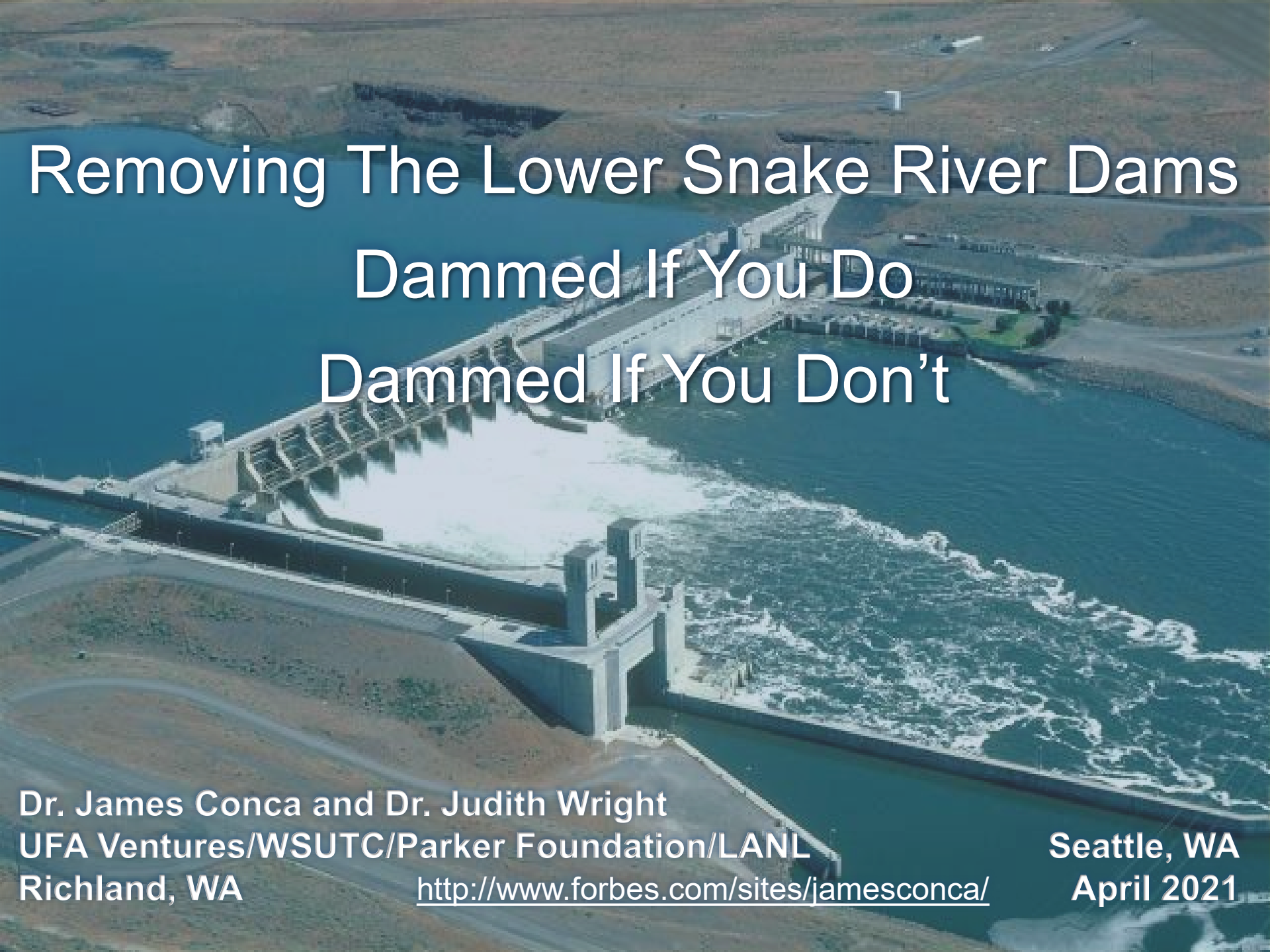


Removing The Lower Snake River Dams

Dammed If You Do
Dammed If You Don’t

Dr. James Conca and Dr. Judith Wright
UFA Ventures/WSUTC/Parker Foundation/LANL
Richland, WA

http://www.forbes.com/sites/jamesconca/

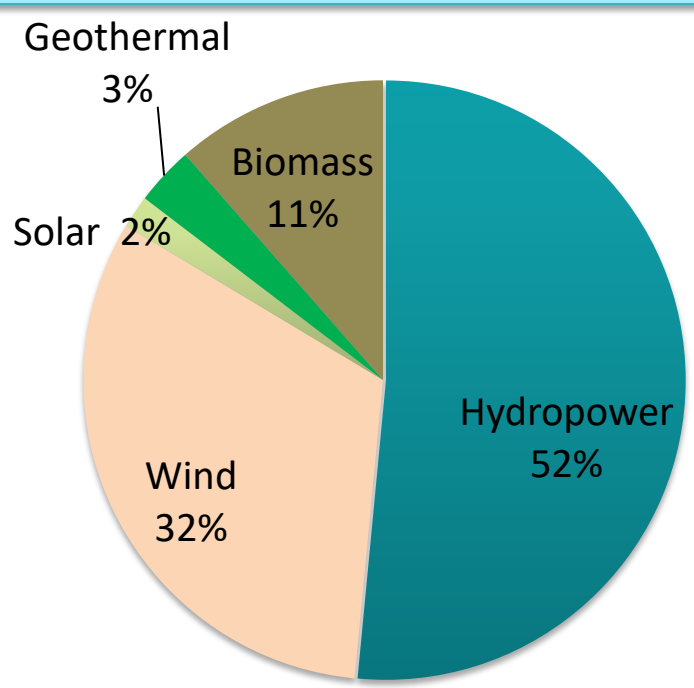
Seattle, WA
April 2021

Key Statistics

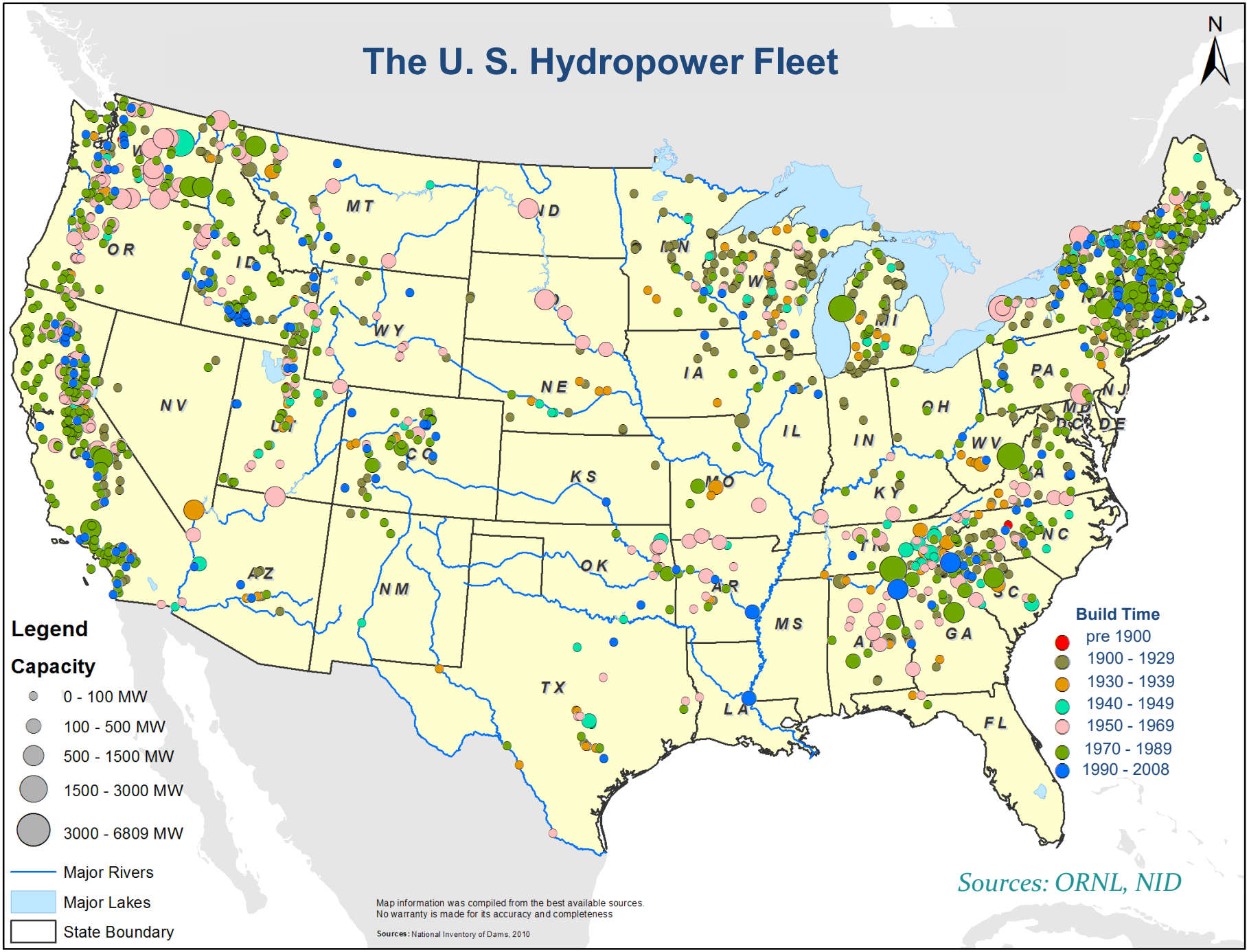
United States
30% coal
34% gas
20% nuclear
7% hydroelectric
6% wind 3% other

Washington	W. Virginia	Illinois
4% coal	92% coal	30% coal
5% gas	2% gas	7% gas
8% nuclear	0% nuclear	54% nuclear
69% hydro	3% hydro	10% renew.
14% renew+bio	3% renew.	

U.S. Renewable Electricity Generation



- America's largest source of RE – **2,198 plants**
- **7%** of overall electricity generation and the majority of renewable electricity in 2014
- Approximately **100 GW** of existing capacity, including **22 GW** of pumped storage.
- 50/50 generation split between public/private and federal (Army Corps, TVA Reclamation)
- Additional benefits: flood control, irrigation, water supply, recreation – 84% of fleets provides one or more


The U. S. Hydropower Fleet
N
MT
ID
OR
ID
WY
NV
UT
CO
NE
IA
IL
IN
OH
PA
NJ
MD
DE
WV
VA
KY
NC
TN
SC
GA
AL
MS
LA
AR
MO
KS
OK
TX
NM
AZ
FL
MI
WI
MN
Legend
Capacity
0 - 100 MW
100 - 500 MW
500 - 1500 MW
1500 - 3000 MW
3000 - 6809 MW
Major Rivers
Major Lakes
State Boundary
Build Time
pre 1900
1900 - 1929
1930 - 1939
1940 - 1949
1950 - 1969
1970 - 1989
1990 - 2008
Map information was compiled from the best available sources.
No warranty is made for its accuracy and completeness
Sources: National Inventory of Dams, 2010
Sources: ORNL, NID


– Flood Risk Management
– Recreation
– Irrigation
– Power
– Fish Migration
– Water Quality
– Fish & Wildlife
– Navigation
– Water Supply
– Cultural Resources

Dam Removal – A Tricky Thing

The four lower Snake River dams include Ice Harbor, Lower Monumental, Little Goose and Lower Granite Dams.

These dams were built for navigation of barge and various river traffic, for low-carbon hydroelectric power, for irrigation and for flood control. They also provide fishing and recreation.

The drive to remove these dams is about restoring river habitat, especially for salmon and various fish species.

Ice Harbor Dam

Lower Monumental Dam

Little Goose Dam

Lower Granite Dam

27 Dams on the Snake River

Since the early 20th century, when Swan Falls Dam was constructed on the middle Snake River upstream of Hells Canyon, the fifteen dams and reservoirs on the river have posed an increasing problem for migrating salmon.

Yes, the 4 Lower Snake River Dams have an affect but the system is very complex and it is not guaranteed that removal would significantly help the salmon or the Orcas.

Other Dams in Washington

There are 1,166 dams in WA State including 38 hydroelectric dams. 11 of these 38 drain into Puget Sound or the Straits, including the Diablo Dam, Ross Dam and Gorge Dam on the Skagit River. Why isn't there discussion of taking these out? They are generally smaller, older, easier to remove and not fish friendly.

Dam Removal – A Tricky Thing

The irrigation provided by these dams is a critical part of the region's economic boom.

Ten million tons of commercial cargo and nearly 67 million bushels of wheat are transported on the Columbia/Snake River annually, an essential part of the region's economic competitiveness. This would have to change to truck and rail to Pasco, to be loaded onto barges, or to the final destimation.

On the other hand, about 3 million cubic yards of sediment accumulate behind Lower Granite Dam, raising water levels and threatening Lewiston.

	Dam	Year Constructed	Capacity (MW)	Avg. Gen. (aMW)	Number of homes project can supply with electric power
Lower Columbia	Bonneville	1938	1104	566	454,000
	The Dalles	1957	2080	823	660,000
	John Day	1971	2480	1083	868,000
	McNary	1952	1120	594	476,000
Lower Snake	Ice Harbor	1962	693	206	165,000
	Lower Monumental	1969	930	308	247,000
	Little Goose	1970	930	283	227,000
	Lower Granite	1975	930	288	231,000
Mid C	Grand Coulee	1942	6809	2439	1,956,000
	Chief Joseph	1958	2614	1361	1,091,000
Headwater	Libby	1975	605	231	185,000
	Hungy Horse	1953	428	89	71,000
	Albeni Falls	1955	49	24	19,000
	Dworshak	1973	465	193	155,000

Dam Removal – A Tricky Thing

Ice Harbor Dam produces 1.7 billion kWhs/yr

Lower Monumental 2.3 billion kWhs/yr

Little Goose 2.2 billion kWhs/yr

Lower Granite 2.3 billion kWhs/yr

a total of about 4% of the State's electricity generation. And it is all very low carbon, especially since these dams are in an arid region and methane production from the flooded area is negligible.

https://mountainjournal.org/the-debate-over-saving-salmon-and-taking-down-dams

Dam Removal – A Tricky Thing

BPA says these dams would be replaced with two modern gas turbines. Such a replacement would cost an additional $274 million to $372 million each year, and would increase carbon emissions by almost 3 million tons per year.
WA State would no longer have the lowest carbon footprint of any state

On the other hand, the only other low-carbon source of baseload electricity is nuclear. If the dams were replaced by a single Oregon NuScale SMR 12-pack, that would solve the energy/climate part of this problem, and could be built before dam removal began - by about 2030.

New small modular reactors are as good as natural gas at load-following, or buffering, renewables. SMRs cannot melt down and all the other scary things have been fixed. We haven't been idle in the last 30 years.

Dam Removal – A Tricky Thing

- A direct tie between higher ocean temperatures and lower number of returning adult salmon
- Warming temperatures in oceans and rivers as a result of climate change
- Human activity have raised the acidity of the water, decreased oxygen levels, and reduced the availability of critical prey for salmon
- Intergovernmental Panel on Climate Change - "the ocean has taken up more than 90% of the excess heat in the climate system," and warns of the impacts this has on the abundance of marine life and fish populations, especially in coastal areas.
- Should this trend continue, and the temperatures continue to rise, salmon certainly face an uncertain future.

Dam Removal – A Tricky Thing

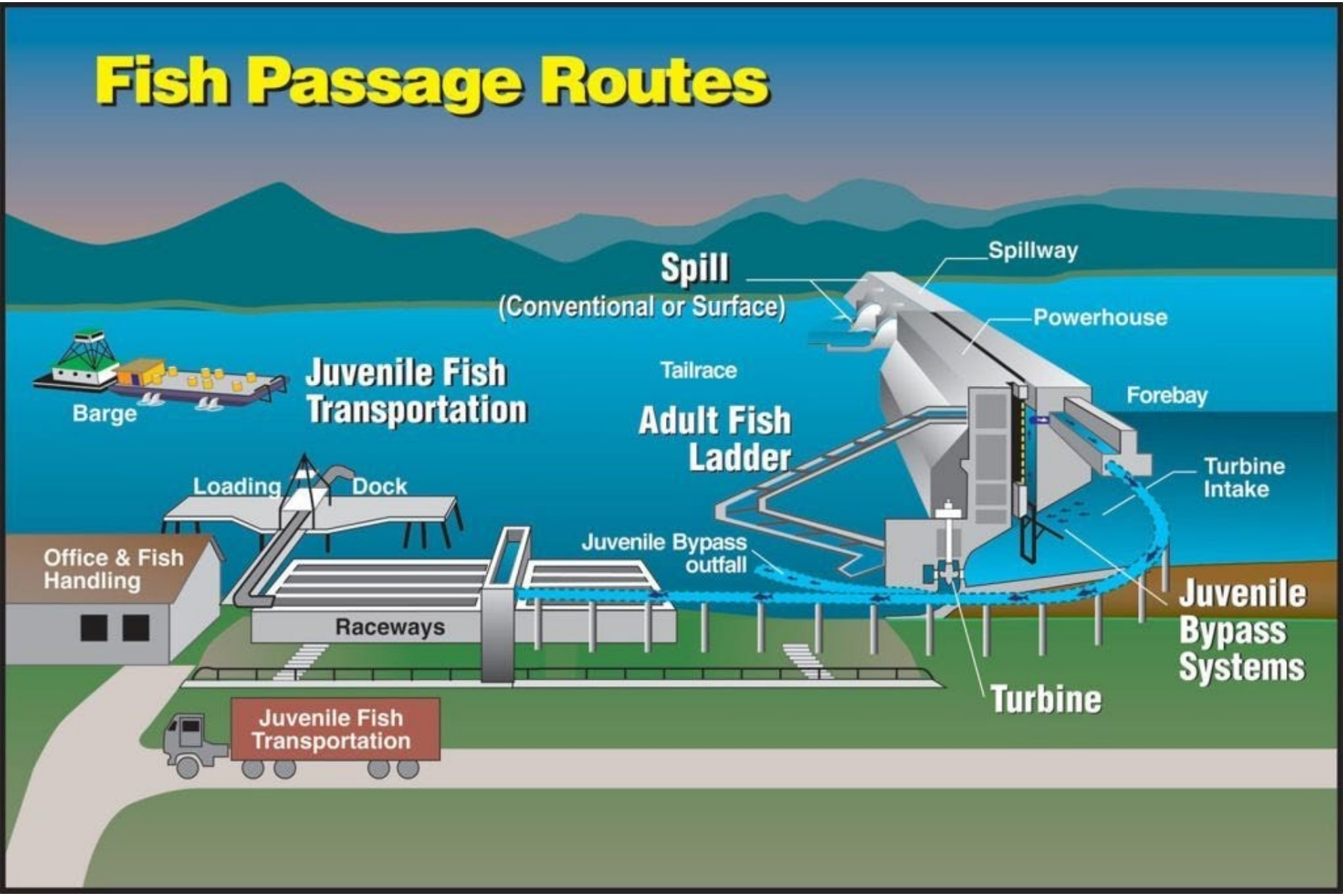
More than any other energy industry, hydropower invests millions of dollars a year on improvements to mitigate the impacts of hydropower and enhance water resources.

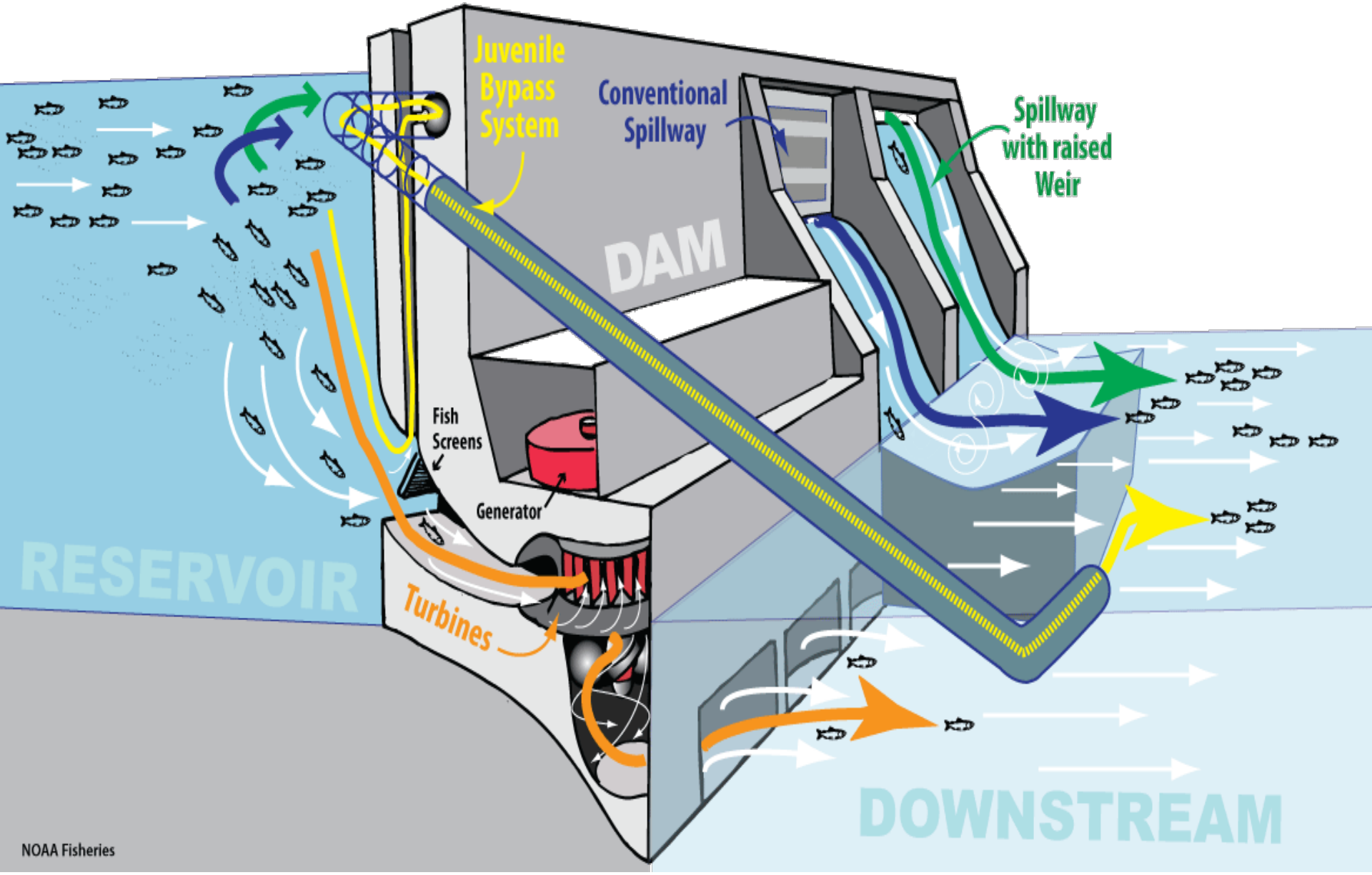
It may make sense for some dams in the United States to be removed, but not all dams. There are certainly dams that are candidates for removal for a variety of reasons. Any dam removal decision that will impact hydropower generation needs to be apolitical and based on sound science. It must also take into account the loss of generation and the source of the replacement power.

It could take up to 25 years to remove these lower Snake River dams. Would this be in time to help salmon? Studies indicate wild Chinook salmon will be gone in 20 years.

There is no way to restore fish runs to pre-civilization levels

Trying To Keep Fish Alive


Fish Passage Routes
Spillway
Spill
(Conventional or Surface)
Powerhouse
Barge
Juvenile Fish Transportation
Tailrace
Forebay
Adult Fish Ladder
Turbine Intake
Loading
Dock
Office & Fish Handling
Juvenile Bypass outfall
Raceways
Juvenile Bypass Systems
Turbine
Juvenile Fish Transportation


Juvenile Bypass System
Conventional Spillway
Spillway with raised Weir
DAM
Fish Screens
Generator
Turbines
RESERVOIR
DOWNSTREAM
NOAA Fisheries

There Are Things We Can Do

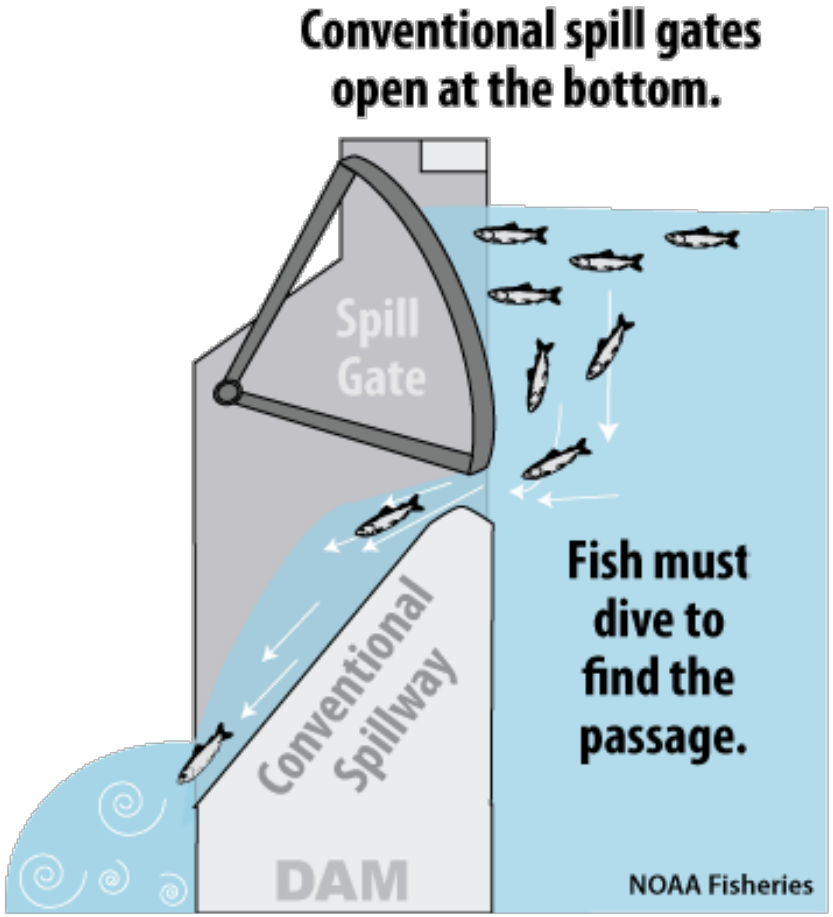
The 2016 Comparative Survival Study (CSS) predicted benefits to fish survival from increasing spill levels at all levels of flow, but most significantly at low flows.

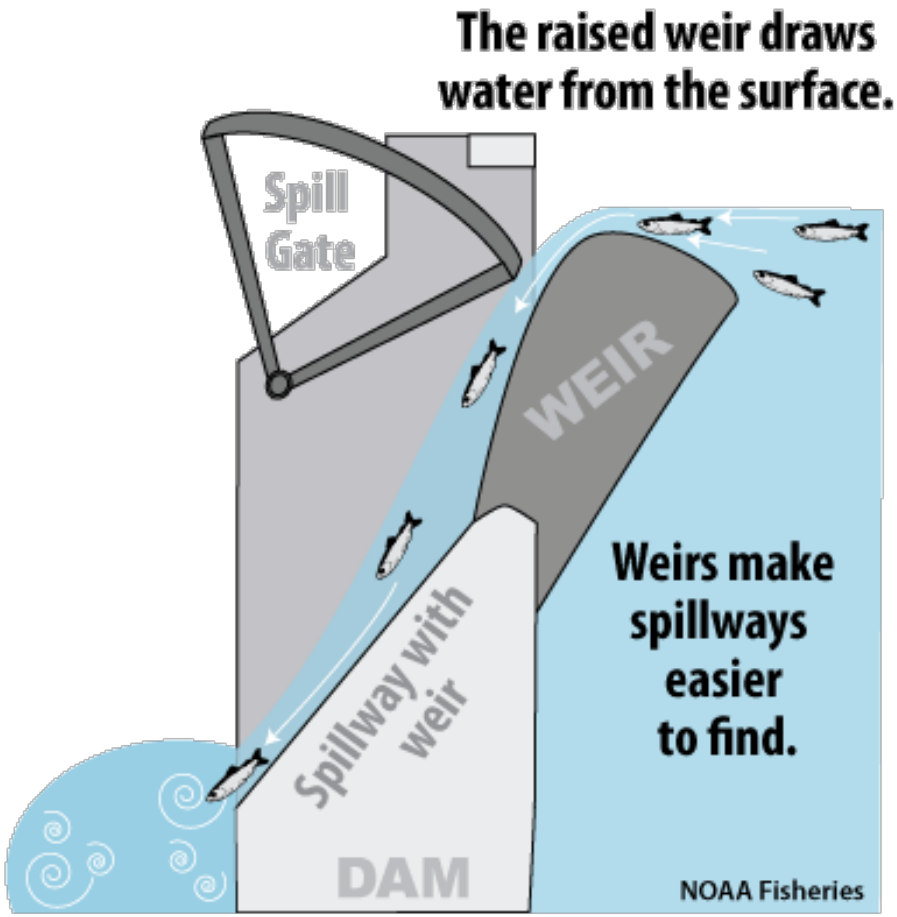
The CSS report said the spill analysis "predicts higher smolt-to-adult returns (SARs) and long-term abundance increases can be achieved by increasing spill levels, and that the benefits of spill are sensitive to flows.

The study also found that upper Columbia and Snake river salmon and steelhead are not achieving the regional 2%-6% smolt-to-adult return goals.

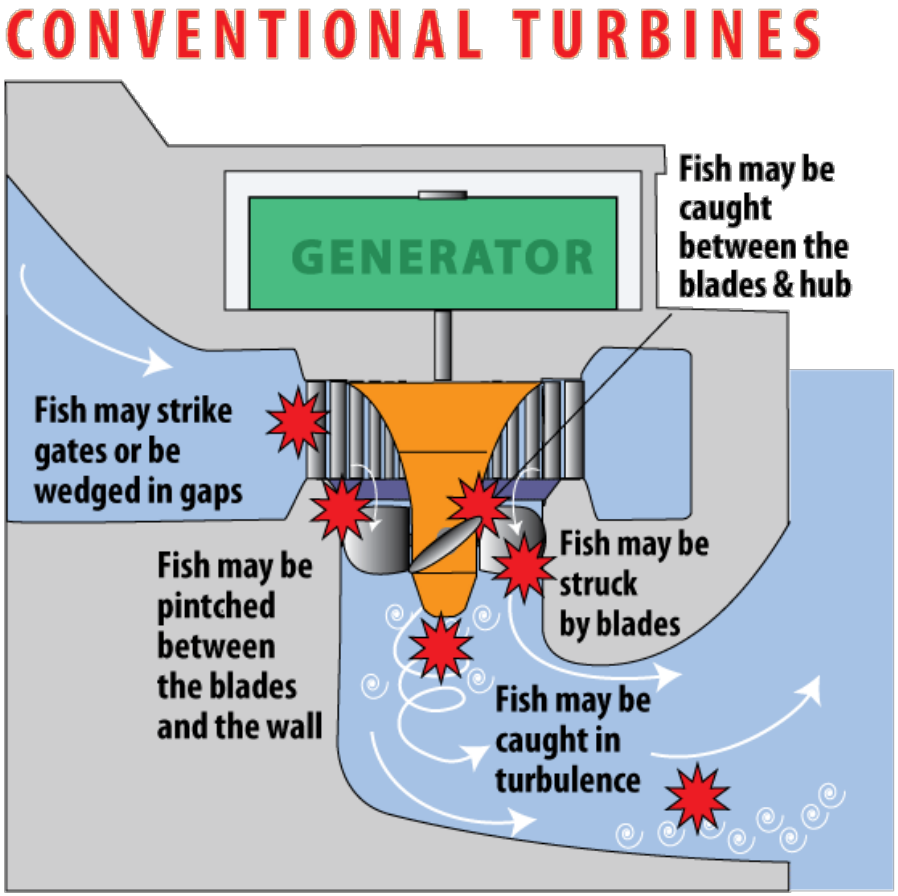
Only middle-Columbia River populations achieved the return goal. These populations— those below the confluence of the Snake and Columbia rivers—have met the survival goals in all but a few years since they've been studied.

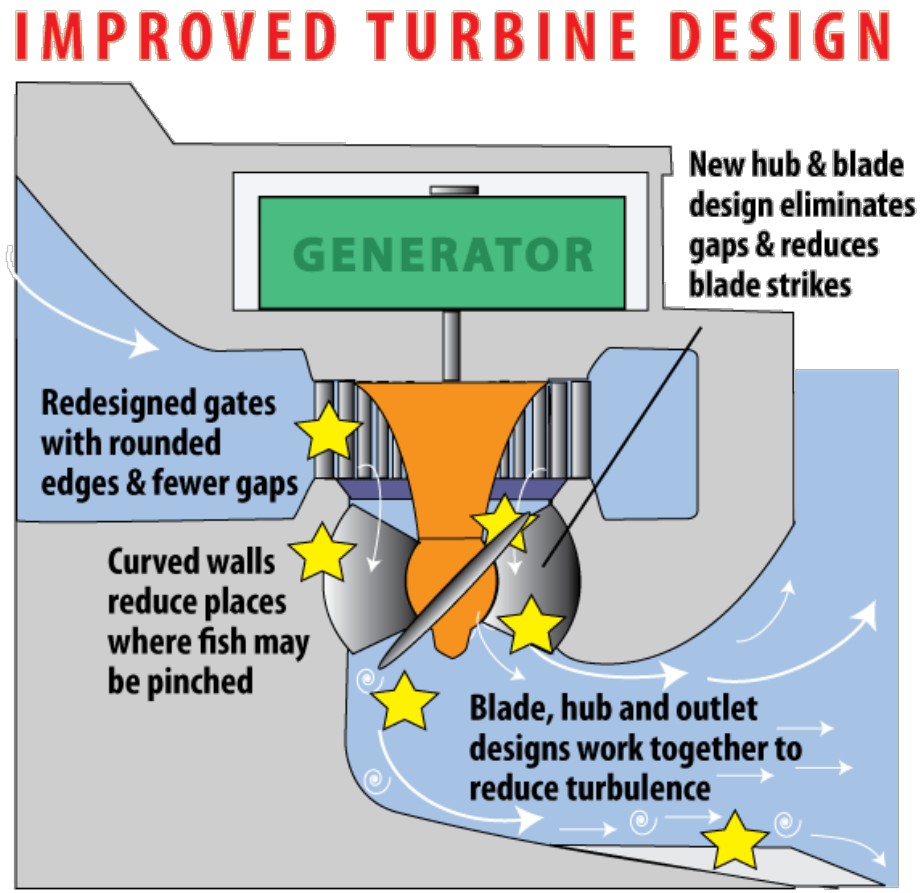
There Are Things We Can Do





There Are Things We Can Do





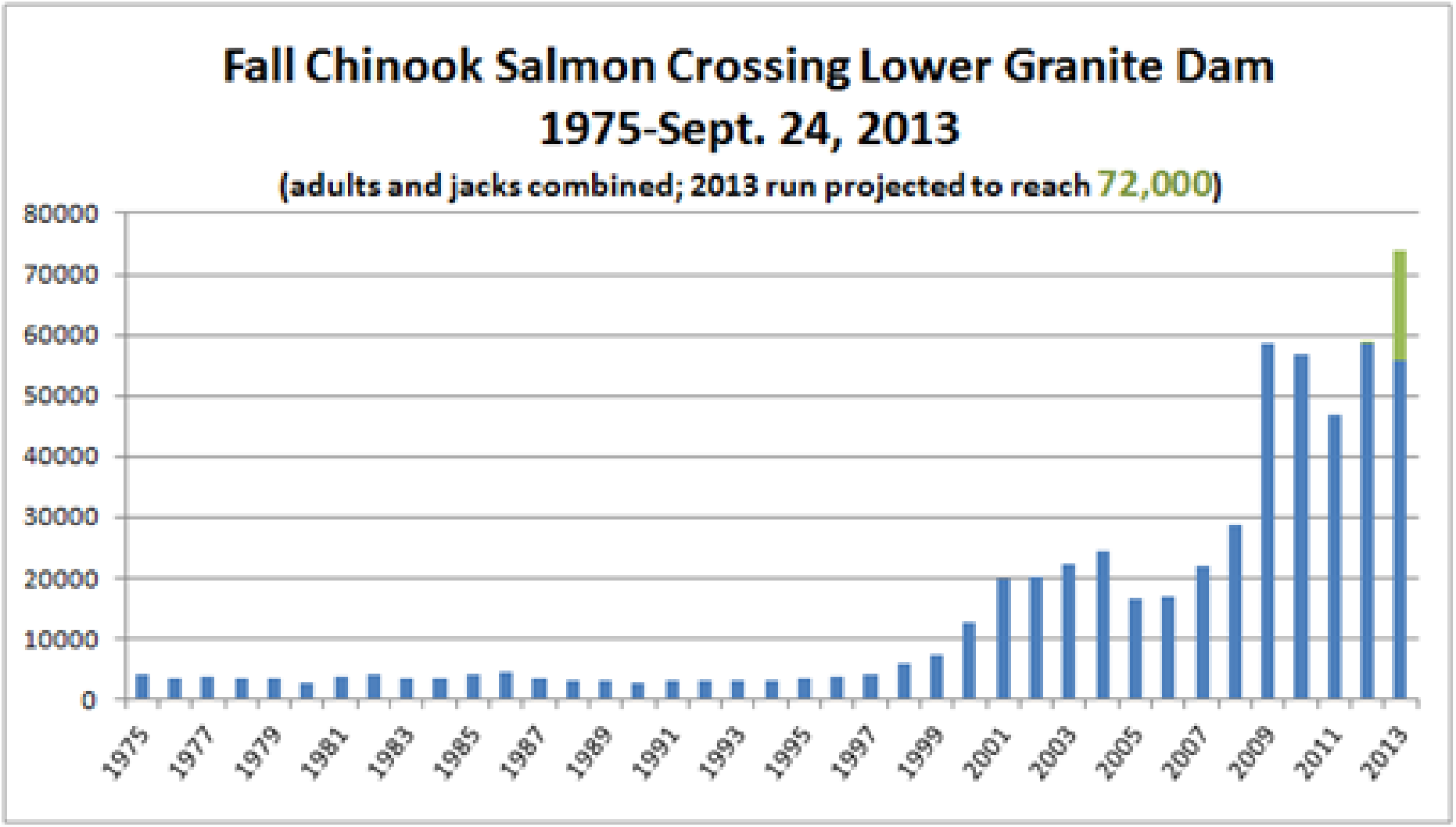
Fish passage improvements are being installed and have a faster effect than dam removal. Lower Granite Dam has emplaced:

A permanent adult fish ladder water cooling system - removes the “thermal barriers” that stop adults from migrating upriver

A Juvenile Bypass System upgrade that “daylights” juvenile fish passages by reconfiguring the juvenile transportation channel to a large elevated bypass flume leading to the Juvenile Fish Facility just downstream of the dam, plus other related fish bypass improvements.

Fish passage improvements over the years have brought fish survival rates through these four dams up to very high levels, over 90%. The number of adult fish returning from the ocean is higher now than in the 1990s when serious tracking began.

Cooling Fish Ladders


Fall Chinook Salmon Crossing Lower Granite Dam
1975-Sept. 24, 2013
(adults and jacks combined; 2013 run projected to reach 72,000)
80000
70000
60000
50000
40000
30000
20000
10000
0
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013

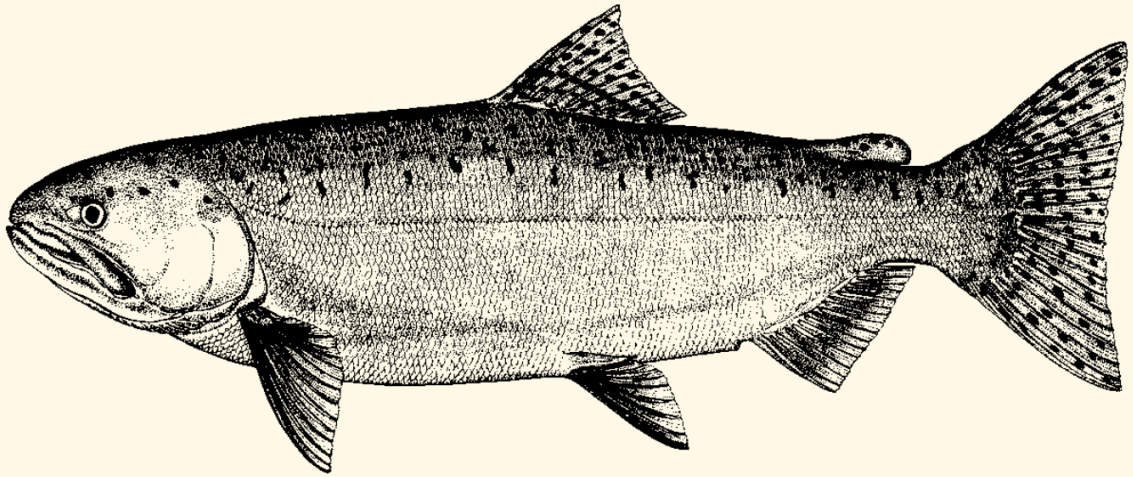
2020 Steelhead Count

From July 1 to December 31, 2020

To view winter passage at Bonneville Dam go to: Corps of Engineers Fish Reporting Site

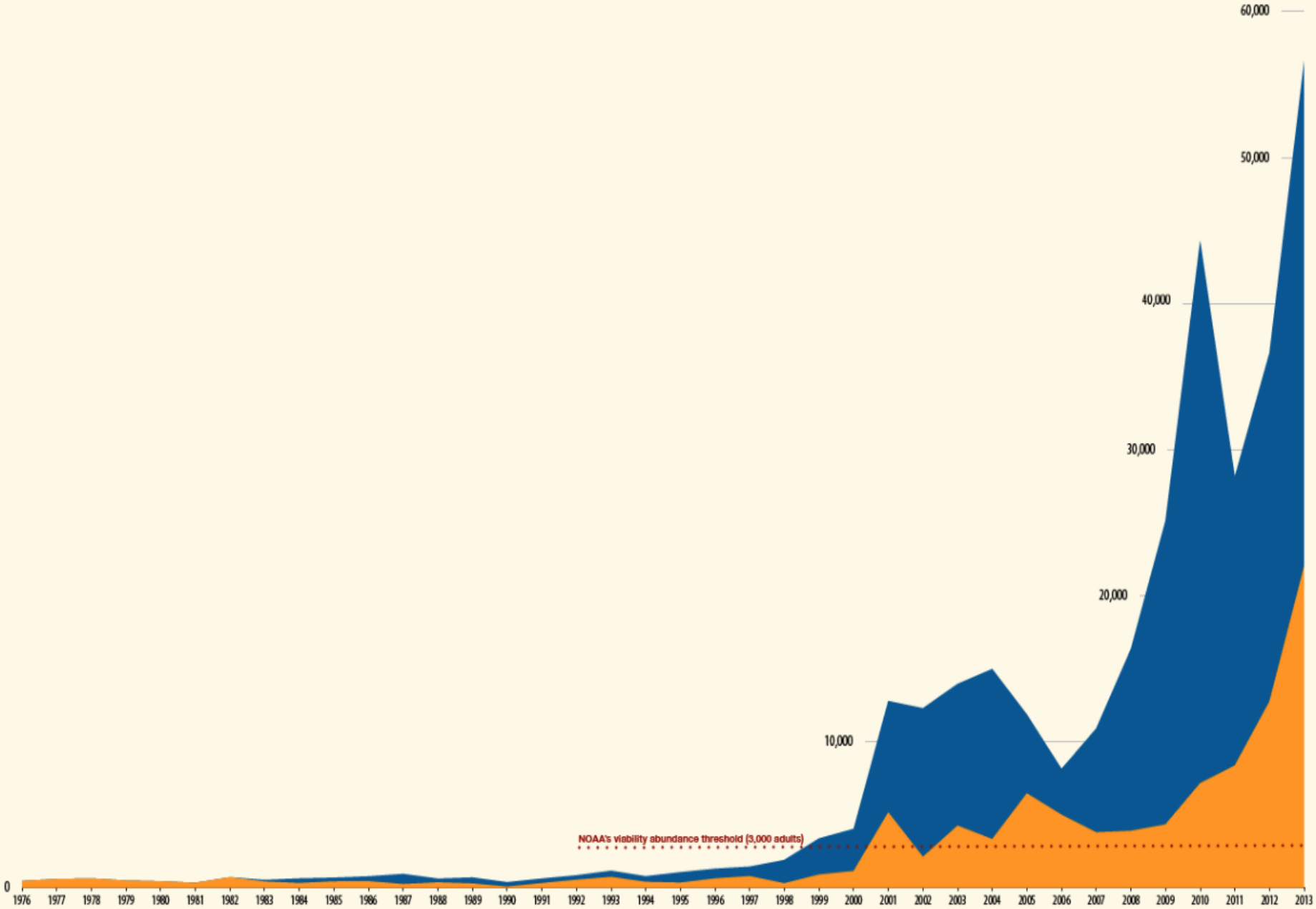
Dam	Date of Count	Daily Count	Total to Date in 2020	Total to Date in 2019	5 Year Average Total Count to Date
Bonneville	Nov 16	14	107,758	72,687	141,743
Lower Granite	Nov 15	113	54,855	30,973	73,092

- Counts include wild and hatchery origin fish. Most steelhead bound for Idaho cross Bonneville Dam between July 1 and October 31.
- Information on numbers of steelhead crossing the Columbia and Snake River dams is taken from data posted by the United States Army Corps of Engineers, and is updated weekly during the counting season.

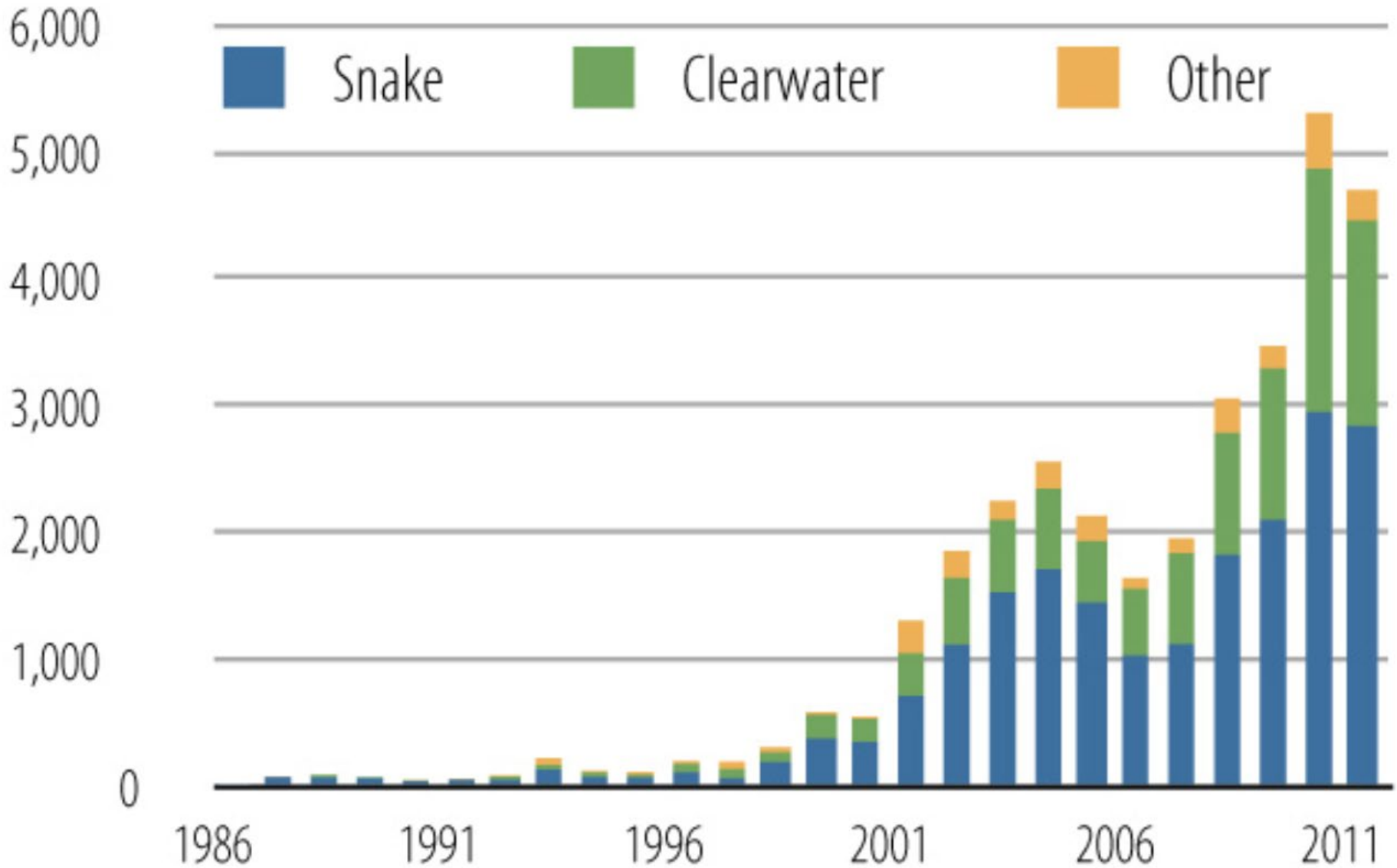


Snake River Fall Chinook Counts at Lower Granite Dam

	Wild	Hatchery	Total
1990	0	78	78
2015	42,151	16,212	58,363


60,000
50,000
40,000
30,000
20,000
10,000
0
NOAA's viability abundance threshold (3,000 adults)
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

Fall Chinook Redds (spawning nests)



Rep. Simpson's Plan $33B

- funded by a federal infrastructure bill called the Columbia River Basin fund

$3.0B on Fish and Wildlife

$2.2B on barge shipper and port mitigation

$1.5B replacement for barge transportation

$0.750B on irrigation extension payments

$0.125B on tourism

$0.225B on economic development in Lewiston/Clarkston (loses port)

$0.975B on economic development in Tri-Cities and rail/road upgrades

$0.500B for Snake River ports, grain elevators and handling

$0.750B for irrigation-impacted farmers along the Lower Snake

$3.6B for water quality improvement in all four states

$2.025B for sturgeon, lamprey and salmon restoration (esp. for Tribes)

$0.500B for dam removal incentives

$2.0B transmission grid upgrade

$14B electric energy from dams replaced (wind, solar, nuclear, storage)

$1.9B for actually breaching the four Snake River dams

Dam Removal – A Tricky Thing

We have never decommissioned dams this large. Smaller dams have taken years from administration to completion. For the Savage Rapids Dam on the Rogue River in Oregon, actual removal began in 2006 and was completed in 2009, but it took almost 20 years to get approval. A third of the dam was left in place since it is exceptionally difficult to remove the whole dam and not have dangerously high levels of silt and toxic components entrained downstream that will kill fish and invertebrates.

And Savage Dam was built entirely for irrigation purposes, and did not provide any flood control, hydroelectric power, navigation, or other beneficial uses, and is tiny compared to the Snake River dams.

Removal of the Marmot Dam, Sandy River, Oregon

Glines Canyon Dam, Olympic Peninsula

After the Elwha Dam Removal, Olympic Peninsula

Breaching the Dams increases annual emissions by the following:

676,250,703

gallons of gasoline consumed

-or-

590,357,564

gallons of diesel consumed

-or-

6,622,019,18

Pounds of coal burned

-or-

79,559

tanker trucks' worth of gasoline

-or-

693,496

homes' energy use for one year

-or-

1,017,502

homes' electricity use for one year

-or-

33,048

railcars' worth of coal burned

-or-

13,914,050

barrels of oil consumed

-or-

245,680,517

propane cylinders used for home barbeques

-or-

Dam Removal – A Tricky Thing

There is no clear answer to this issue.

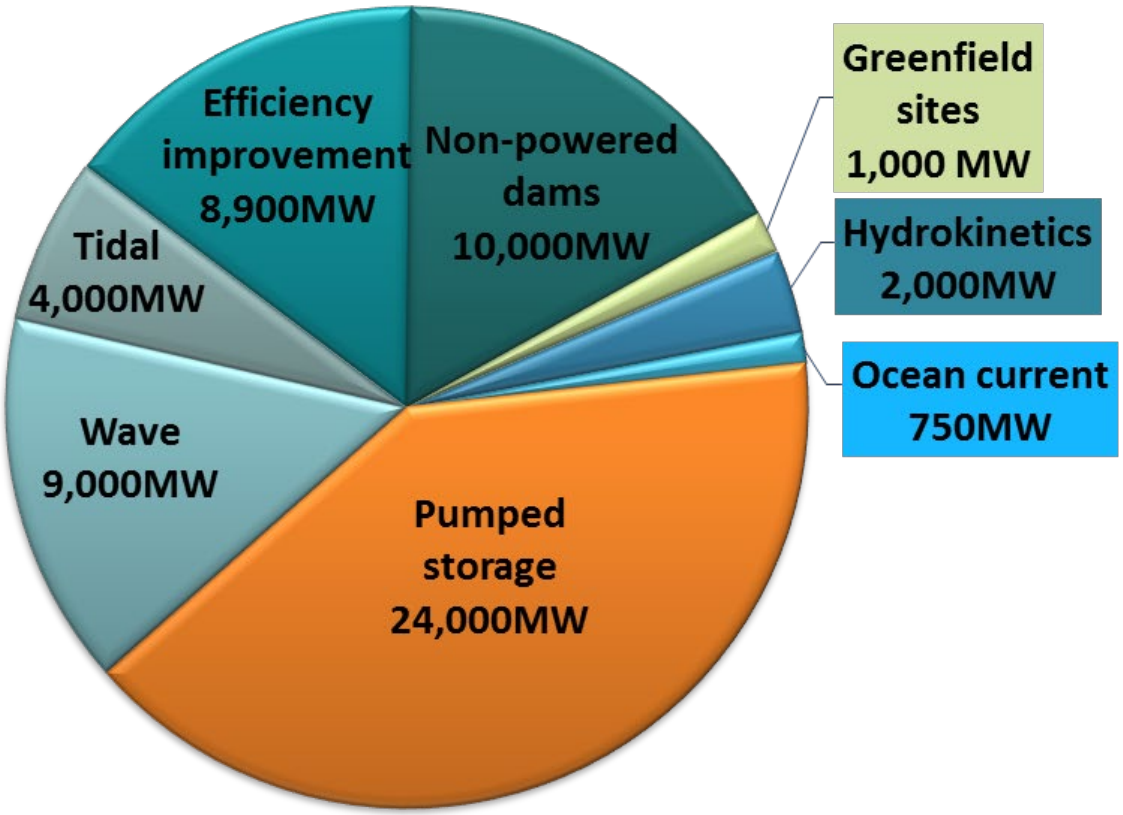
It should be up to the people of this region whether to remove these dams or not. People from Seattle or D.C. should have some say.

There are alternatives to all of the benefits provided, except habitat restoration, but it will be a long and difficult process, destined to be overly politicized in both directions.

Future hydro availability

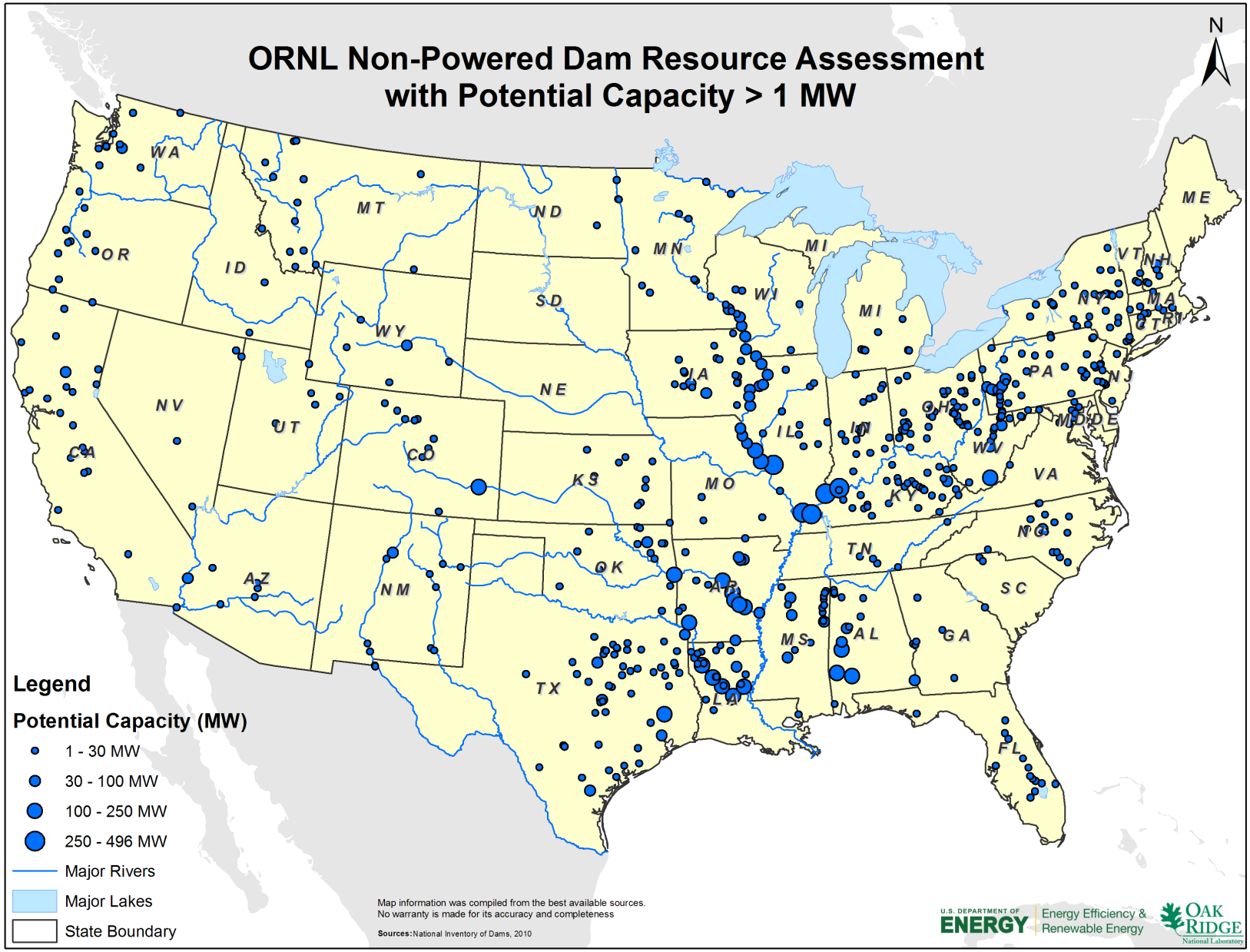
With the right policies in place, **the U.S. could add 60 GW** of new hydro capacity by 2030, much of which can be created by maximizing existing infrastructure, uprates and efficiency improvements, low-impact projects.

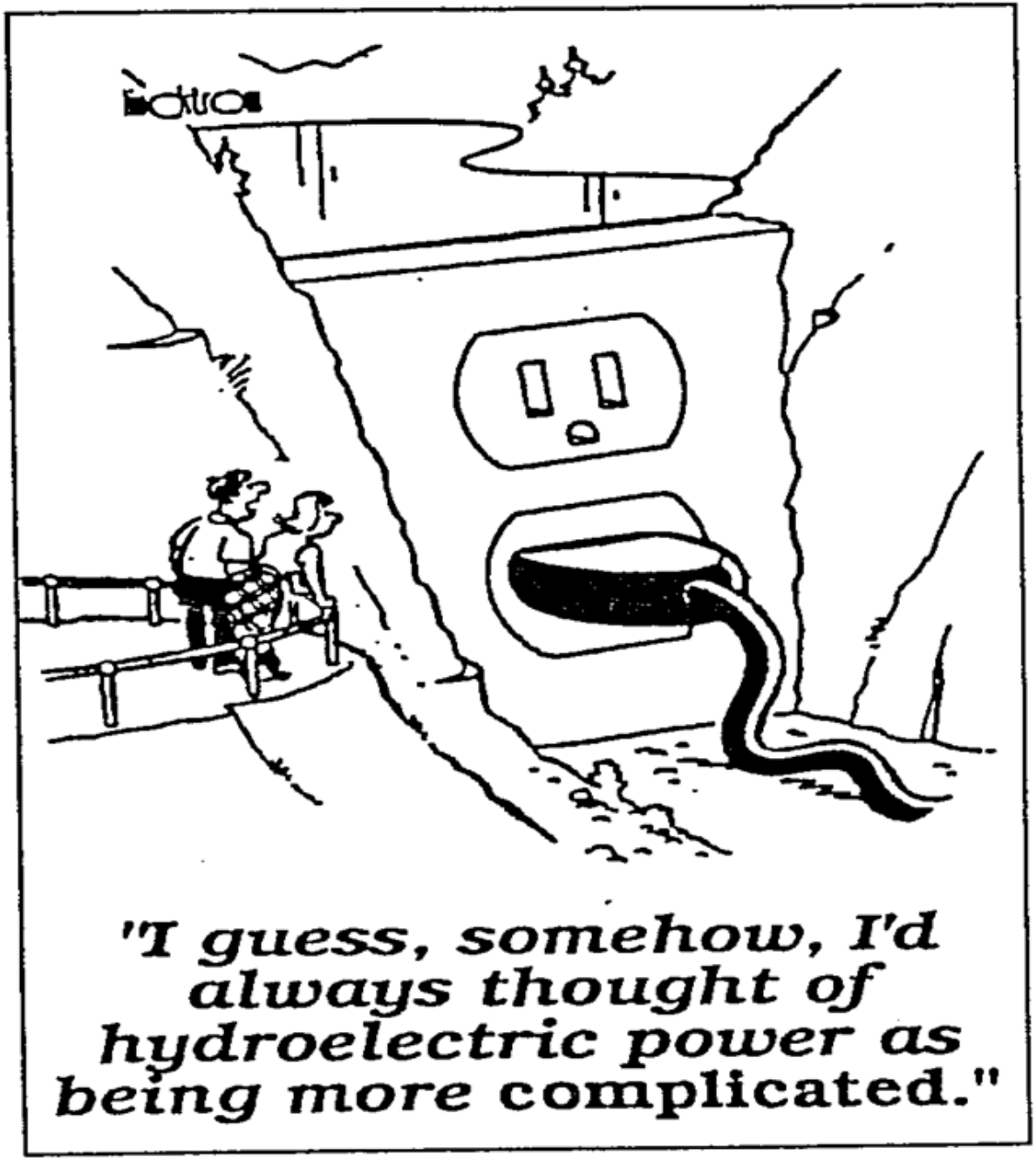
Hydro Capacity Growth by Technology



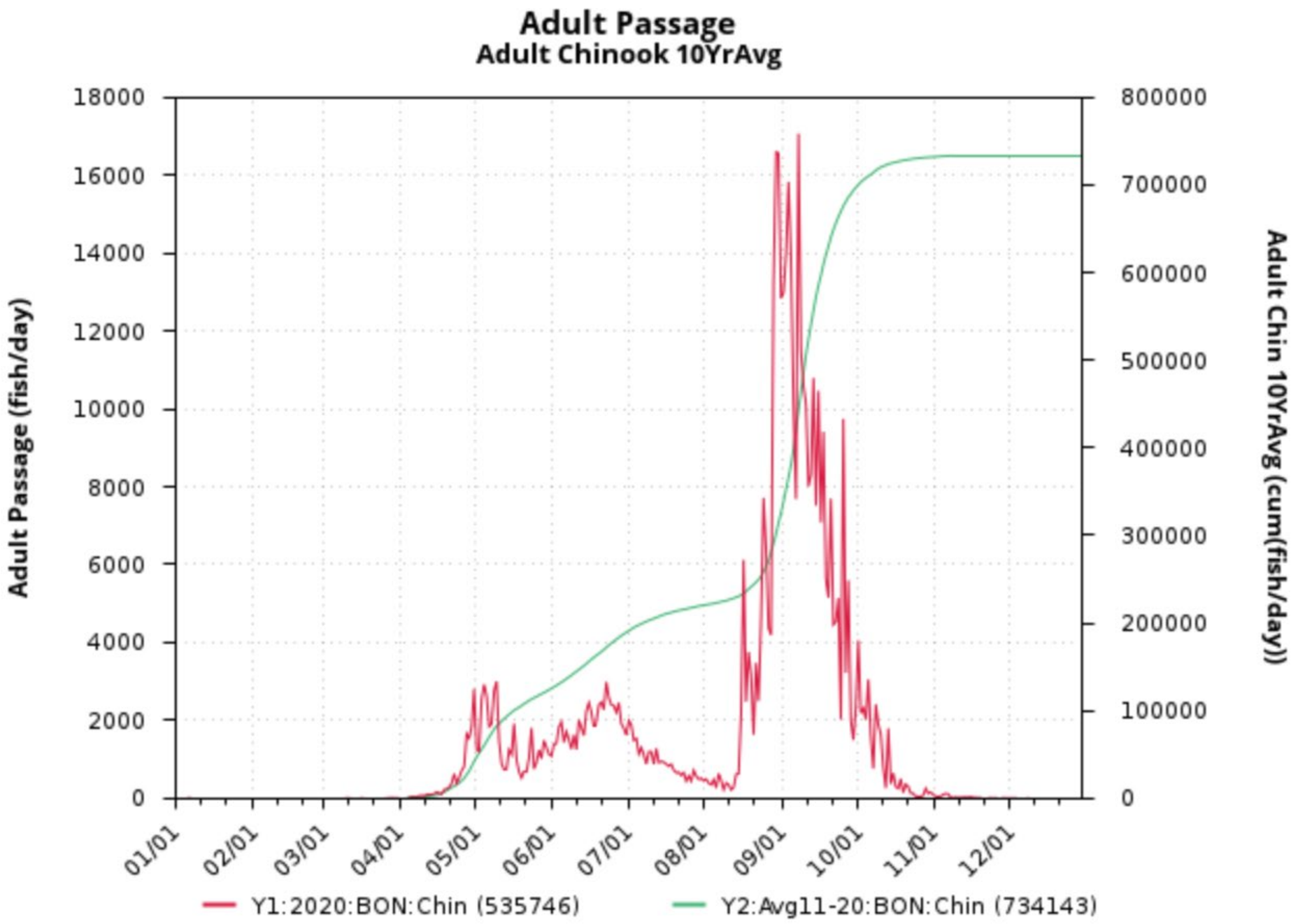
Navigant Consulting Study, 2009

DOE/ORNL: 12 GW at over 54,000 sites - Only 3% of our 80,000 dams generate power, mostly owned by the Army Corps - 8 GW in top 100 sites





"I guess, somehow, I'd always thought of hydroelectric power as being more complicated."


Adult Passage
Adult Chinook 10YrAvg
Adult Passage (fish/day)
Adult Chin 10YrAvg (cum(fish/day))
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
800000
700000
600000
500000
400000
300000
200000
100000
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01
Y1:2020:BON:Chin (535746)
Y2:Avg11-20:BON:Chin (734143)