Clear Today and Chance of Salmon Tomorrow…
Fish, Weather, and Water: Columbia Basin Salmon Recovery

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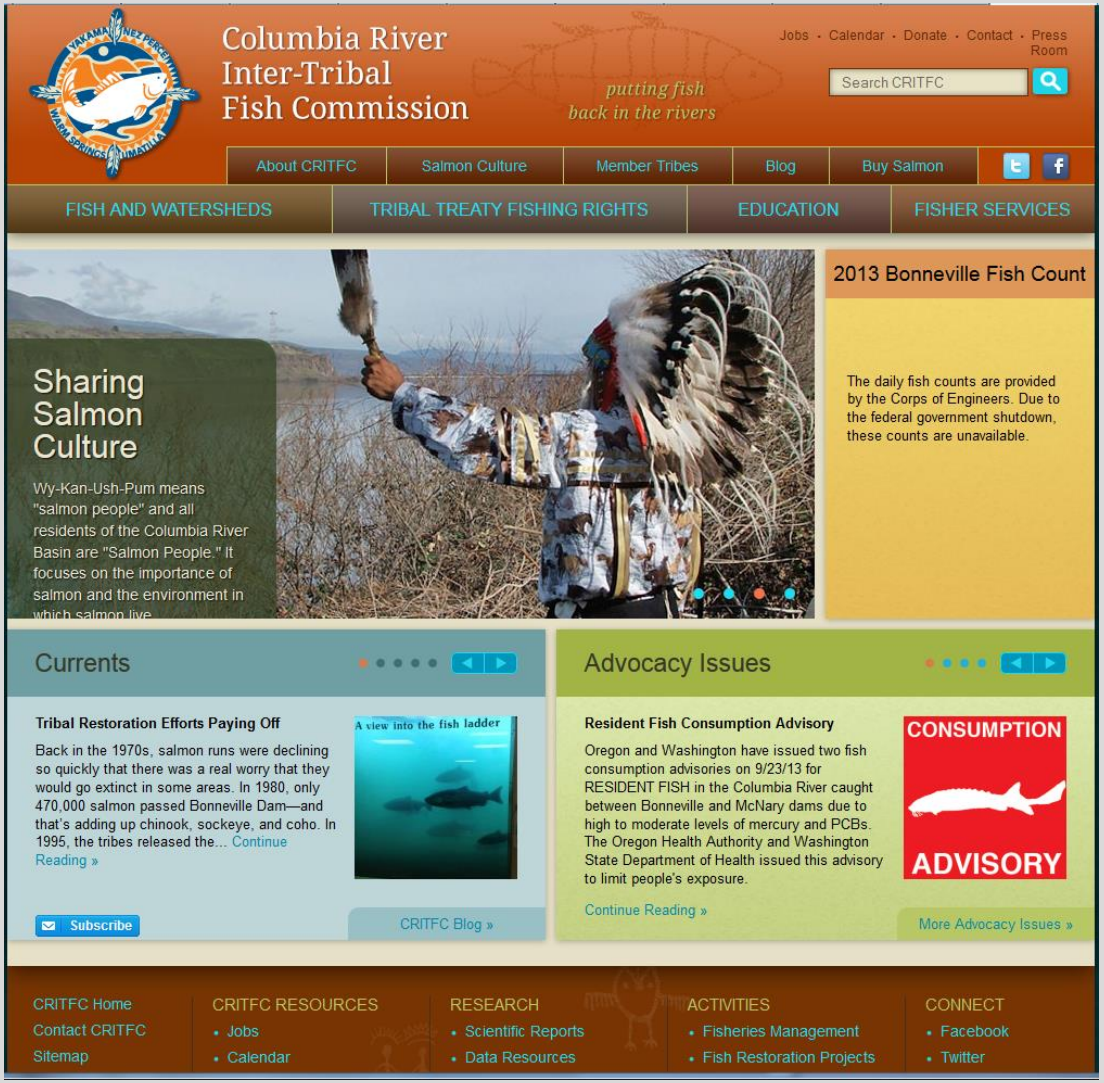
January 29th, 2025

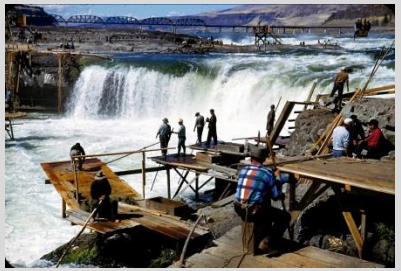
Oregon AMS guest lecture, Stark Street Pizza

Columbia River Inter-Tribal Fish Commission

Portland, Oregon

Columbia River Inter-Tribal Fish Commission





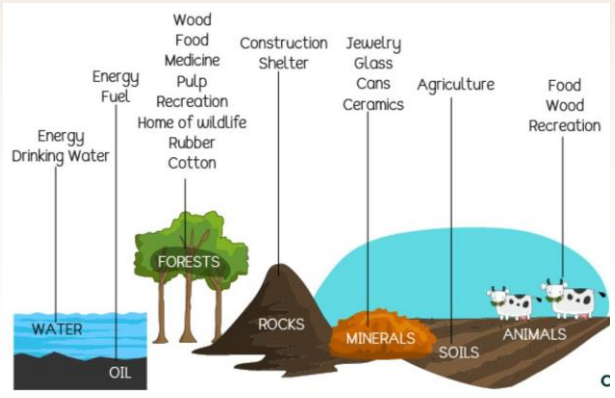
CRITFC website, http://www.critfc.org

WHY IT MATTERS…BIG PICTURE

Pop Quiz #1

- What percent of annual Tribal Government budgets are spent on Natural Resource management?
- (A) 1-2%
- (B) 2-5%
- (C) 5-10%
- (D) 10-15%
- (E) 25-50%

Correct answer: (E) **25-50%** WOW! ☺



WHY IT MATTERS…THE CONTEXT

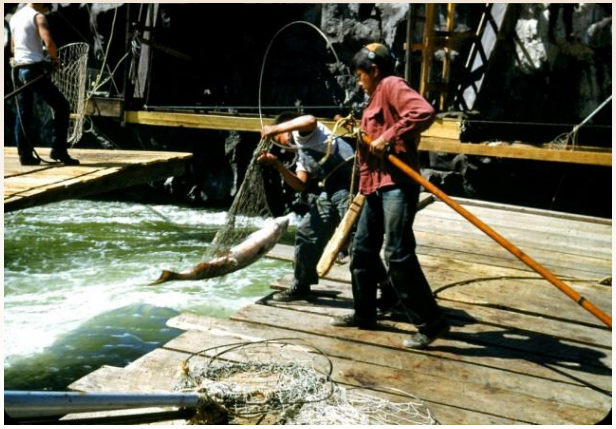
HOW DO TRIBES MANAGE NATURAL RESOURCES?

- What is "TEK"? How does TEK compare with modern methods?
- Traditional Ecological Knowledge – intimate knowledge of land/water.
- Practitioners: Indigenous peoples, the Vikings, farmers.

WHY IT MATTERS…

Salmon…Tribes…Culture

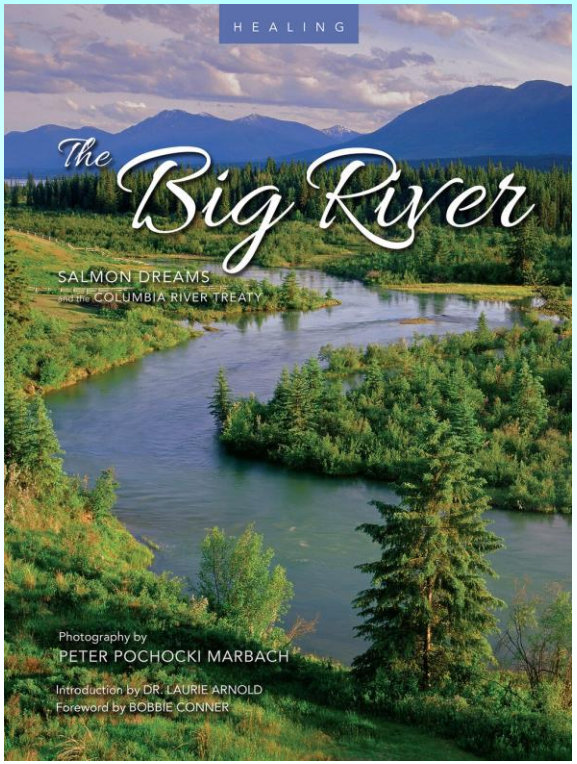
- Traditional tribal diets were highly rich in salmon.
- PNW tribal populations were in sharp decline for over 100 years. Now they are rebounding – hence their need for more traditional foods.
- PNW tribal members do exercise their legal fishing treaty rights.
- Salmon are a major part of PNW tribal religion and culture.



WHY IT MATTERS…

PNW citizens…Salmon

- Columbia River had 10+ million Salmon return each year.
- PNW residents enjoy Salmon for recreation and job opportunities.
- PNW Salmon is a major regional cultural icon.

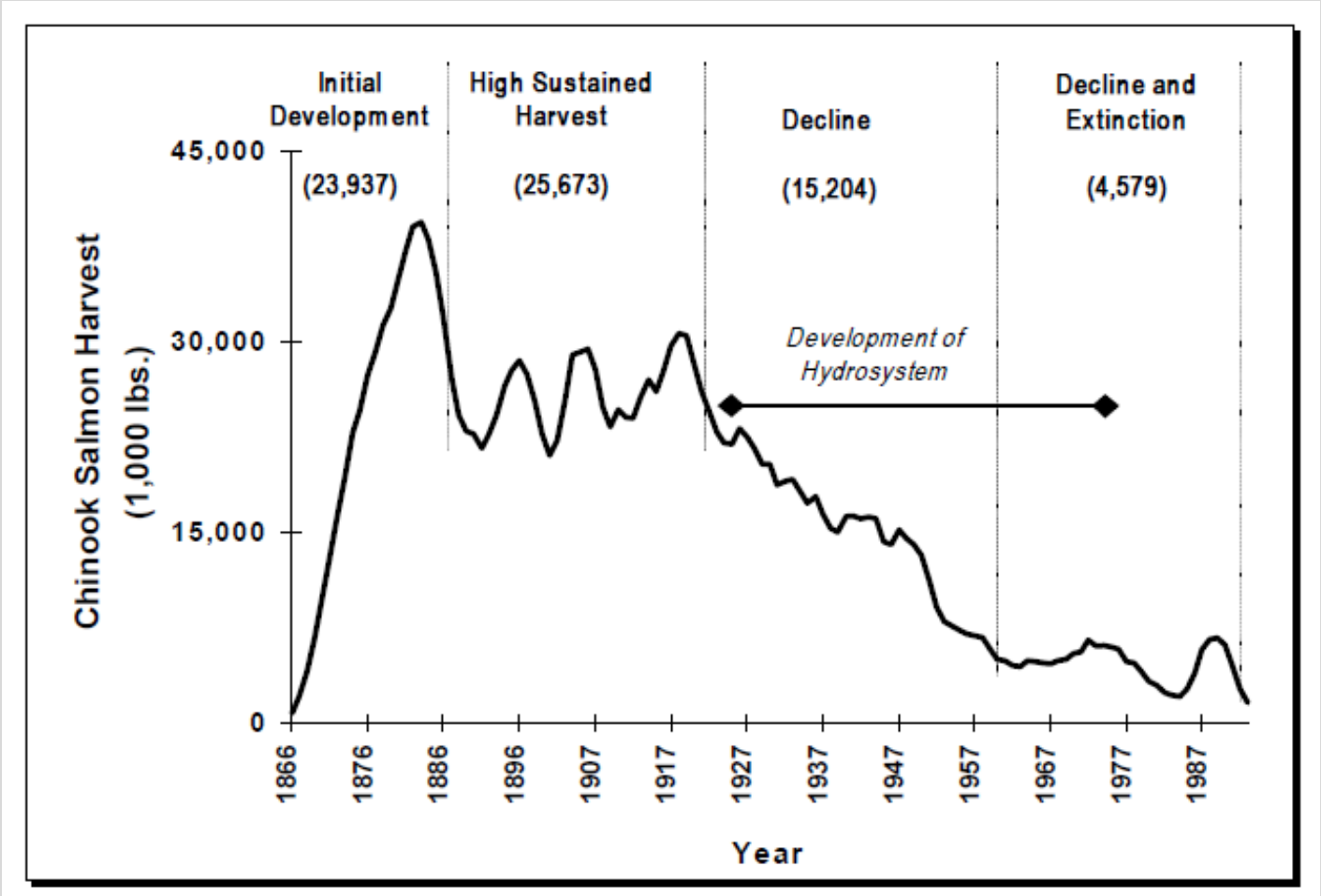


Overview

- Salmon live in freshwater, the estuary, and the ocean - *Anadromous*. Salmon are a **cold-water** species.
- Natural Factors - Hydrologic, Meteorological, Oceanic, and Geologic - affect the salmon and its Life Cycle.
- Improving in-river conditions for fish passage and habitat is one major element of recovery programs.
- Salmon recovery program components include "4H" -- **H**ydro, **H**abitat, **H**atcheries, and **H**arvest.

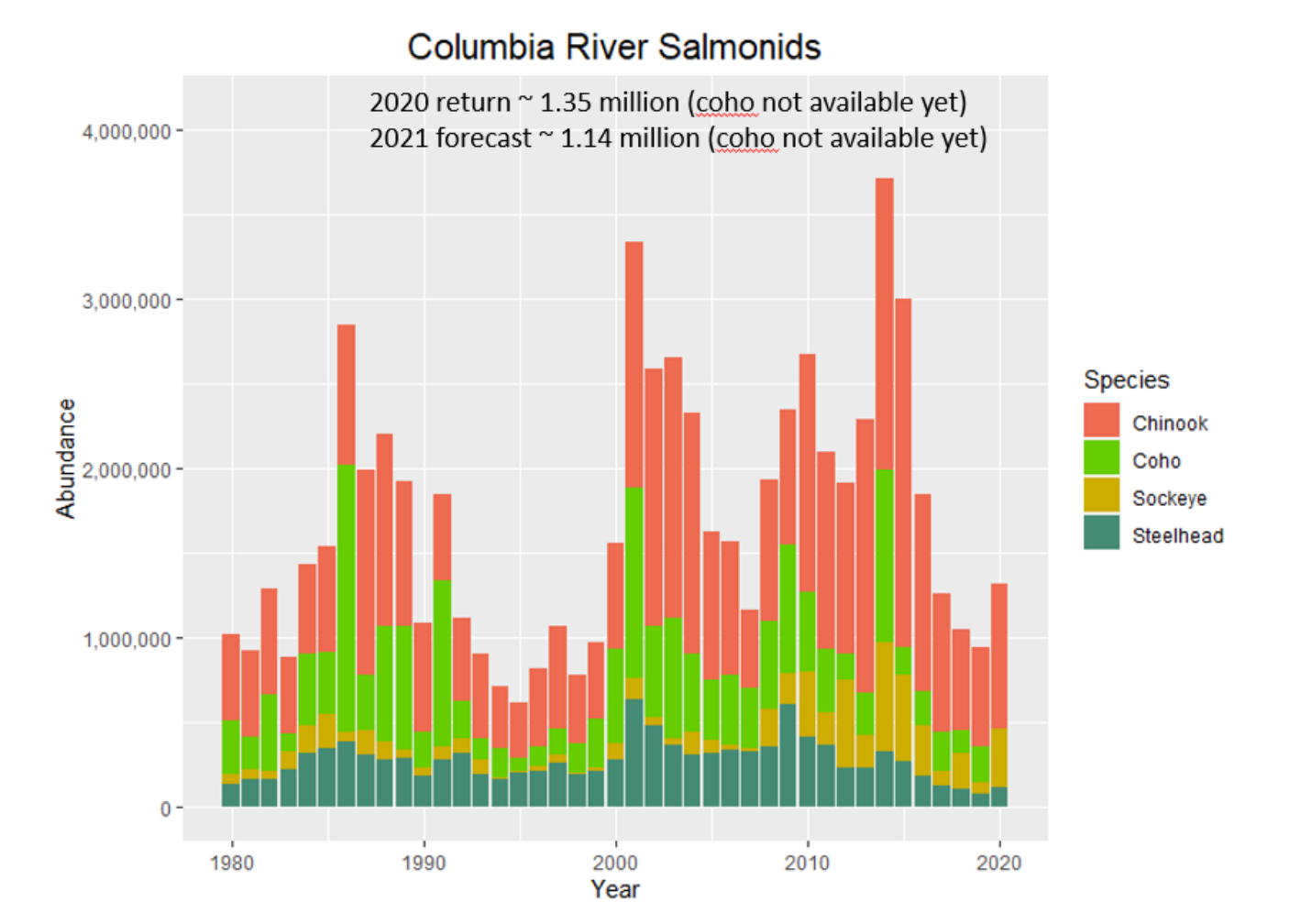
How MUCH salmon has been lost?

Reason for PNW Salmon decline



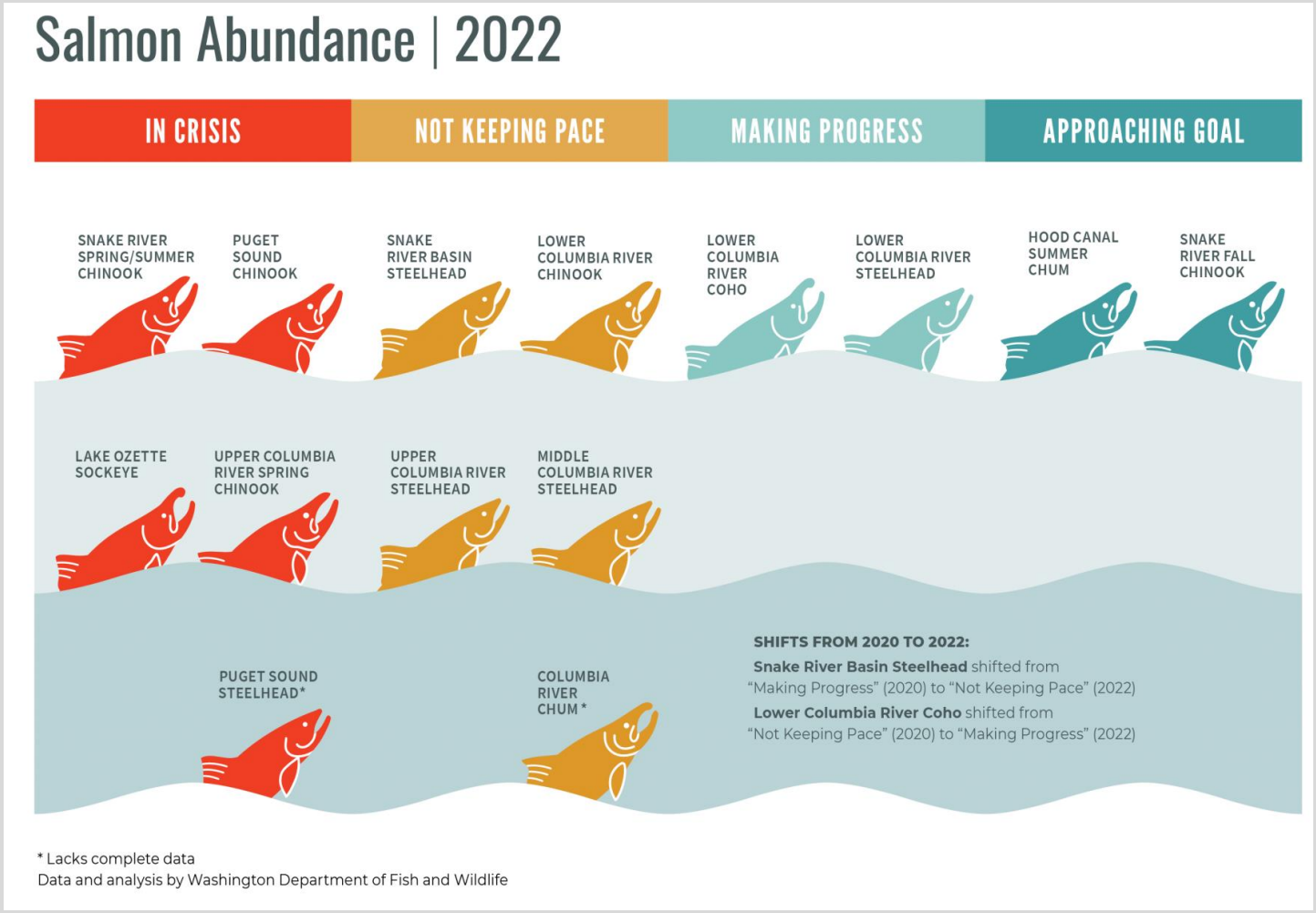
Source: NWPCC Return of the River, http://www.nwcouncil.org/reports/2000/2000-12

Current PNW Salmon counts



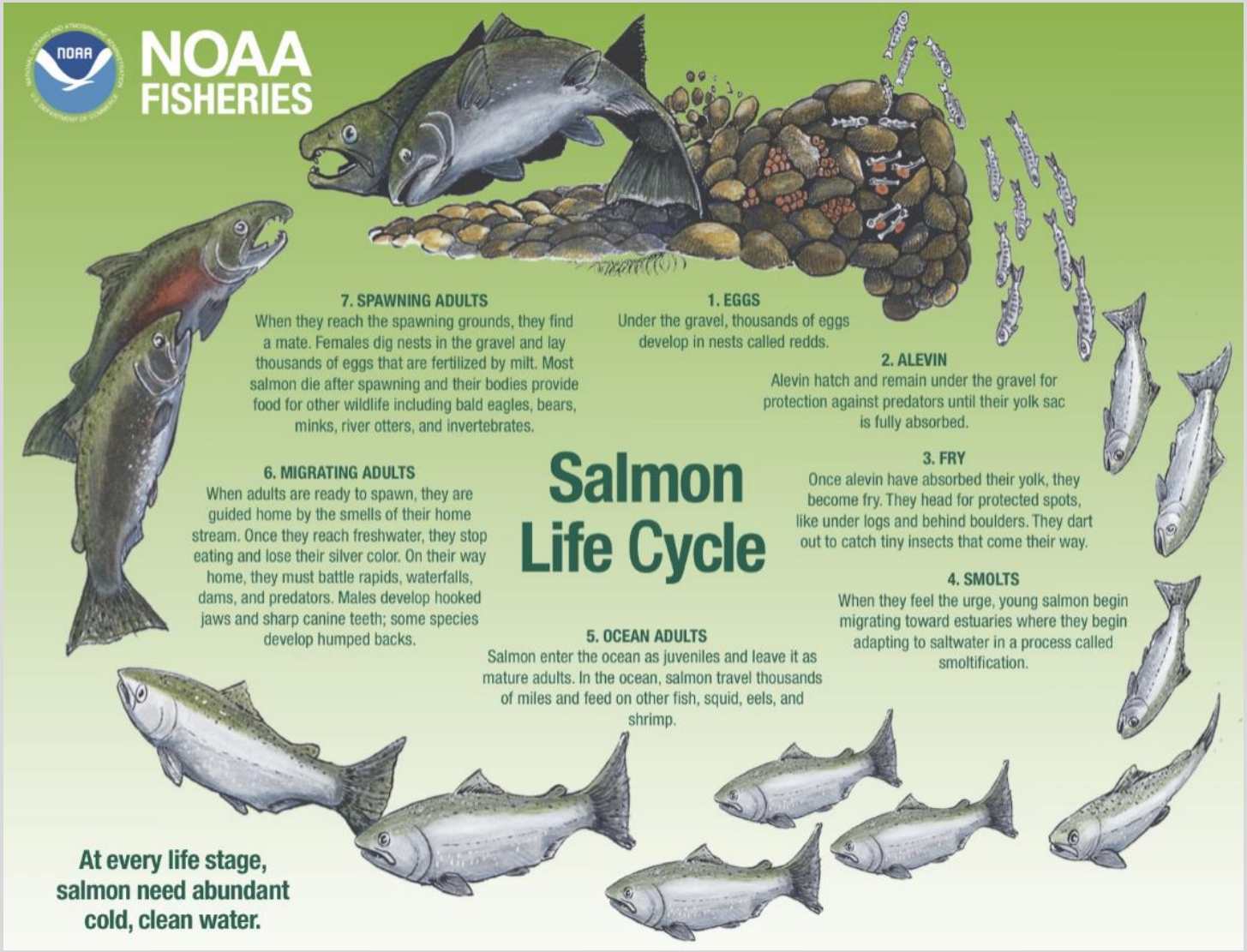
Source: NWPCC, https://www.nwcouncil.org/news/few-exceptions-columbia-river-salmon-and-steelhead-returns-continue-downward-trend/

Current WA Salmon counts



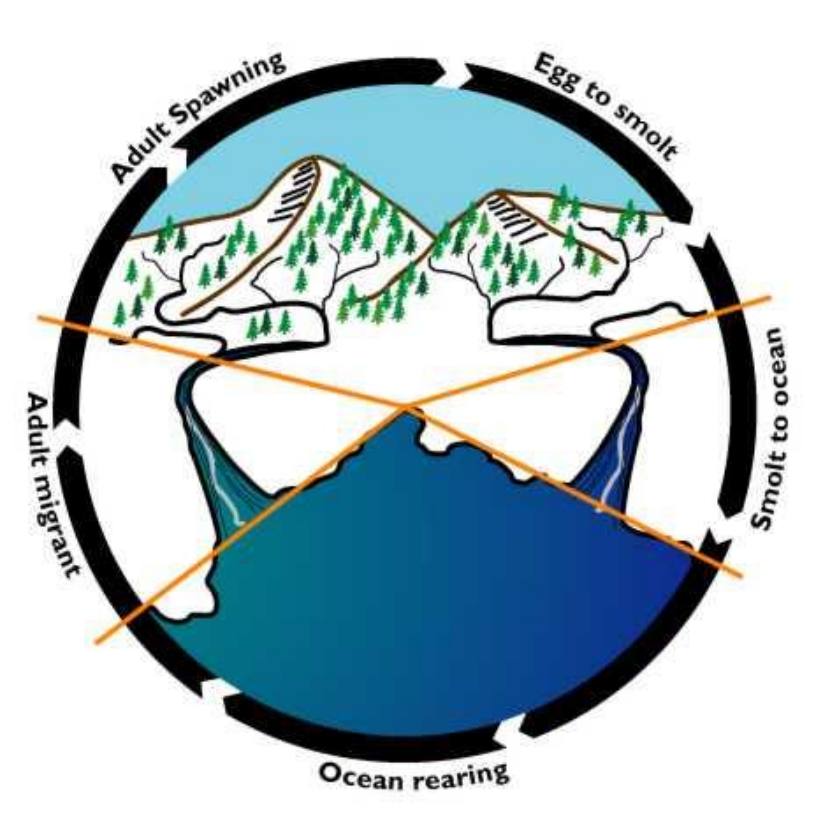
Source: https://stateofsalmon.wa.gov/executive-summary/salmon-status/

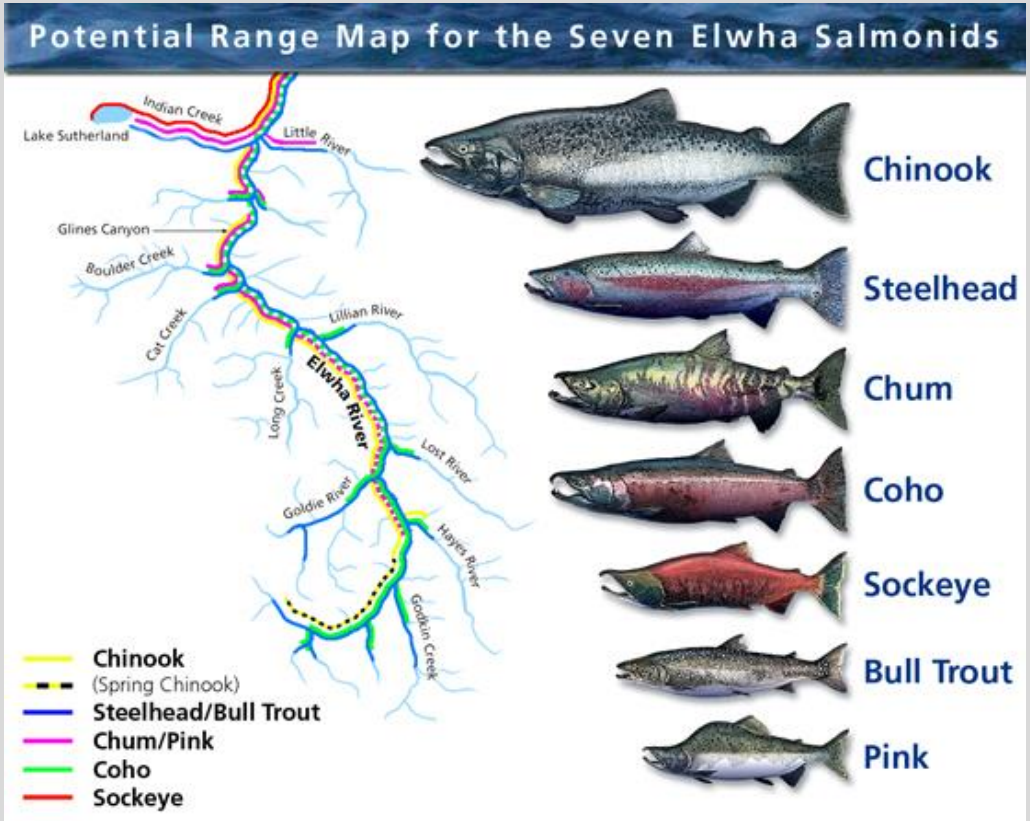
Salmon Life Cycle



Source: https://www.fws.gov/media/columbia-river-fwco-salmon-classroom-tank-resources-posters-and-infographics

Salmon Life Cycle

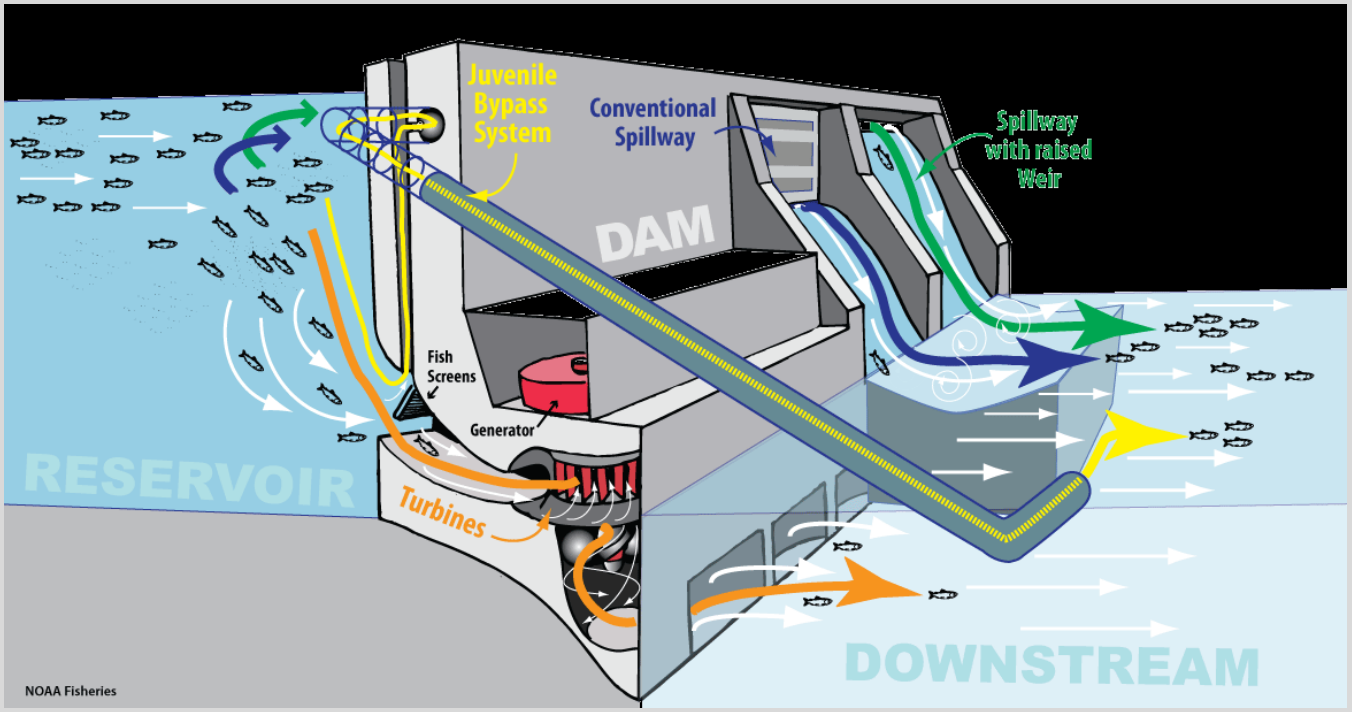


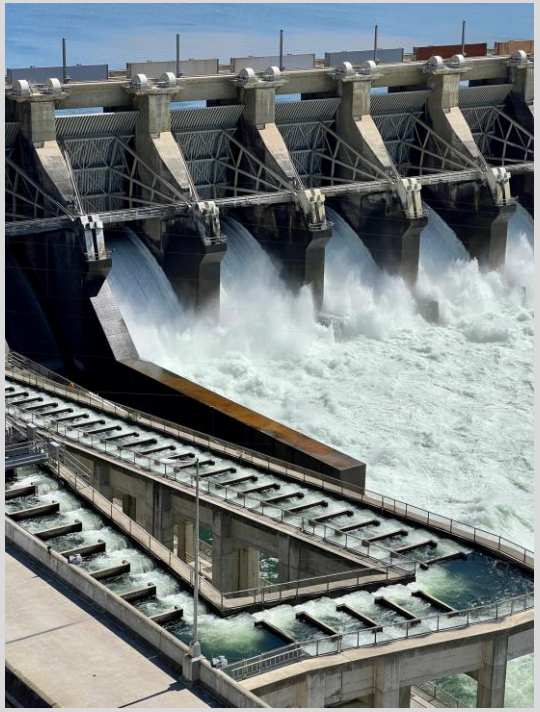


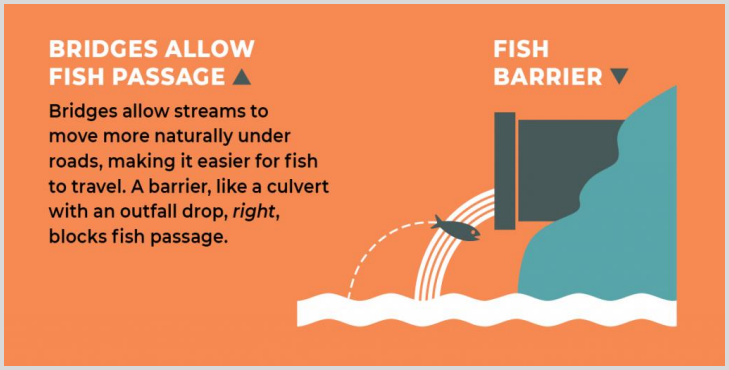
Source: CRITFC Columbia River Salmon, http://www.critfc.org/salmon-culture/columbia-river-salmon/

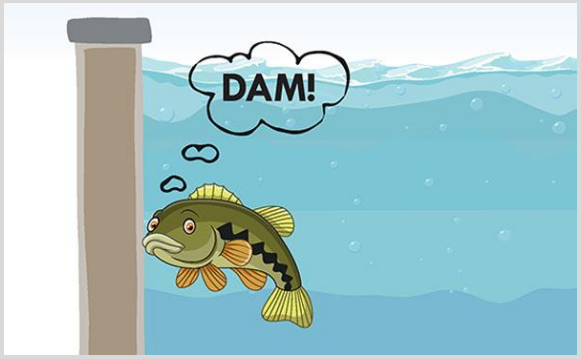
NAIADS: https://naiads.blog/2014/01/27/water-and-an-open-door-will-bring-wild-salmon-home/

4H Concept - Hydro









Federal Columbia River Power System

Source: NRC (2004), https://nap.nationalacademies.org/catalog/10962/managing-the-columbia-river-instream-flows-water-withdrawals-and-salmon/

4H Concept - Hatcheries

Nez Perce Tribal Hatchery

Located on the banks of the Clearwater River in Idaho, the Nez Perce Tribal Hatchery Complex began operations in 2003. This is the main facility supporting the Clearwater River component of the Snake River fall chinook program. At the facility, the tribe strives to preserve the genetic integrity of affected fish populations while enhancing harvest opportunities for treaty Indian and non-Indian fishers. The Nez Perce Tribal Hatchery Complex uses several semi-natural rearing techniques to encourage hatchery-reared fish to behave like their wild counterparts.

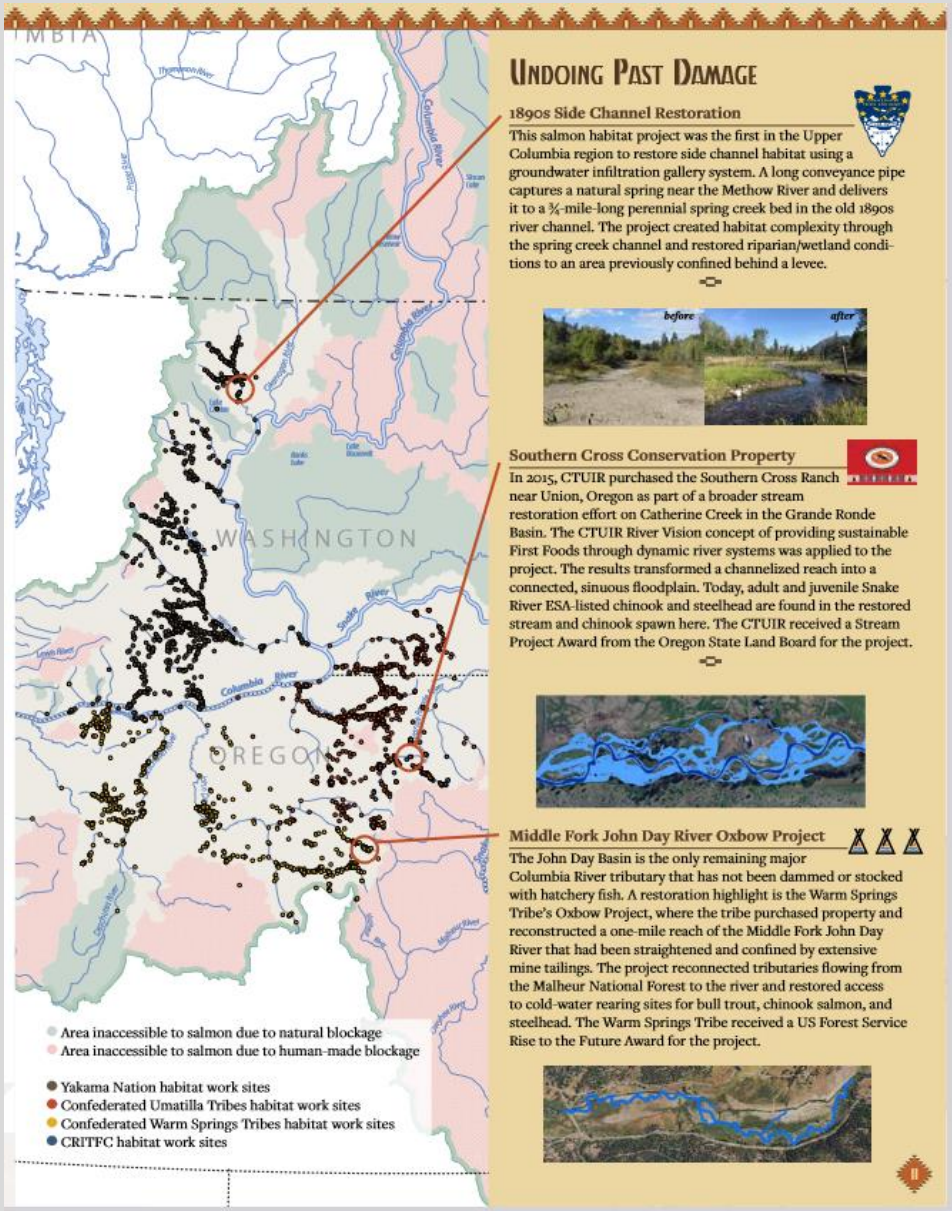
seeks to harmonize the federal government's duties to the tribes and the ESA.

Hatchery Production

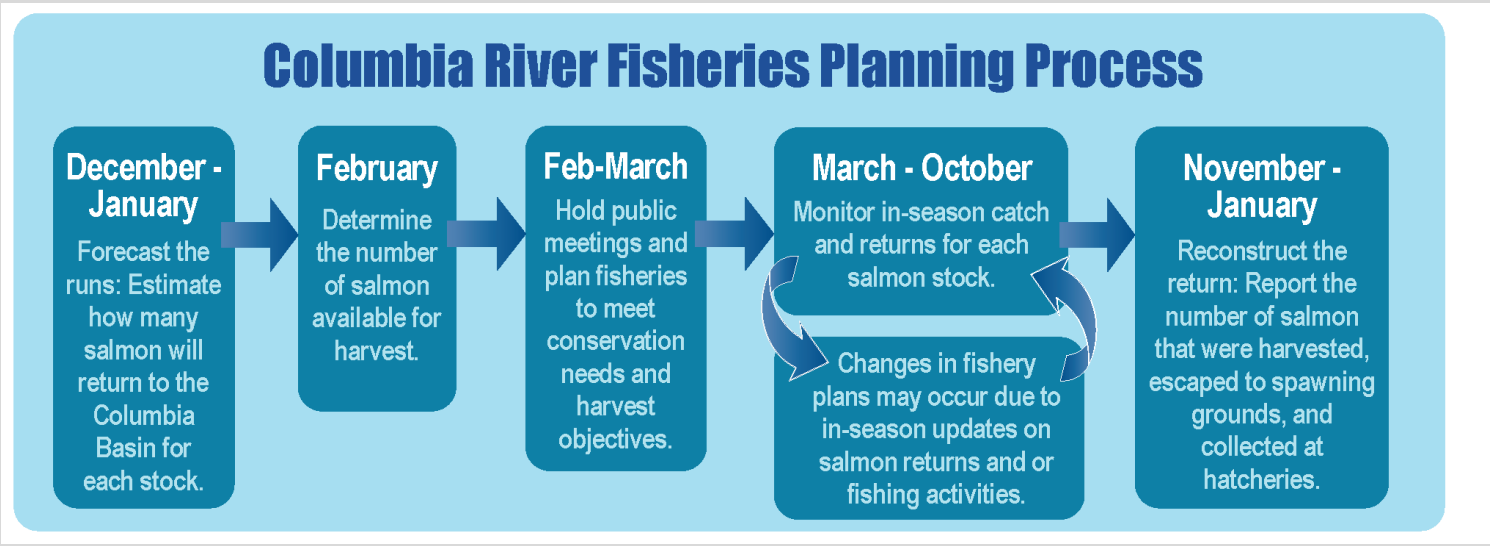
The details of the Snake River Fall Chinook Program were refined in 1995 through *U.S. v. Oregon* processes, when the four Columbia River Treaty Tribes reached an agreement with state and federal agencies to begin supplementation of Snake River fall chinook above Lower Granite Dam. The development of numerous rearing and acclimation facilities in the Snake River Basin as well as the Nez Perce Tribal Hatchery were essential to the implementation of the program. The tribes secured the initial funding for the program through the U.S. Congress. In 1996, Congress instructed the U.S. Army Corps of Engineers to construct acclimation facilities under the Lower Snake River Compensation Plan. Today the Nez Perce Tribe operates and maintains three acclimation facilities at Captain John Rapids, Pittsburgh Landing and Big Canyon under the LSRCP in addition to the Nez Perce Tribal Hatchery.

Total hatchery (shown in blue) and natural origin (shown in orange) Snake River fall chinook salmon counts at Lower Granite Dam. The year the Snake River Fall Chinook Recovery Program began is circled in red.

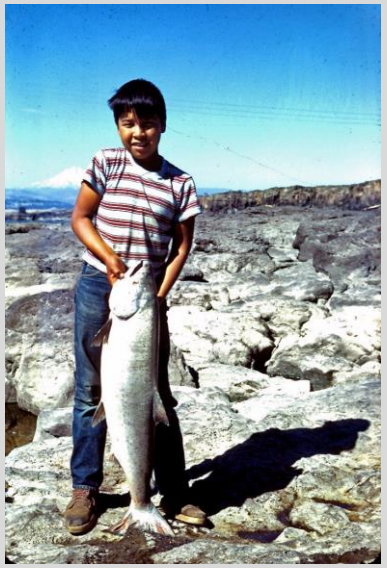
4H Concept - Habitat



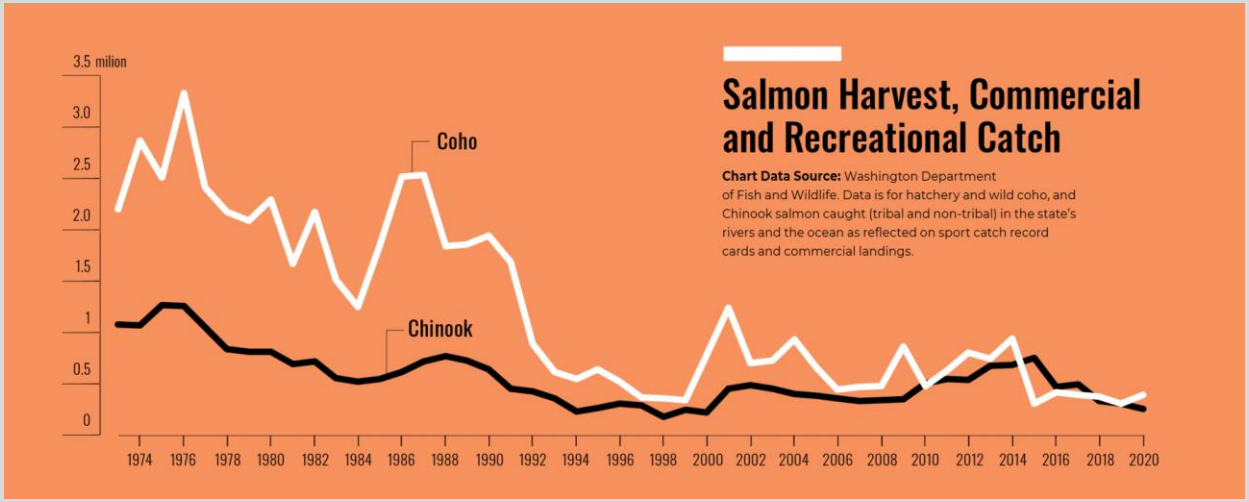
4H Concept - Harvest



Source: https://critfc.org/tribal-treaty-fishing-rights/equitable-harvest/



Property of Museum of History & Industry, Seattle



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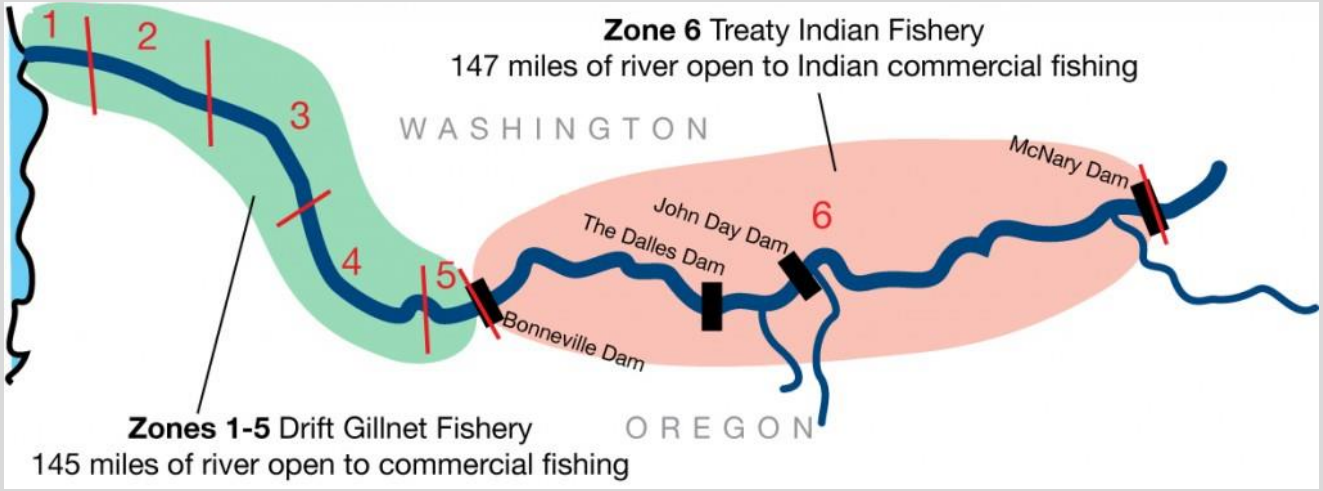
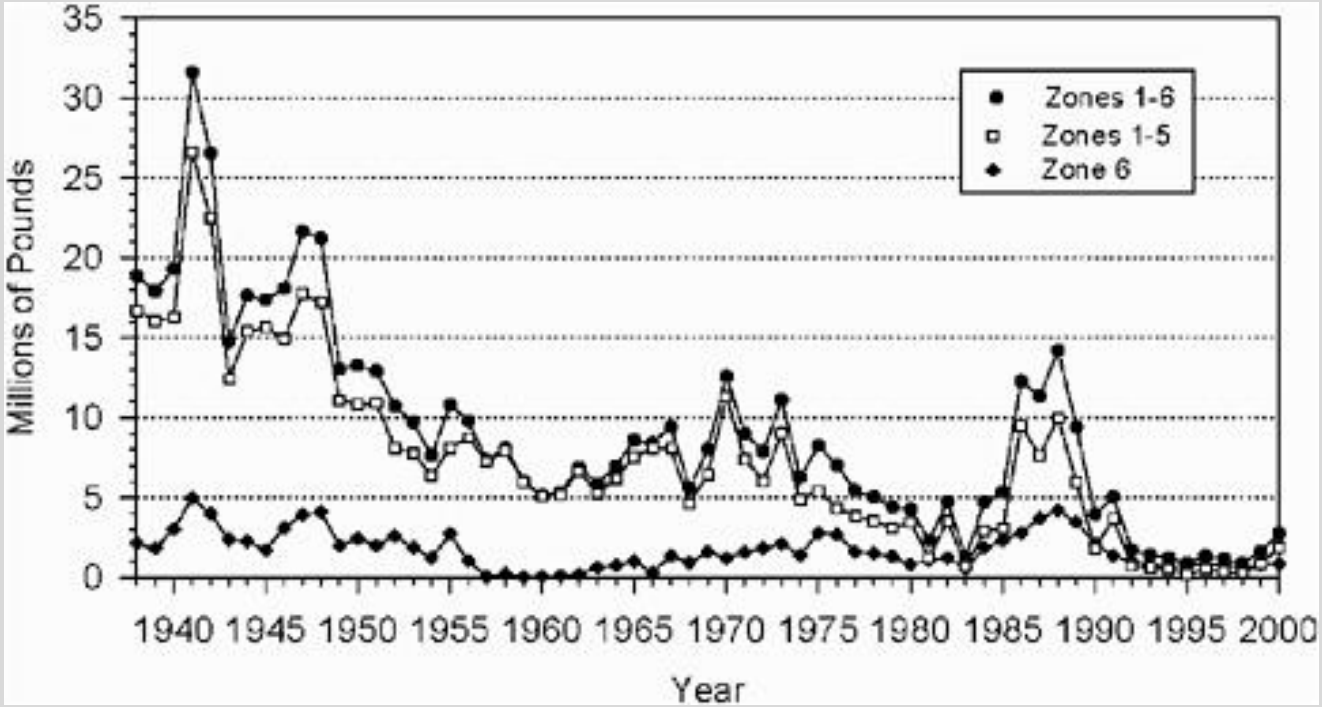




Protests

The Boldt decision that ruled tribes were entitled to half the salmon harvest enraged sport and commercial fishers. The decision sparked protests, some even burning effigies of Judge Boldt. Photo: Alaska Native News

WHY IT MATTERS…BIG PICTURE

Pop Quiz #2

- What weather/hydro queues do Salmon know when to migrate?
- (A) Water Temperature
- (B) Quantity of river-flow (i.e., discharge)
- (C) Turbidity (i.e., clear vs. murky water)
- (D) Occurrence of Rainfall-on-River surface
- (E) All of the above

Correct answer: (E) **All of the above** Very Good! ☺

Hydrologic Factors and Salmon

- Dam operations often conflict with salmon. The Columbia River basin was altered to suit human needs (e.g., flood control, power, irrigation).
- The slack water behind the dams has slowed travel time - exposing juvenile salmon to disease and predation as they migrate to the ocean.
- Big river flow fluctuations in the Hanford Reach (central WA) can strand and kill young salmon.
- Flood Control operations – very conservative dam management hinders spring river flows for fish.

Federal Hydro Operations and Columbia River Salmon

- NOAA-Fisheries "Biological Opinion" - guidance.
  Set of prescribed measures to prevent further decline of salmon stocks: real-time operations.
  -- Target flows in mainstem Columbia R., Snake R.
  -- Reservoir refill probability – Grand Coulee, etc.
- Target Flows: spring and summer seasonal flow values are targeted at key summation points: Lower Granite, Priest Rapids, and McNary dams.
- Spill operations and structural modifications – all designed to enhance fish passage and survival.

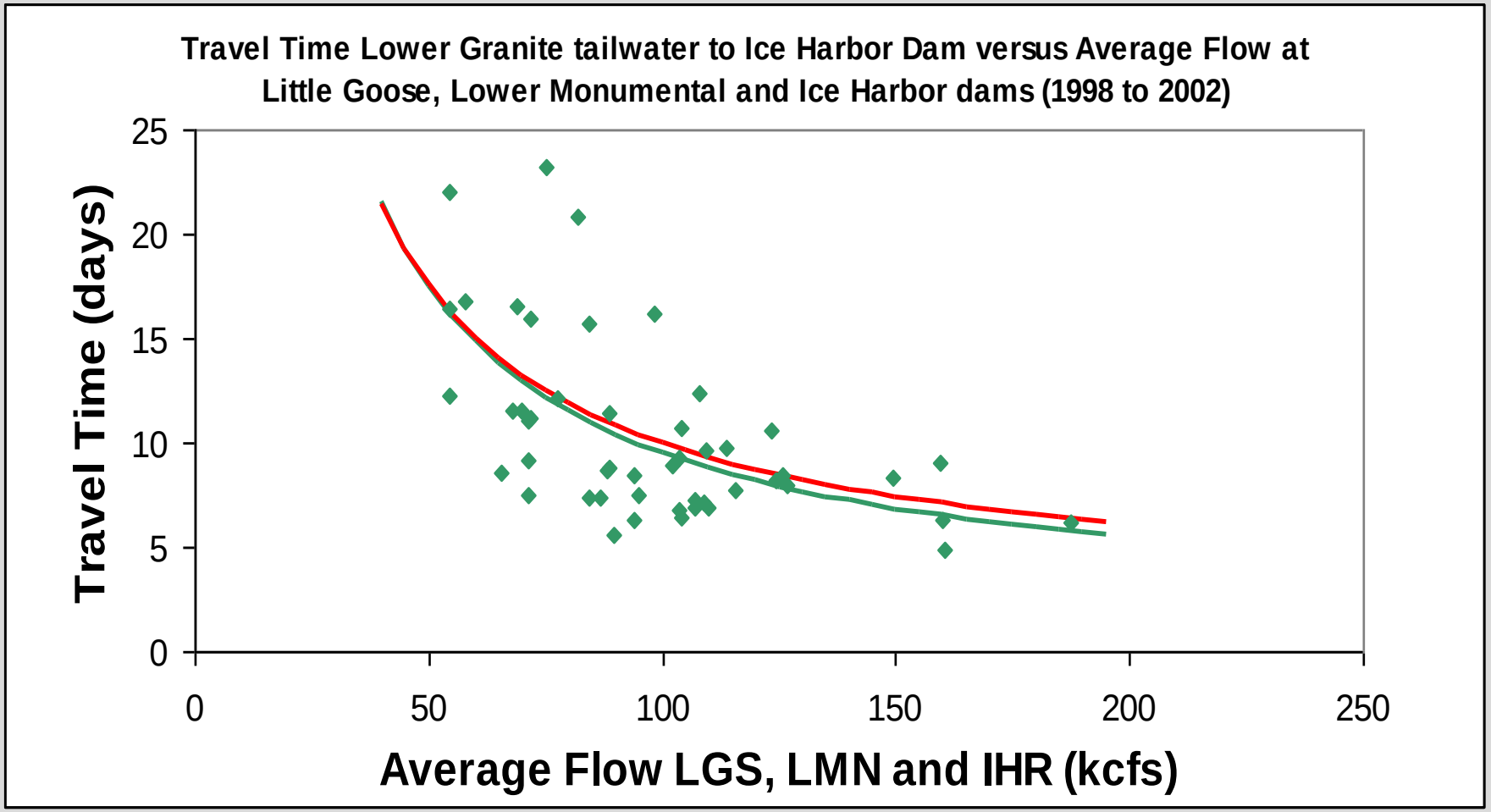
Federal Biological Opinion Target Flows – track record?

Spring Flow Targets	LWG 10-Apr 20-Jun Target	(kcfs) Observed	Departure (%)	PRD 10-Apr 30-Jun Target	(kcfs) Observed	Dep. (%)	MCN 20-Apr 30-Jun Target	(kcfs) Observed	Dep. (%)
1995	96.3	100.9	5%				249.2	253.0	2%
1996	100	138.3	38%				258	357.1	38%
1997	100	162.5	63%				260	454.8	75%
1998	90.3	115.6	28%	135	153.9	14%	220	287.8	31%
1999	100	117.0	17%	135	169.6	26%	260	303.6	17%
2000	97	85.1	-12%	135	158.1	17%	246.4	243.4	-1%
	3-Apr 20-Jun Target	Observed		Target	Observed		10-Apr 30-Jun Target	Observed	
2001	85	47.5	-44%	135	76.7	-43%	220	123.9	-44%
2002	97	83.4	-14%	135	180.6	34%	246	269.3	9%
2003	89.1	90.0	1%	135	141.4	5%	220	231.4	5%
2004	85	70.1	-18%	135	126.7	-6%	220	203.2	-8%
2005	85	66.3	-22%	135	122.7	-9%	220	195.7	-11%
2006	100	125.3	25%	135	191.3	42%	260	325.4	25%
2007	85	61.2	-28%	135	168.0	24%	237	239.0	1%
2008	100	94.4	-6%	135	167.6	24%	260	286.7	10%
2009	100	110.3	10%	135	140.8	4%	228	268.1	18%
2010	85	78.1	-8%	135	137.7	2%	220	225.7	3%
2011	100	137.8	38%	135	231.4	71%	260	377.4	45%
2012	100	107.9	8%	135	232.4	72%	260	342.4	32%
2013	85	67.9	-20%	135	187.4	39%	226	261.9	16%
2014	100	91.8	-8%	135	185.9	38%	260	286.3	10%
2015	85	53.3	-37%	135	114.9	-15%	220	174.2	-21%
2016	96	84.0	-13%	135	156.0	16%	243	248.0	2%
2017	100	140.5	41%	135	237.4	76%	260	378.4	46%
2018	100	111.3	11%	135	230.8	71%	260	345.5	33%
2019	95	120.4	27%	135	123.5	-9%	220	250.1	14%
2020	86	88.0	2%	135	175.8	30%	235	275.1	17%
2021	85	60.9	-28%	135	133.3	-1%	220	203.4	-8%
2022	85	88.0	4%	135	174.2	29%	240	269.9	12%
2023	100	94.8	-5%	135	128.6	-5%	233	228.6	-2%
2024	88	79.8	-9%	135	107.5	-20%	220	179.3	-19%
Hits:	14 of 30 years			19 of 26 years			22 of 29 years		
average:	93	96	1%	135	164	19%	239	270	12%

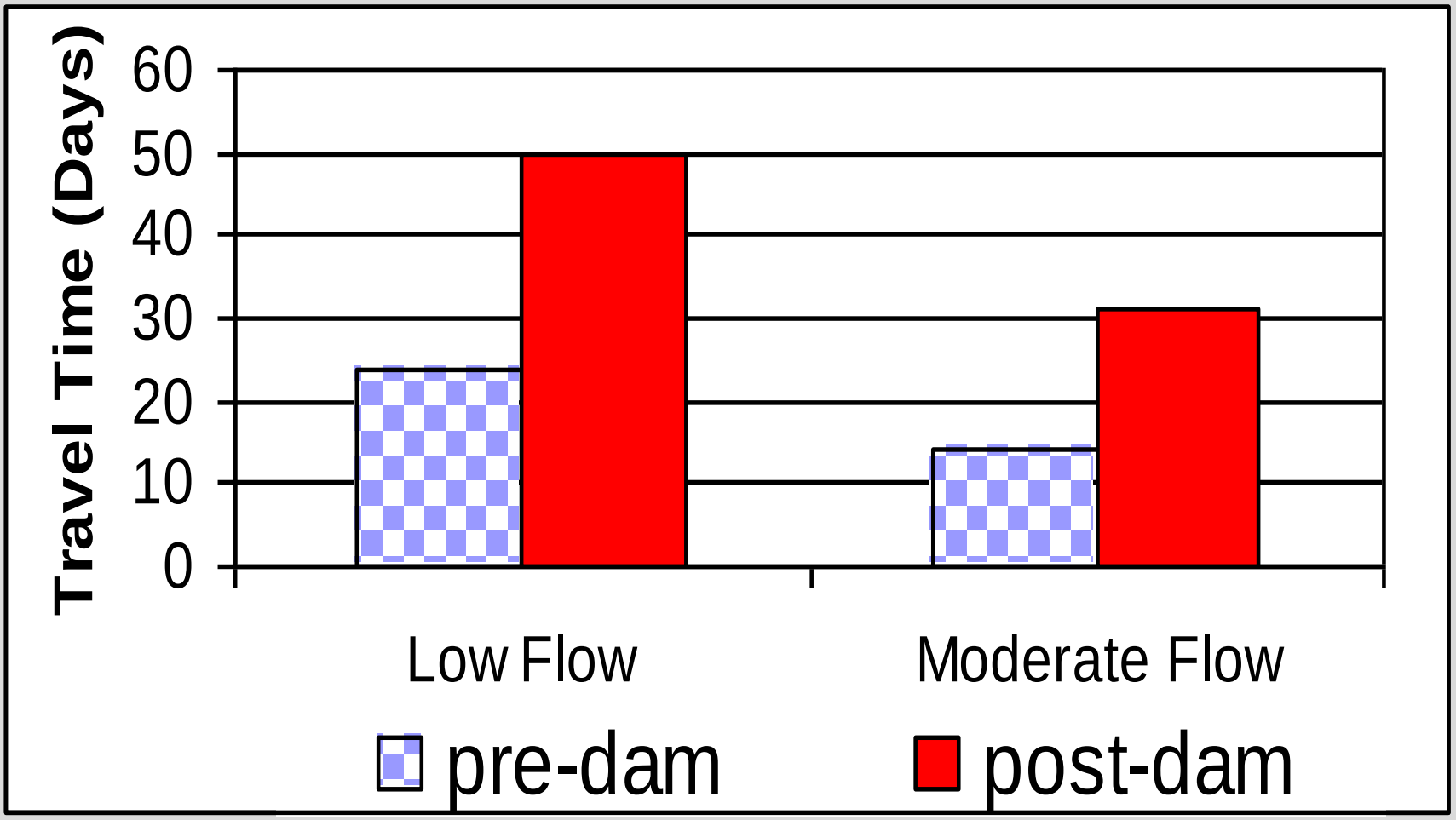
Federal Biological Opinion Target Flows – track record?

Summer Flow Targets	LWG 6-21/8-31 Target	(kcfs) Observed	Departure (%)	MCN 7-01/8-31 Target	(kcfs) Observed	Departure (%)
1995	51.3	55.3	8%	200	165.0	-18%
1996	52.5	52.7	0%	200	214.5	7%
1997	55	66.3	21%	200	236.5	18%
1998	50.6	53.2	5%	200	169.7	-15%
1999	54.3	56.0	3%	200	228.2	14%
2000	51.3	33.7	-34%	200	153.6	-23%
2001	50	25.4	-49%	200	90.9	-55%
2002	51.3	41.0	-20%	200	189.1	-5%
2003	50.5	32.3	-36%	200	135.5	-32%
2004	50	33.2	-34%	200	133.7	-33%
2005	50	33.4	-33%	200	165.1	-17%
2006	54	37.6	-30%	200	166.5	-17%
2007	50	28.8	-42%	200	163.3	-18%
2008	52.5	57	9%	200	172.8	-14%
2009	52.5	48.2	-8%	200	141.8	-29%
2010	50	47	-6%	200	154.8	-23%
2011	55	81.2	48%	200	261.2	31%
2012	52	42.3	-19%	200	265.2	33%
2013	50	29.9	-40%	200	183.9	-8%
2014	52	23.9	-54%	200	189.8	-5%
2015	50	25.9	-48%	200	142.6	-29%
2016	50.5	30.8	-39%	200	155.4	-22%
2017	55	49.1	-11%	200	166.1	-17%
2018	53.3	37.5	-30%	200	161.9	-19%
2019	53	36.8	-31%	200	143.6	-28%
2020	50	45.8	-8%	200	193.2	-3%
2021	50	25.7	-49%	200	146	-27%
2022	50	44.8	-10%	200	206.8	3%
2023	52.5	34.4	-34%	200	140.5	-30%
2024	50.3	31.6	-37%	200	133.7	-33%
Hits:	7 of 30 years			6 of 30 years		
average:	52	41	-20%	200	172	-14%

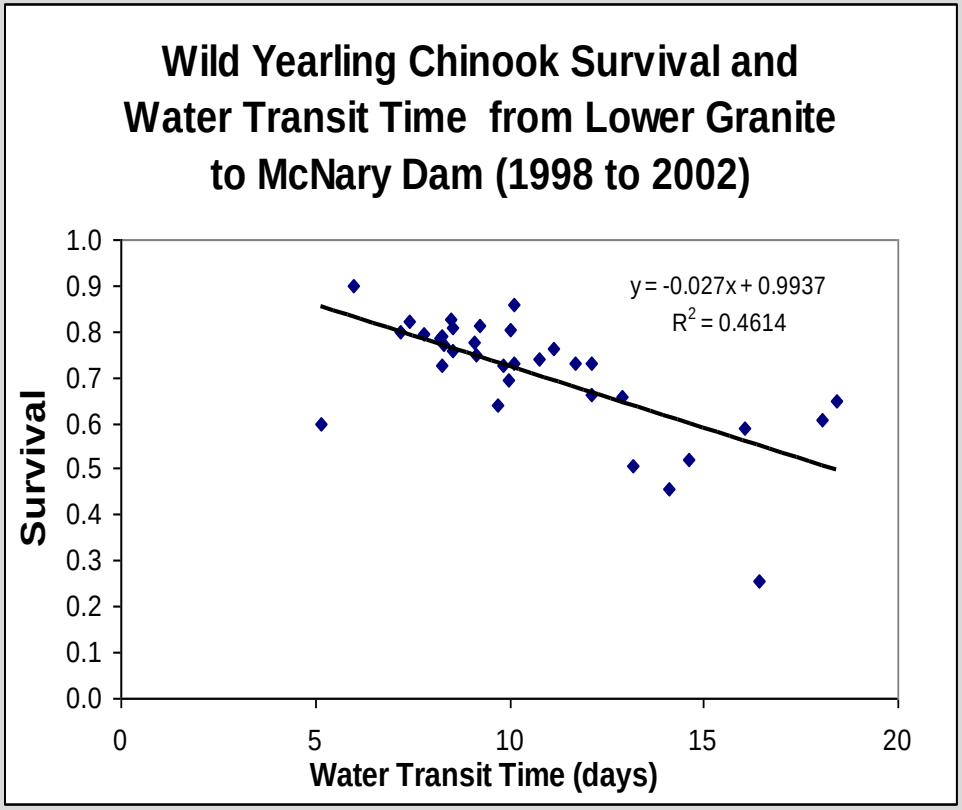
Salmon Flow and Travel Time

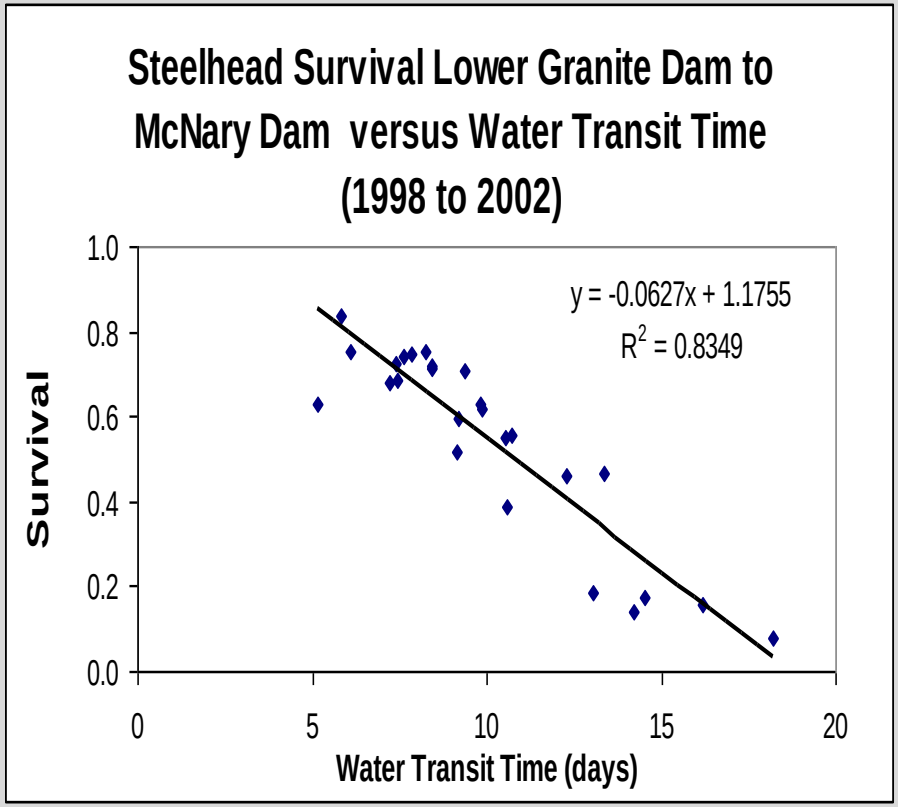


Travel Time: pre-dam and post-dam (Salmon River, Idaho to Astoria, Oregon)

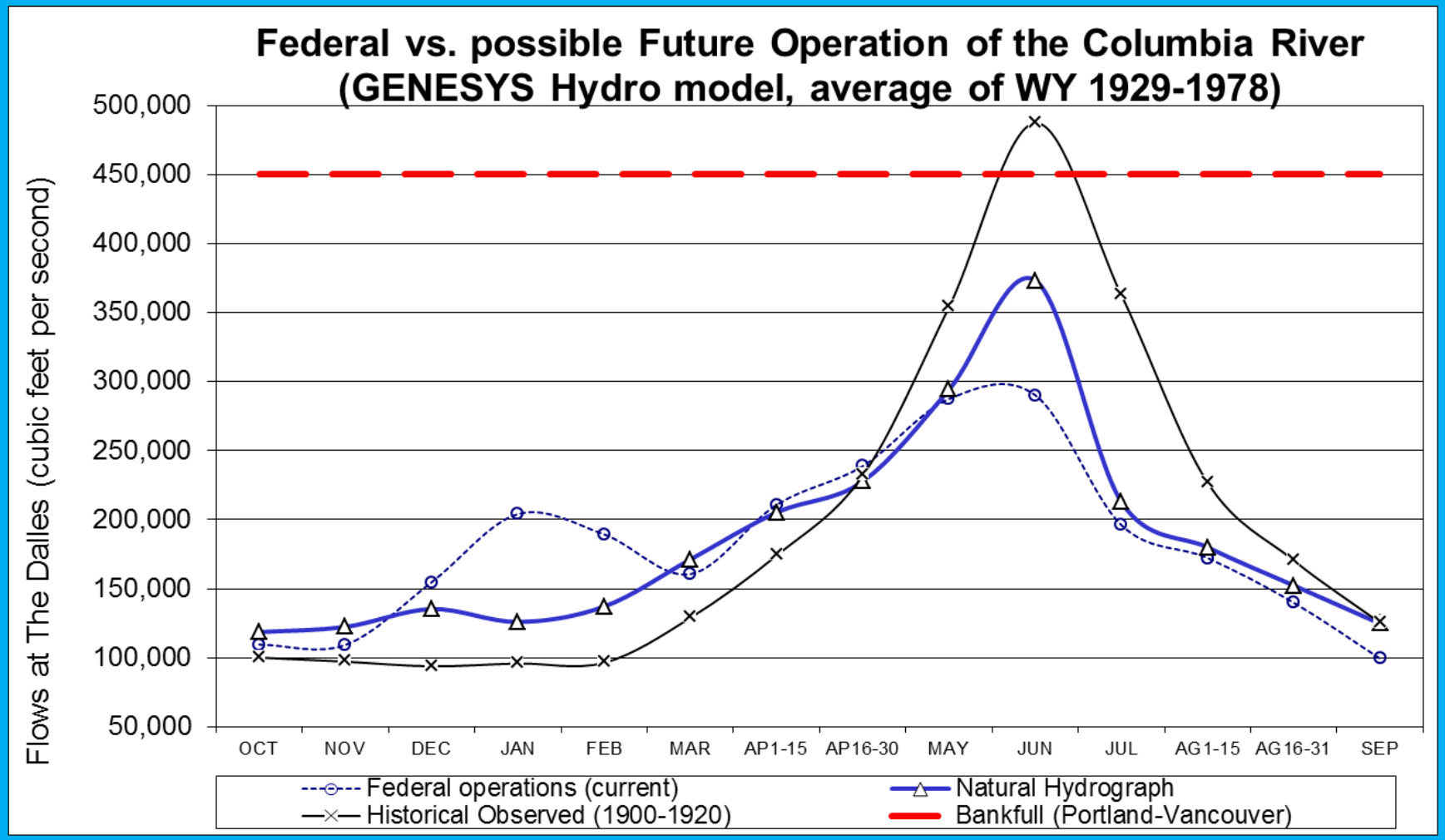


Travel Time & Salmon Survival





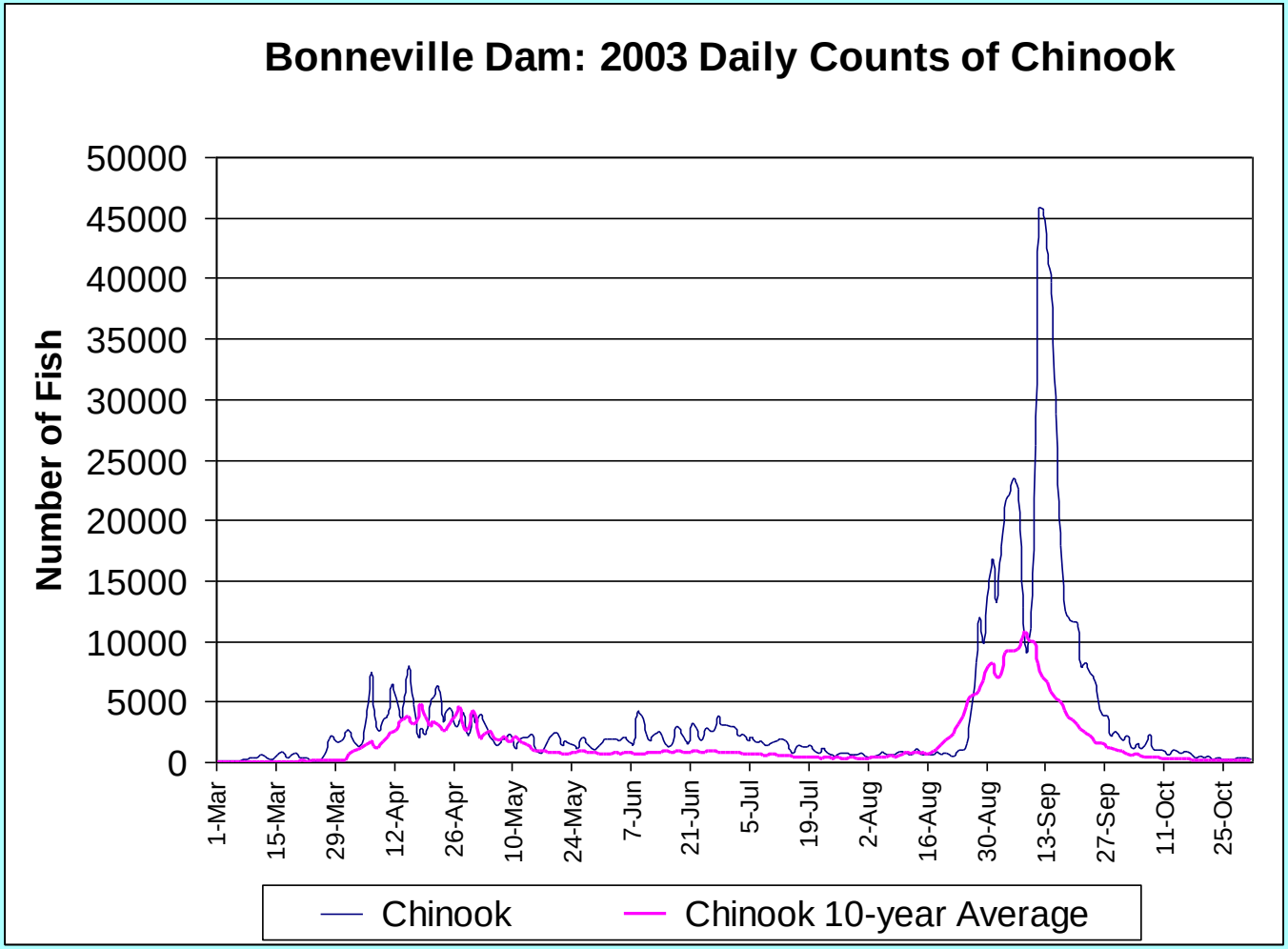
Past/present/future dam flows



Weather and Climate Change Factors

- Changes in Water temperature can temporarily accelerate or halt an entire migration of fish.
- Temperature control is a big goal during summer hydro-system operations.
- Warm water temperatures can greatly impact adult salmon during spawning.
- Salmon can sense rainfall on the river.

Water Temperature and Fish Passage

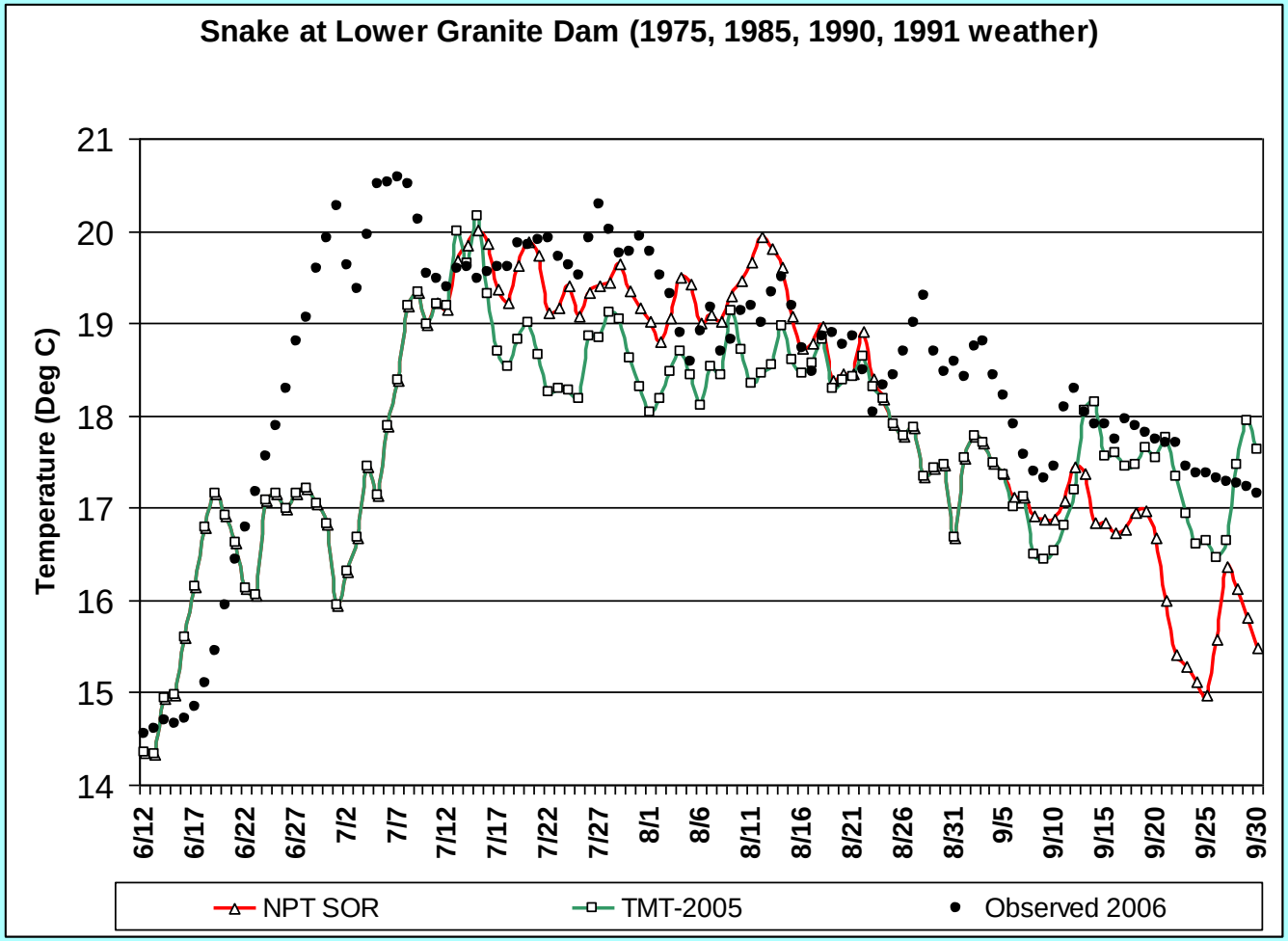


Note what happens when water temperatures cool down to 68 degF.

Water Temperature and Fish Passage at a dam

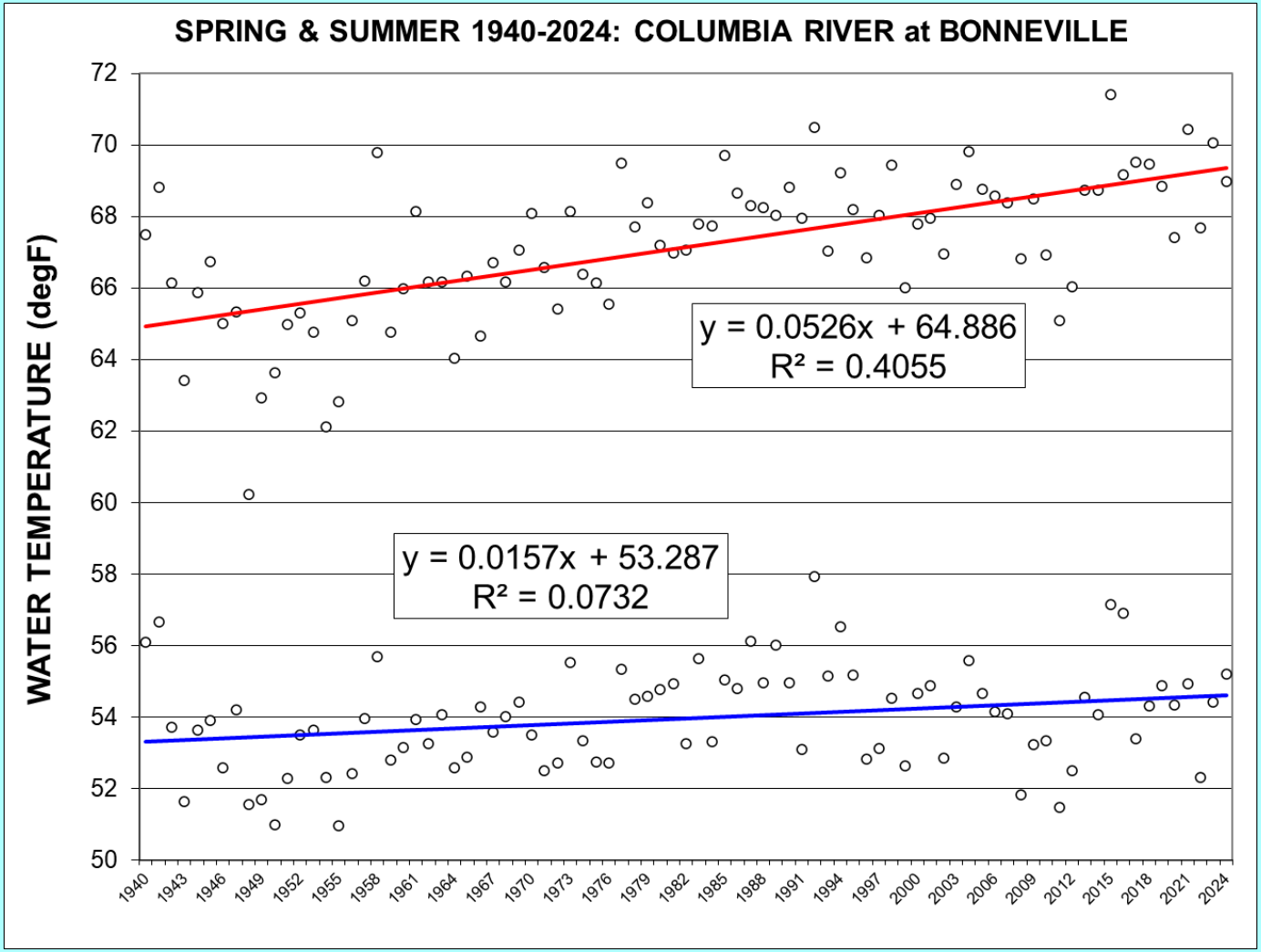
Traffic jam at the fish ladders of Bonneville Dam!!

Water Temperature Management and Dams



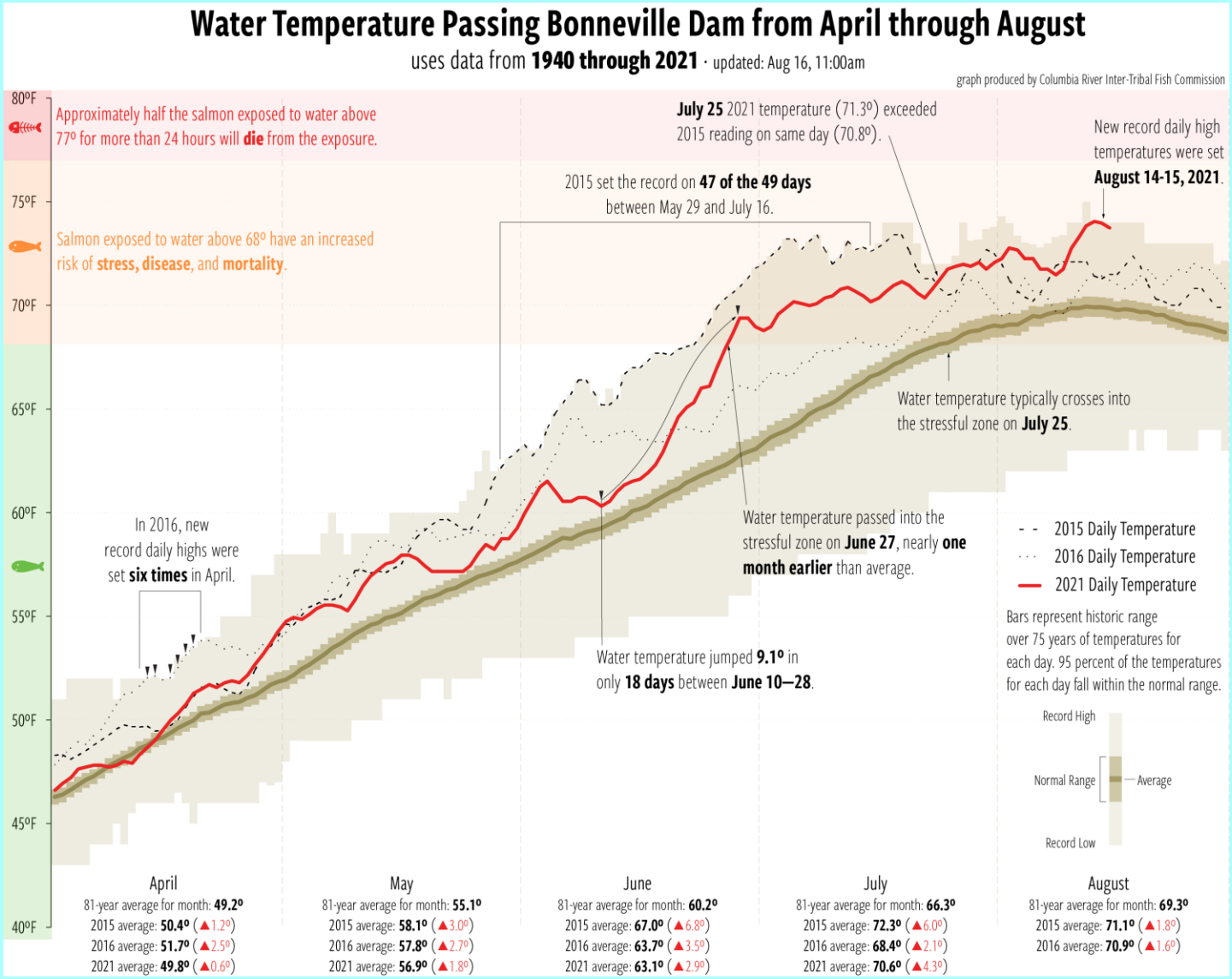
Use of Dworshak Dam outflow to control Snake River water temperatures.

Water Temperature and Climate Change



Summer water temperatures have increased twice as fast as spring temperatures.

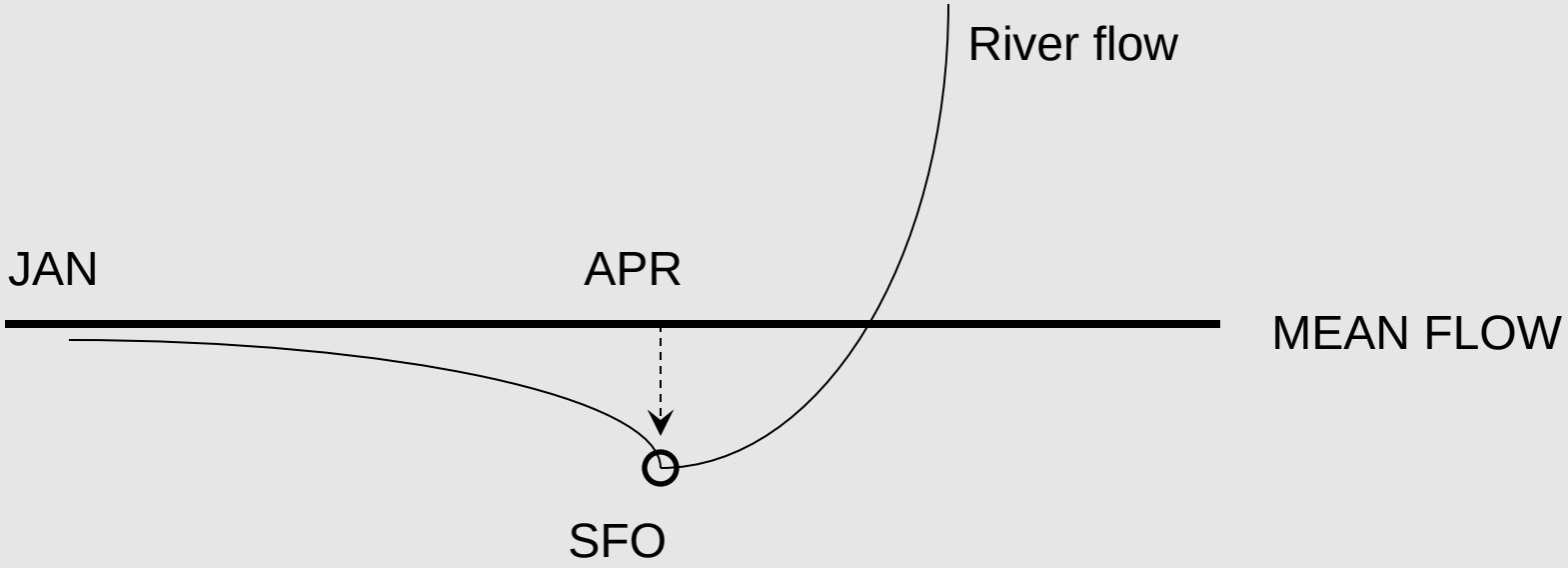
Water Temperature, Dams, and Climate Change



Past Climate Change & Rivers: Spring Flow Onset

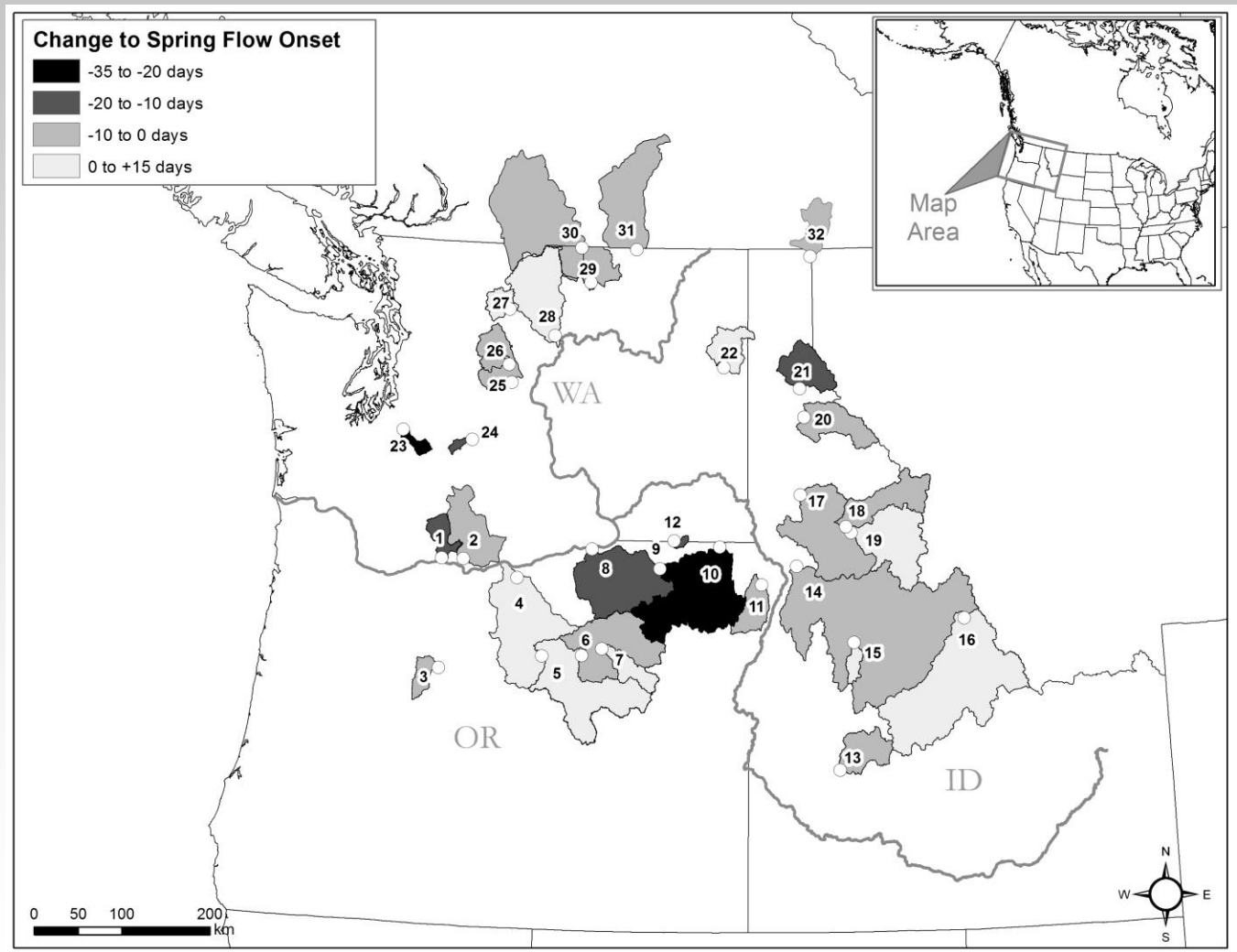
SFO = CUMULATIVE NEGATIVE DEPARTURES

FROM THE MEAN FLOW ARE AT A ***MINIMUM***



Source: Dittmer (2013)

Spring Flow Onset (SFO):
start date of the seasonal snow-melt



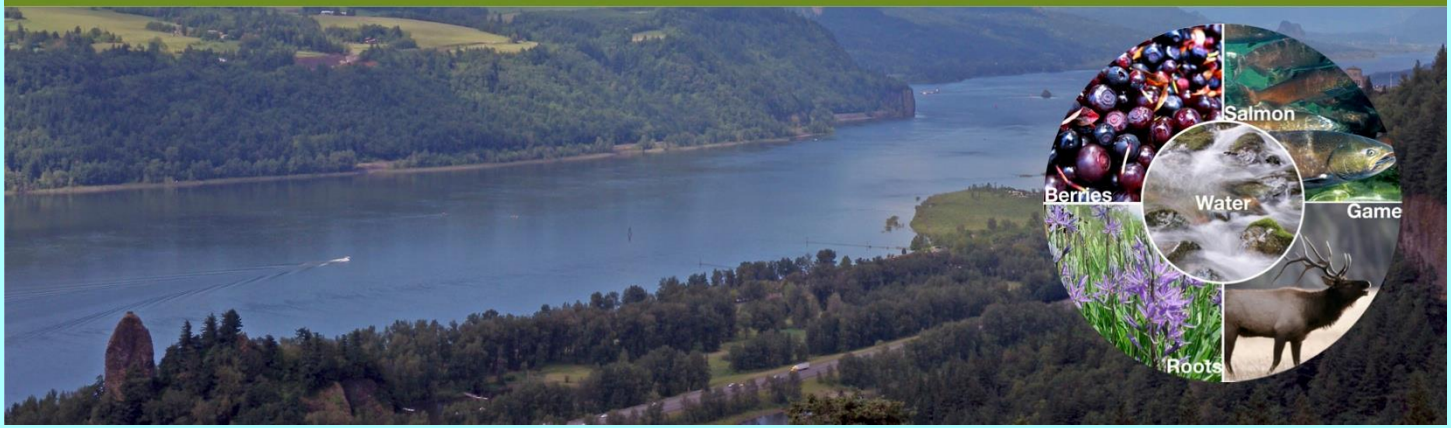
Source: Dittmer (2013)

River Flow and Climate Change

Oct 2013 Special Issue of Climatic Change Journal *http://bit.ly/tribal-climate*

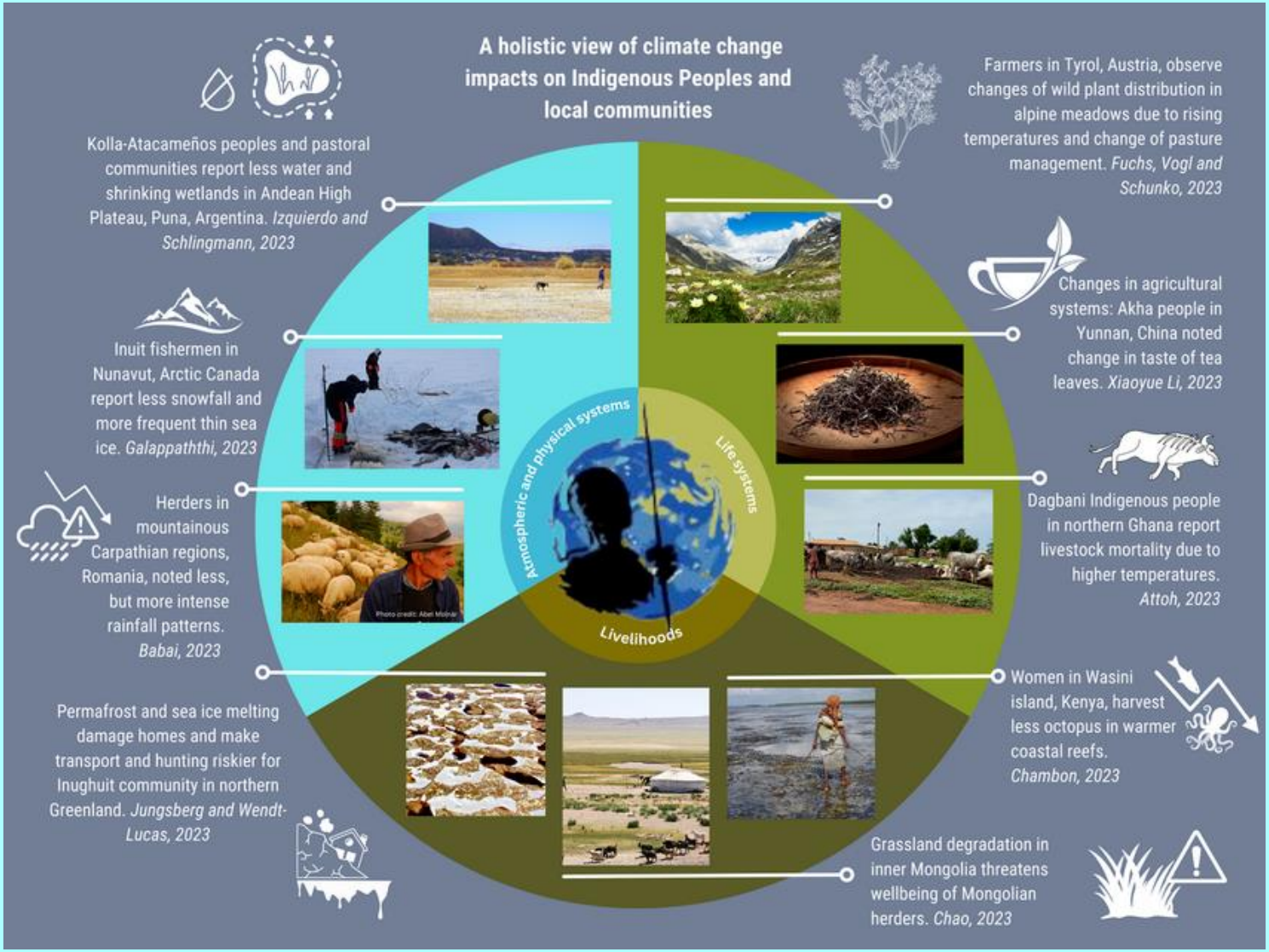
Climate Change and Indigenous Peoples in the United States: Impacts, Experiences and Actions

Book edition coming in February 2014 by Springer Publishing



Dittmer (2013): http://link.springer.com/article/10.1007/s10584-013-0745-0

Tribes and Climate Change

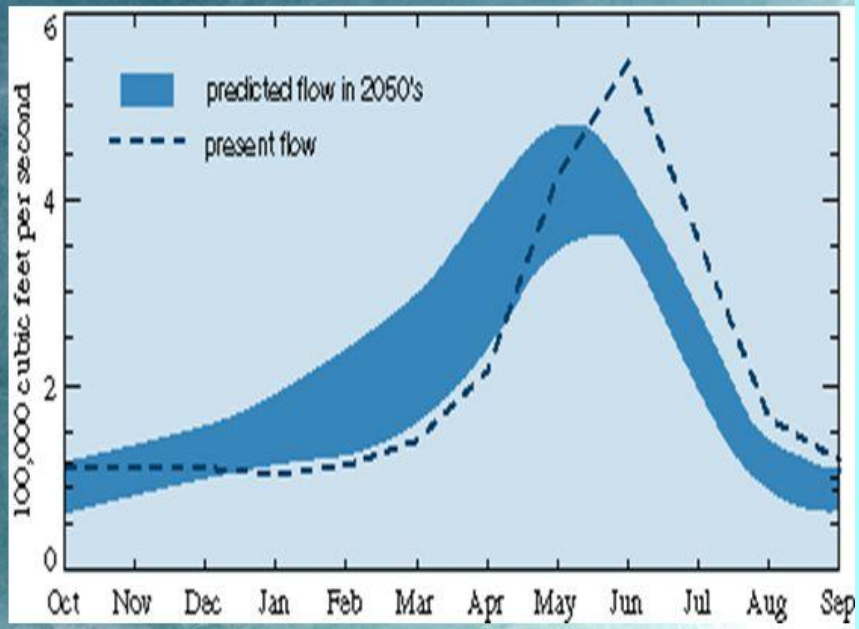


River Flow and Future Climate Change (2050): U-WA/CIG

Impacts of Climate Change on Streamflow

- Less snow, earlier melt means less water in summer (Summer low flow issues)
  - irrigation
  - urban uses
  - fisheries protection
  - energy production
- More water in winter
  - energy production
  - Flooding

Earlier Spring runoff
-20 days earlier
(1984-1995 compared to 1970 – 1983)



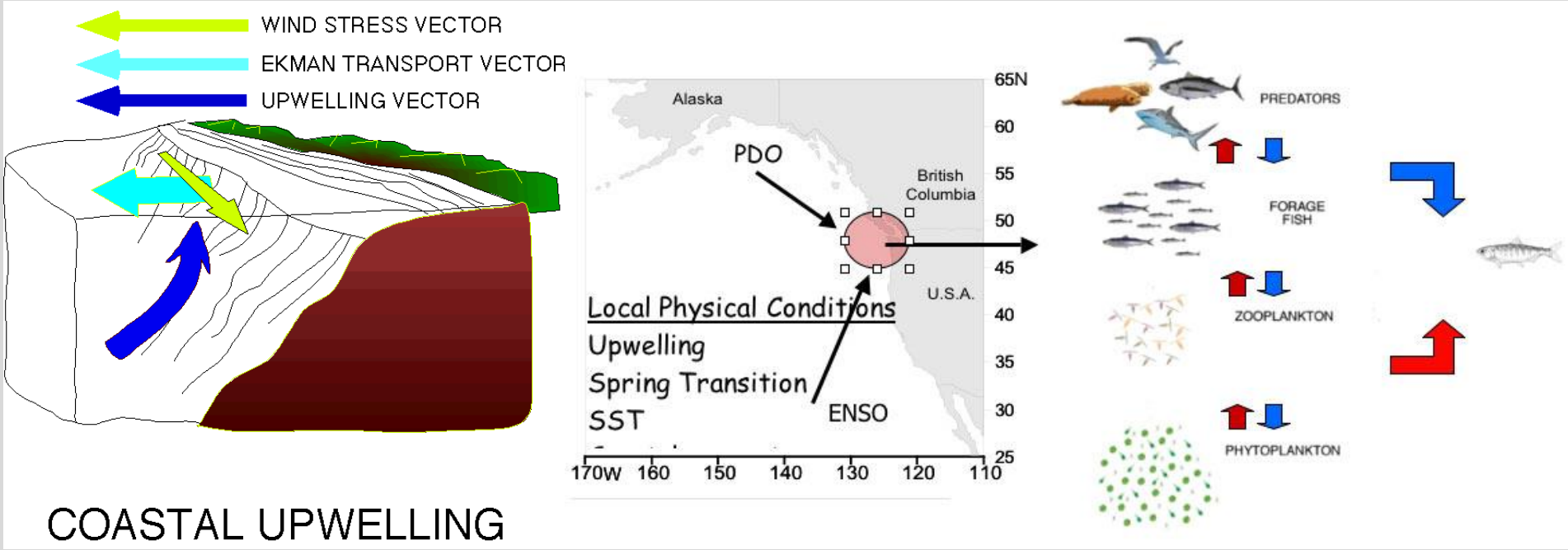
Natural Columbia River flow at the Dalles, OR.

Source: P. Mote, University of Washington

Oceanographic Factors

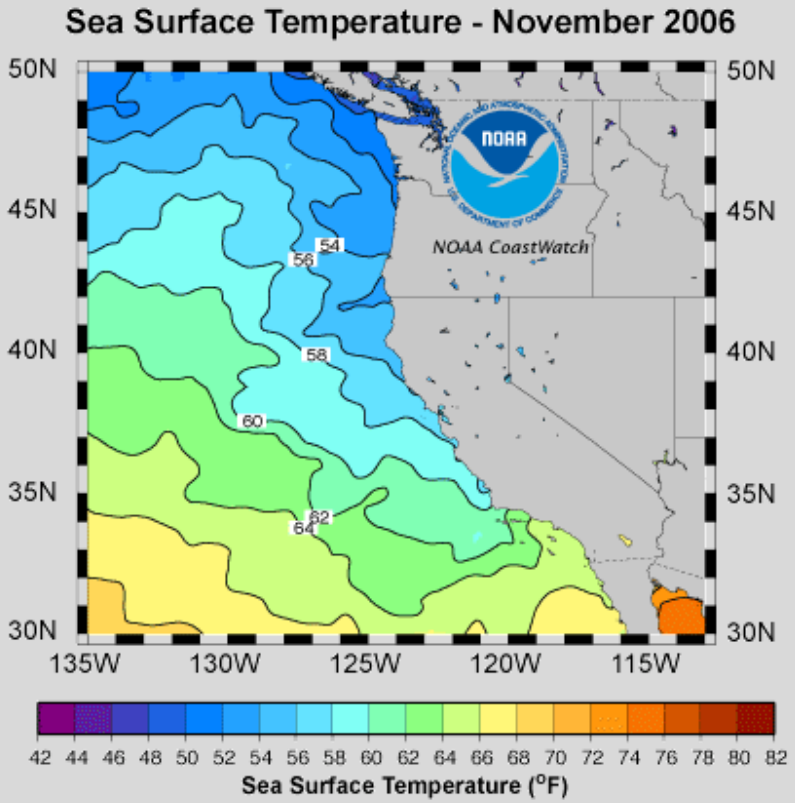
- Upwelling winds - coastal ocean.
- Water temperature and stratification - coastal ocean. Impacts nutrient supply.
- Estuary plume – seasonal Columbia River flow pulse that enters the ocean.
- *El Niño* and *La Niña* events (short-term).
- **P**acific **D**ecadal **O**scillation, or the PDO (a long-term 20–30-year cycle).

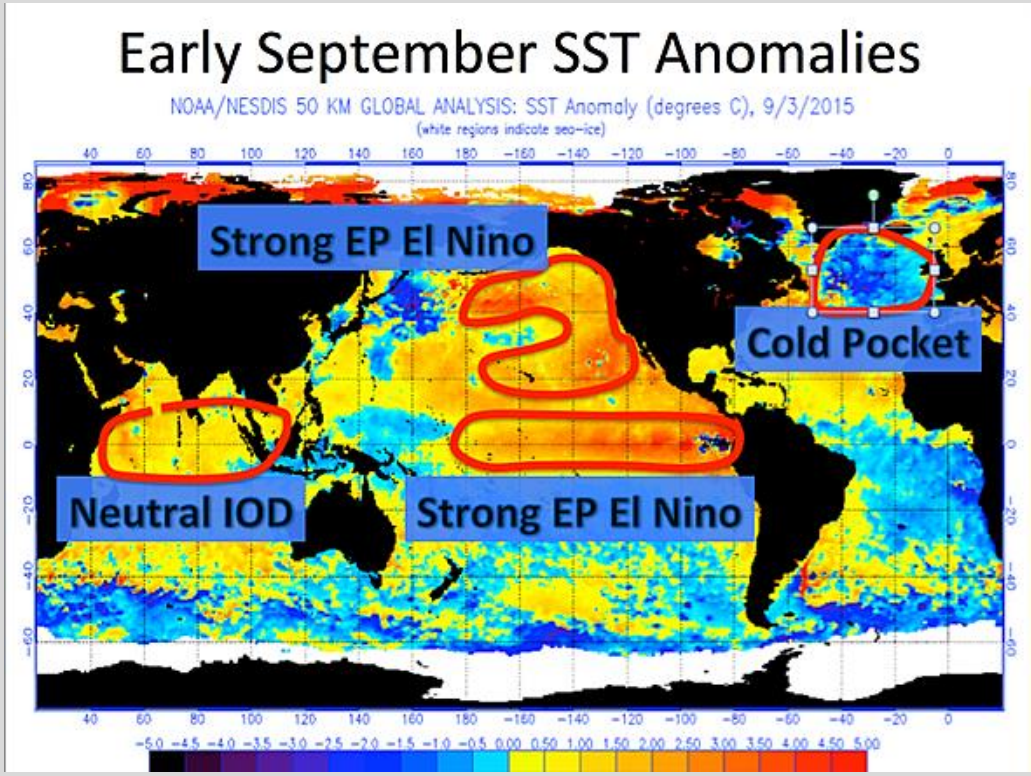
Coastal Upwelling and Wind



What is the relationship between upwelling and food supply for fish?

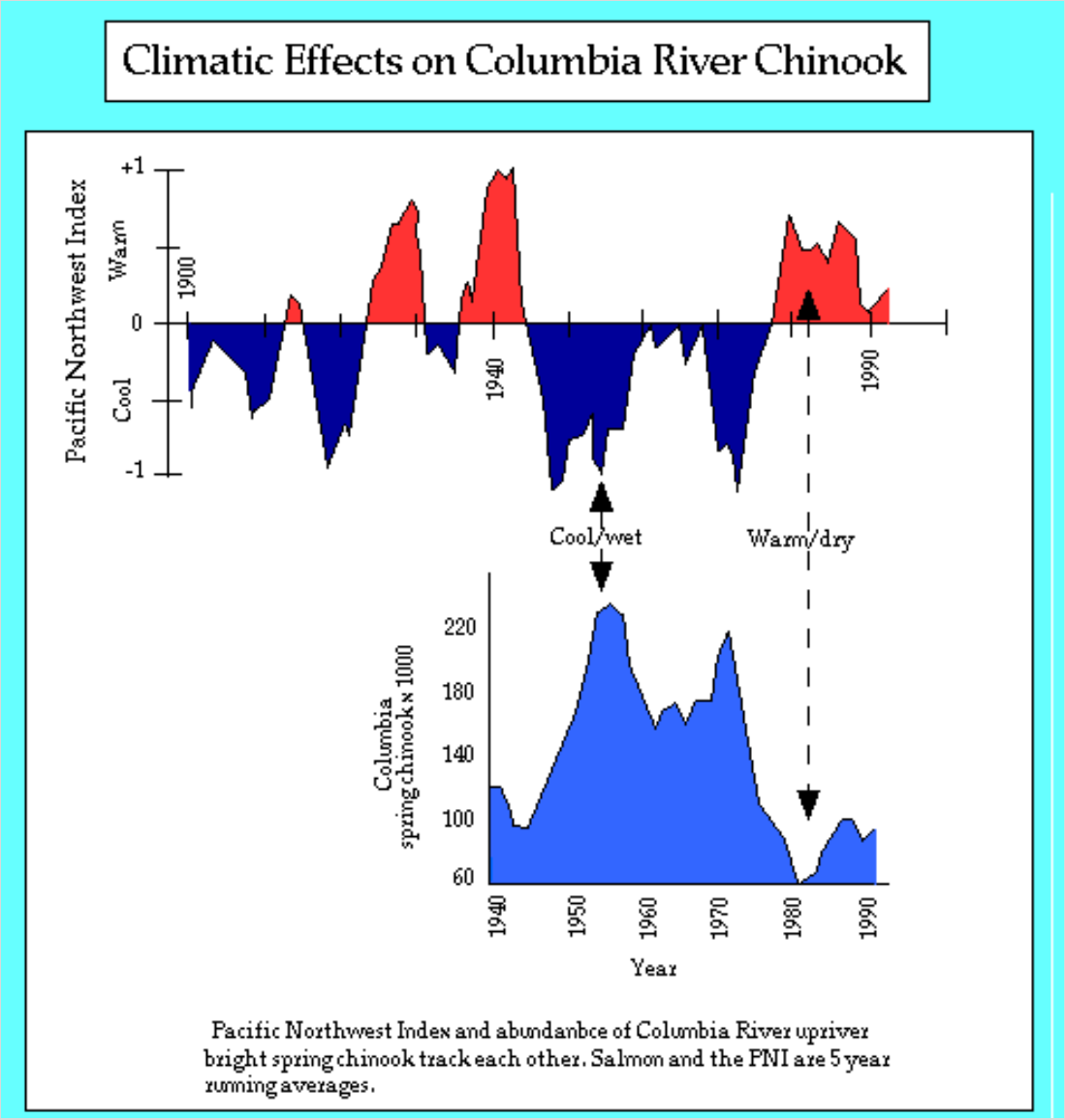
Coastal Upwelling…Temperature





ENSO events either increase (*La Niña*) or decrease (*El Niño*) coastal upwelling.

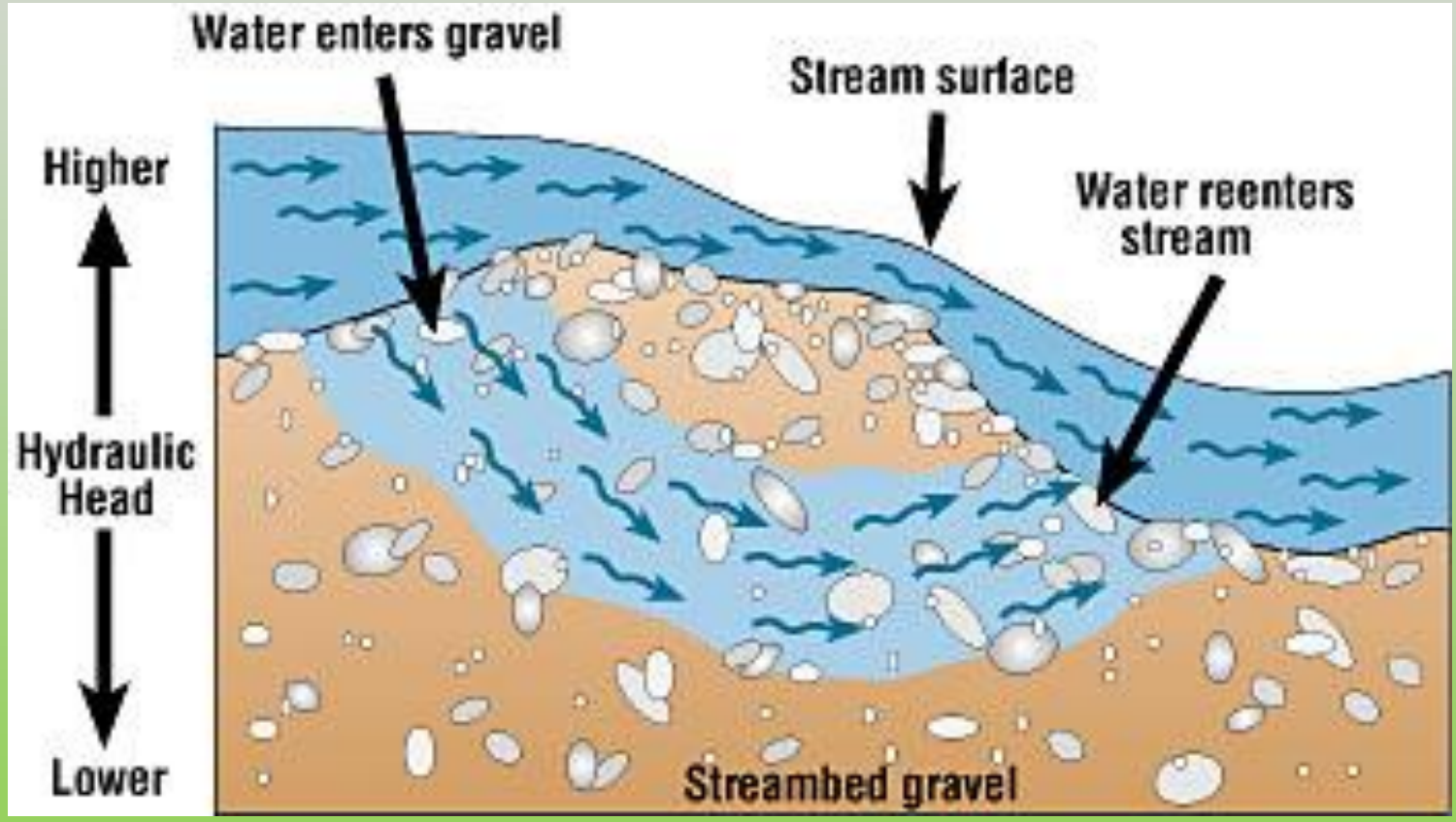
Ocean, natural Climate Variability, and Salmon



Geologic Factors

- Salmon need clean stream gravels to spawn.
- Streams need to have consistent flow (depth and velocity), good Water Quality (e.g., cool temperature, dissolved Oxygen, and turbidity), and complex channel shapes.
- "*Hyporheic*" zones -- groundwater seeps.
- Salmon rapidly recover from sudden geologic events (i.e., volcanic eruptions, landslides).

Geologic Factors



Hyporheic seeps -- salmon tend to seek out these spots.

WHY IT MATTERS…BIG PICTURE

Pop Quiz #3

- When did pre-contact Tribes know <u>when</u> to fish w/o overharvesting?
- (A) Consulted with stone Petroglyph writings in the Columbia R. Gorge
- (B) Made note of past river-flow patterns
- (C) Followed instructions left behind by Ancient Space Aliens
- (D) Noted the proportion of spring rain days vs. dry summer days
- (E) Studied the *Book of Bumbles*

Correct answer: (B) **River-flow patters** Very Good! ☺

PNW Salmon – Policy/Legal

- NWPCC – annual Water Budget (1980s) process divided Columbia River water volume for power and fish/water conservation purposes.
- NOAA-Fisheries Biological Opinions (1995 to now), ESA listings.
- Columbia Basin Fish Accords (2008) – Federal/Tribal partnership.
- Idaho Senator Simpson (2021) – Energy/Salmon Initiative.
- Columbia River Basin Initiative (2024) – State/Tribal partnership.

Sources: Fish Accords, https://critfc.org/fish-and-watersheds/fish-and-habitat-restoration/columbia-basin-fish-accords/

Simpson: https://idahocapitalsun.com/2023/08/09/dam-breaching-and-saving-salmon-an-idaho-debate-without-an-end/

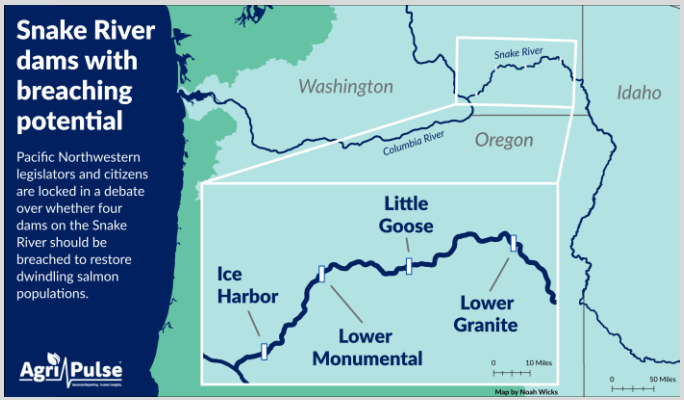
https://idahocapitalsun.com/2021/08/24/the-content-of-simpsons-salmon-plan-has-been-at-forefront-but-its-character-may-matter-even-more/

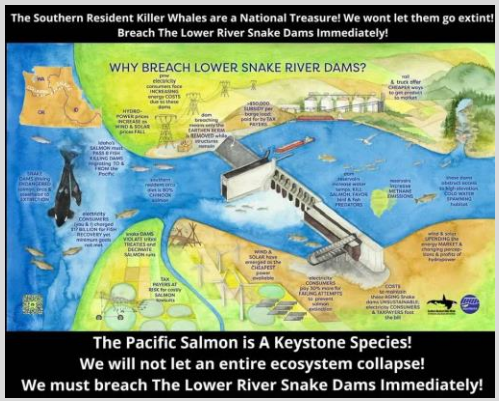
CRBI (CRITFC): https://critfc.org/cbri/

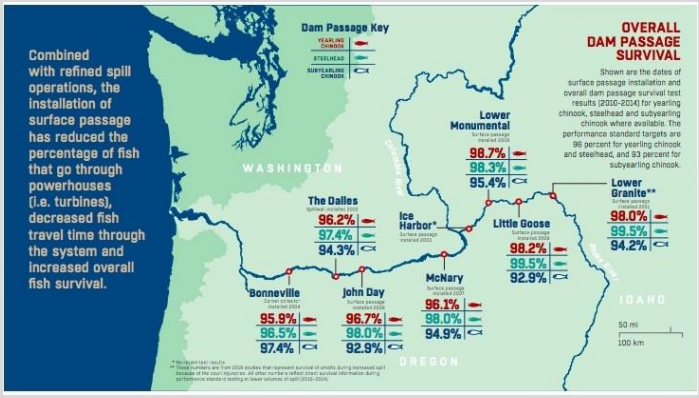
CRBI (Simpson): https://simpson.house.gov/uploadedfiles/simpson_presentation_idaho.pdf

PNW Salmon – Dam Breaching

- Four Lower Snake River dams are targeted for breaching.
- These dams impede salmon passage and have degraded fish habitat.
- Four Lower Snake dams yield 5% of PNW energy. Replacement power?
- Can technical improvements elsewhere mitigate Snake dam breaching?







Sources: https://www.agri-pulse.com/articles/17517-pacific-northwest-divided-over-snake-river-dam-breaching-debate

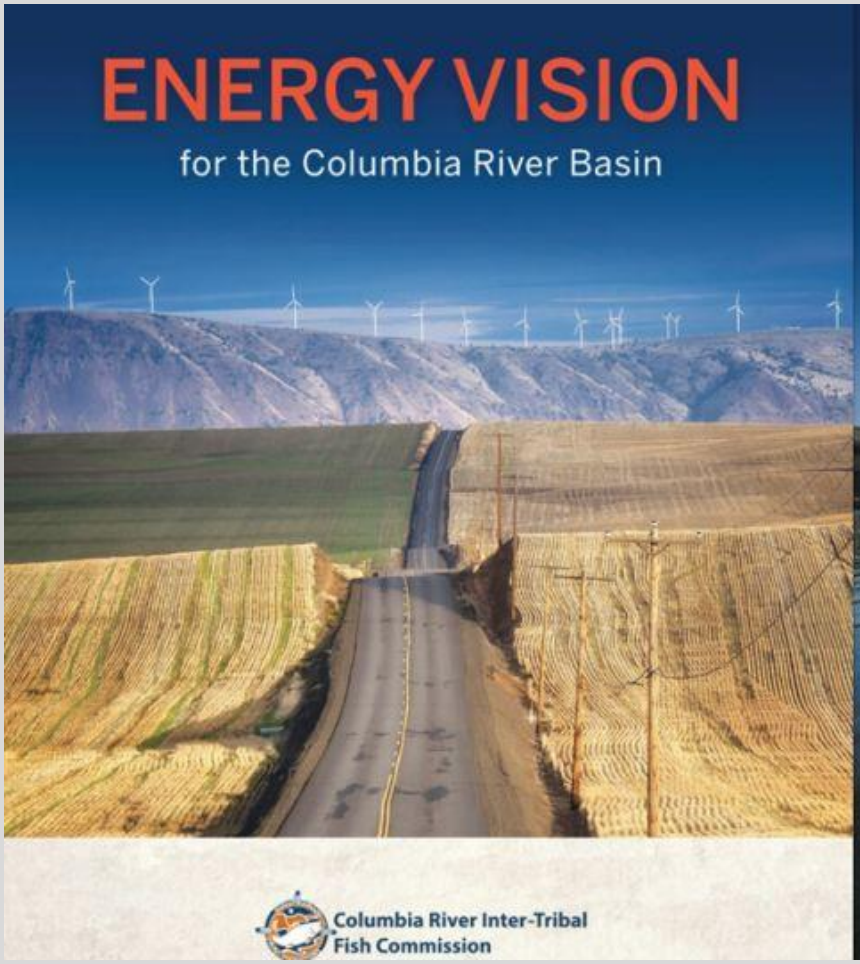
Earth Justice: https://earthjustice.org/press/2023/us-government-sets-a-path-to-breach-the-four-lower-snake-river-dams/

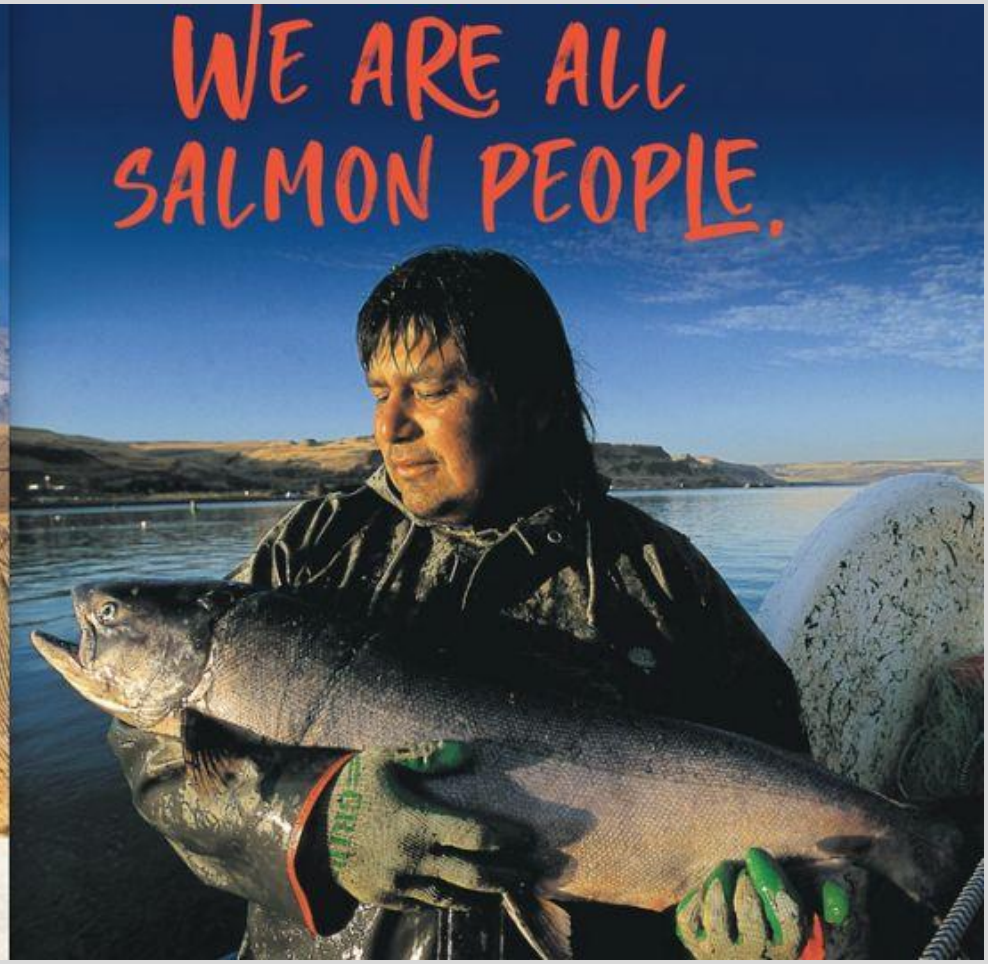
WA Gov. Inslee: https://governor.wa.gov/sites/default/files/2022-11/LSRD%20Benefit%20Replacement%20Final%20Report_August%202022.pdf

Future Salmon Recovery – Tribal Restoration Plan

Source: https://plan.critfc.org/

Future PNW Energy – Renewable/Green resources





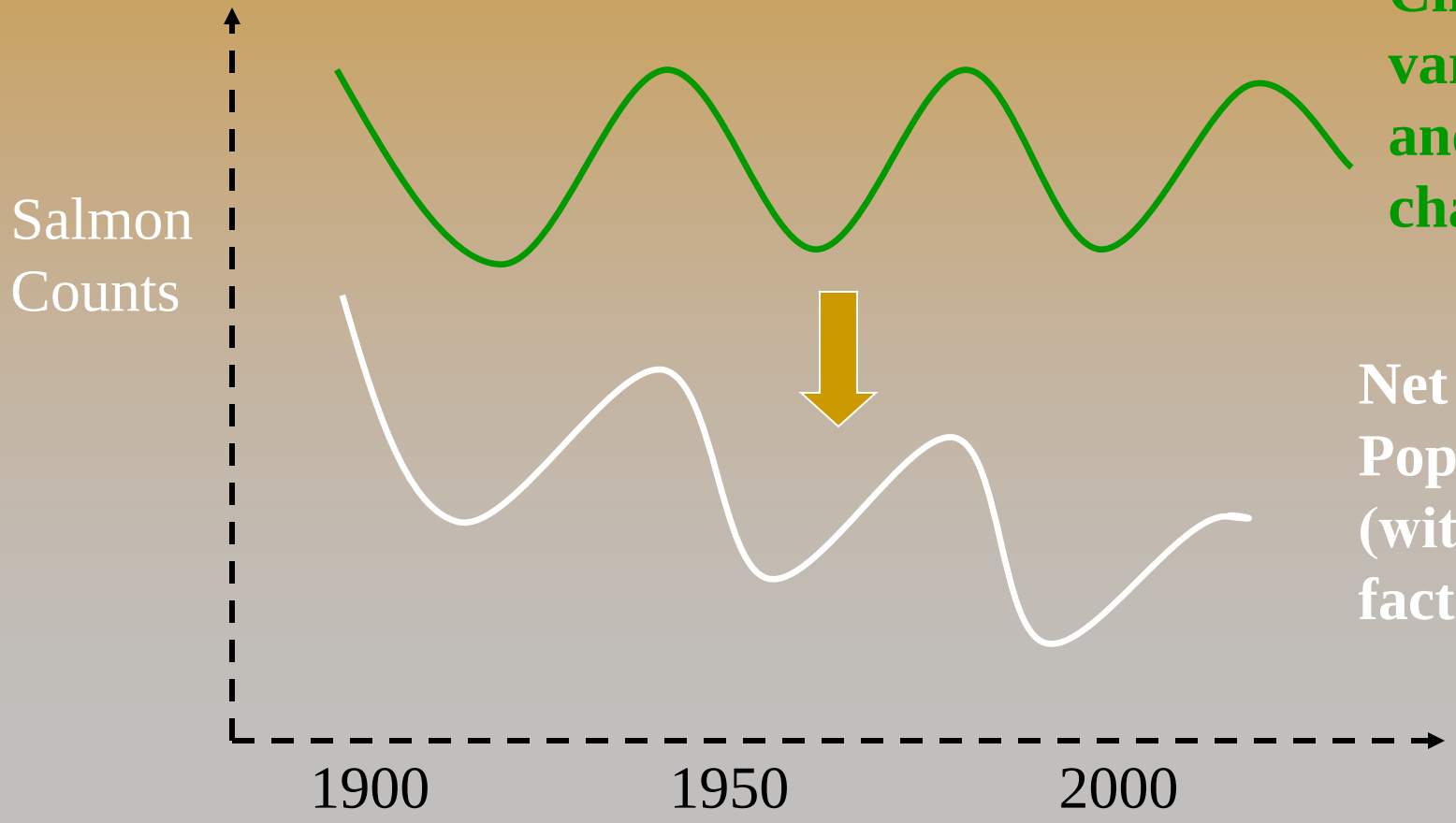
Source: https://critfc.org/energy-vision/

In summary: PNW Salmon recovery needs…

- Good in-river flow conditions – a more natural Hydro regime (i.e., natural timing), increased spill.
- Restore damaged river Habitat – tribal projects.
- Promote Hatchery reform – "supplementation."
- Maintain Harvest agreements – "*US vs. Oregon*."
- Climate Variability will mask management actions.

What about the FUTURE?

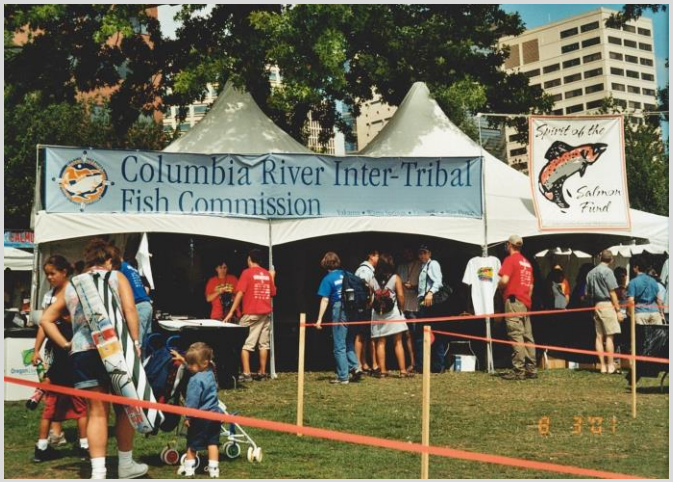
The Future…



Climate variability and climate change?

Net Fish Population (with "4-H" factored in)

BRING HOME THE SALMON!



"JAMMIN' FOR SALMON" – TRIBE'S MAJOR MUSIC AND OUTREACH EVENT, PORTLAND WATERFRONT, 2001

Thank you for your time!

Thank you for your attention!

What are your questions? ☺