

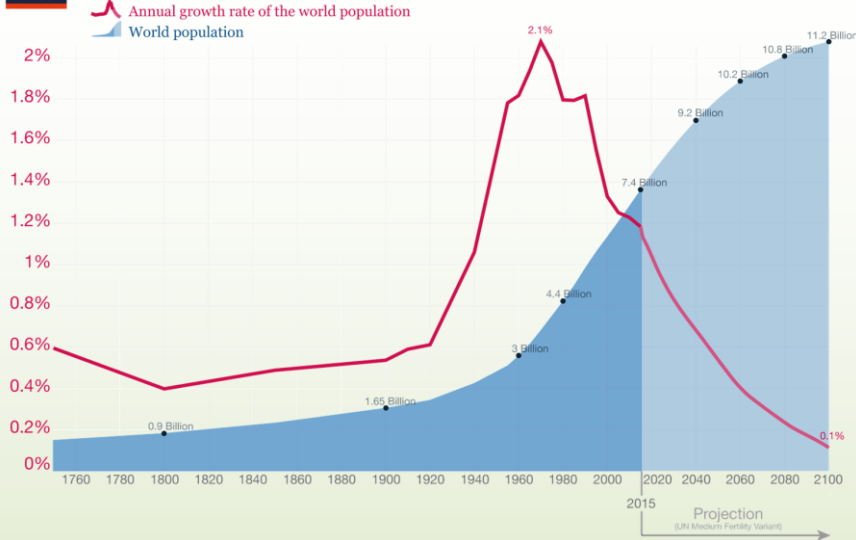
Update on Net Pens in WA State & Fish Health

Linda Rhodes
Island County Marine Resources Committee



IC MRC monthly meeting
4 December 2018

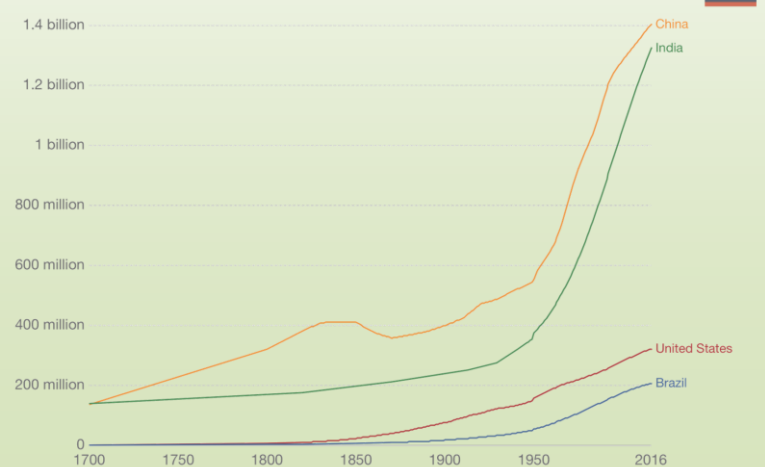
World population growth, 1750-2100



Data sources: Up to 2015 OurWorldInData series based on UN and HYDE. Projections for 2015 to 2100: UN Population Division (2015) – Medium Variant. The data visualization is taken from OurWorldInData.org. There you find the raw data and more visualizations on this topic. Licensed under CC-BY-SA by the author Max Roser.

DRIVERS: HUMAN POPULATION

Population by country



Source: Gapminder until 1949, UN Population Division from 1950-2016

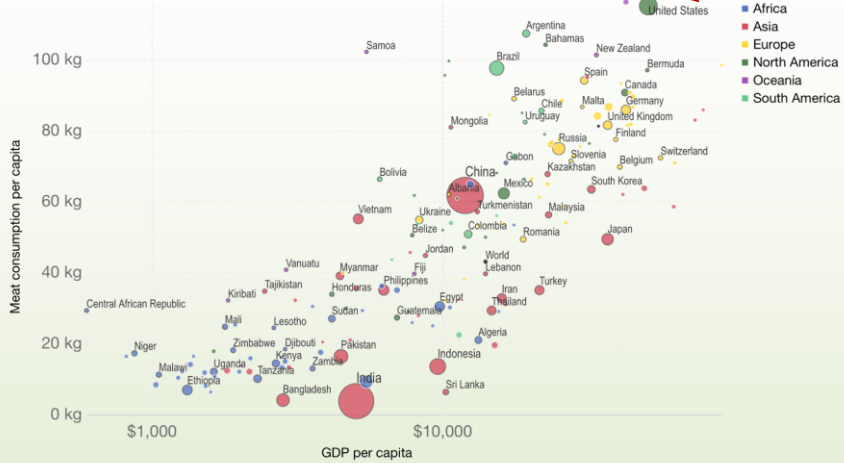
CC BY-SA

Max Roser and Esteban Ortiz-Ospina (2018) - "World Population Growth". Published online at [OurWorldInData.org](https://ourworldindata.org/world-population-growth). Retrieved from: 'https://ourworldindata.org/world-population-growth' [Online Resource]

Meat consumption vs. GDP per capita, 2013

Average meat consumption per capita, measured in kilograms per year versus gross domestic product (GDP) per capita measured in 2011 international-\$. International-\$ corrects for price differences across countries. Figures do not include fish or seafood.

OurWorld
in Data



Source: UN FAO; World Bank, World Development Indicators

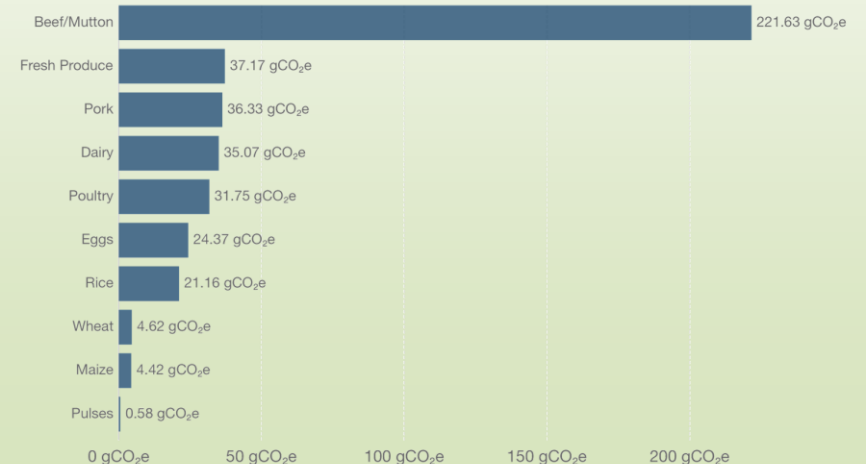
OurWorldInData.org/meat-and-seafood-production-consumption/ - CC BY-SA

DRIVERS: PROTEIN CONSUMPTION

Greenhouse gas emissions per gram of protein, by food type

Average greenhouse gas emissions per unit protein, by food type measured in grams of carbon dioxide equivalents (CO₂e) per gram of protein. Average values are based on a meta-analysis of studies across 742 agricultural systems and over 90 unique foods.

OurWorld
in Data

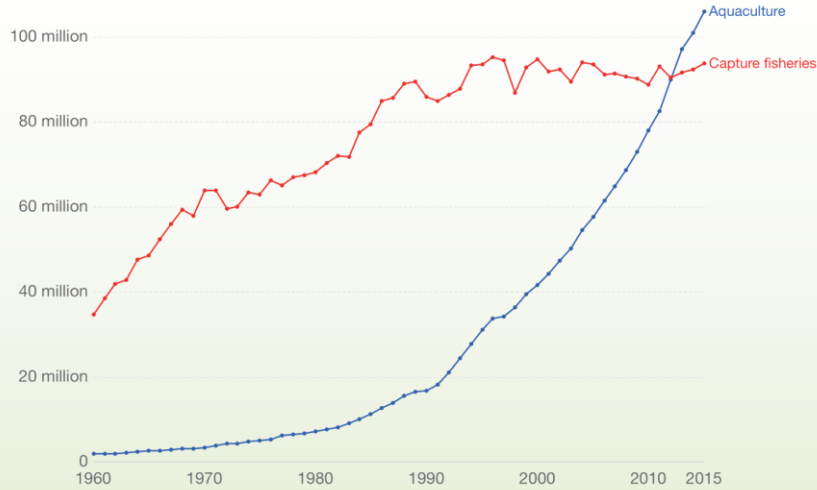


Source: Clark & Tilman (2017)

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Capture fisheries vs. aquaculture (farmed fish) production, World

Annual production of seafood from wild-catch fisheries and aquaculture (farmed seafood) practices, measured in metric tonnes per year. Data is inclusive of all aquatic species, including aquatic animals and plants.



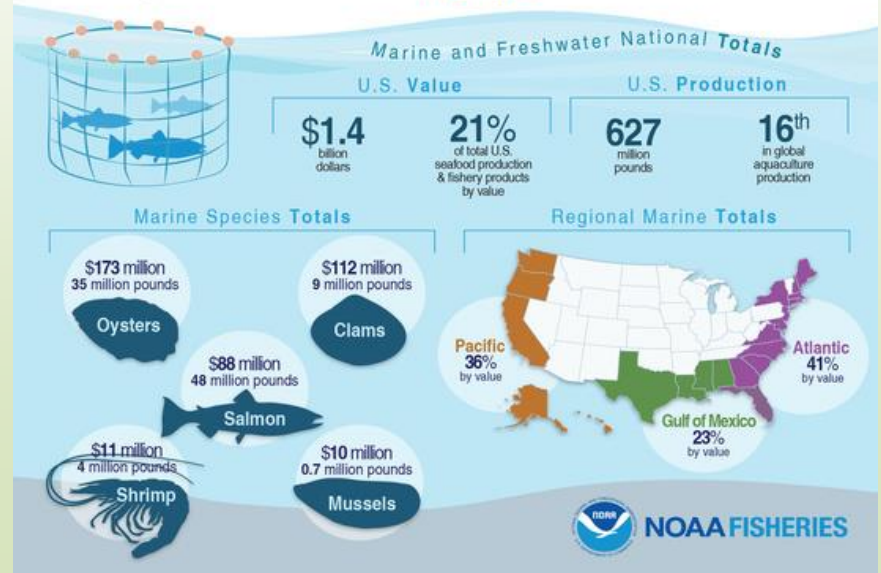
Source: World Bank- World Development Indicators

OurWorldInData.org/meat-and-seafood-production-consumption/ - CC BY-SA

Hannah Ritchie and Max Roser (2018) - "Meat and Seafood Production & Consumption". Published online at [OurWorldInData.org](https://ourworldindata.org/meat-and-seafood-production-consumption/). Retrieved from: 'https://ourworldindata.org/meat-and-seafood-production-consumption' [Online Resource]

AQUACULTURE AS A SOURCE OF PROTEIN

2015 Aquaculture Production Highlights



ATLANTIC SALMON RELEASES

1905 – 1935

8,000,000 deliberately released in BC

1995 - 2005

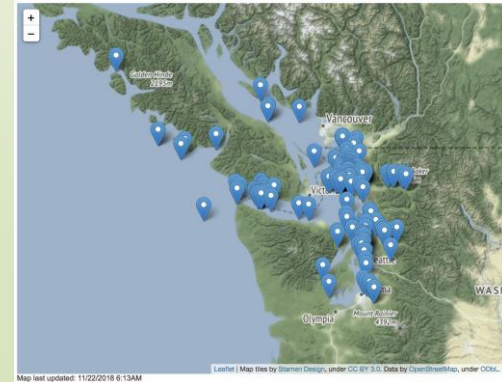
667,000 escapes from WA net pens

- 1951 – 1981:** WA Dept. Fisheries released approximately 76,000 smolts in an effort to establish naturally spawning populations. All attempts failed
- 1972:** First Atlantic salmon farm on the Pacific Coast established by NOAA at Manchester
- 1982:** Atlantic salmon farms in Washington large enough to be economically viable
- 1996:** 107,000 Atlantic salmon escape net-pen
- 1997:** 369,000 Atlantic salmon escape net-pen
- 1999:** 115,000 Atlantic salmon escape net-pen
- 2016:** Cooke Aquaculture purchases Icicle Seafoods and runs existing net-pens as Cooke Aquaculture Pacific
- August 2017:** 160,000 Atlantic salmon escape Cypress #2 net-pen

ATLANTIC SALMON DETECTIONS

Time	Survey Type(s)	# Detected
2003 – 2008	Snorkel surveys in 35 rivers	152 (all but 3 from below Scatter Creek)
December 2008	Fishermen (commercial & recreational)	3
May – December 2008	Foot surveys (n = 24)	0
May – December 2008	Snorkel & electrofishing surveys (93 in 26 rivers)	0

- In the August 2017 Cypress Island netpen collapse, >200,000 (out of 305,000) fish were unaccounted.
- As of November 2018, 1965 have been captured by recreational & commercial fisheries.



Cooke's fish farms in Washington

Cooke Aquaculture Pacific owns eight operations in four locations in Washington.

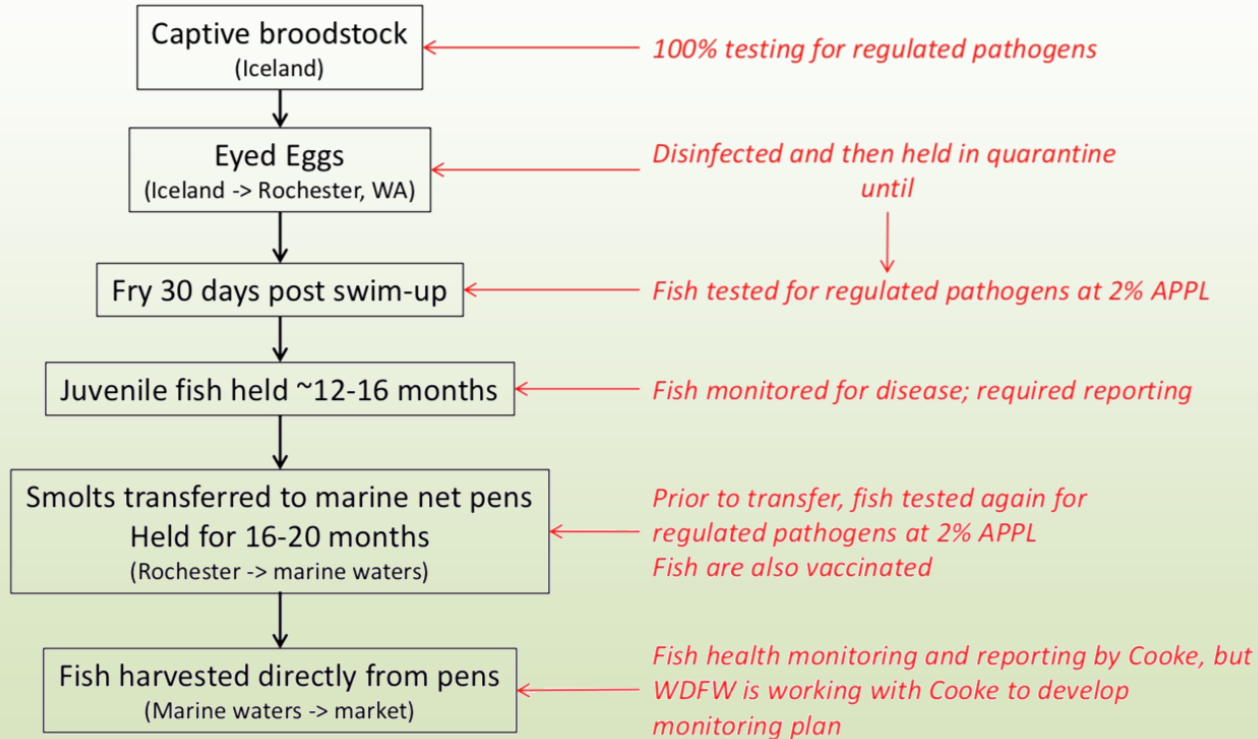


- Colonization
- Competition
- Hybridization
- Predation
- Disease Transfer

ATLANTIC SALMON RISKS

- **Colonization:** no evidence of successful spawning
- **Competition:** no observations of eating fish or eggs, empty stomachs
- **Hybridization:** difficult under lab conditions, sterile offspring
- **Predation:** no evidence in freshwater, limited evidence in seawater
- **Disease Transfer:** no evidence of transfer, all detected pathogens are endemic to NW

Life cycle of commercial net pen Atlantic salmon (Cooke Aquaculture in Puget Sound)



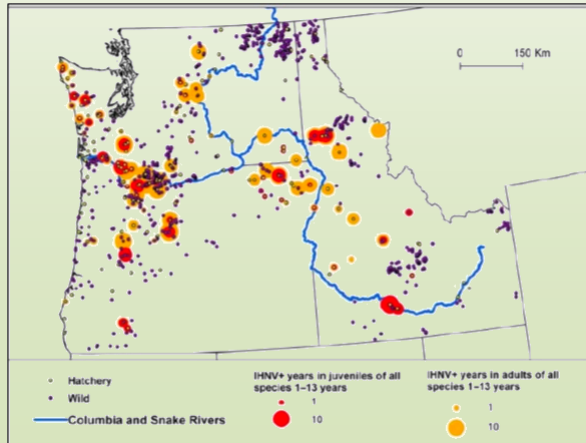
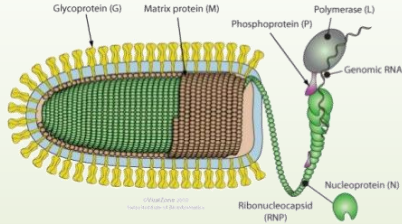
INFECTIOUS HEMATOPOIETIC NECROSIS VIRUS (IHNV)

Aetiological agent

Agent strains

The fish rhabdovirus, IHNV, has a bullet-shaped virion containing

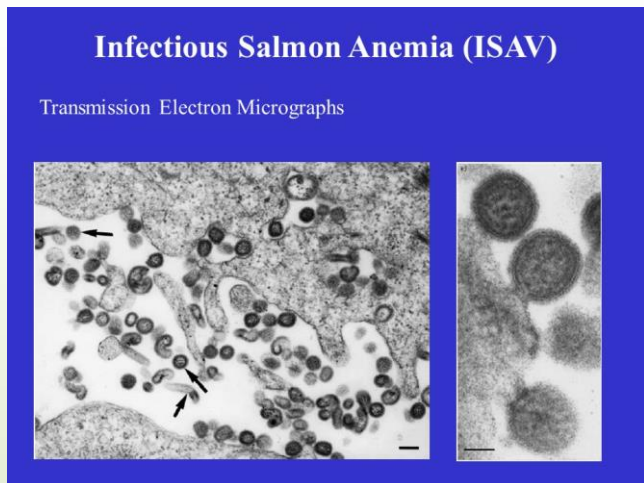
- ❖ a non-segmented,
- ❖ negative-sense,
- ❖ single-stranded RNA genome



Breyta et al. 2017

- Regulated pathogen – required testing prior to any transport
- Sockeye, rainbow, steelhead, Chinook most affected species
- Wide geographic distribution - Puget Sound, Columbia River, WA coast
- 2012 outbreak at Bainbridge Island (Rich Passage) farm
- Most likely transmitted from free-ranging sockeye to Atlantic salmon

INFECTIOUS SALMON ANEMIA VIRUS (ISAV)



- Regulated pathogen – required testing prior to any transport
- Severe disease in Atlantic salmon in Atlantic states
- 2011 claim of ISAV detection in BC Pacific salmon
- Senator Cantwell: survey of Pacific salmon for ISAV

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University Communications / Media Releases / Media Releases 2011 / Lethal Atlantic Virus found in Pacific Salmon

MEDIA RELEASE

Lethal Atlantic Virus found in Pacific Salmon

European Strain of ISA virus threatens North Pacific salmon and herring

October 17, 2011

Environment | Local News | Local Politics

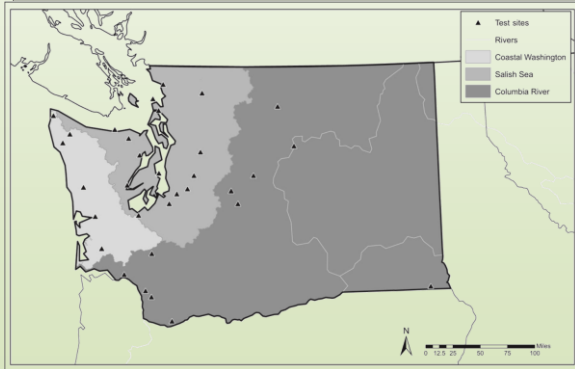
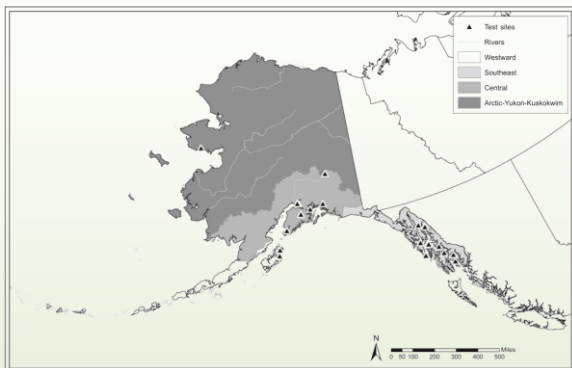
Sen. Cantwell wants U.S. to confirm salmon virus

Originally published November 2, 2011 at 10:24 am | Updated November 2, 2011 at 1:09 pm

U.S. Sen. Maria Cantwell is calling on the National Oceanic and Atmospheric Administration to independently confirm the presence of a deadly virus found in two Pacific salmon in British Columbia.

INFECTIOUS SALMON ANEMIA VIRUS (ISAV)

- Multi-agency (USDA, WDFW, ADF&G, NWIFC, USFWS, USGS, NOAA)
- 3.5 years of sampling
- ~5,000 fish, 5 species of Pacific salmon + steelhead + Atlantic salmon + herring
- **ZERO (0) detections of ISAV**



A systematic surveillance programme for infectious salmon anaemia virus supports its absence in the Pacific Northwest of the United States

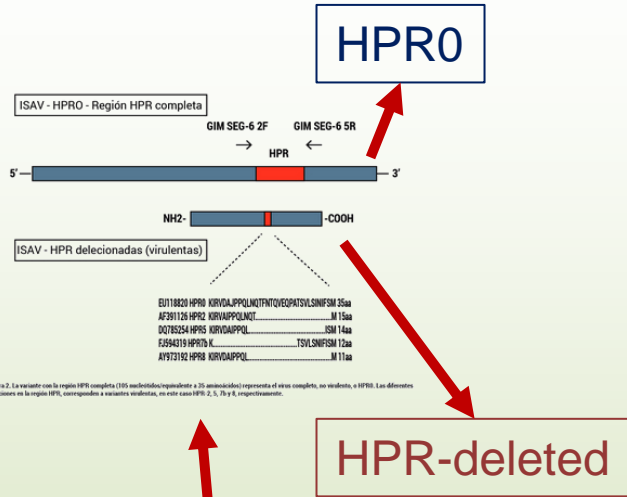
Journal of Fish Diseases

By: Lori L. Gustafson, Lynn H. Creekmore, Kevin R. Snekvik, Jayde A. Ferguson, Janet V. Warg, Marilyn Blair, Theodore R. Meyers, Bruce Stewart, Kenneth I. Warheit, John Kerwin, Andrew E. Goodwin, Linda D. Rhodes, Janet E. Whaley, Maureen K. Purcell, Collette Bentz, Desiree Shasa, Joel Bader, and James R. Winton

<https://doi.org/10.1111/jfd.12733>



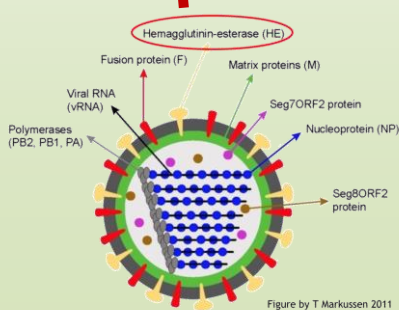
ISAV MOLECULAR BIOLOGY



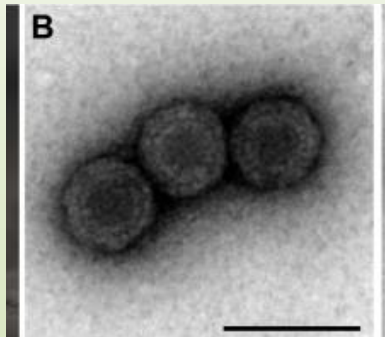
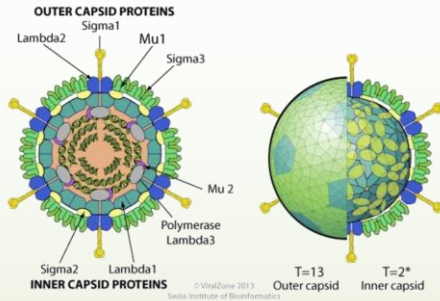
OIE Findings

- HPR-deleted causes acute disease
- HPR0 does not cause acute disease
- HPR0 causes transient subclinical infection
- No evidence for infection or replication in species other than Atlantic salmon
- Most likely HPR-deleted derived from HPR0
- Both variants are reportable by OIE

OIE = World Organisation for Animal Health



PISCINE ORTHOREOVIRUS VIRUS (PRV)



- Associated with disease in farmed Norwegian salmon, Heart-Skeletal Muscle Inflammation (HSMI)
- HSMI not reported in any wild salmonids
- PRV genetic material in wild & cultured Pacific salmon, but no HSMI
- PRV genetic material present in Pacific NW salmon BEFORE Atlantic salmon aquaculture (1977)
- Presence of PRV genetic material is insufficient evidence for HSMI

PISCINE ORTHOREOVIRUS VIRUS (PRV)

Species	Region	# Pops Tested	# Pops Positive	# Individ. Tested	# Individ. Positive	% Individ. Tested
Chinook	Col. R	6	4	64	7	11%
	PS & SJF	10	2	153	10	7%
	WA Coast	5	0	90	0	0%
Chum	Col. R	0	0	0	0	na
	PS & SJF	7	0	115	0	0%
	WA Coast	3	0	65	0	0%
Coho	Col. R	5	3	75	4	5%
	PS & SJF	5	2	70	5	7%
	WA Coast	8	6	135	13	10%
Pink	Col. R	0	0	0	0	na
	PS & SJF	7	1	115	1	<1%
	WA Coast	0	0	0	0	na
Sockeye	Col. R	2	0	60	0	0%
	PS & SJF	4	0	95	0	0%
	WA Coast	5	0	110	0	0%
Steelhead	Col. R	9	1	145	1	<1%
	PS & SJF	3	0	100	0	0%
	WA Coast	8	0	130	0	0%
TOTALS		87	19 (22%)	1522	41	2.6%

PISCINE ORTHOREOVIRUS VIRUS (PRV)

PRV-1

1a Norwegian & BC Atlantic salmon
WA & AK Pacific salmonids
Chilean farmed coho

1b Chilean Atlantic salmon
Chilean farmed coho

PRV-2 Japanese farmed coho

PRV-3 Chilean farmed coho
Norwegian farmed rainbow trout

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE [Print Version](#)

NEWS RELEASE

600 Capitol Way North, Olympia, WA 98501-1091

May 17, 2018

Contact: Ken Warheit, 360-902-2595

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**WDFW denies permit for company to place 800,000
Atlantic salmon into Puget Sound net pens**

Icelandic strain

Did not match existing PRV-1

WDFW now includes PRV testing

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE [Print Version](#)

NEWS RELEASE

600 Capitol Way North, Olympia, WA 98501-1091

August 28, 2018

Contact: Ken Warheit, 360-902-2595

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**WDFW authorizes transfer of
Atlantic salmon into net pens**

WHAT ARE THE CANADIANS DOING?

- Active research on impacts of aquaculture
- Regular monitoring (audits) of farms for fish health
- Formal risk assessments -> policy documents



The screenshot shows the official website of Fisheries and Oceans Canada. The page is titled "Program for Aquaculture Regulatory Research (PARR)". It features a navigation menu with categories like "On the water", "Fisheries", "Science and research", "Ecosystems", "Species", "Aquaculture", and "Regions". The main content area includes a description of the PARR program, its research priorities, and a list of research themes. A "Services" sidebar on the right offers links to "Find research projects" and "Find technical project facts sheets".

Government of Canada / Gouvernement du Canada | Canada.ca | Services | Departments | Français

Fisheries and Oceans Canada

Canada

On the water | Fisheries | Science and research | Ecosystems | Species | Aquaculture | Regions

Home → ... → Aquaculture science and research

Program for Aquaculture Regulatory Research (PARR)

The Program for Aquaculture Regulatory Research (PARR) funds research that advances our understanding of the interactions between aquaculture and the aquatic environment. The program is designed to increase our scientific knowledge and inform regulatory decision making and policy development.

Services

- [Find research projects](#)
- [Find technical project facts sheets](#)

Research priorities

The research priorities are driven by regulatory needs and knowledge gaps. This includes gaps identified in the [Aquaculture Pathways of Effects report](#). This report describes the links between aquaculture activities and their impacts on the aquatic environment.

What we do

Our main activities include:

- coordinating and conducting aquaculture research to fulfill regulatory needs and fill information gaps
- assessing risks between aquaculture activities and changes in the environment
- providing science advice to government for developing aquaculture policy and regulations
- sharing research results with government, aquaculture industry, Indigenous groups, non-governmental organizations and the public

Research themes

We fund research for the following 5 themes.

- [Fish pest and pathogen treatment and management](#)
 - This research helps us understand aquaculture diseases and pests, and their control treatments.
 - This includes how on-farm infections develop and spread.
- [Interactions with wild populations](#)
 - This research helps us understand the ecological and genetic interactions between farmed and wild fish.