

Aquaculture in the Pacific Northwest: Benefits and Drawbacks

OCTOBER 11, 2018

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Not just net pens!

Salmon ranching:

- 83 hatcheries operated by WDFW
- 45 operated by the NWIFC
- 3 Colville Confederated Tribes
- 3 Yakama Nation
- 12 Federal hatcheries
- Significant hatchery production in Alaska, Russia, Japan, and Canada

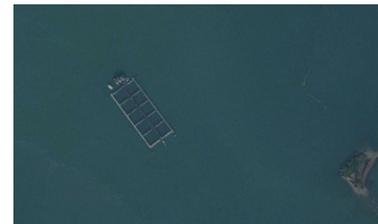
Oyster/geoduck/clam production

Steelhead/Rainbow Trout

But you probably want to talk net pens . . .

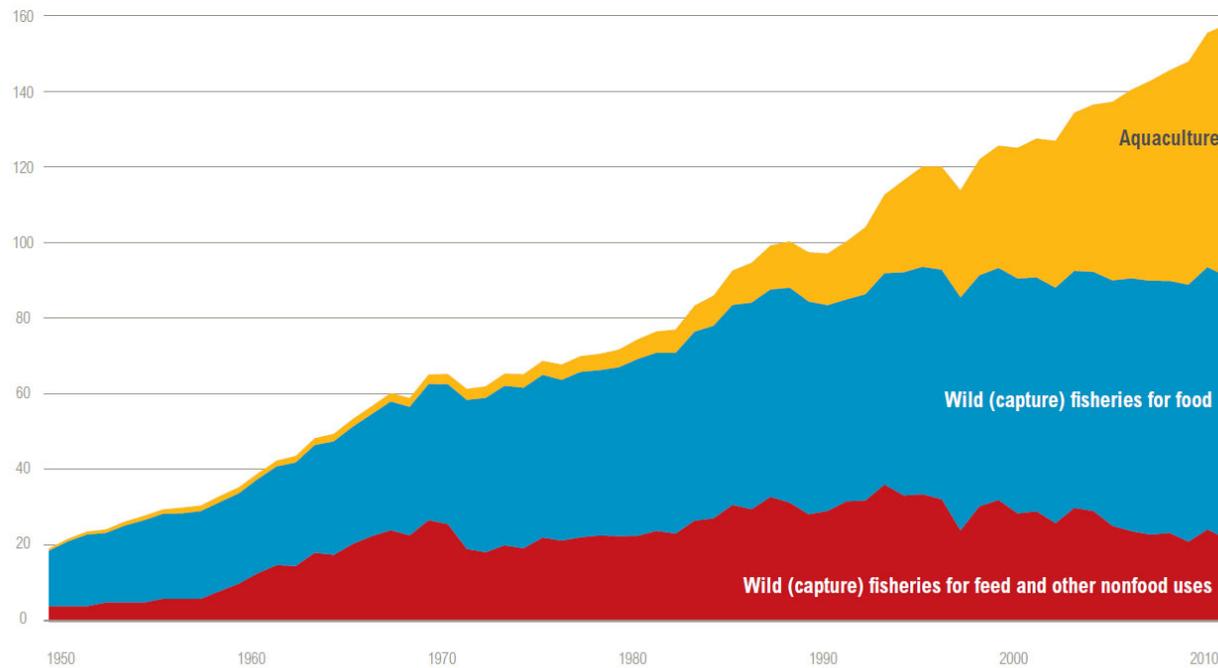
Not just Atlantic salmon:

- Salmon enhancement pens
- Trout production in the Columbia River
- Black cod (in development)



Why Aquaculture?

Figure 3 | Aquaculture production is expanding to meet world fish demand (million tons)

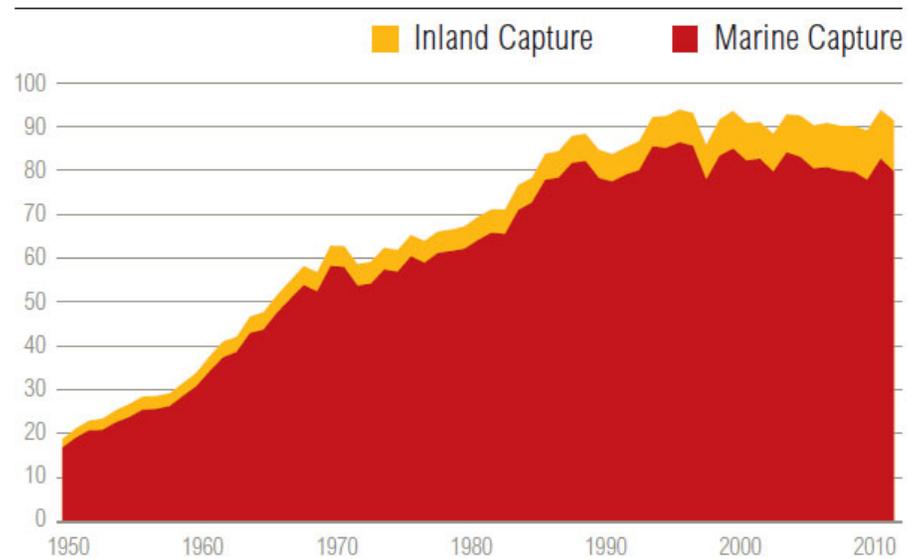


Sources: FAO (2014b), FAO (2013), FAO (2012b), FAO (2012c).

World Resources Institute, Installment 5 of "Creating a Sustainable Food Future"

Wild catch is flat

Figure 1 | **The wild fish catch has stagnated since the 1990s (million tons)**

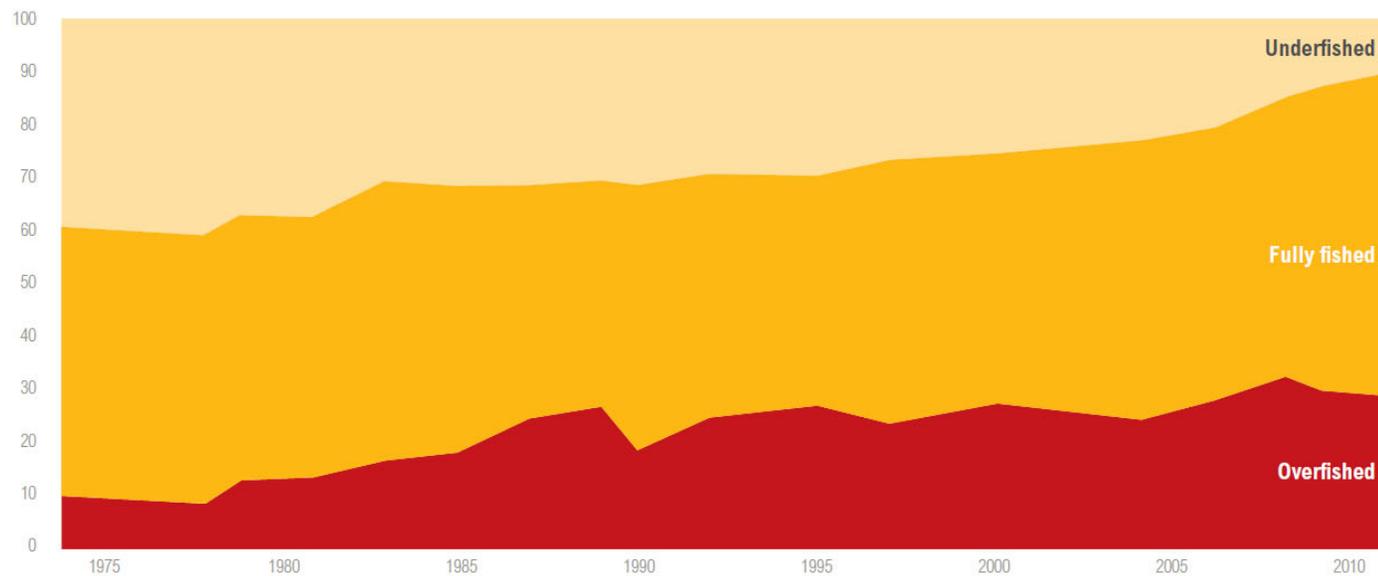


Note: “Wild catch” includes finfish, mollusks, crustaceans, and other aquatic animals from marine and freshwater ecosystems. It excludes all aquaculture.

Source: FAO (2014b).

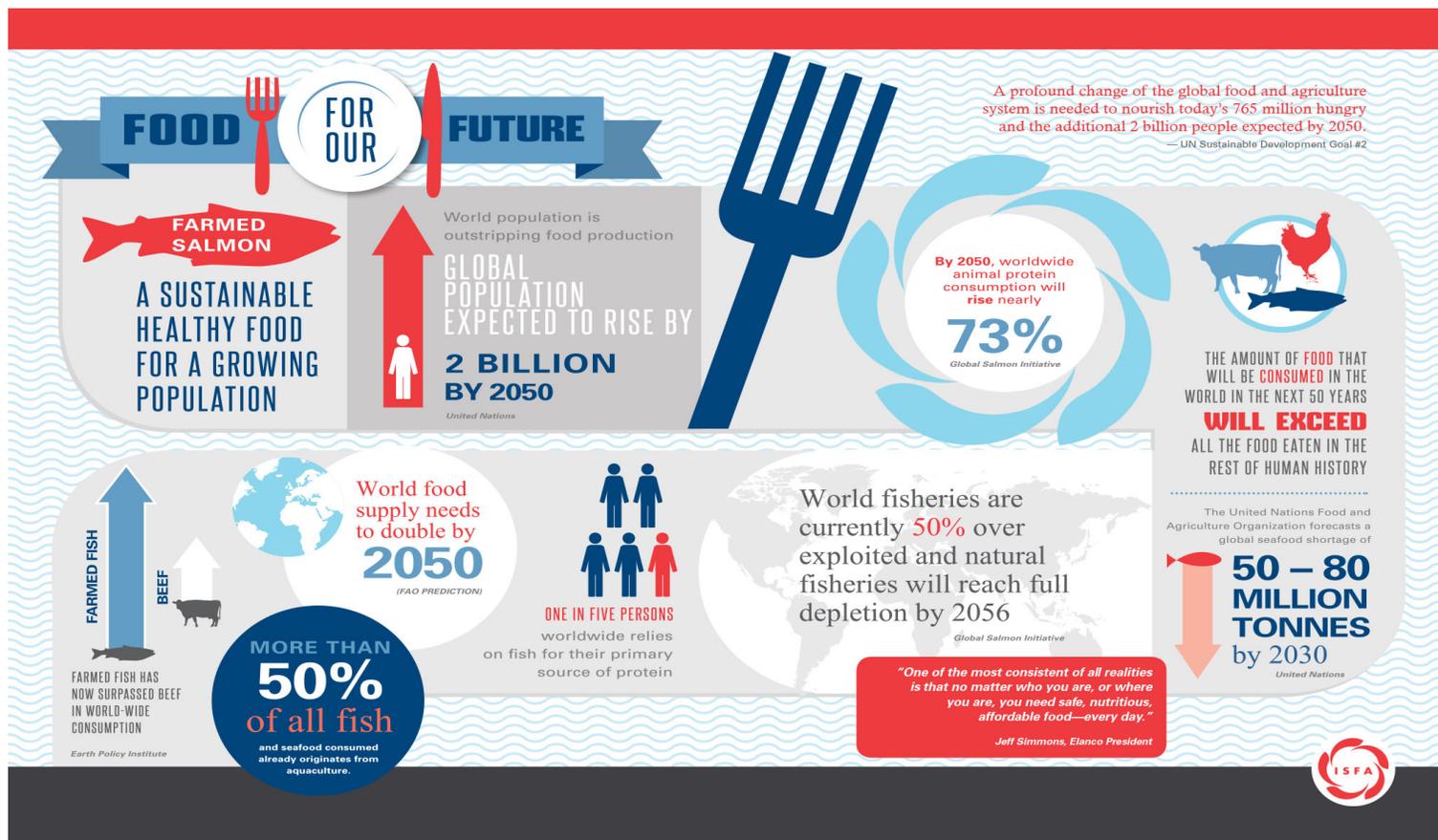
Fisheries are overfished

Figure 2 | Overfishing has risen over the past 40 years (percentage of marine fish stocks assessed)



Source: FAO (2014b).

Why farm salmon?



Why farm salmon?



SUSTAINABLE SALMON

LOW FRESH WATER USE



AVERAGE % OF WILD FISH INGREDIENTS IN FEED

1990:

80%

2017:

20-30%



SALMON ARE FEED CONVERSION CHAMPIONS

1 KG
OF FEED



1 KG
FARMED
SALMON

2 KG
OF FEED



1 KG
CHICKEN

10 KG
OF FEED



1 KG
BEEF



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Why farm Atlantic salmon in Pacific waters?

Local source of year-round protein:

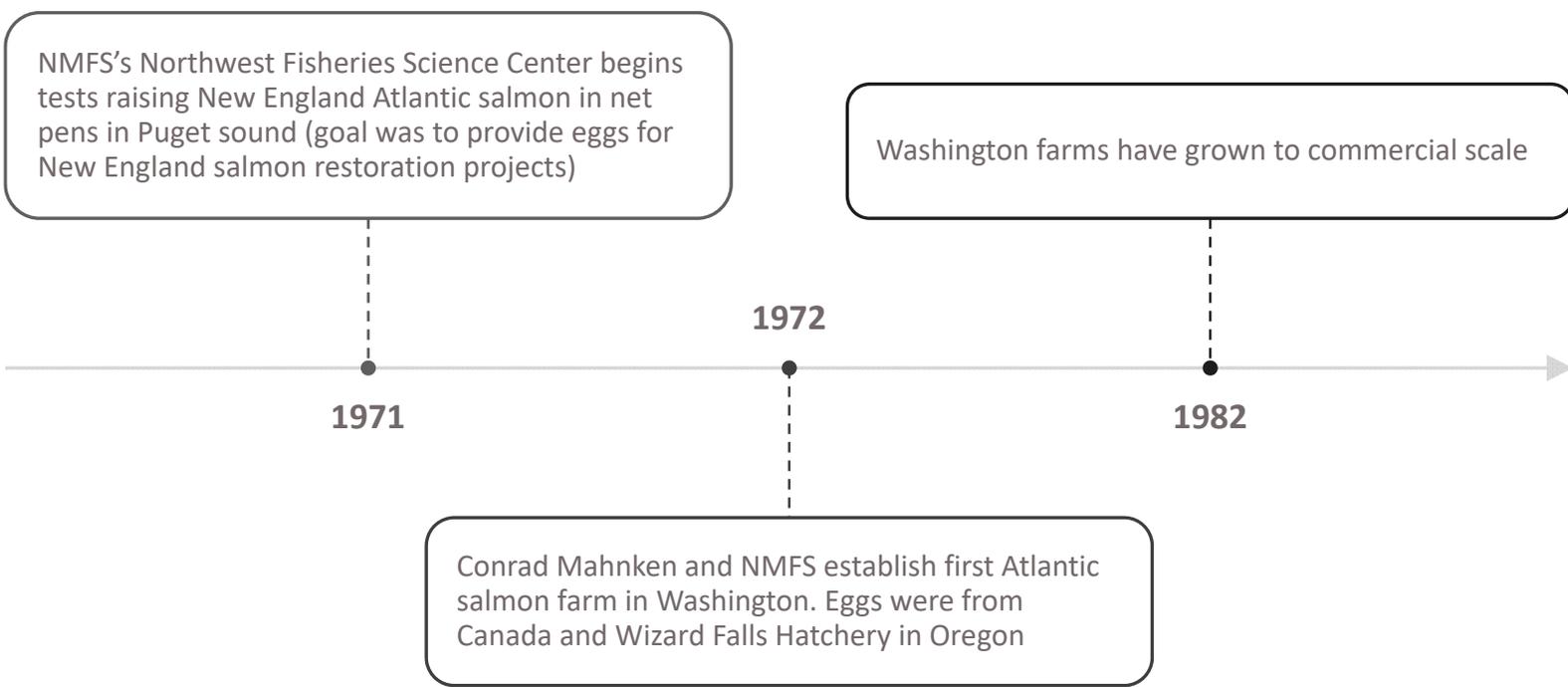
- Chile/Norway/Canada other producers of Atlantic salmon consumed in Washington
- Washington-grown fish serves Western United States markets

Brood stock has been developed over many generations:

- Docile, generally good performers with respect to feed conversion
- Animal health and welfare well-developed
- Poor performers in the wild
- No ability to interbreed with native stocks

The farming of salmon *should* be consistent with the locally-sourced, low carbon, low impact ethos of many metropolitan areas in the Pacific Northwest

History of farming Atlantic salmon in Washington



Regulatory oversight of farms

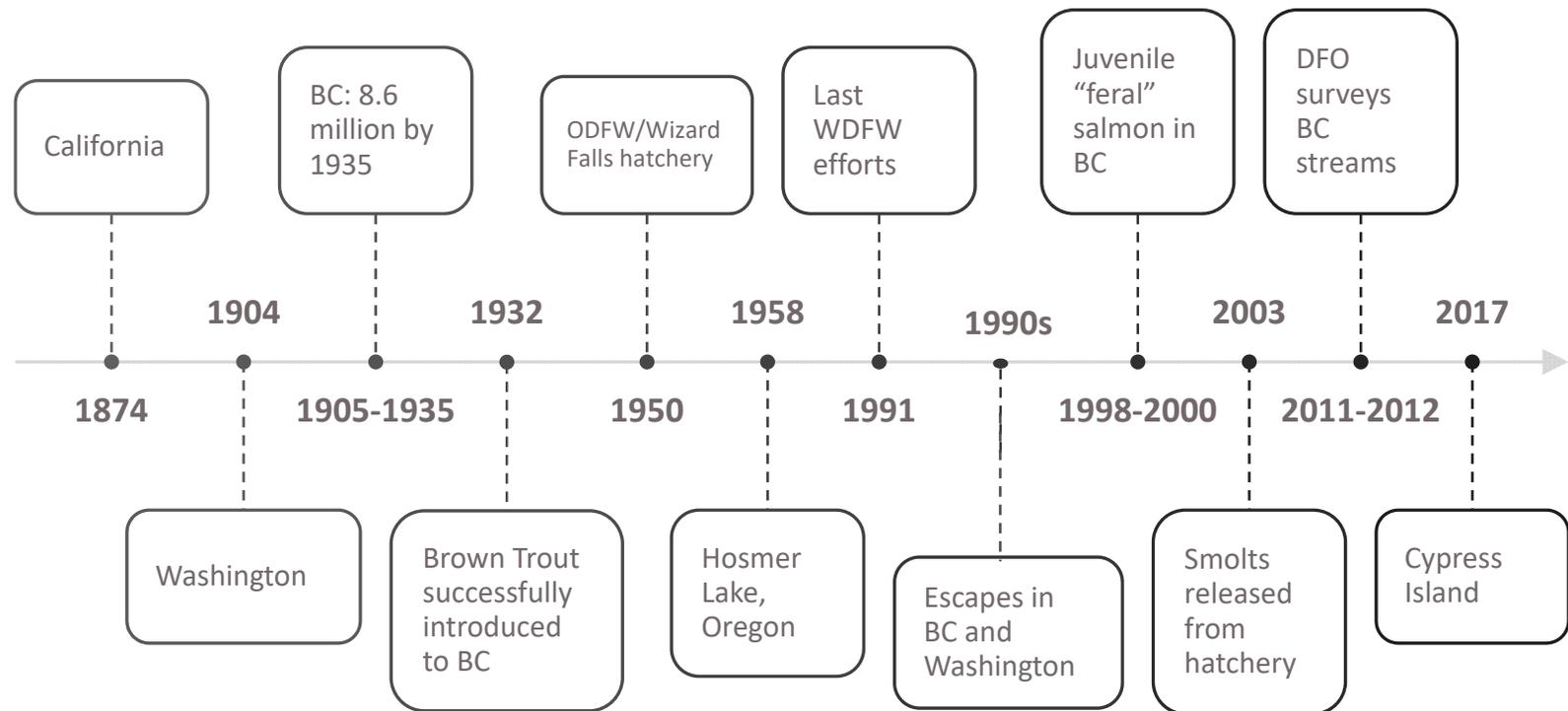
Multiple layers of regulatory oversight:

- 1) Water quality: Washington Department of Ecology through NPDES permitting process
- 2) Fish health/disease: WDFW and federal government (USDA)
- 3) Structural and lease compliance: DNR/Ecology/WDFW
- 4) ESA: EPA/NMFS

Common concerns

- 1) "Invasive"
- 2) Colonization
- 3) Disease
- 4) Water quality
- 5) Competition

Invasive? Risk of colonization?



No established populations despite millions of fish and deliberate attempts

Disease?

Sea lice - varying effects on wild and farmed fish based on geography and environmental conditions:

- Puget Sound: low enough salinities that sea lice are not a problem in farms
- BC: famous prediction of collapse of Broughton Archipelago Pink salmon (did not come to pass), Marty et. al. (2010) looked at trends in pink salmon populations and fish farming—no association

Viruses/bacteria:

- Atlantic salmon susceptible to endemic diseases in the Pacific
- Farmers are proactive with fish health
- Scientific consensus is virus transmission risk to wild fish is low

Water quality

Ecology-issued NPDES permits:

- Sediment sampling (grain size, TOC, copper/zinc)
- Dissolved oxygen (surface, half depth and within one meter of bottom)
- Photographic survey
- Exceedance monitoring
- Closure monitoring
- Operational requirements:
 - Feed
 - Disease control chemicals
 - Sea lice monitoring
 - Preparation and implementation of plans

Competition/Predation

Farmed Atlantic salmon are poor predators:

- Habituated to feed
- Stomach analyses from past escapes show low (single digit percentage) stomach contents
- Cypress Island escapees:
 - NWIFC examined fish stomach contents, none reported
 - WDFW examined fish stomach contents; one fish backbone in Skagit River fish recovered early 2018
 - Presumably WFC examined fish stomach contents, no reports of contents
 - Cooke examined ~500 stomachs and found them all empty
 - Only alleged picture of a fish in stomach turned out to have been lifted from blog of anti-salmon activist, and was published in 2007 (not Cypress escapee)

Why do some people care so much?

Doug's opinion:

- Salmon are sacred to tribes
- Salmon are revered by many in the Pacific Northwest
- Significant fear on part of fisheries when fish farming started
- Misconceptions regarding impacts



Questions?



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