

# How Warm is Too Warm? Growth Impacts of Thermal Stress on Juvenile Chinook and Coho Salmon in the Deshka River

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# BACKGROUND

- Climate warming is happening fastest at high latitudes such as Alaska.
- Chinook populations are declining with many drivers unknown.
- How are these warm freshwater conditions effecting juvenile Chinook and Coho?



## PRESS RELEASE

**FOR IMMEDIATE RELEASE:**

July 10, 2019

**MORE INFORMATION:**

Sue Mauger, Science Director (907.399.2070)  
Brandon Hill, Chief Creative Officer (207.632.0861)

### HEAT WAVE HITS COOK INLET SALMON STREAMS

*Climate Crisis Sends Stream Temperatures Off the Charts*

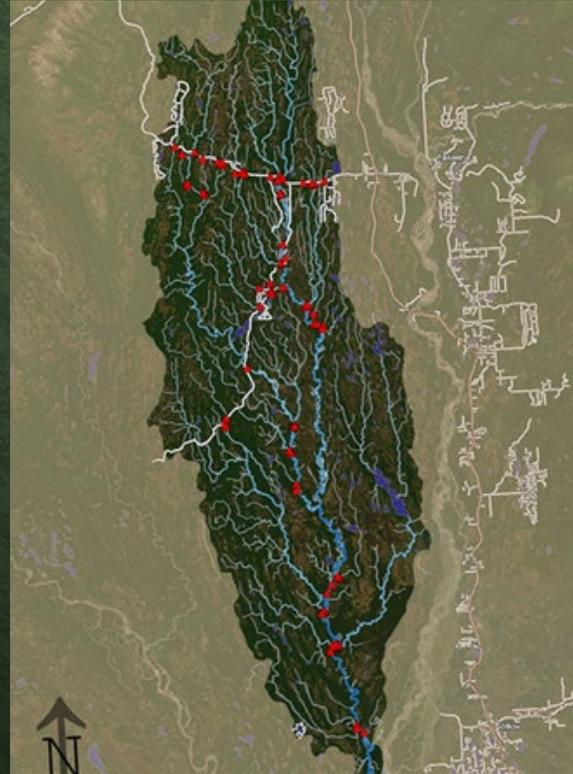
HOMER, AK— As Alaskans suffer through the smoke, haze and danger of a record-breaking heat wave, Alaska's salmon are suffering too. On July 7<sup>th</sup>, stream temperatures topped 81.7 °F (27.6 °C) in the Deshka River, a major salmon stream on the west side of Cook Inlet in the Mat Su Valley.

"We've been tracking stream temperatures in non-glacial systems across the Cook Inlet watershed since 2002," said Sue Mauger, Cook Inletkeeper's Science Director. "But this is a first – we've never seen stream temperatures above 76 degrees Fahrenheit."



<https://www.mcnary.fish/juvenile-tucnonn-river-spring-chinook-and-summer-steelhead>

We hypothesize that Alaska's warmest freshwater temperatures already impair the growth of juvenile Pacific salmon due to direct effects of heat stress or indirectly via increased metabolic rates that exceed consumption.

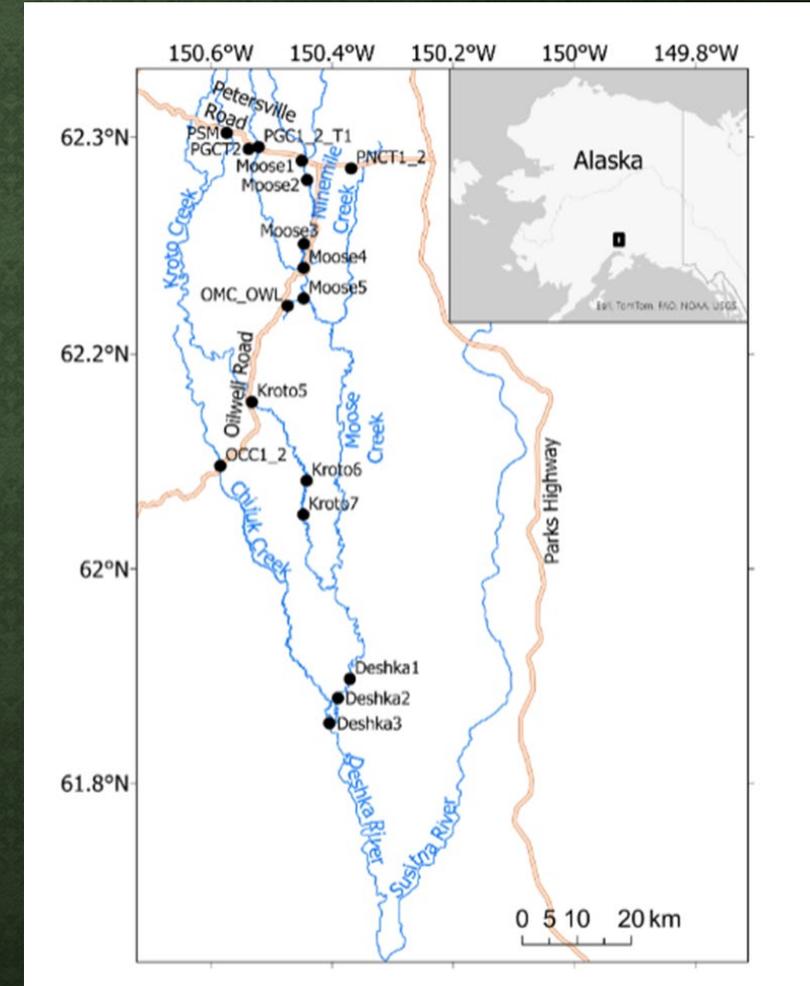


# THE DESHKA RIVER

- Non-glacial, warm, constantly above 20°C during summer months.
- Representative of the warmest salmon systems across the state
  - used to understand future change in cooler systems.

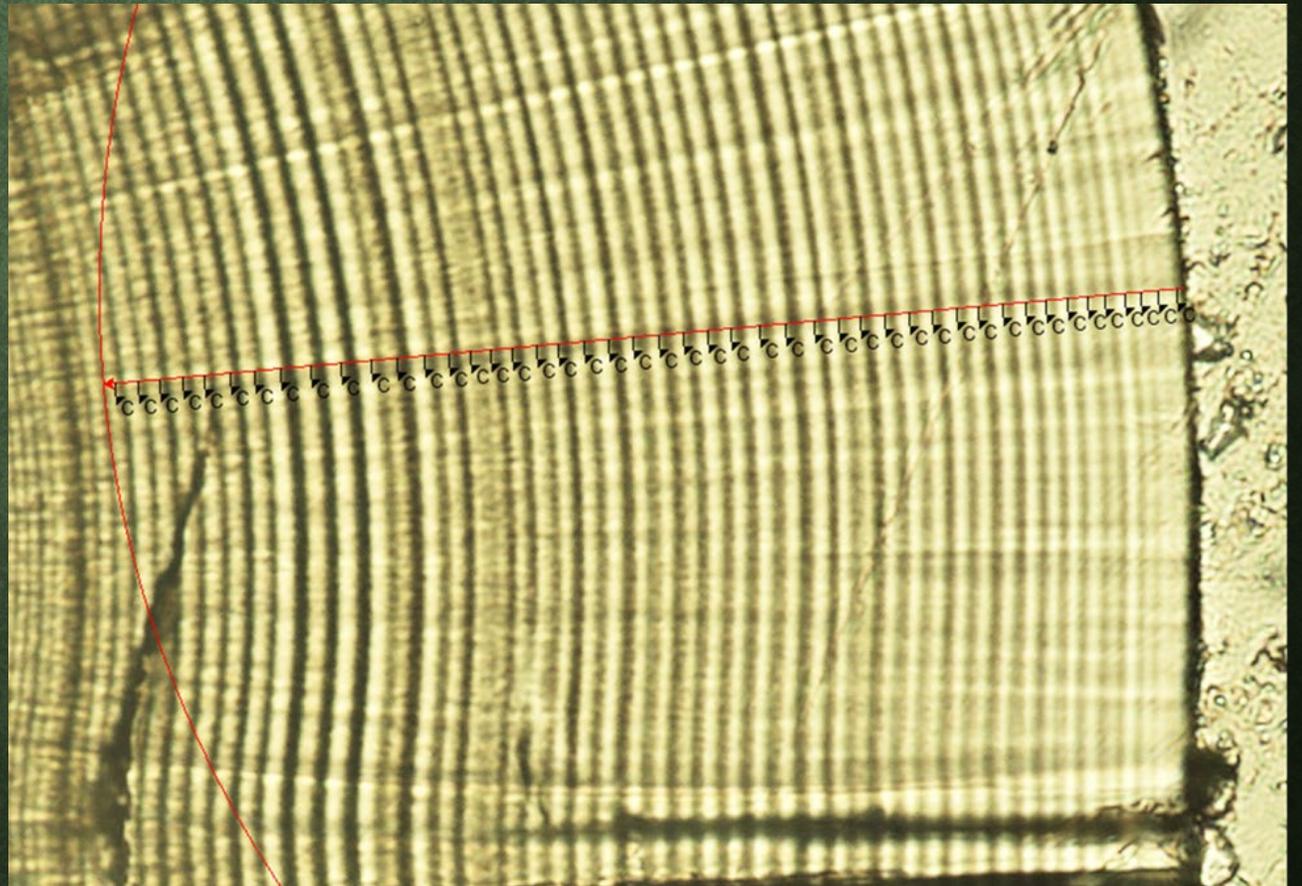
# DATA COLLECTION

- Collected data from 2019 – 2022
- 82 temperature monitoring / sampling sites throughout watershed
- Trapped with baited minnow traps
- Collected a subsample of fish to calculate growth using otoliths
- Majority of sites were clustered in groups of 3 around tributaries



# OTOLITH DAILY GROWTH INCREMENTS

- Inner ear bone of fish
- Juvenile fish lay increments at a daily rate
- Increment width has been correlated to somatic growth in juvenile Chinook.
- Calculated a 10-day average for each fish to use as growth metric.



# Thermal Heterogeneity in the Deshka River

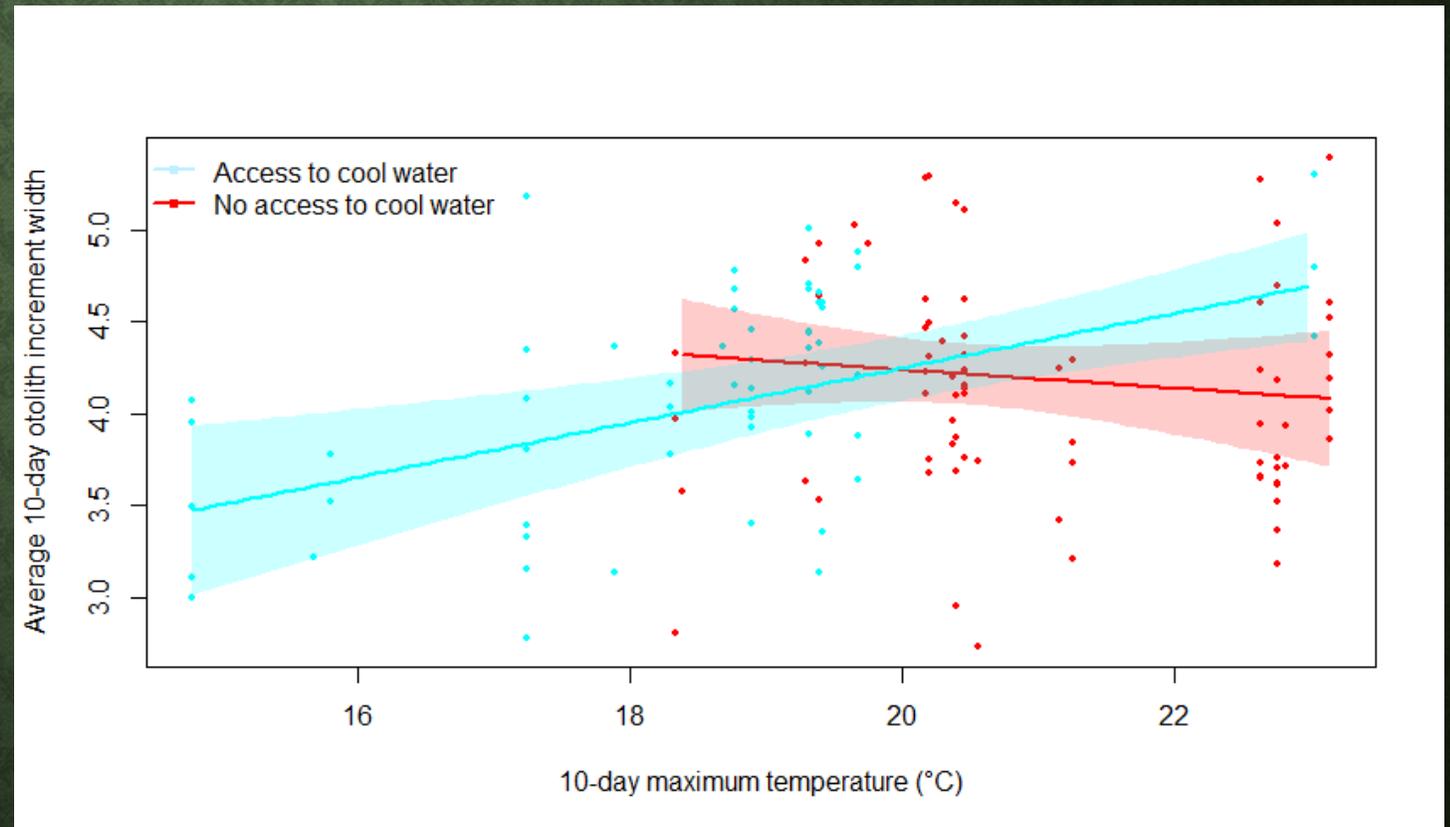
July 2<sup>nd</sup> 2020

- OMCT3 -- 14.9 °C
- OWL1 -- 21.9 °C
- < 250 m apart



# EFFECTS ON JUVENILE CHINOOK GROWTH

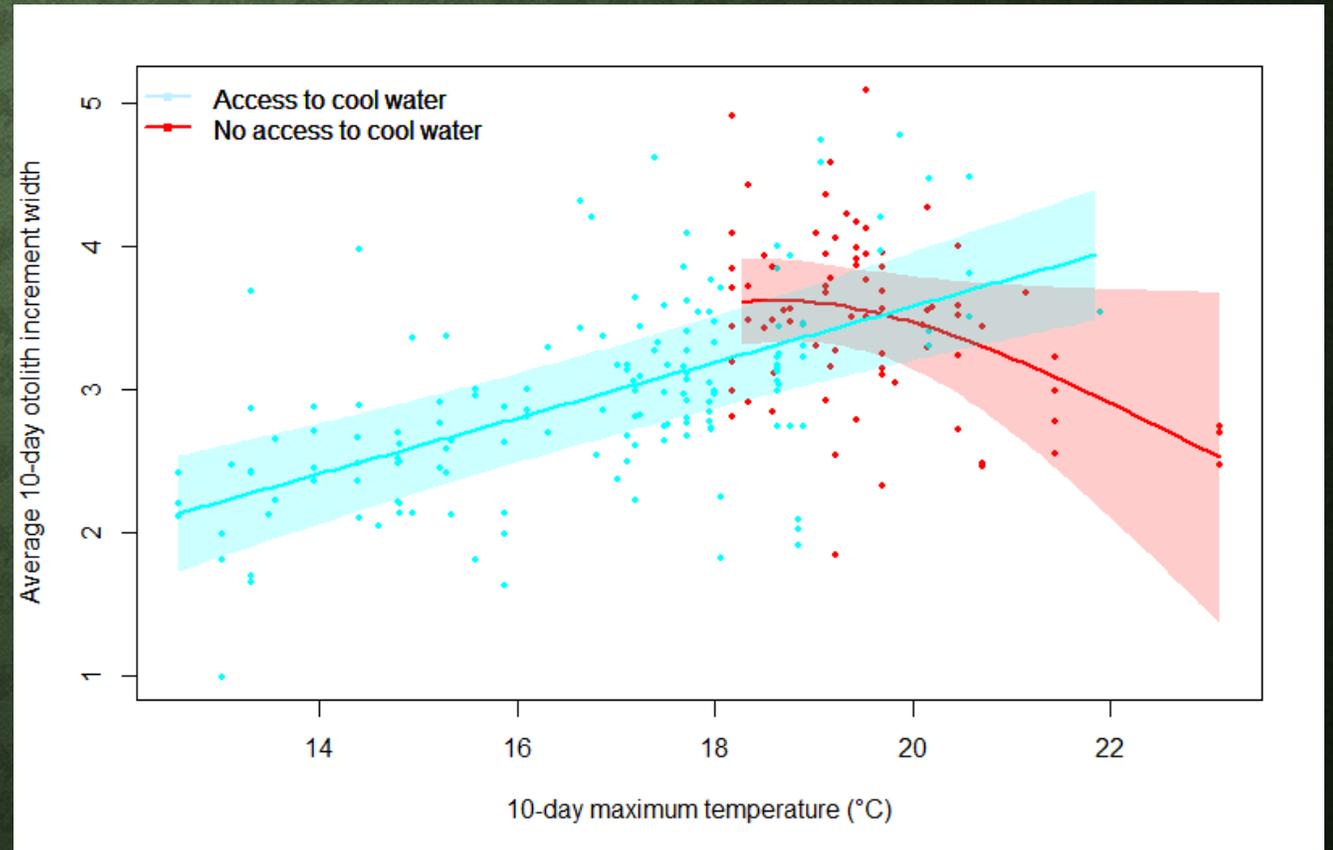
- Chinook with **access** to cool water express positive growth up to 23 °C
- Chinook with **no access** to cool water express negative growth from 18-23 °C



Chinook Model:  $\text{Growth} \sim s(\text{Max temp}, k=4, \text{by} = \text{Cool water access}) + \text{Fork Length} + \text{Year}$  Adjusted  $R^2: 0.345$

# EFFECTS ON JUVENILE COHO GROWTH

- Coho with **access** to cool water express positive growth up to 22 °C
- Coho with **no access** to cool water express negative growth from 19-23 °C



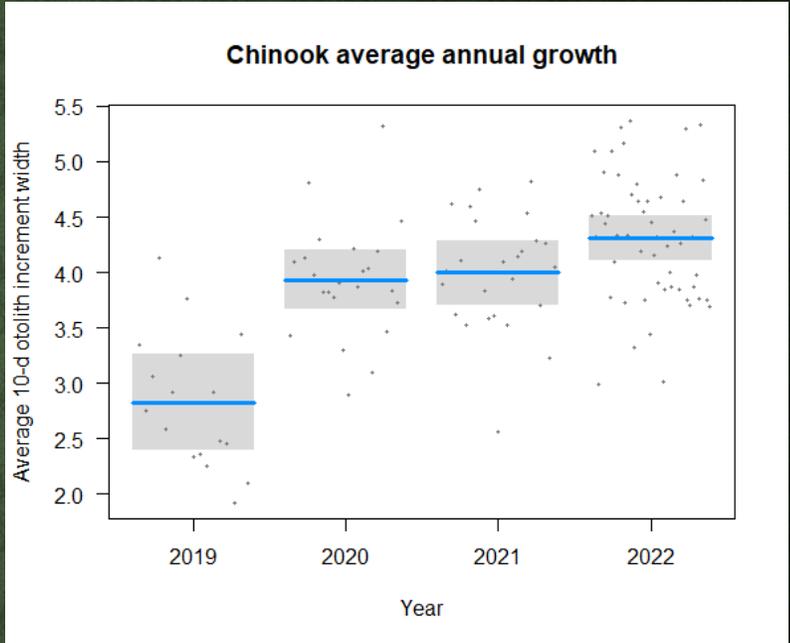
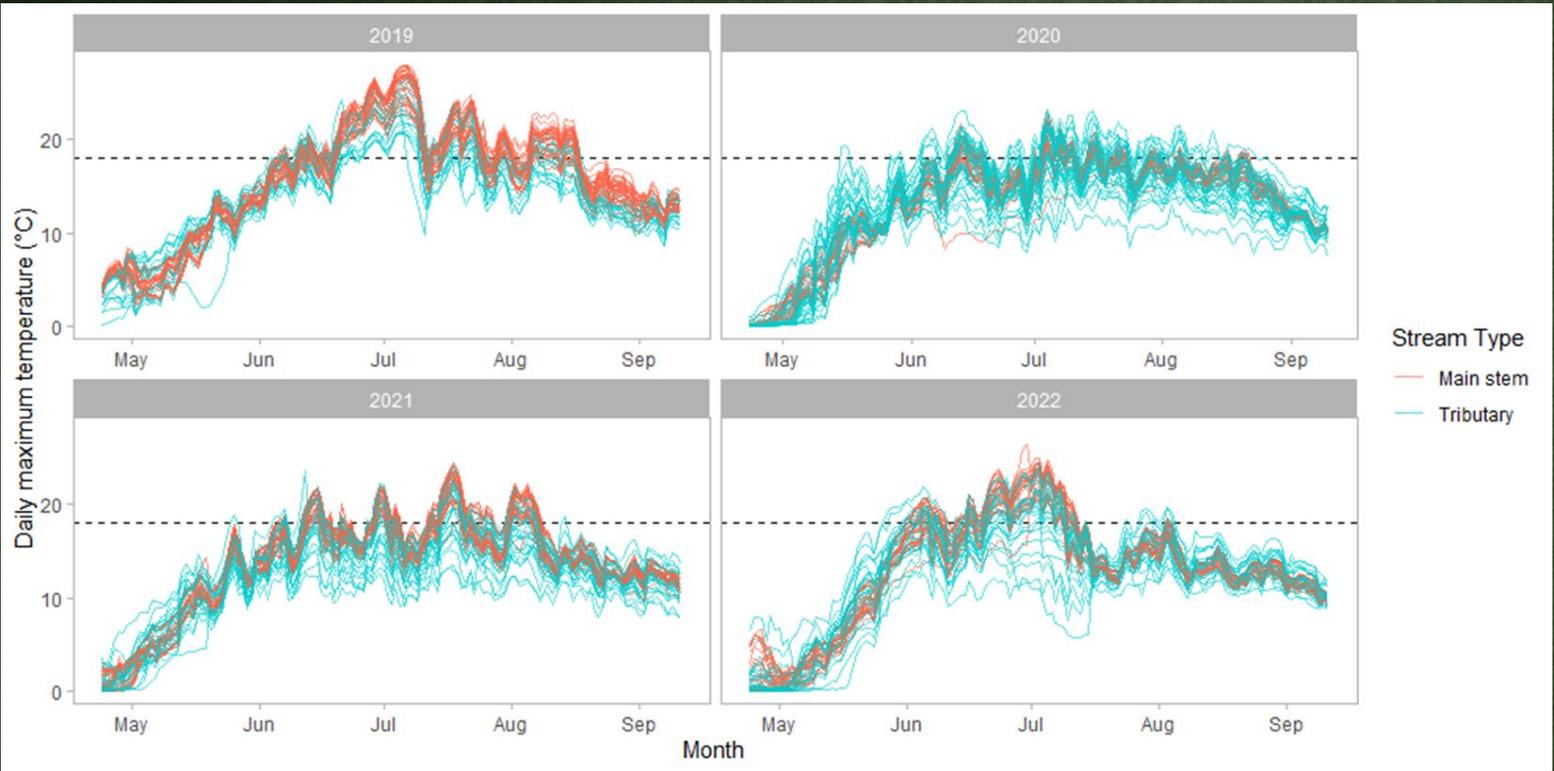
Coho Model: Growth ~ s(Max temp, k=4, by = Cool water access) + Year + Cluster Adjusted R<sup>2</sup>: 0.567

# UPPER THERMAL FEEDING LIMIT

- Baited minnow traps captured actively feeding fish
- No captures occurred in water  $>23$  °C, even though fish were regularly observed.
- We anticipate a precipitous decline in growth water temperatures  $>23$  °C, followed by mortality.



<https://oodmag.com/ask-a-co-does-a-minnow-trap-need-to-be-marked-with-the-licence-holders-name/>



2019

2022

- Lowest growth
- All sites > 18 °C for multi- week period

- Highest growth
- Extended warming yet many sites remained < 18 °C for multi- week period

# IN CONCLUSION

- Bittersweet!
- Chinook and Coho Salmon are maintaining high rates of growth in warmer water than previously.
- The homogenization of warm within freshwater systems will begin to eliminate usable rearing habitat for both species.



# QUESTIONS?

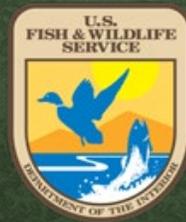
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# FINAL DATA

- No Coho HSP70 data 2019-2020
- Limited sampling sites for Chinook 2019-2020

Year	Otolith Increments		HSP70		Stomach fullness		Cluster	
Species	Chinook	Coho	Chinook	Coho	Chinook	Coho	Chinook	Coho
2019	19	0	17	0	15	0	2	0
2020	26	97	24	0	26	97	2	20
2021	29	88	25	28	21	87	8	20
2022	65	46	55	42	56	46	11	10