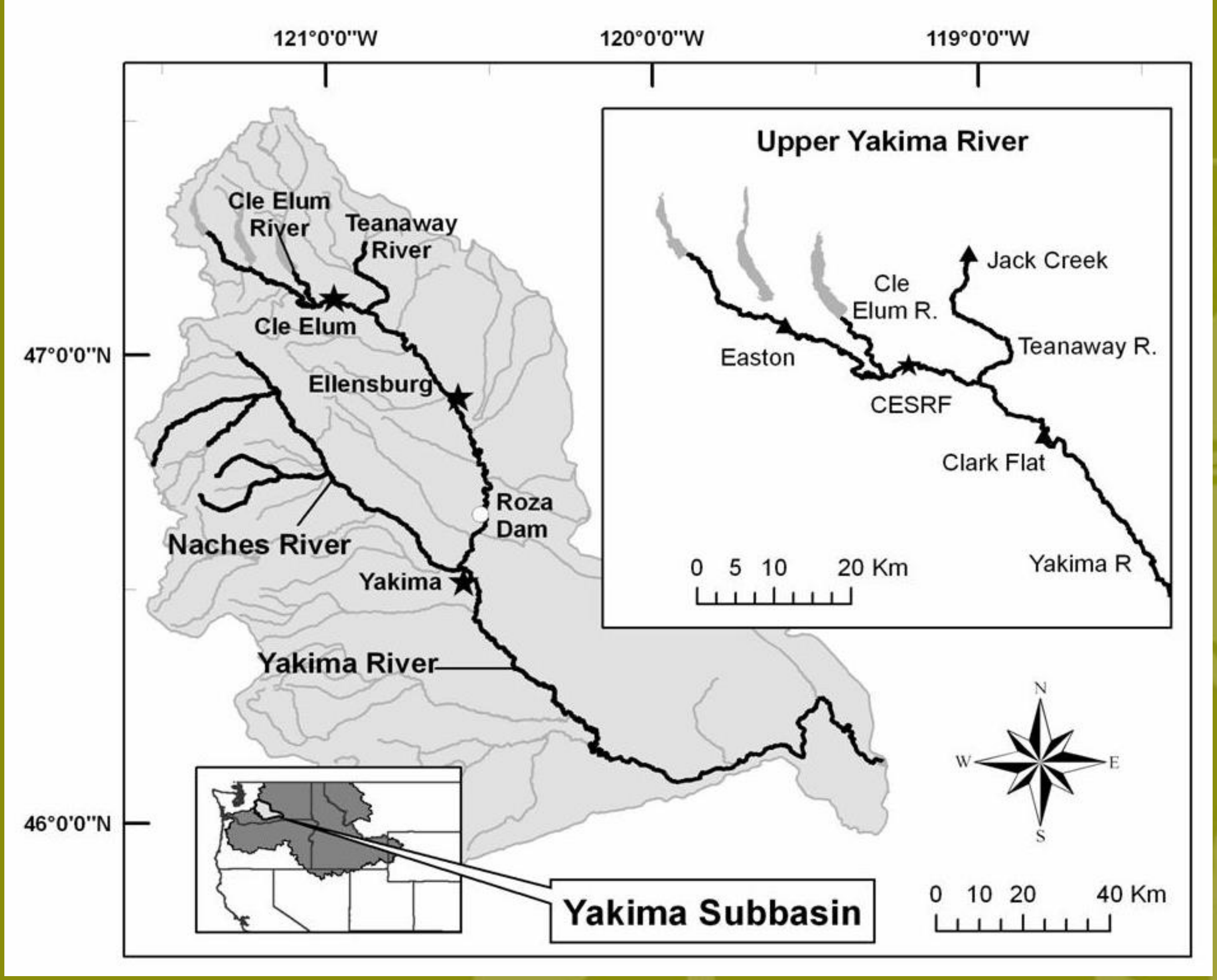
"Supplementation is the use of artificial propagation in an attempt to maintain or increase natural production^ and harvest while maintaining the long term fitness of the target population, and keeping the ecological and genetic impacts on nontarget populations within specified limits".

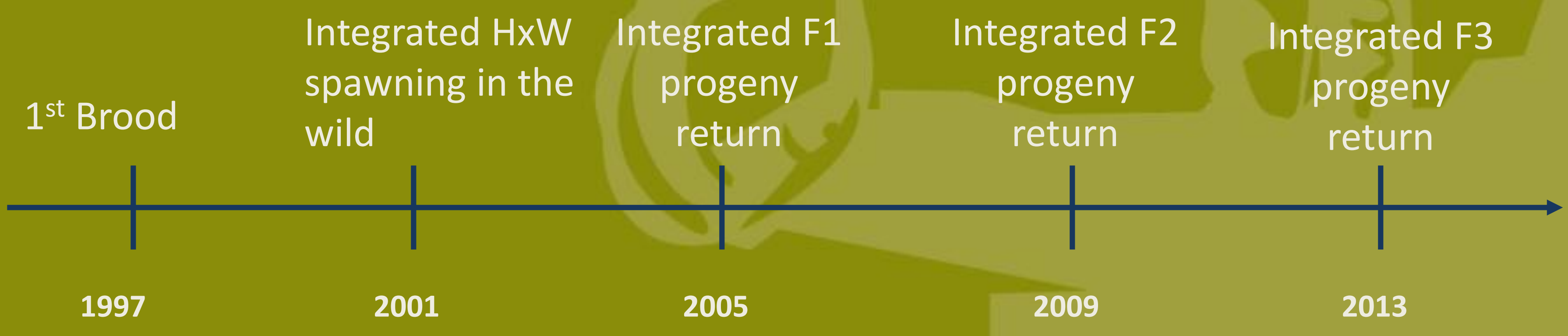
Evaluation Topics

1. Life history traits and morphology
2. Precocious male maturation
3. Homing and spatial distribution
4. Reproductive traits and success
5. Redd and natural-origin abundance
6. Gene flow
7. Ecological interactions
8. Pathogen screening
9. Harvest

CESRF Management Practices
Cuenco et al 1993, Mobrand et al 2005

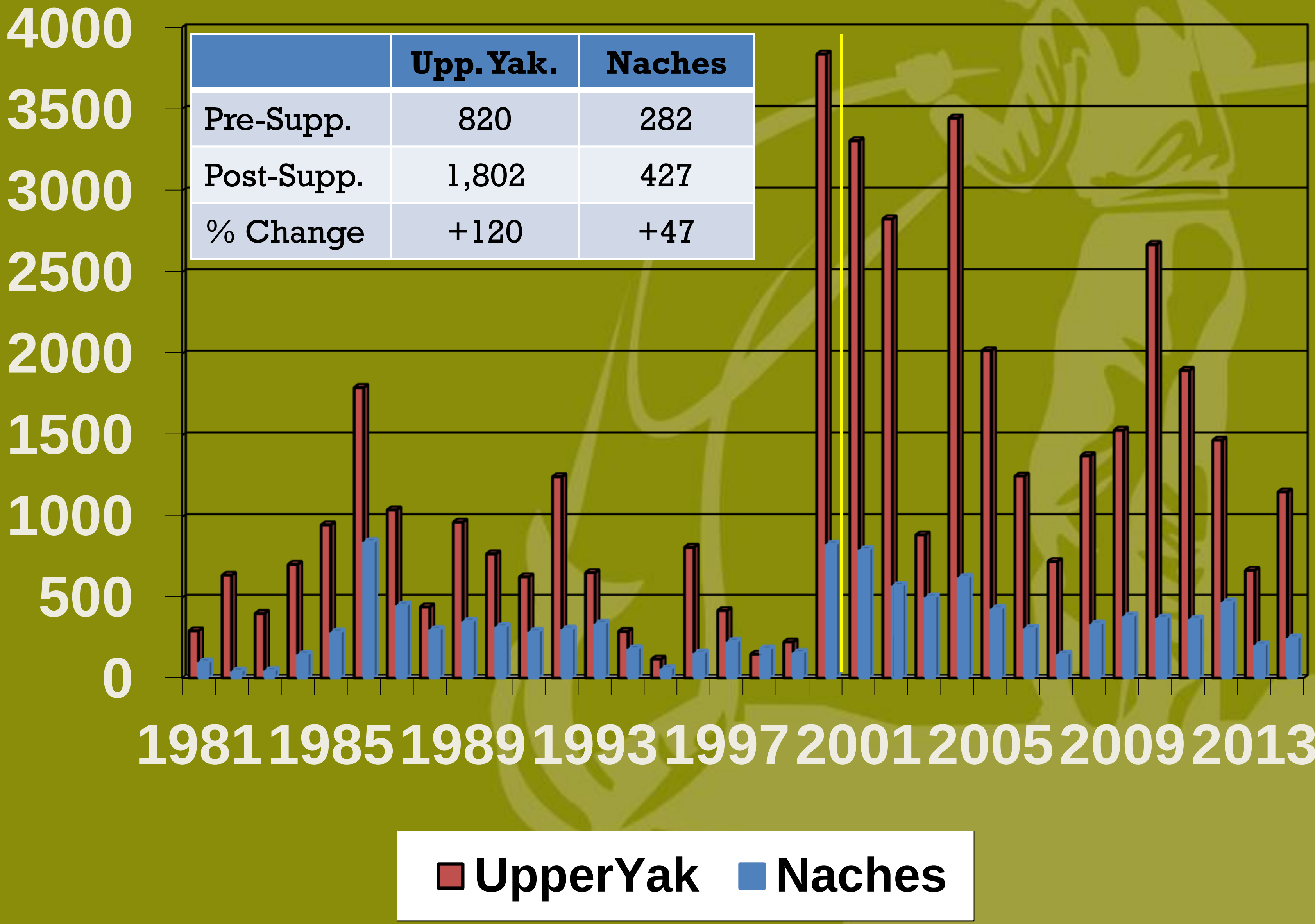
- random, representative broodstock selection
- local broodstock
- use natural broodstock if possible
- factorial mating to maintain diversity
- low rearing densities
- underwater feeders and cover to encourage natural behavior
- intensive disease monitoring
- acclimation sites in natural spawning areas
- state-of-the-art marking strategies for M&E
- test different rearing/release strategies to increase survival


121°0'0"W
120°0'0"W
119°0'0"W
47°0'0"N
46°0'0"N
Cle Elum River
Teanaway River
Cle Elum
Ellensburg
Roza Dam
Naches River
Yakima
Yakima River
Yakima Subbasin
0 10 20 40 Km
N
S
E
W
Upper Yakima River
Jack Creek
Cle Elum R.
Teanaway R.
Easton
CESRF
Clark Flat
Yakima R
0 5 10 20 Km

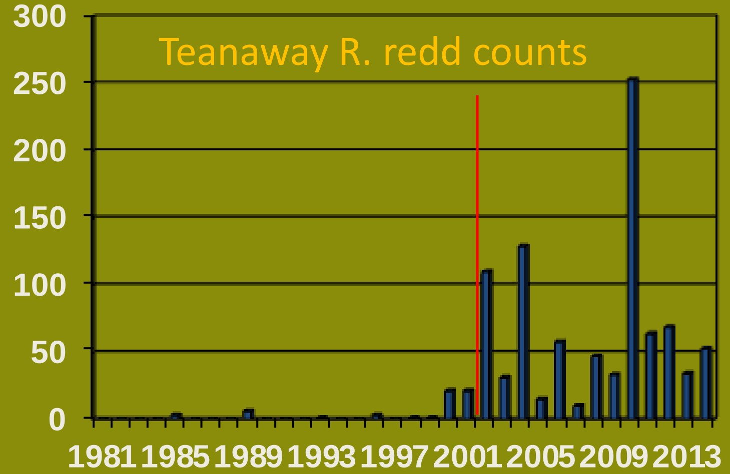

1st Brood
Integrated HxW spawning in the wild
Integrated F1 progeny return
Integrated F2 progeny return
Integrated F3 progeny return
1997
2001
2005
2009
2013

Upper Yakima vs Naches Redds, 1981-2014

	Upp. Yak.	Naches
Pre-Supp.	820	282
Post-Supp.	1,802	427
% Change	+120	+47

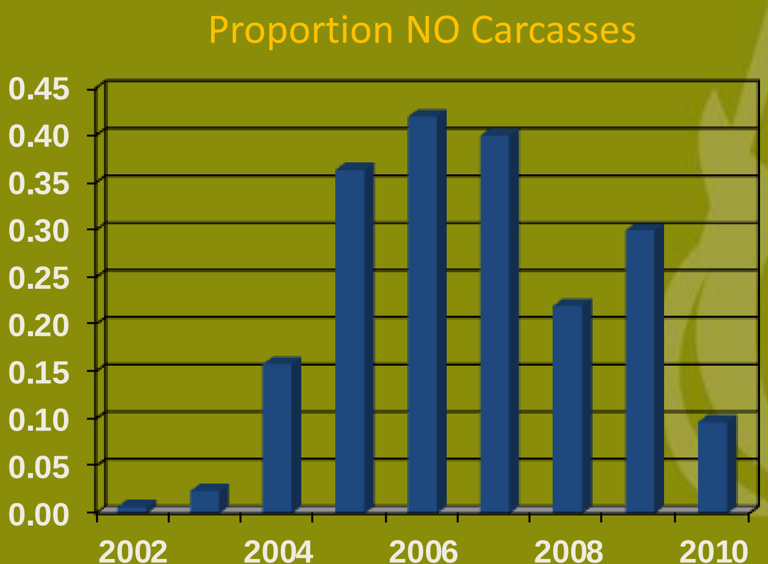


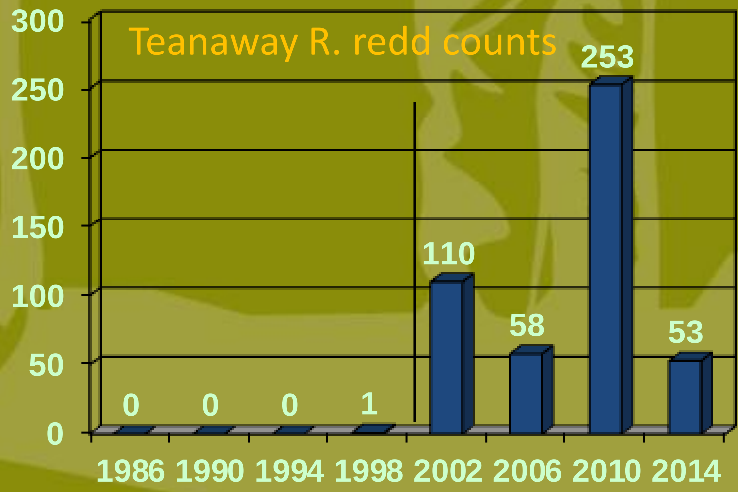
Restoring Fish and Habitat in the Teanaway



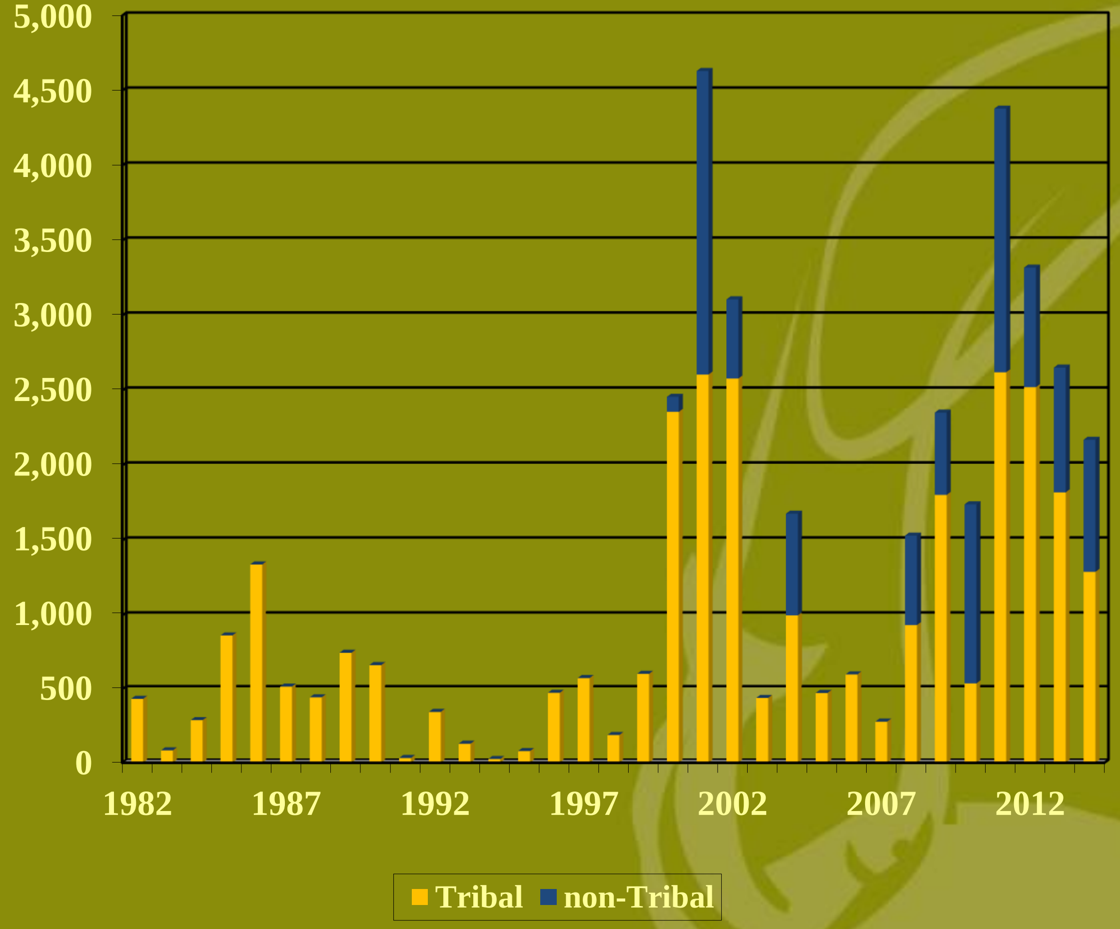
- pre-supplementation mean: 3
- post-supplementation mean: 70

This selected excerpt for one four-year brood cycle shows the potential of supplementation into relatively unoccupied habitats when habitat conditions are favorable.





Total Estimated Harvest, 1982-2014

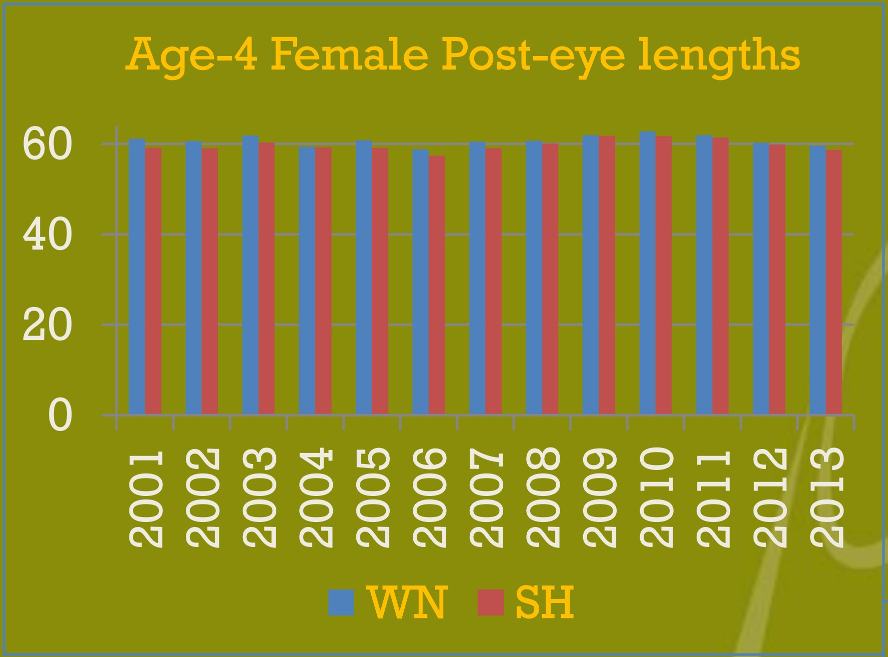


Mean Annual Harvest

Pre-CESRF: 550
Post-CESRF: 2,100

58% of all fish harvested since 2001 have been CESRF fish

Life History Trait Differences, etc.

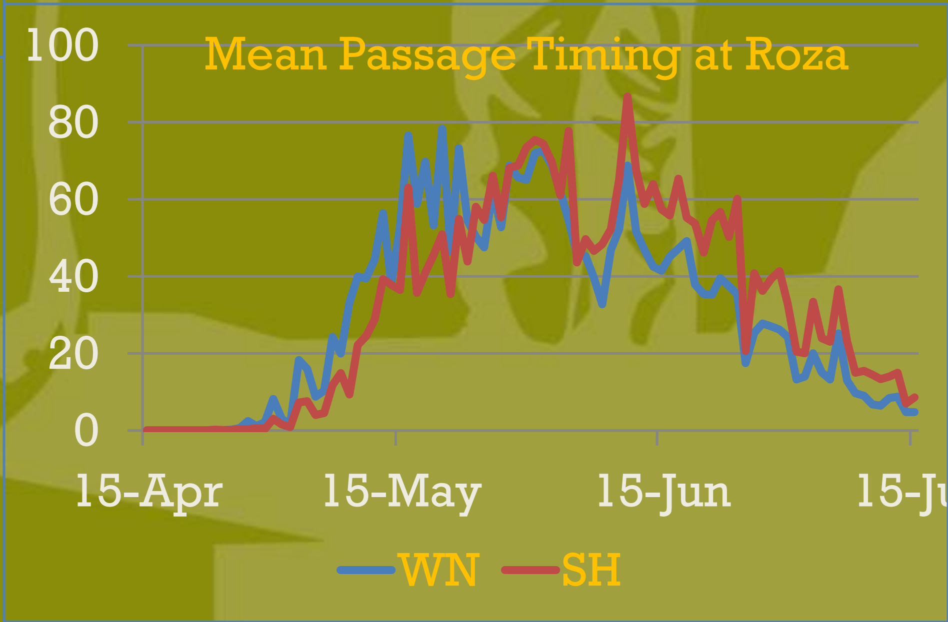


SH: more age-3s, smaller, later run timing, earlier spawn timing, and different body shapes than WN.

If same size, no difference in fecundity or egg mass for females.

Knudsen et al. 2006, 2008

Busack et al. 2007



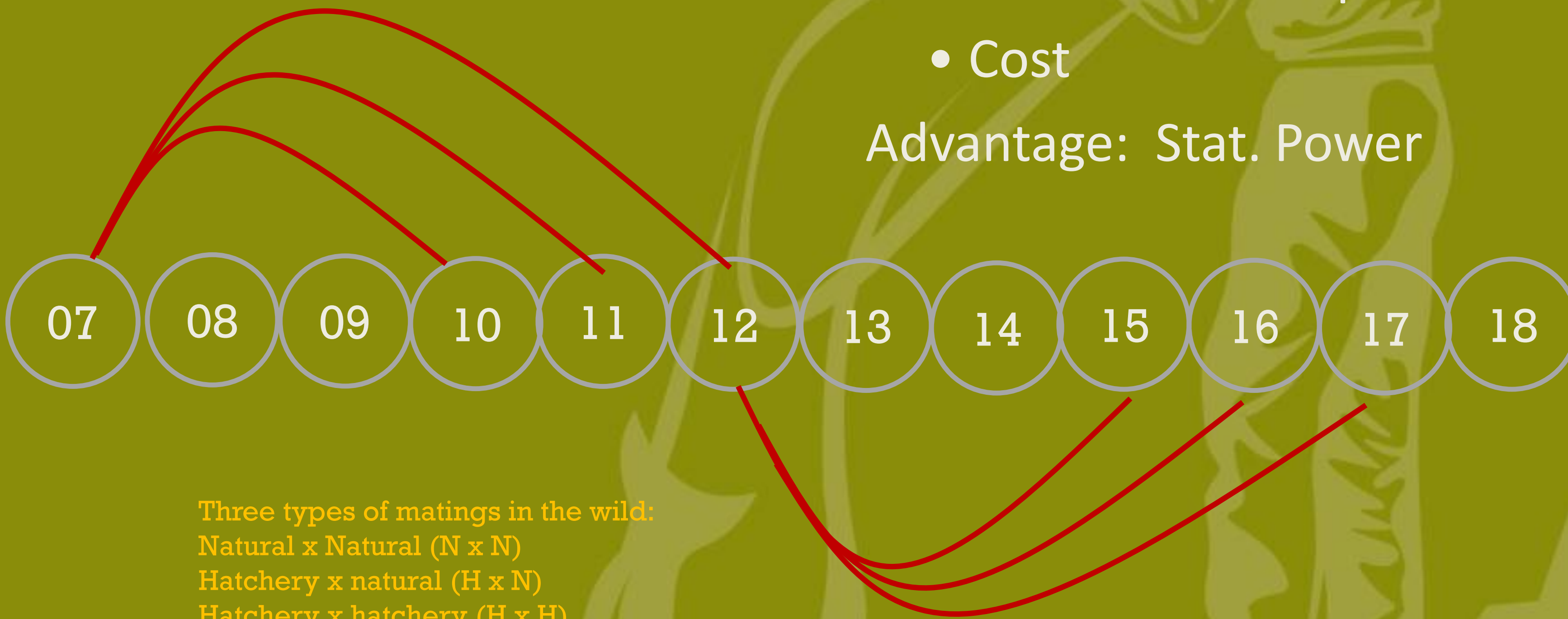
Whole River Pedigree Study

Hatchery-reared fish, H (parents were N)
Natural-origin, N

Challenges:

- Number of Samples
- Cost

Advantage: Stat. Power



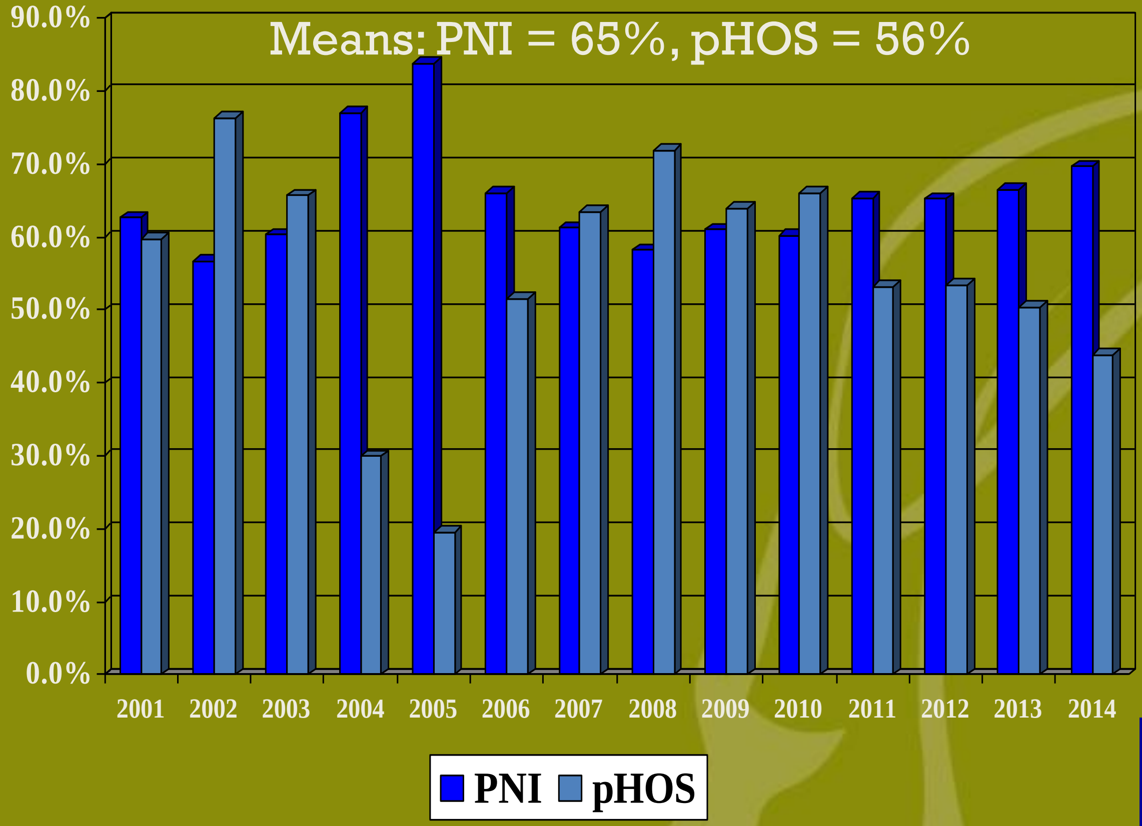
Three types of matings in the wild:
Natural x Natural (N x N)
Hatchery x natural (H x N)
Hatchery x hatchery (H x H)

Natural-origin (wild-spawned) F_2s

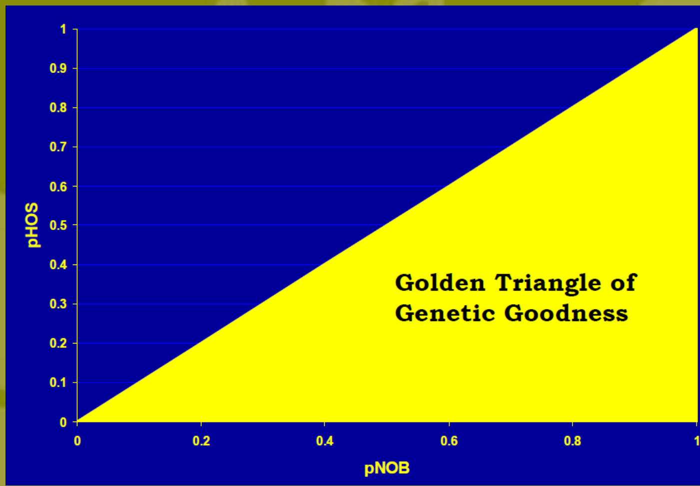
SPAWNING CHANNEL - Constructed summer 2000

RRS: Survival to Fry Schroder et al. 2008, 2010		
	W/N	H
Males	1.00	1.00
Females	1.00	0.94

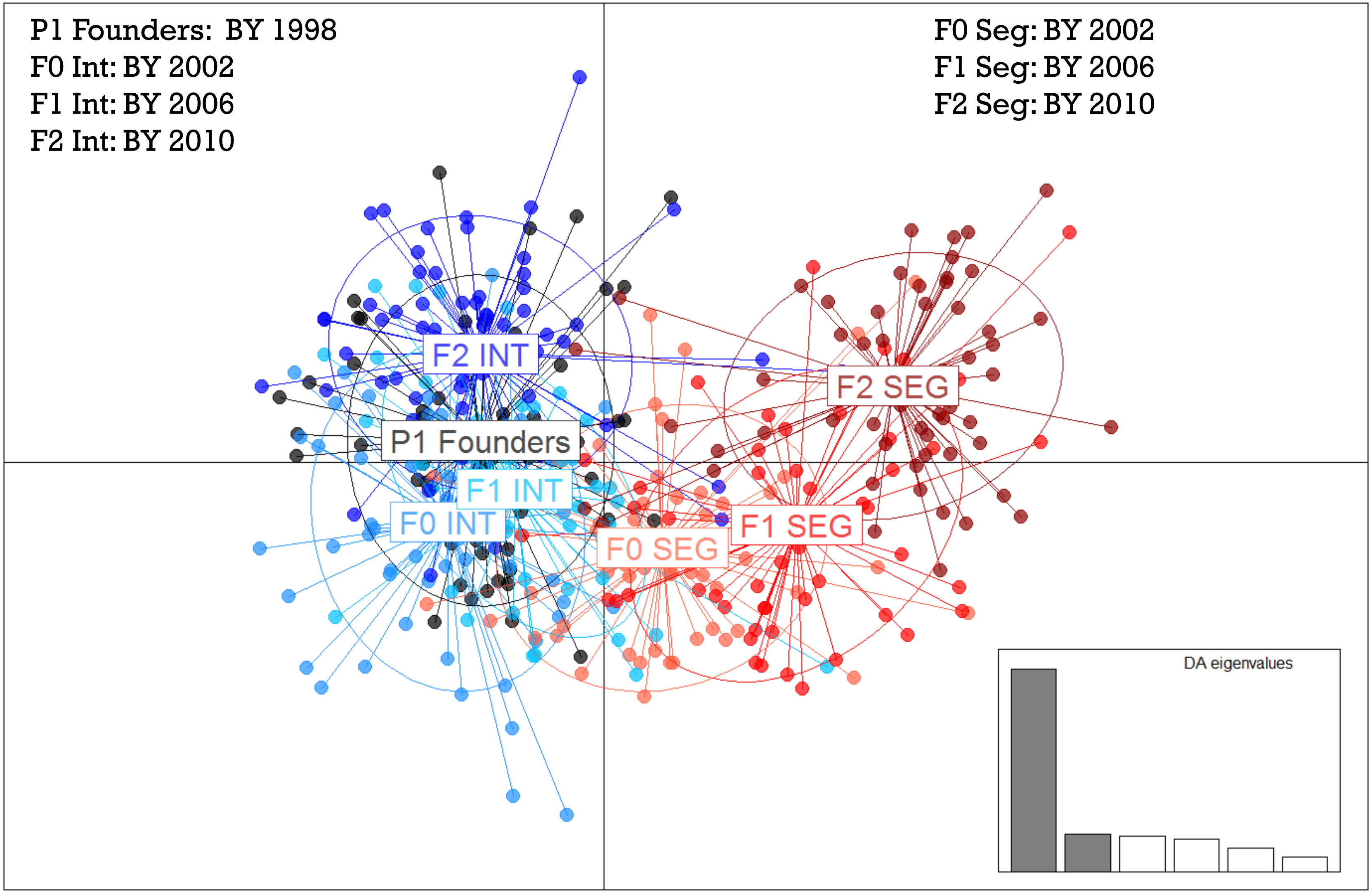
Annual PNI and pHOS



$$PNI = \frac{pNOB}{pNOB + pHOS}$$

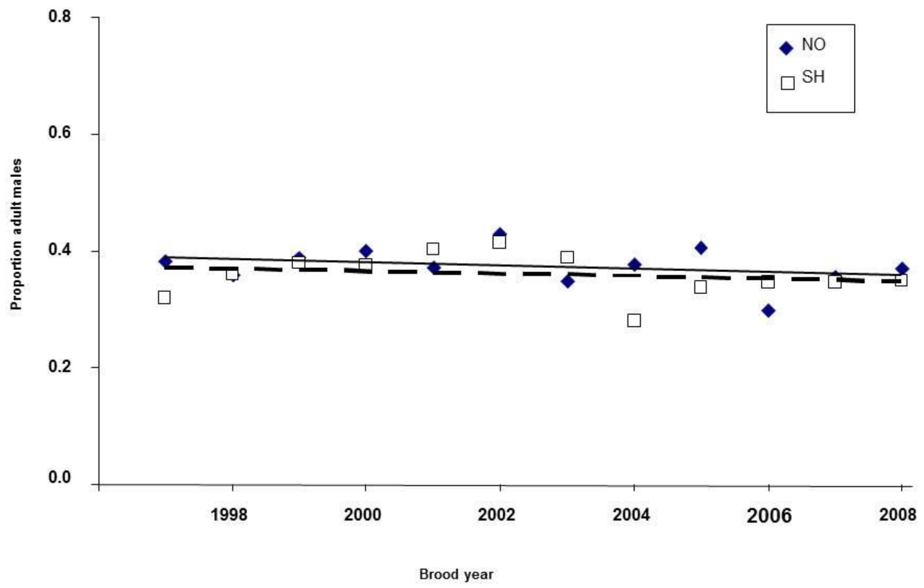


Evaluating Managed Gene Flow, Waters et al.



Residual/Precocious Wild and Hatchery Spring Chinook

Work by Larsen et al., Pearsons et al., and Knudsen indicate large proportion of hatchery-origin mini-jack and jack production



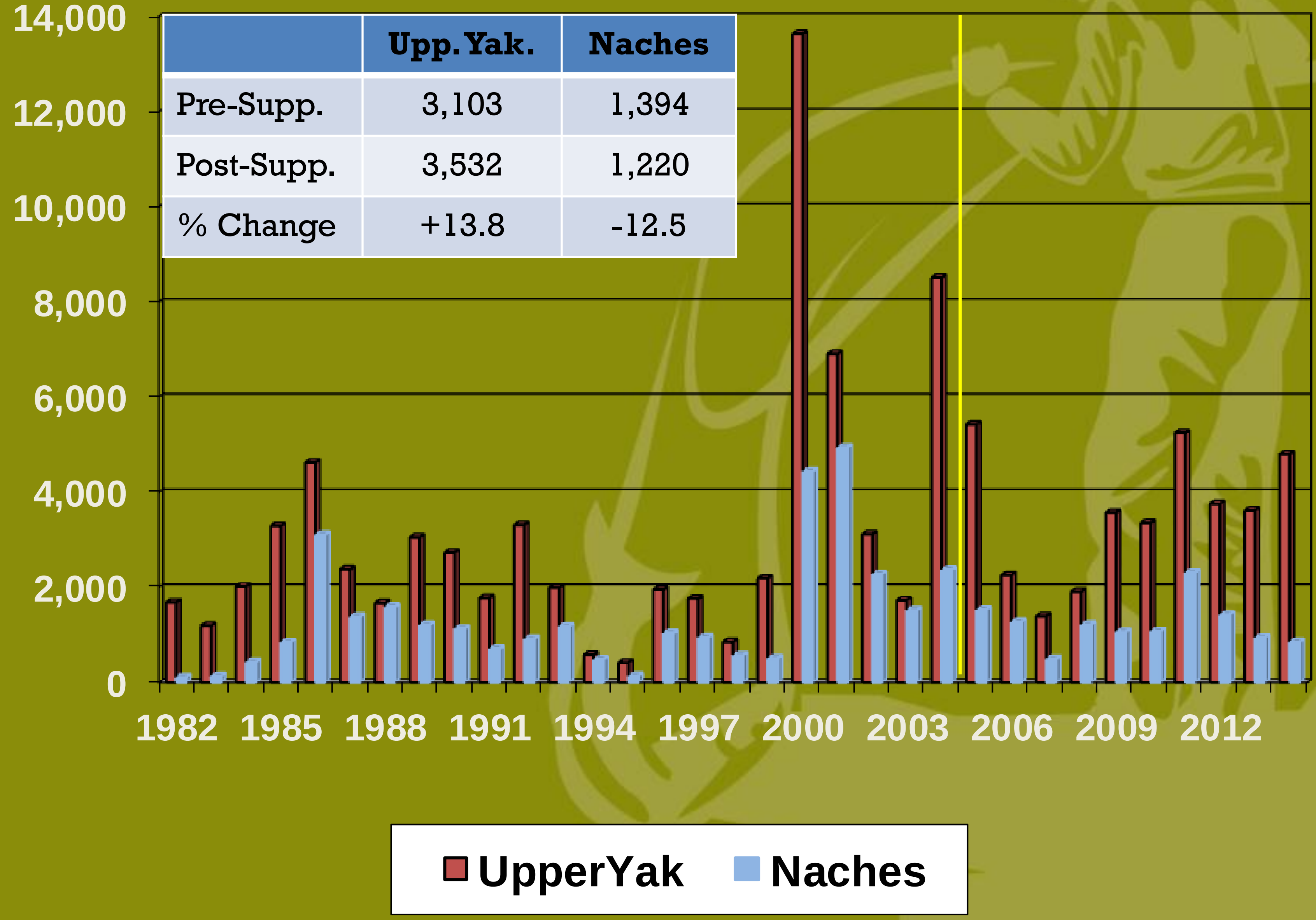
But Knudsen work for this study indicates no difference in returning HO and NO age-4 and age-5 male proportions

Other Ecological Risks

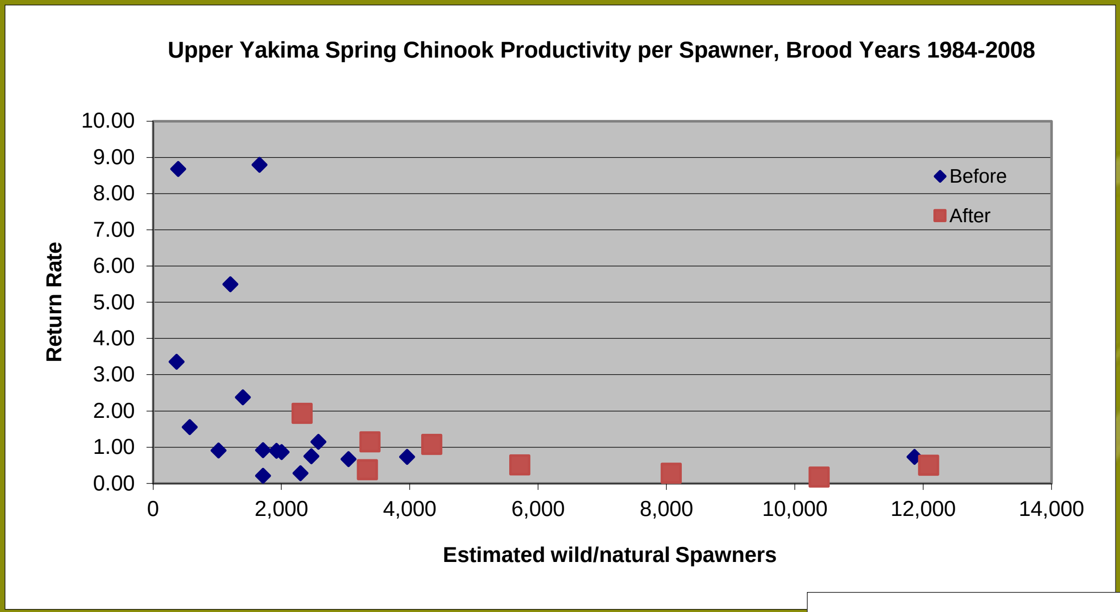
- Ecological interactions within adopted guidelines
- Stray rates < 5%
- Pathogen and BKD risk profiles very low

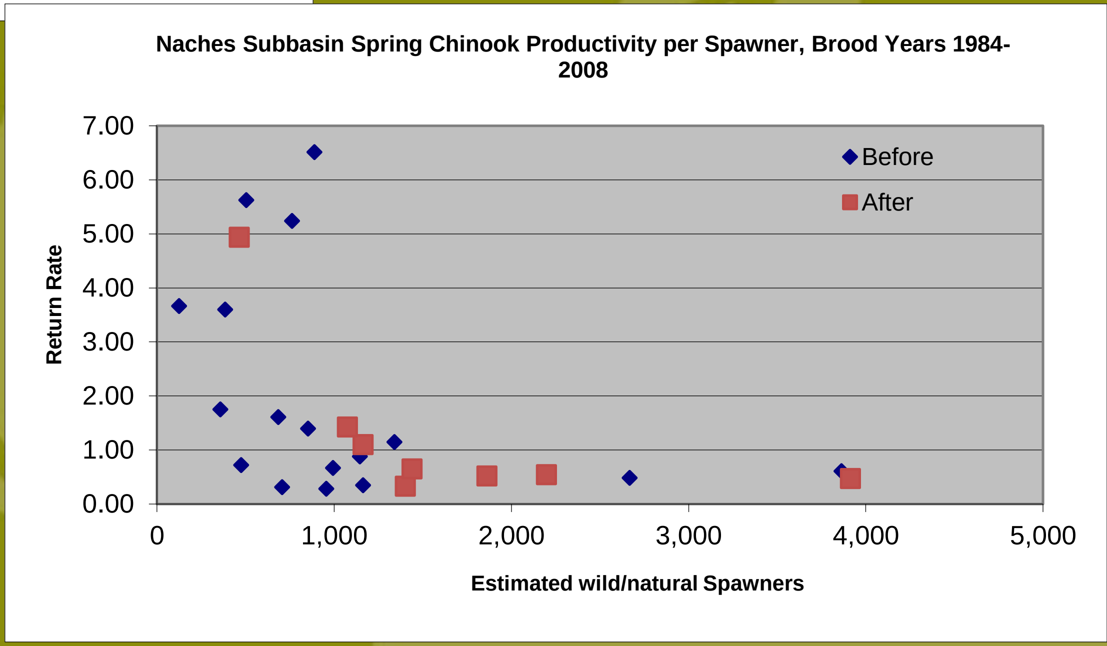
Upper Yakima vs Naches Natural-Origin Returns, 1982-2014

	Upp. Yak.	Naches
Pre-Supp.	3,103	1,394
Post-Supp.	3,532	1,220
% Change	+13.8	-12.5

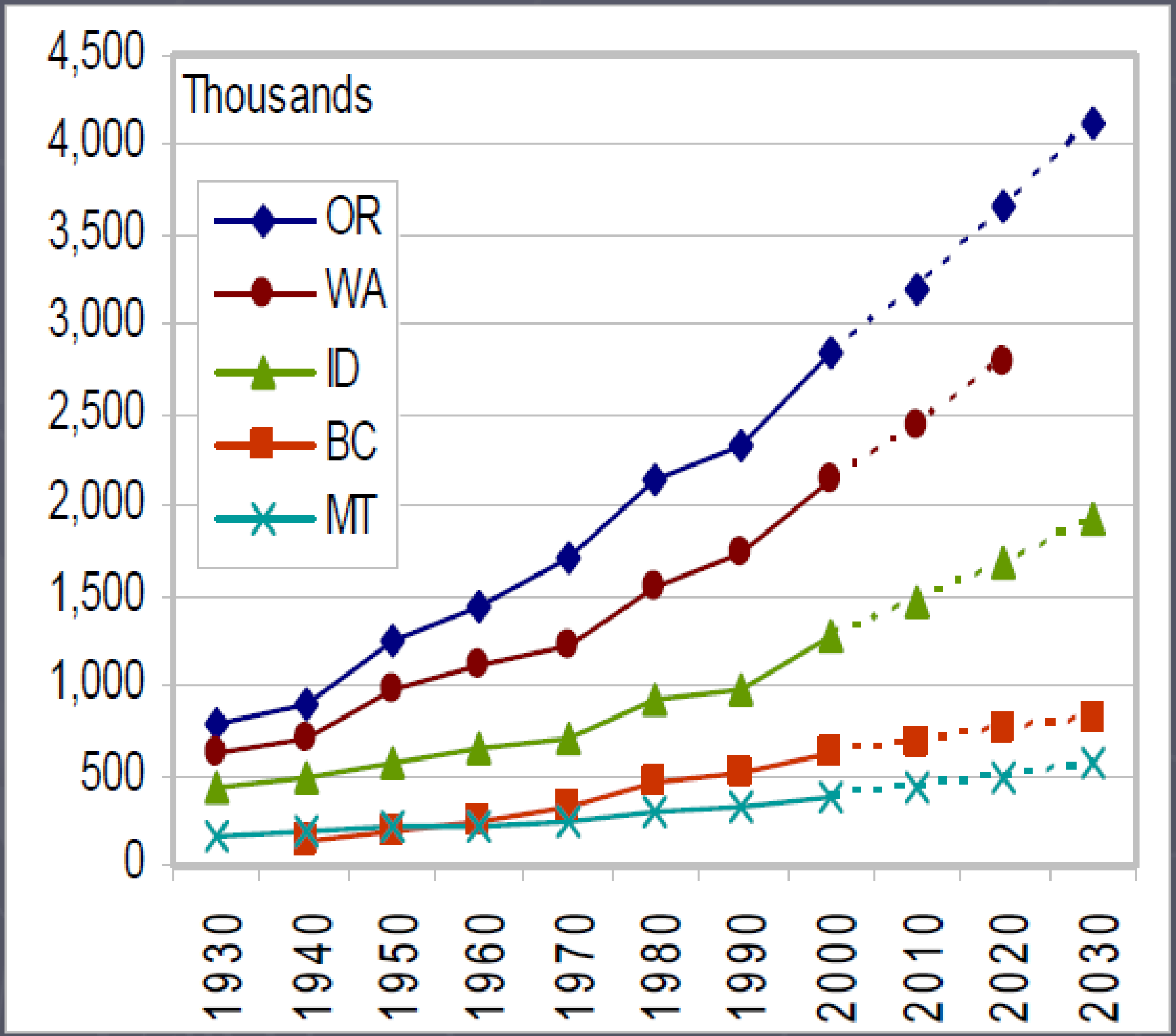


Density Dependence?





Human Population Growth (ISAB 2008)



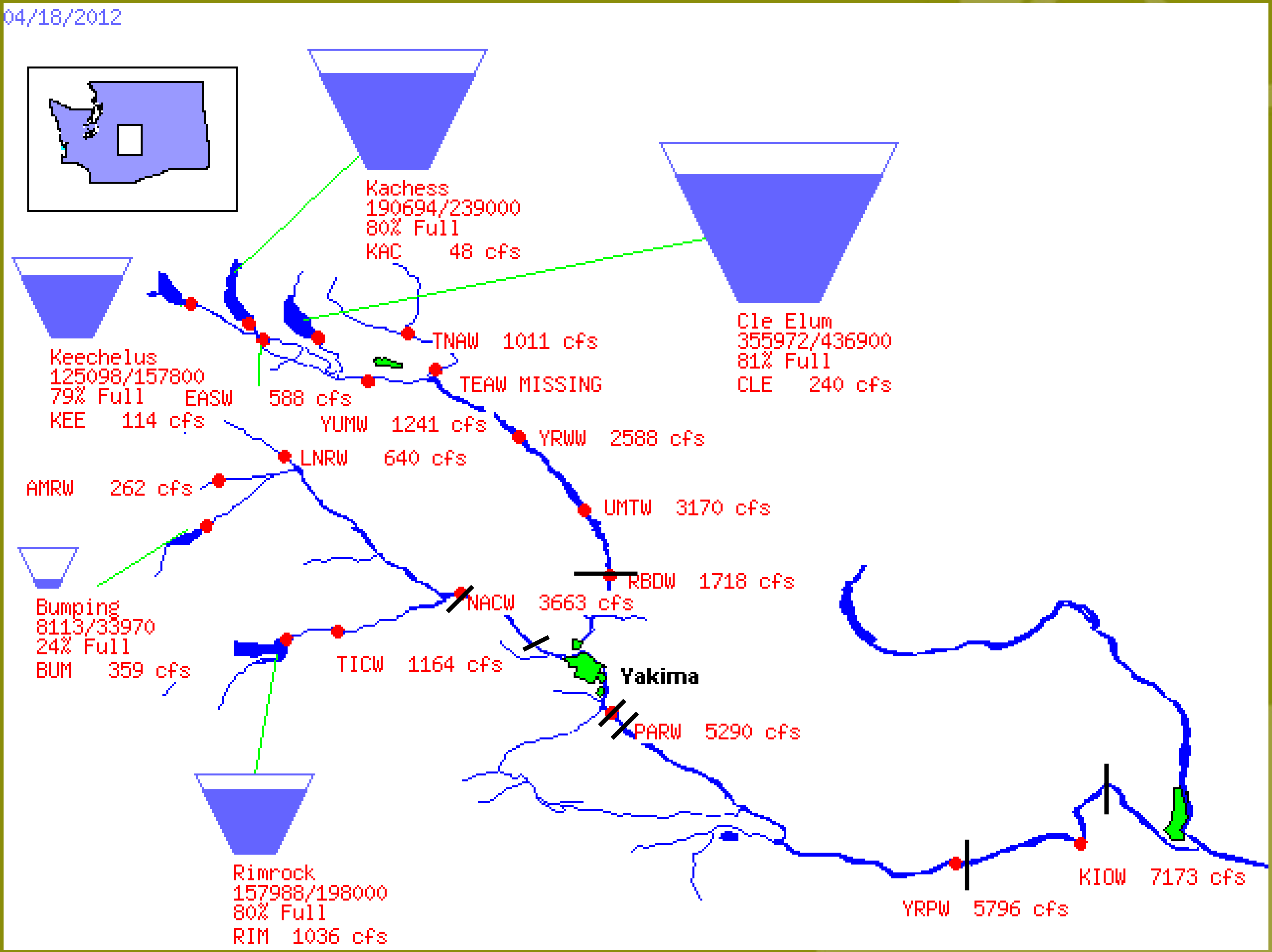
US and Canada censuses. State and regional district projections for 2010 and 2020

Since 2000:

Yakima County +11%

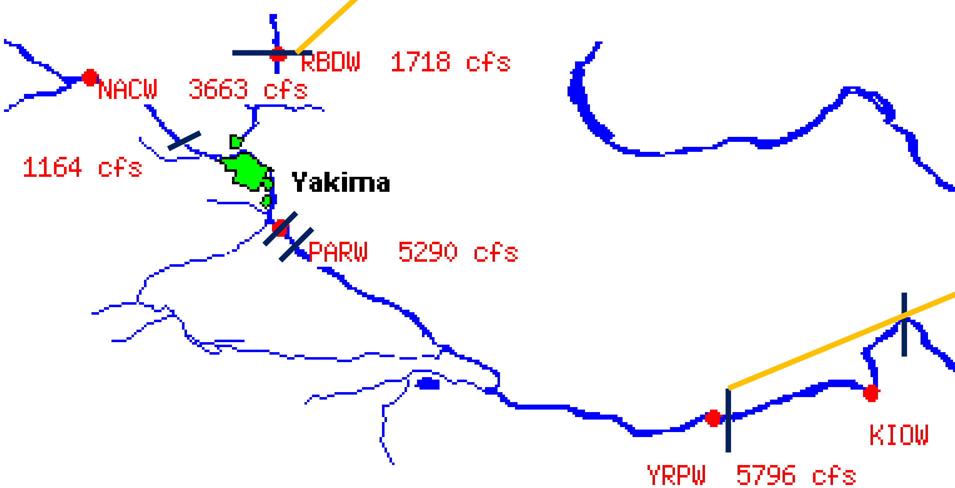
WA State +18%

Bureau of Reclamation, Pacific Northwest Region
Major Storage Reservoirs in the Yakima River Basin

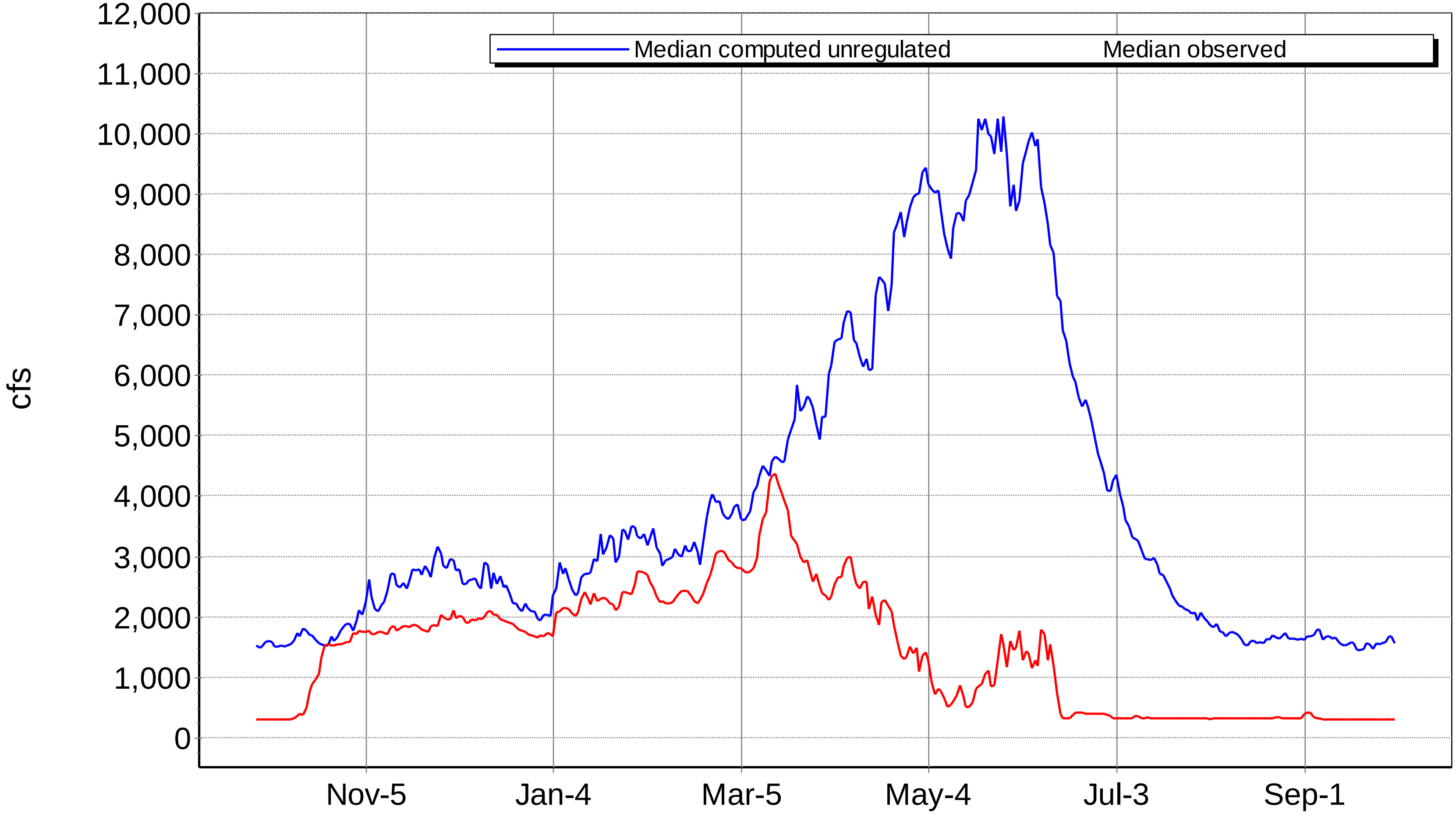


Bureau of Reclamation Diversion Dams

Yakama Nation Fisheries



Flow Regime Highly Altered

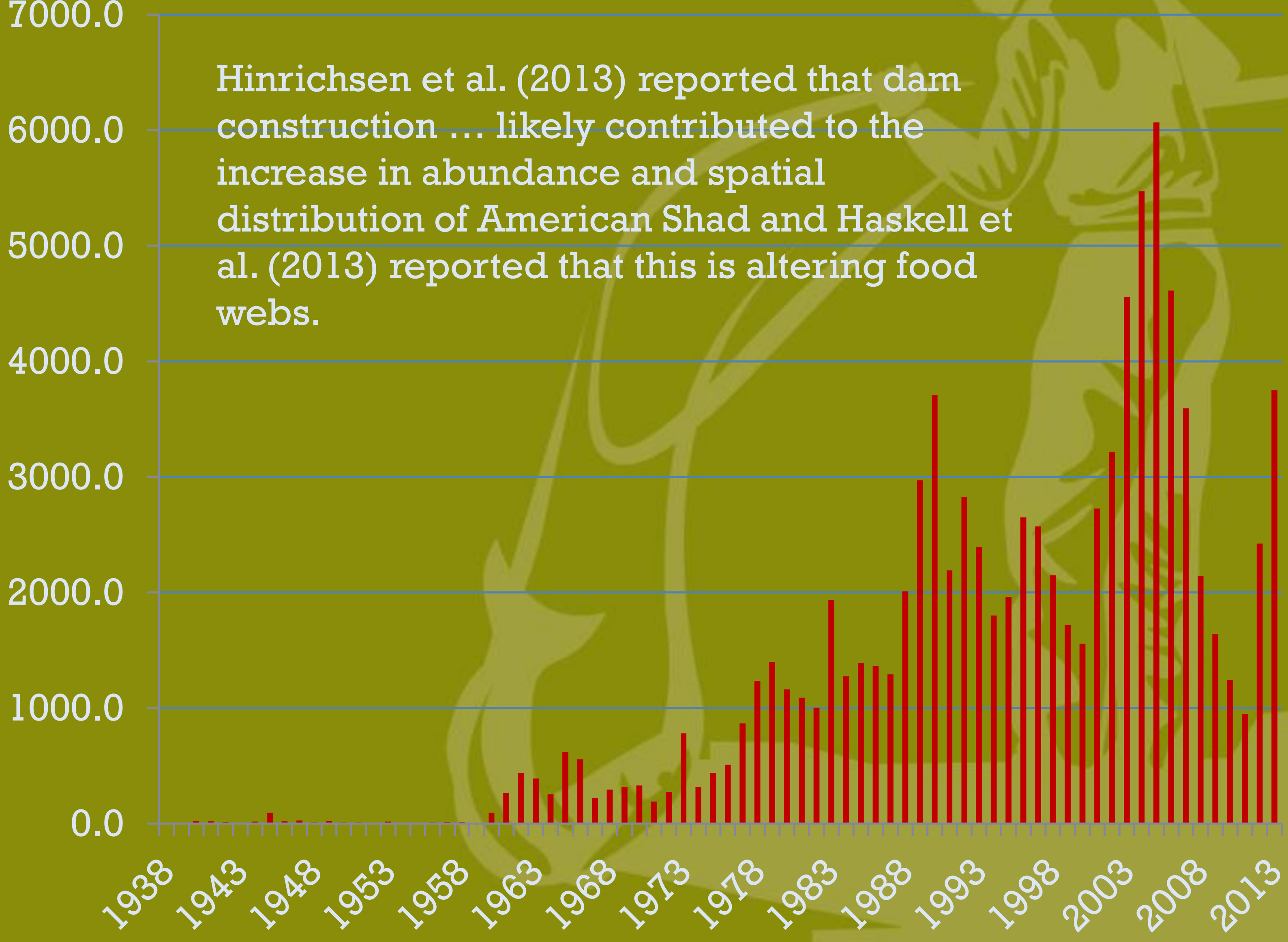


Predation

Yakama Nation Fisheries

Channel Catfish

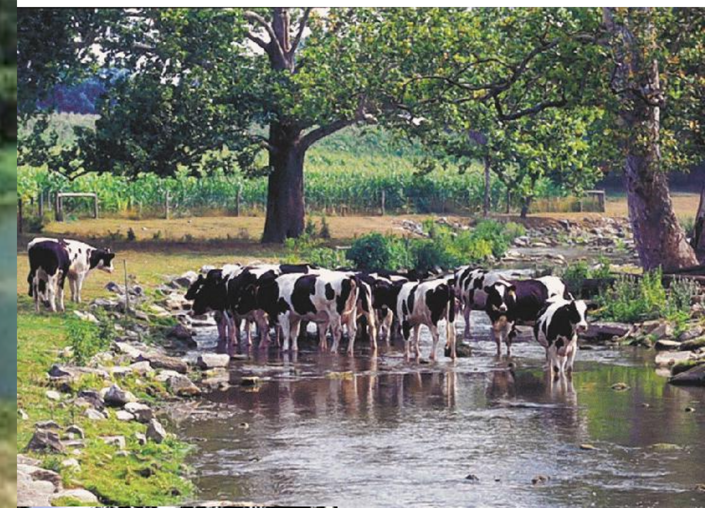
American Shad – Bonneville Counts

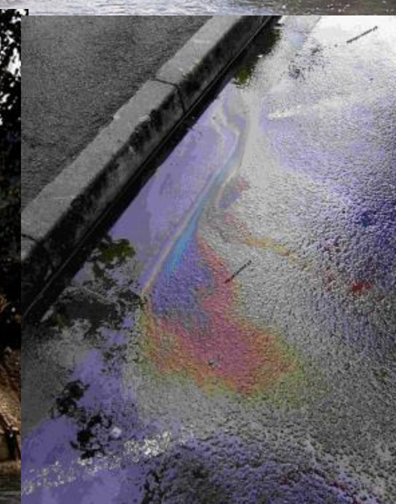


Hinrichsen et al. (2013) reported that dam construction … likely contributed to the increase in abundance and spatial distribution of American Shad and Haskell et al. (2013) reported that this is altering food webs.

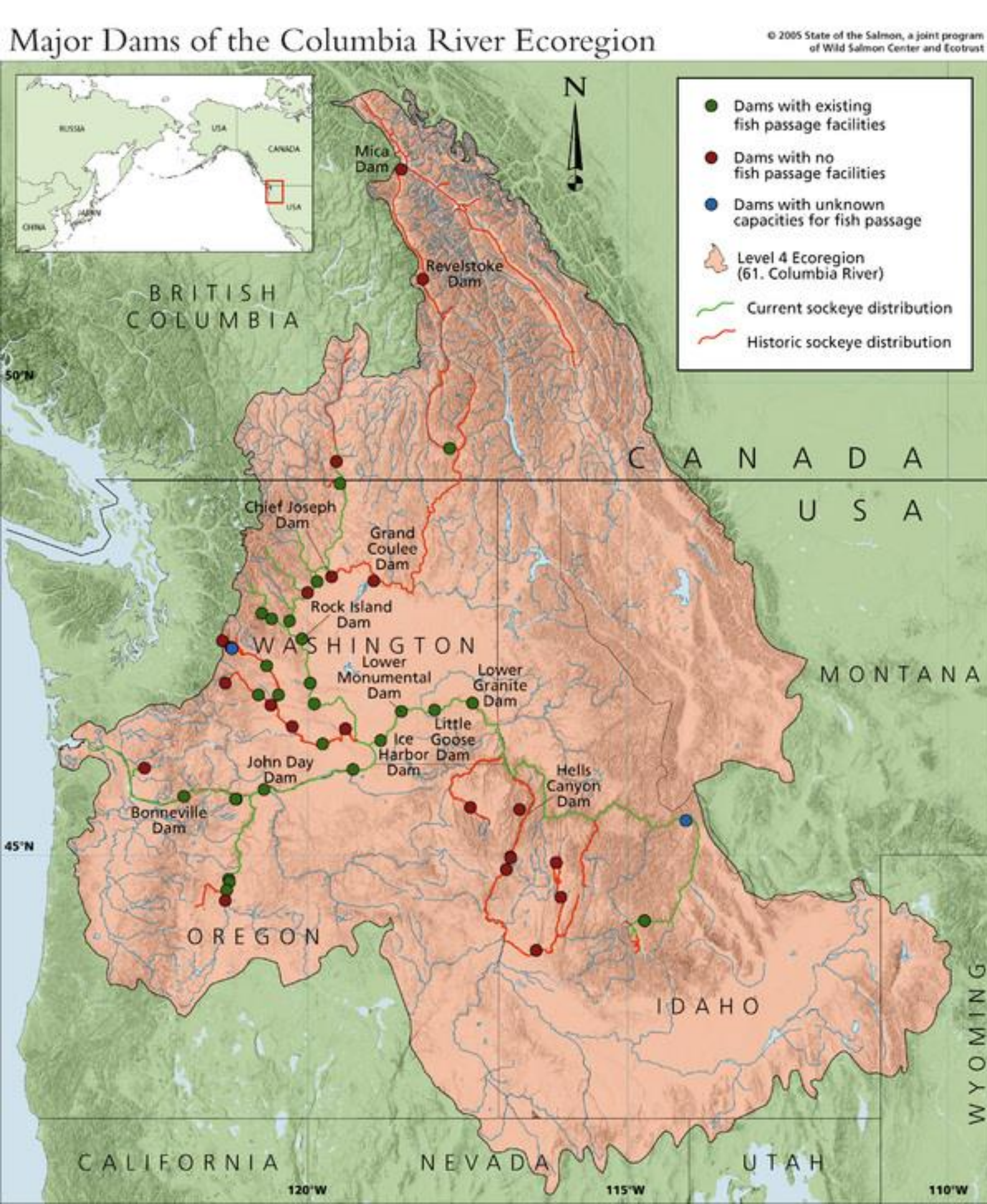
Some Other Factors Affecting Stream Productivity or Carrying Capacity

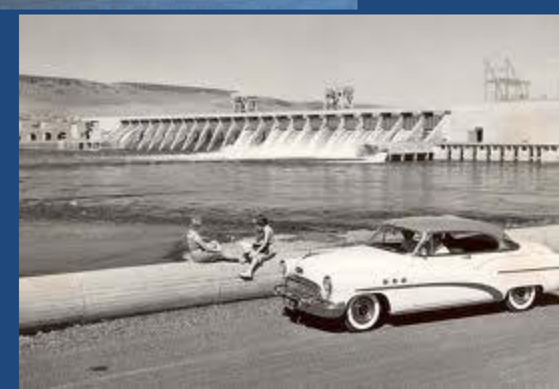
Yakama Nation Fisheries

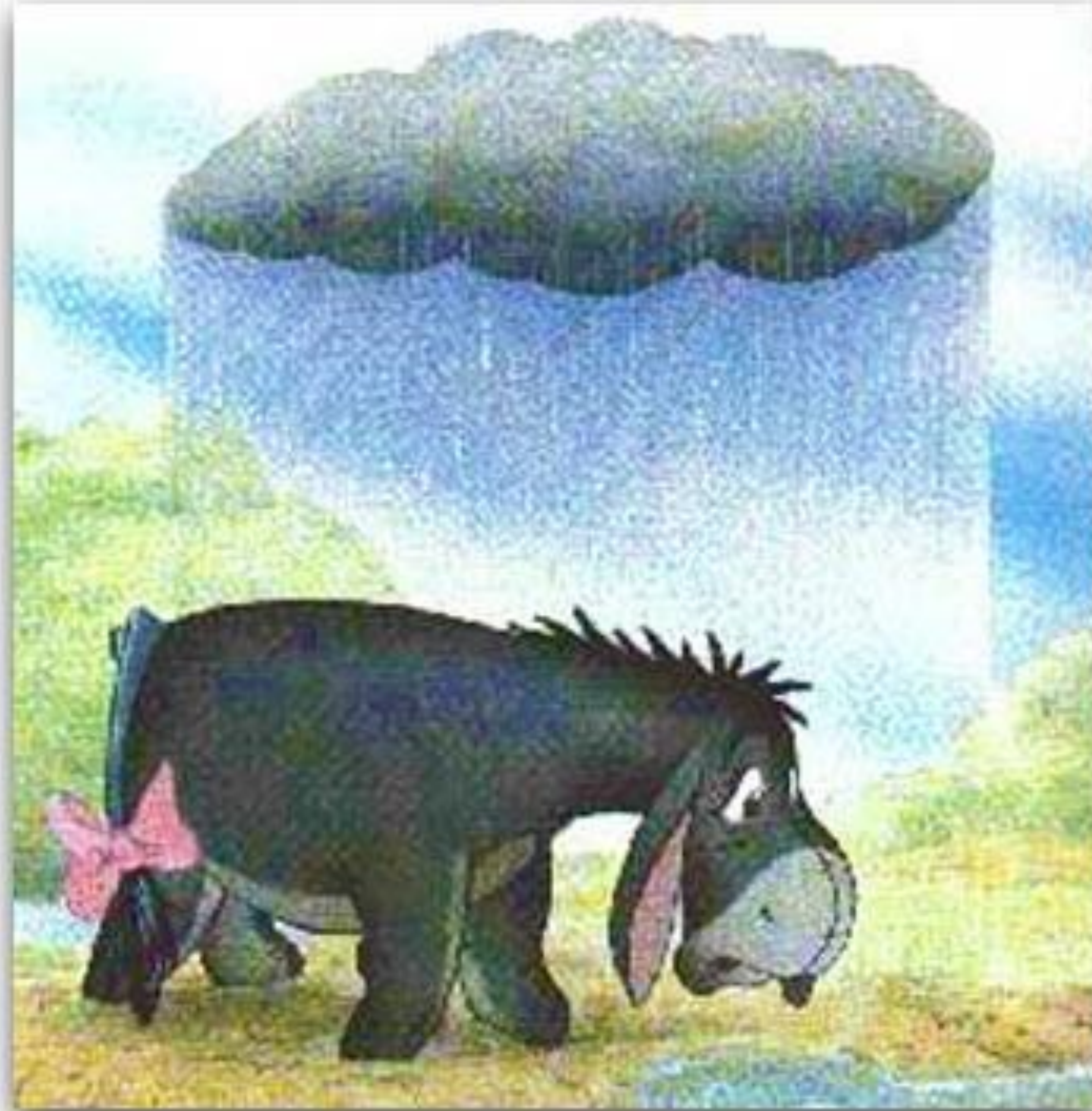




HONOR. PROTECT. RESTORE.


Major Dams of the Columbia River Ecoregion
© 2005 State of the Salmon, a joint program of Wild Salmon Center and Ecotrust
N
Dams with existing fish passage facilities
Dams with no fish passage facilities
Dams with unknown capacities for fish passage
Level 4 Ecoregion (61. Columbia River)
Current sockeye distribution
Historic sockeye distribution
RUSSIA
USA
CANADA
CHINA
JAPAN
USA
BRITISH COLUMBIA
CANADA
USA
WASHINGTON
MONTANA
OREGON
IDAHO
WYOMING
CALIFORNIA
NEVADA
UTAH
50°N
45°N
120°W
115°W
110°W
Mica Dam
Revelstoke Dam
Chief Joseph Dam
Grand Coulee Dam
Rock Island Dam
Lower Monumental Dam
Lower Granite Dam
Little Goose Dam
Ice Harbor Dam
John Day Dam
Hells Canyon Dam
Bonneville Dam





TROUT UNLIMITED

FORTERRA

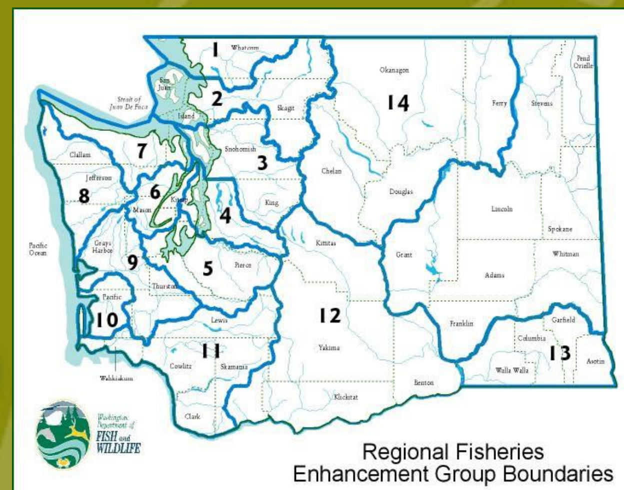
BLUE MOUNTAIN LAND TRUST

UPPER COLUMBIA SALMON RECOVERY BOARD

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION

M2

KCT



COWICHE CANYON CONSERVANCY

NOAA

YAKIMA BASIN FISH AND WILDLIFE RECOVERY BOARD

The Nature Conservancy

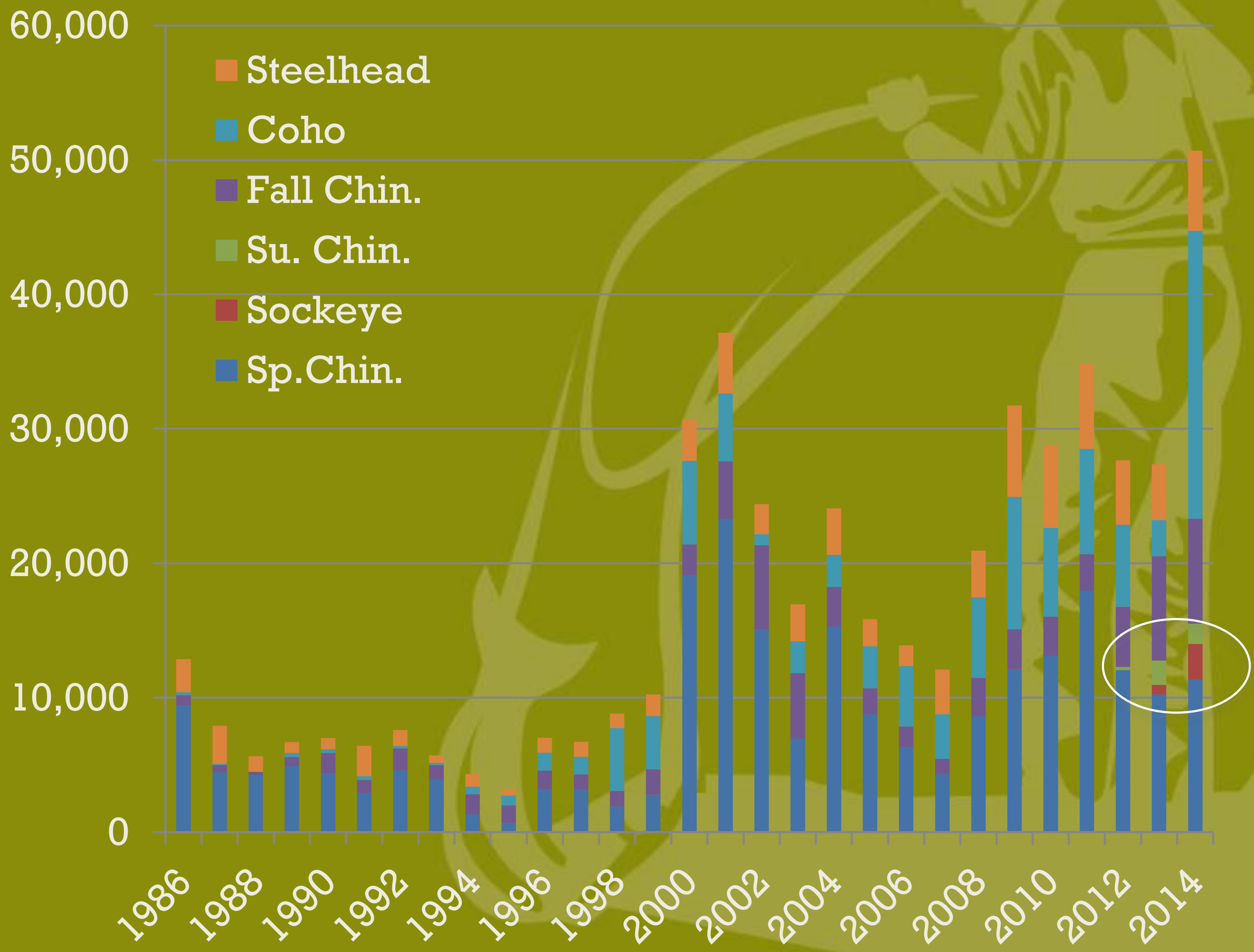
Protecting nature. Preserving life.

Bonneville Power Administration

At a Glance

Yakama Nation Fisheries

50,000+ Salmon and Steelhead to Yakima Basin in 2014!!



Summary

- Expectations need to be consistent with reality
- Hatcheries aren't the cause of poor productivity
- Hatchery reform can work
- Each Subbasin is unique
- Let's keep working to address factors limiting natural productivity

More info:
Yakima Basin Science Conf.
http://ykfp.org/par.html
bbosch@yakama.com