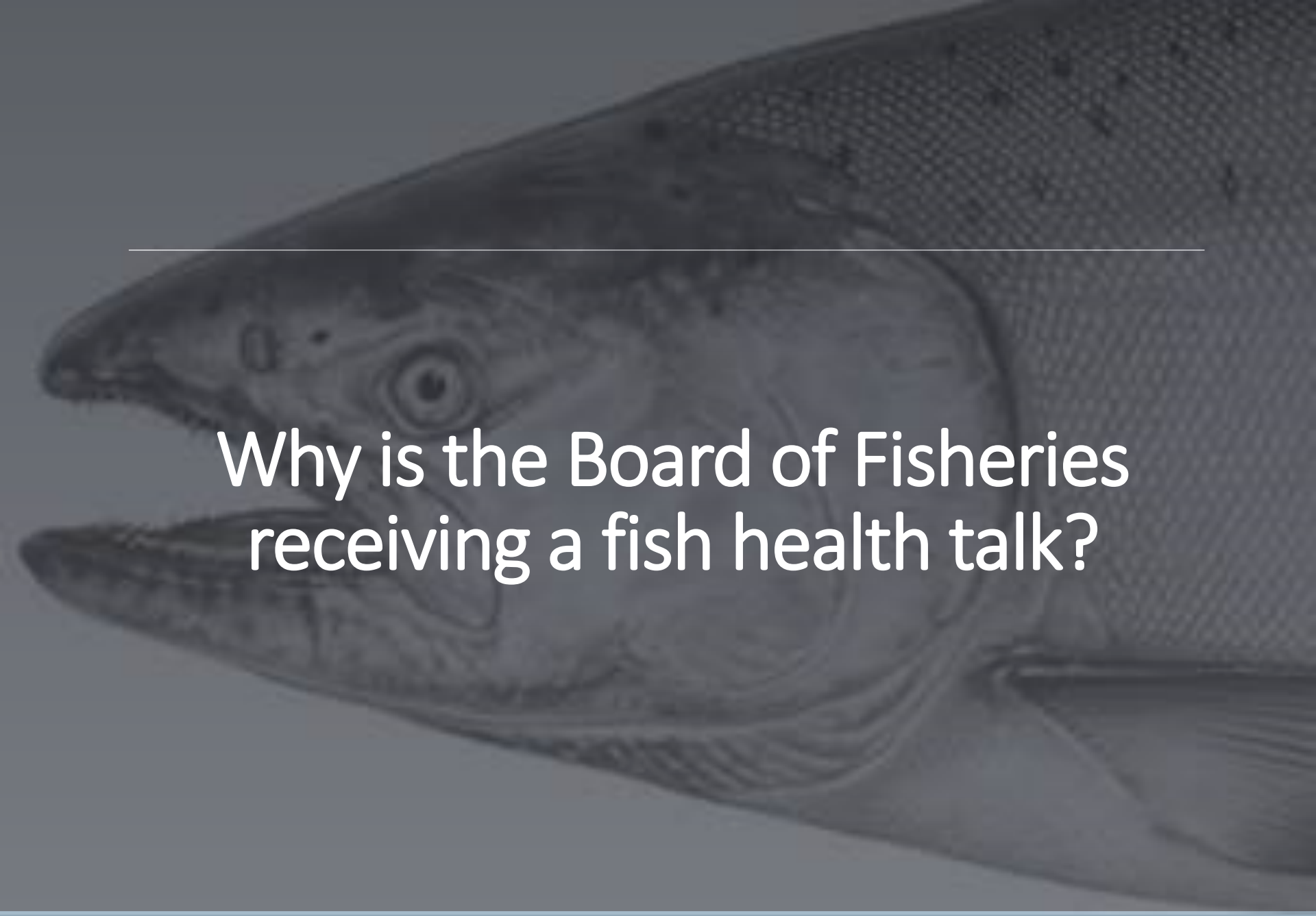
Investigating the impacts of *Ichthyophonus* on Yukon River Chinook Salmon

Report to the Alaska Board of Fisheries

Presented by
Zachary Liller – AYK Region Research Coordinator
Jayde Ferguson – ADF&G Fish Pathologist

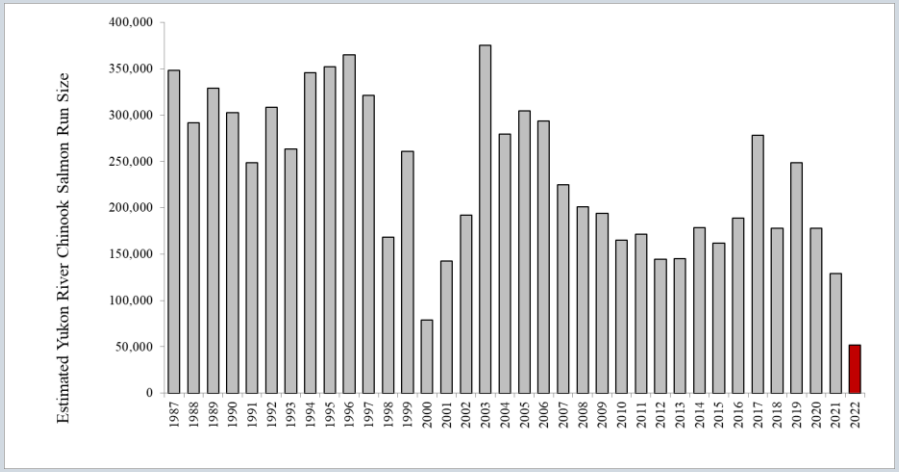
Oral report: RC 3 Tab 9



Why is the Board of Fisheries receiving a fish health talk?

Fish Health has Implications for run size, harvest opportunity, and escapement goal performance

Yukon River Chinook salmon total run (all stocks)



Escapement goal performance

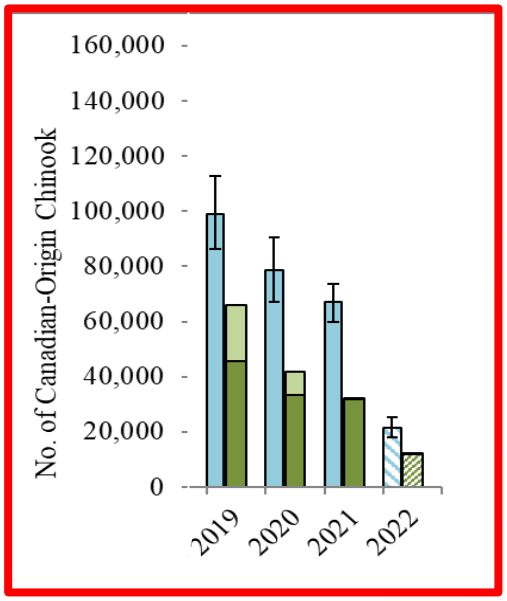
	Goal range		Escapement			
River	Lower	Upper	2019	2020	2021	2022
EF Andreafsky R.	2,100	4,900	5,134	NS	1,454	NS
WF Andreafsky R.	640	1,600	904	508	NS	NS
Anvik R.	1,100	1,700	1,432	675	NS	179
Nulato R.	940	1,900	1,141	862	NS	60
Chena R.	2,800	5,700	2,404	NS	1,416	355
Salcha R.	3,300	6,500	4,863	NS	2,081	1,041
U.S./Canada	42,500	55,000	42,052	30,967	31,452	*12,025

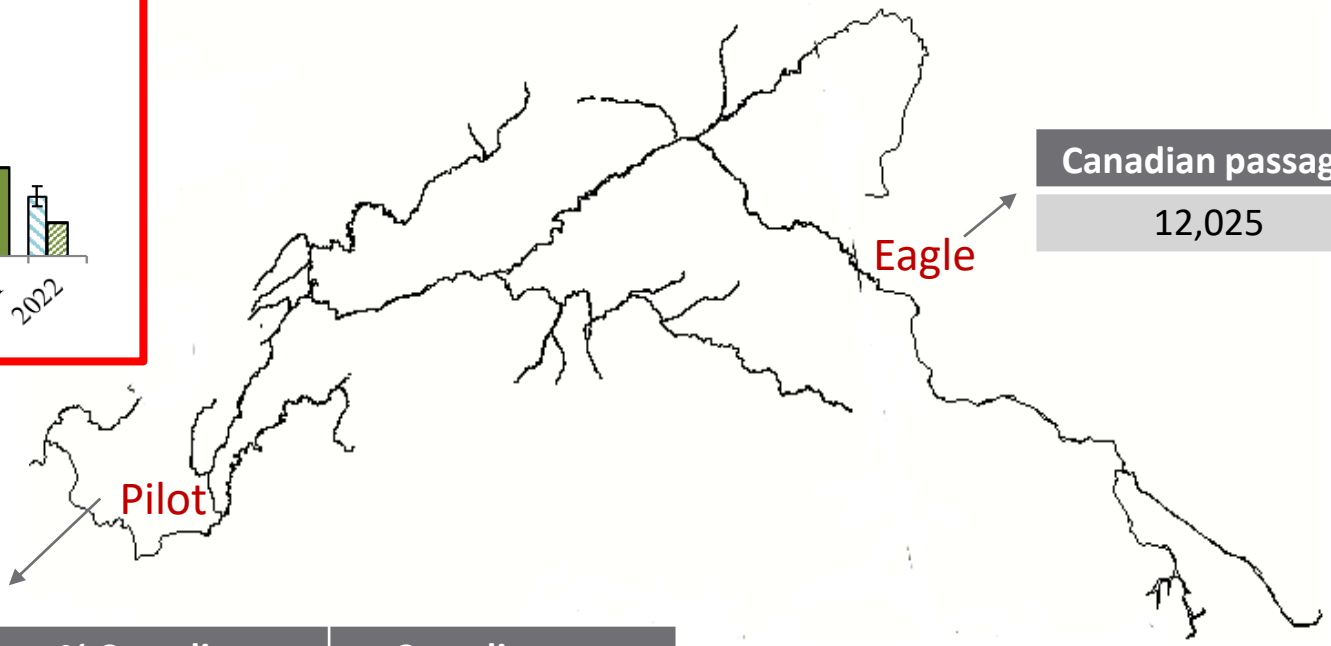
above lower bound
below lower bound
No survey

Over the past four years: 2019 – 2022

- *Variable run sizes*
- *Record low run size in 2022*
- *Poor escapement goal performance*

Four Consecutive Years of "Difference Between Estimates"





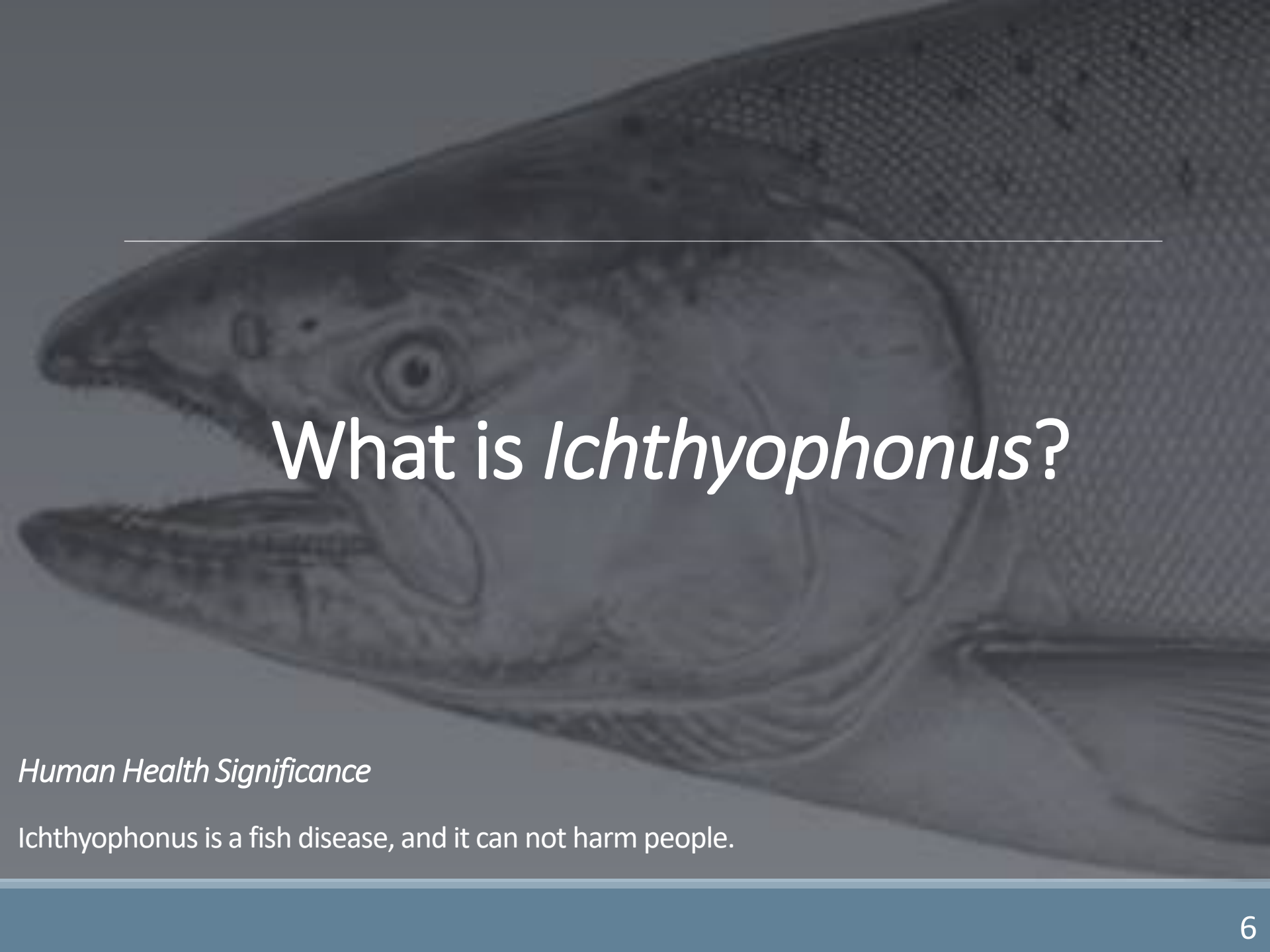
Canadian passage
12,025

All Stocks	% Canadian	Canadian run
48,439	45%	21,648 ± 5,000

Ichthyophonus can display as white spots or streaks in a salmon fillet

Outline

1) What is *Ichthyophonus*?
2) What is known about *Ichthyophonus* and Yukon River Chinook Salmon?
3) What have we learned from our 2022 sampling efforts.
4) What are the plans moving forward?



What is *Ichthyophonus*?

Human Health Significance

Ichthyophonus is a fish disease, and it can not harm people.

Cause of Infection and Transmission

**Ichthyophonus is a naturally occurring parasite

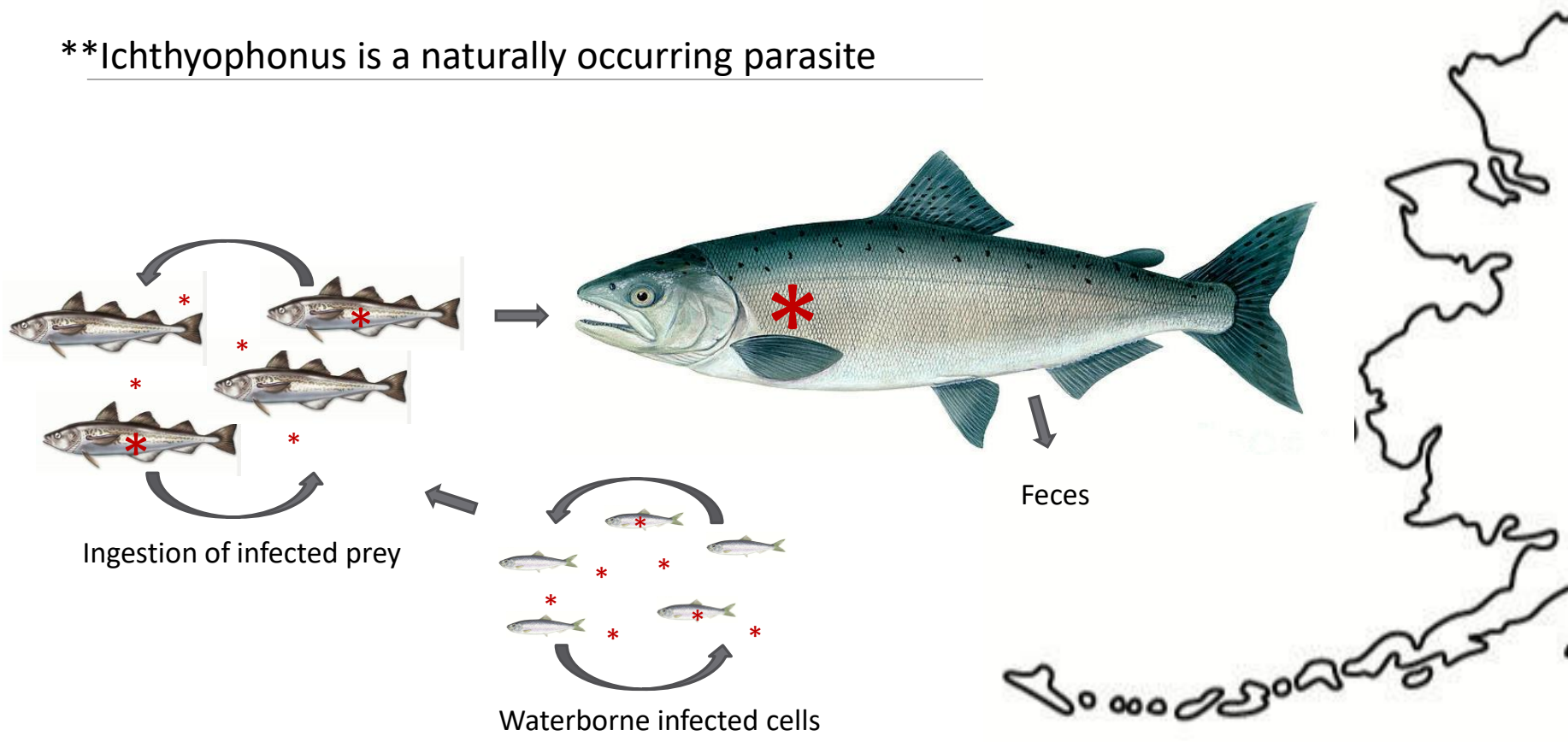
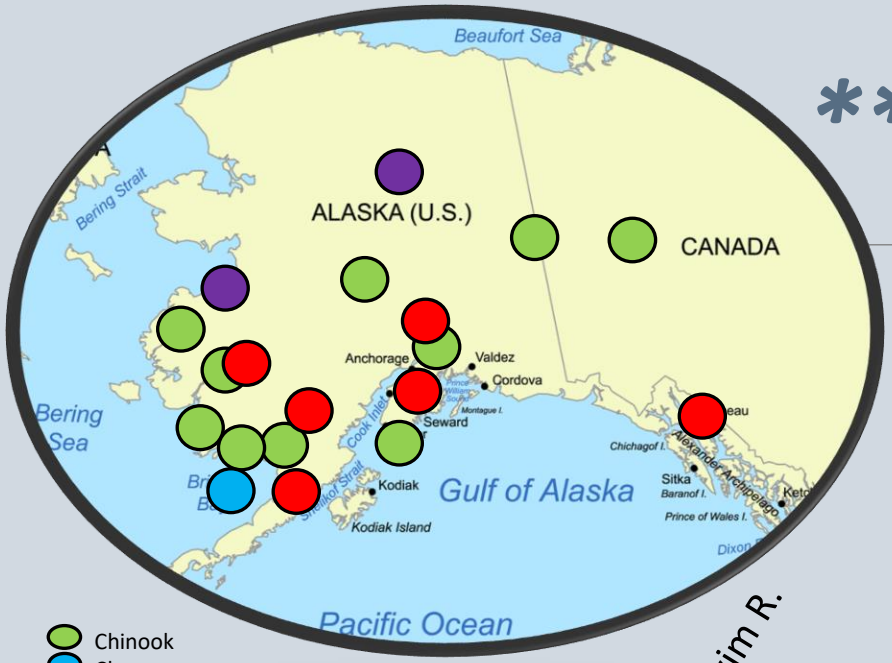


Photo credit: Chinook Carlyn Iverson
Herring: Scandinavian Fishing Yearbook
Pollock: NOAA FishWatch
Diagram modified from Kocan et al. 2004

**Host Species - Alaska



1988 – Chinook, Yukon R.
1989 – Chinook, Kuskokwim R.
1993 – Herring, Douglas
– Sockeye, Chilkat R.
1998 – Chum, Yukon R.
2001 – Coho, Big Cr.
2003 – Saffron Cod, Seward
2005 – Burbot, Yukon R.
– Black Rockfish, Sitka S.
2011 – Pacific Halibut, Homer
2019 – American Shad, Kodiak
2020 – Dolly Varden, Nome
– Atka Mackerel, Bering Sea
– Walleye Pollock, Seward

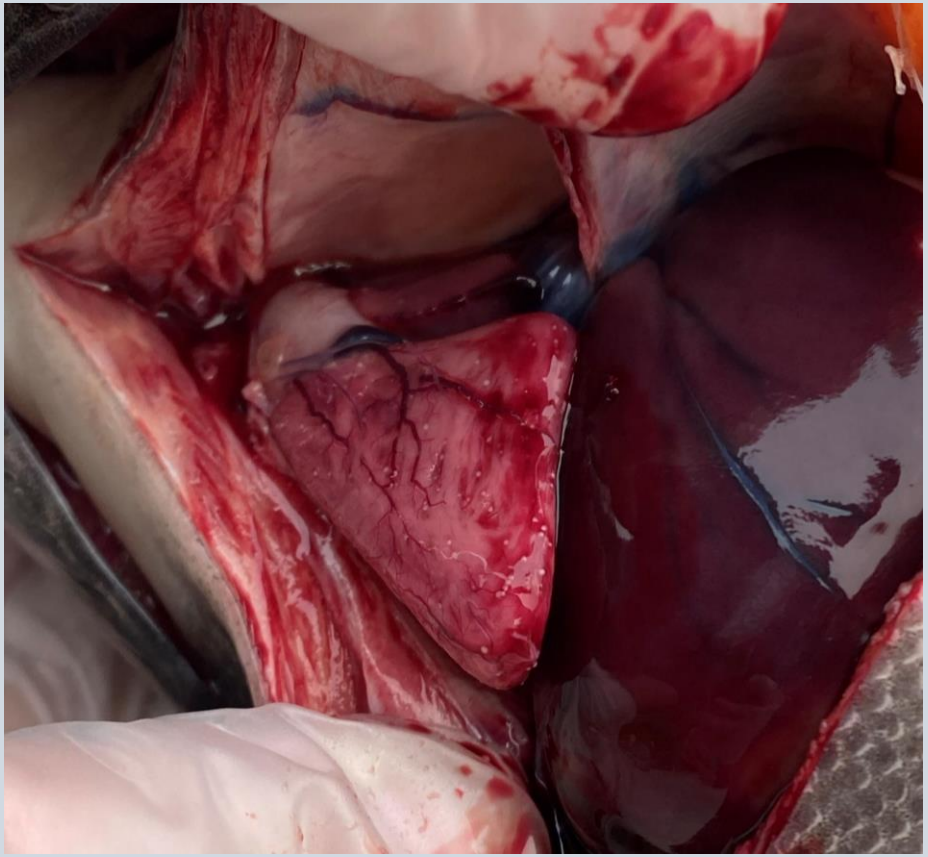
Timeline of first recorded** *Ichthyophonus* infections

** Opportunistic samples evaluated by ADF&G Pathology Lab.

Meat has white “streaks” &” fruity” smell

Blood organs have white spots

Visual signs of infection

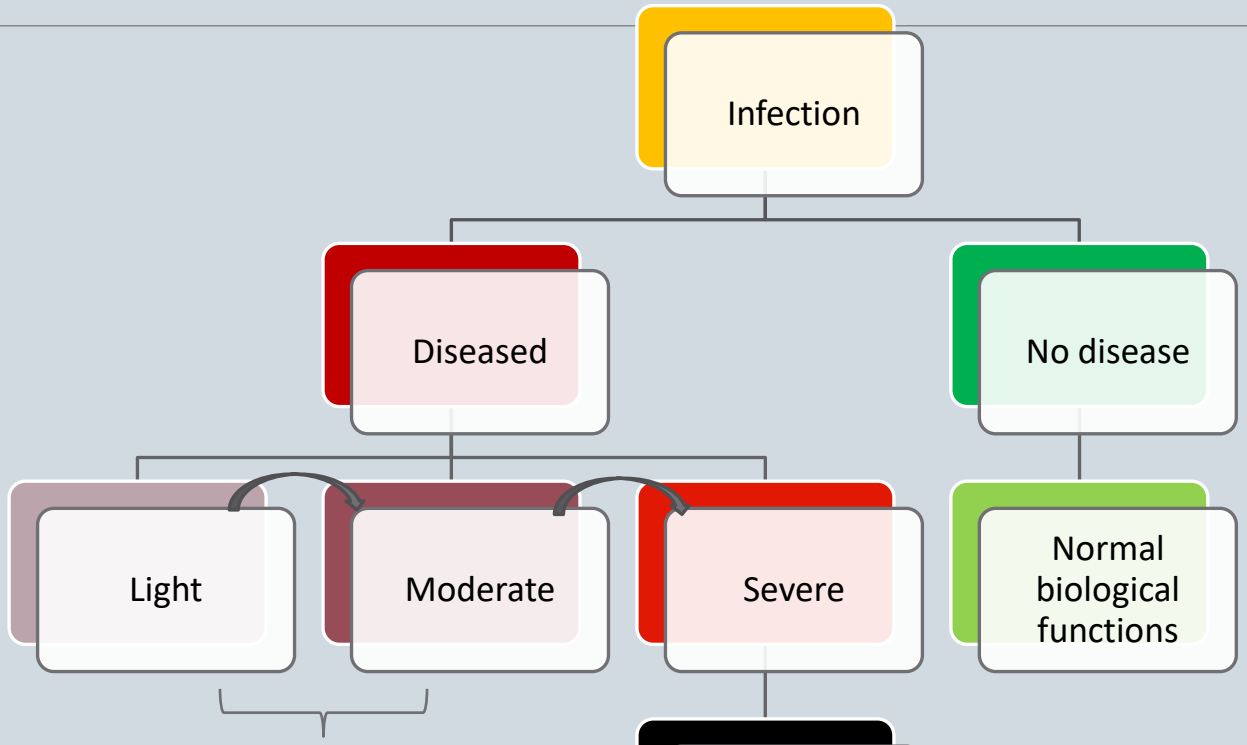


LABORATORY EXAMINATION OF TISSUE (TYPICALLY THE HEART) IS REQUIRED TO DIAGNOSE ICHTHYOPHONUS

THERE ARE CURRENTLY NO NON-LETHAL METHODS AVAILABLE

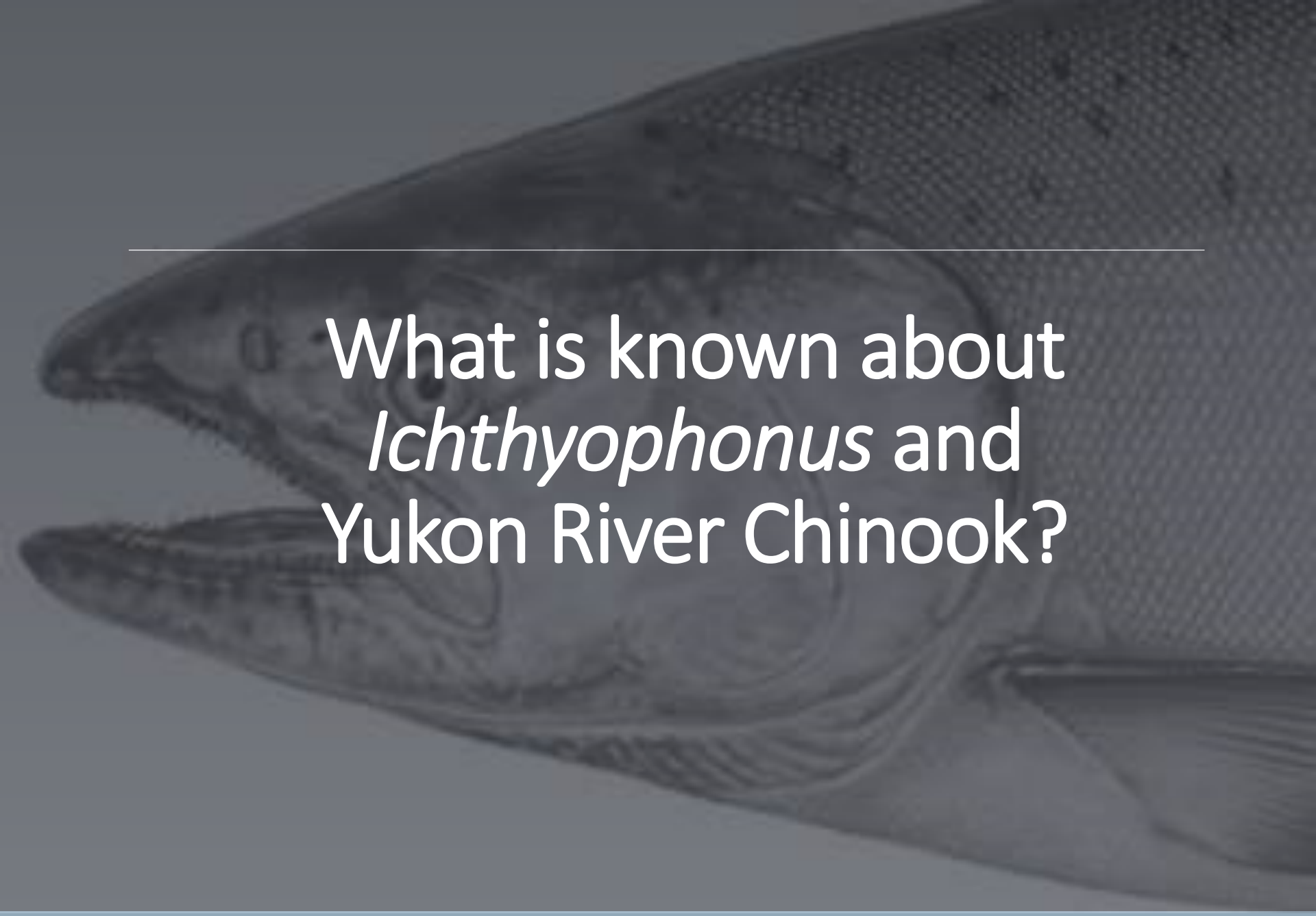
Diagnosis - infection is not the same as diseased

Prognosis for host



Compromised biological functions:

- Cardiac stress ⬆
- Plasma cortisol levels ⬆
- Hemoglobin and red blood cells ⬇
- Swimming speed ⬇



What is known about *Ichthyophonus* and Yukon River Chinook?

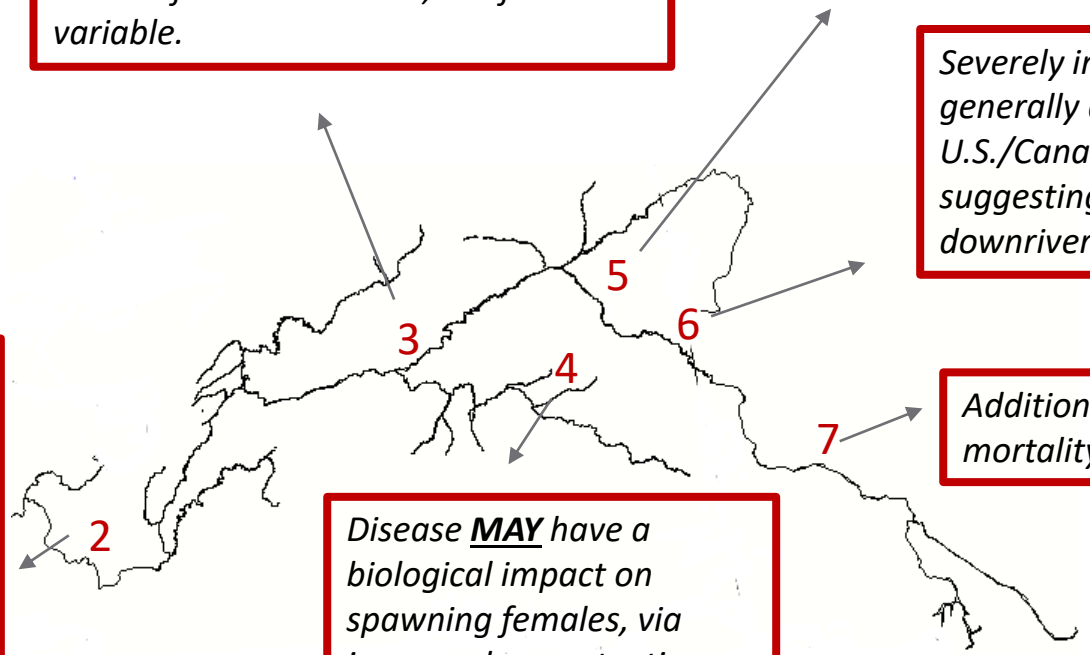
Local and Western Knowledge

Disease severity "peaks" midriver, and Chinook display visible signs of infection. Severity of infection increases throughout the run and progresses faster in warm water. Fish do not recover from the disease, but fates are variable.

Harvested Chinook near Ft. Yukon rarely have visible signs of disease.

Infection occurs though consumption of unknown infected prey in the marine environment.

Severely infected fish are generally absent at the U.S./Canada border – suggesting en route mortality downriver.



Fish enter the Yukon River with a set number of infections, but most infected fish are not yet "diseased". Infected Chinook rarely have visible signs of disease and only sensitive lab tests can detect "lightly infected" fish.

Additional pre-spawning mortality in Canada is likely.

*Disease **MAY** have a biological impact on spawning females, via increased egg retention.*

What sampling was done in 2022?

ADF&G & USFWS collaboration

with support by local fishers and communities.

PROJECT OBJECTIVES

√ Develop an annual *Ichthyophonus* monitoring program and build a new predictive tool capable of providing timely information * about the level of Chinook salmon mortality associated with *Ichthyophonus* disease.

√ If after years of development this project is successful, it will provide necessary information to encourage precautionary management when disease levels are high and allow for a better management and protection of Chinook salmon for years to come.

*** Anticipated three-year effort to develop these new tools and actionable advice.**

Study Design

Pilot Station Sonar

1) Proposed site of a future annual *Ichthyophonus* monitoring location.
2) Fish arrive with infections
3) Severity of infections at this site MAY provide information about disease progression and mortality upriver.

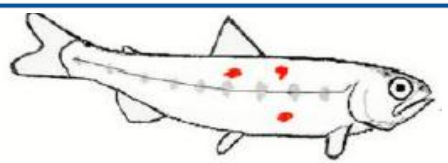
Rapids

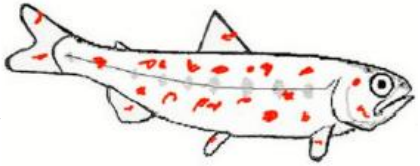
1) Located mid-river.
2) Infection reaches "max" before fish die.
3) Samples over the next 3 years are needed to understand disease progression "rate" upriver from Pilot Station.

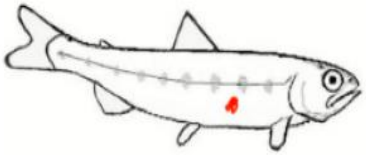
Eagle

1) Measures infection in "survivors" to Eagle.
2) Samples over the next 3 years are needed to measure the "die-off" of infected fish between Rapids and Eagle.
3) Estimate a "lethal threshold".

Eagle Samples are Critical



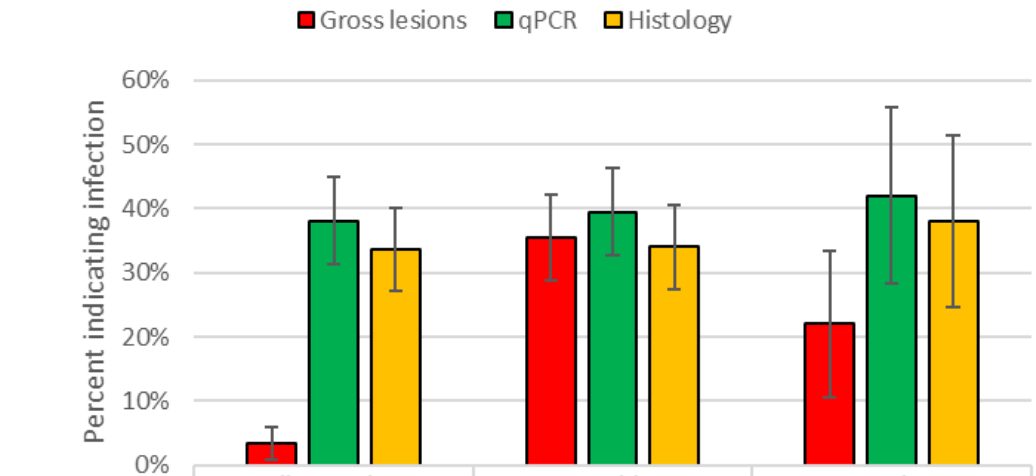




Sacrifice ***200*** representative samples at three locations and develop statistical associations that will allow us to estimate mortality

What was learned from the 2022 sampling?

Percentages of Chinook salmon with Ichthyophonus infections

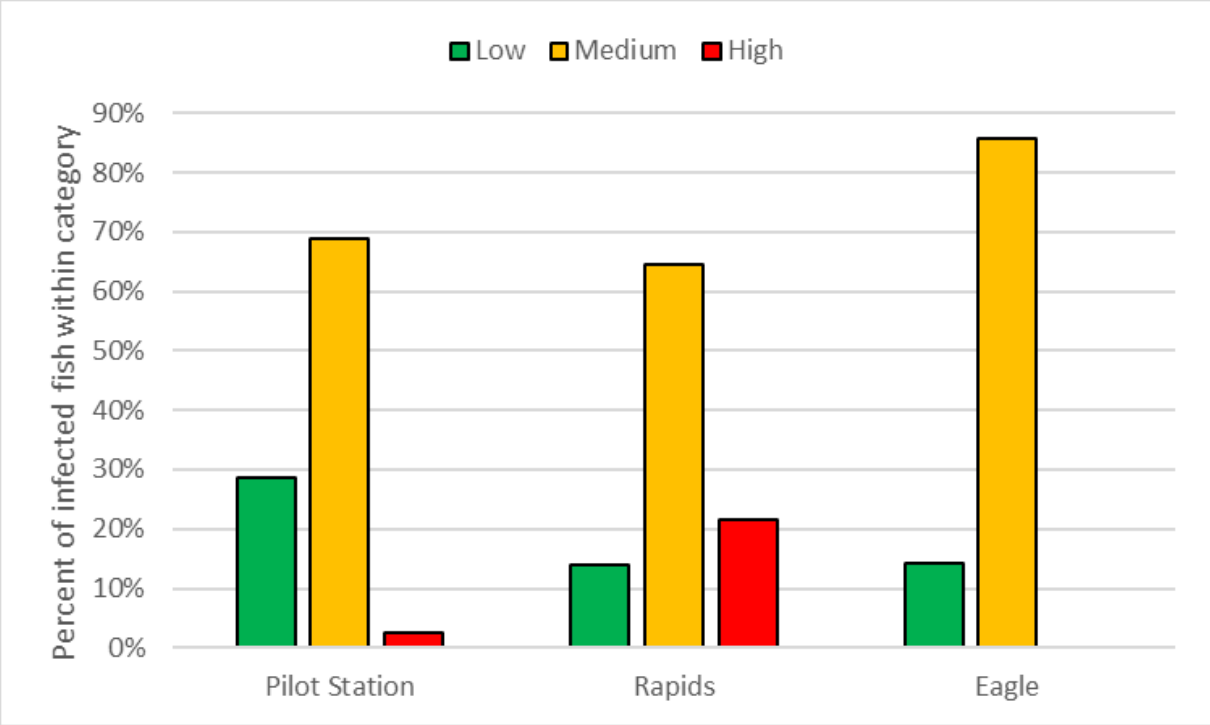


	Pilot Station	Rapids	Eagle
Gross lesions	3%	36%	22%
qPCR	38%	40%	42%
Histology	34%	34%	38%
Sample size	202	200	**50**

Preliminary Conclusions

- Lab methods produced similar results and were more sensitive than visual (i.e., gross) examination of lesions.
- Ichthyophonus infections were prevalent at all locations at very high levels.

Percentage of infected fish by severity category



Vs.

No visible infection

Visible infection

Preliminary Conclusions

- Disease severity and percentage of heavily infected fish increased significantly between Pilot Station and Rapids.
- There were no heavily infected fish detected at Eagle, which is suggestive that heavily infected fish died *en route*.

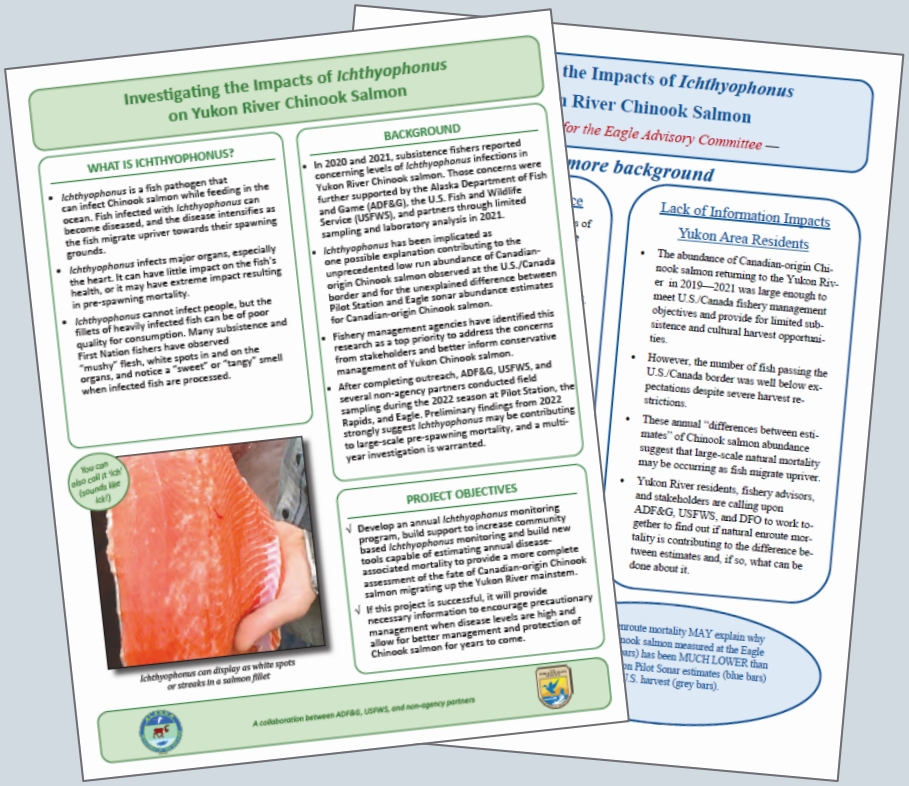
General Impressions based on preliminary findings

- Ichthyophonus infection and disease impacted the 2022 run of Yukon River Chinook salmon.
- Prevalence of infection was one of the highest recorded for Yukon River Chinook salmon.
- Disease progression followed expected patterns between sample locations.
- It is premature to conclude that the observed "difference between estimates" in 2022 was caused by Ichthyophonus-associated *en route* mortality, but ***it remains a leading hypothesis***.

Plans Moving Forward

Analysis and reporting of 2022 results, preparation for 2023 and 2024 sampling, and community outreach

Informational Flyers



Meeting Presentations

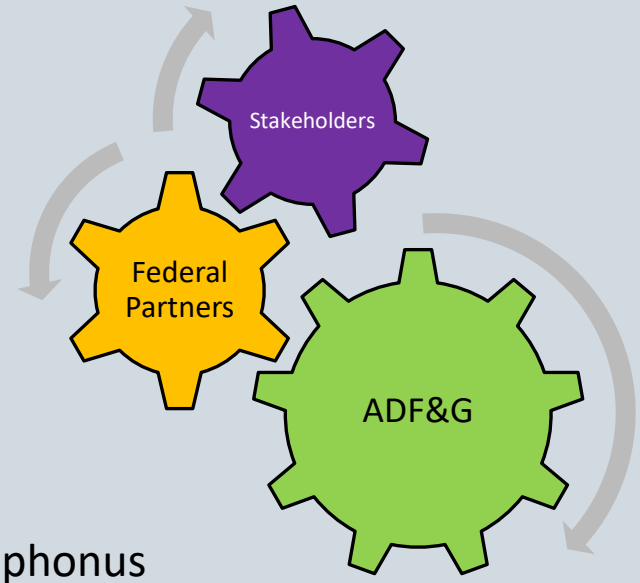
- SOA Advisory Committees
- Federal Regional Advisory Committees
- Yukon River Panel, Joint Tech Committee
- Yukon River Panel
- Alaska Board of Fisheries
- YRDFA
- Other venues upon request..

Closing Thoughts

A truly collaborative effort

The Ichthyophonus investigation is one important piece of a broader multi-agency effort to understand what is driving the poor abundance of Yukon River Chinook salmon stocks.
Other programs include:

- Marine surveys
- Analyses of environmental correlations
- Drainagewide radio telemetry studies
- Egg thiamine investigations
- Female fecundity data collection
- Heat stress evaluations
- Freshwater life history (otolith microchemistry)
- Feasibility of non-lethal methods to screen for Ichthyophonus
- General health screening



We acknowledge

- There is a broad range of support for this work. Some stakeholders have provided encouragements and others have requested we stop until run sizes rebound
- Lethal sampling when run sizes are at record low levels and fisheries are closed is unpopular and often controversial.
- The decision to undertake this study was made thoughtfully and intentionally.
- We believe this project is necessary so we can quantify the biological impact of this disease and provide responsible and actionable advice to fishery managers.

Acknowledgements

Project leaders

ADF&G:

- Jayde Ferguson
- Fred West
- Zachary Liller

USFWS:

- Holly Carroll
- Keith Ivy
- Scott Walter

Project partners

- Stan Zuray
- Dr. Richard Kocan
- Eagle Tribe

Thanks to field staff who led the daily operations and sampling at Pilot Station Sonar, Rapids fishwheel, and Eagle sonar

Thank you to all the community members who attended preseason planning and inseason outreach meeting to offer perspectives on this work.

Questions

Contact us if you have any comments or questions!

FRED WEST

Summer Season Yukon Area Research Biologist - ADF&G

(907) 267-2237
fred.west@alaska.gov

JAYDE FERGUSON, Ph.D.

Fish Pathologist (AFS/FHS certified) - ADF&G

(907) 267-2394
jayde.ferguson@alaska.gov

SCOTT T. WALTER, Ph. D.

Fishery Biologist – USFWS

(907) 456-0218
Scott_walter@fws.gov

KEITH HERRON IVY

Fishery Biologist - USFWS

(907) 312-3397
keith_ivy@fws.gov

Zachary W. Liller
Research Coordinator
Arctic-Yukon-Kuskokwim Region
Alaska Dept of Fish and Game
Division of Commercial Fisheries
Phone (907) 267-2135