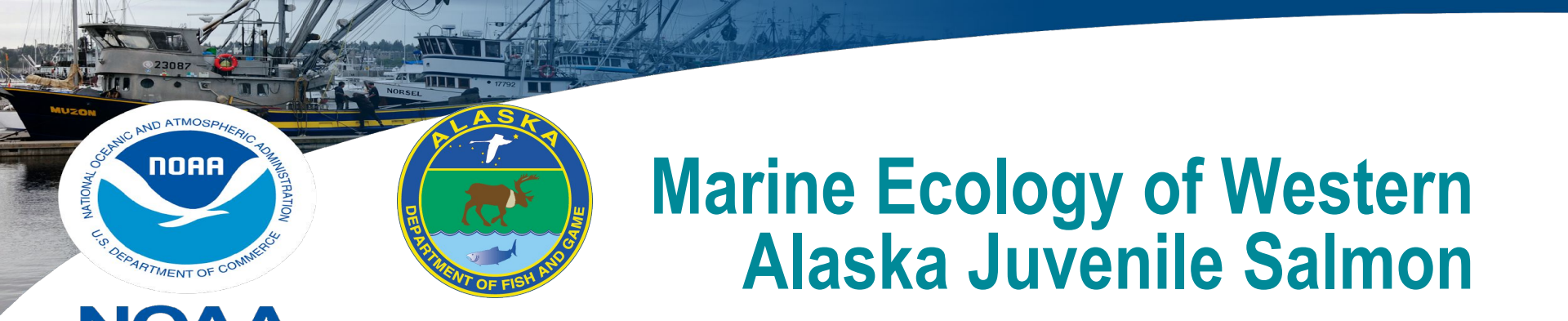


NOAA FISHERIES
Alaska Fisheries Science Center
Auke Bay Laboratories

Alaska Department of Fish and Game

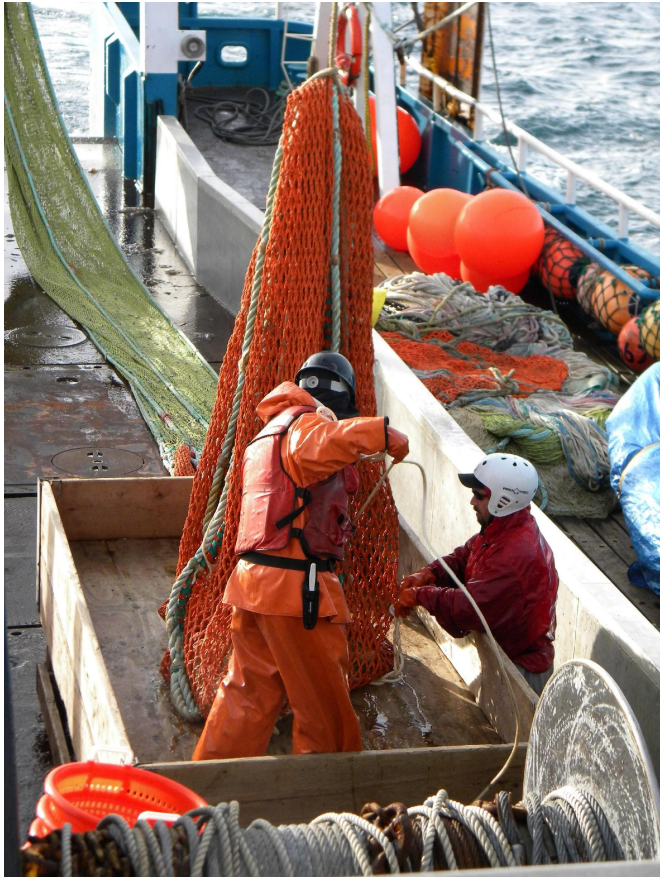
Marine Ecology of Western Alaska Juvenile Salmon

Jim Murphy, Alaska Fisheries Science Center
Sabrina Garcia, Alaska Department of Fish and Game

Yukon River Drainage Fisheries Association

November 17, 2020

Northern Bering Sea Surface Trawl Surveys

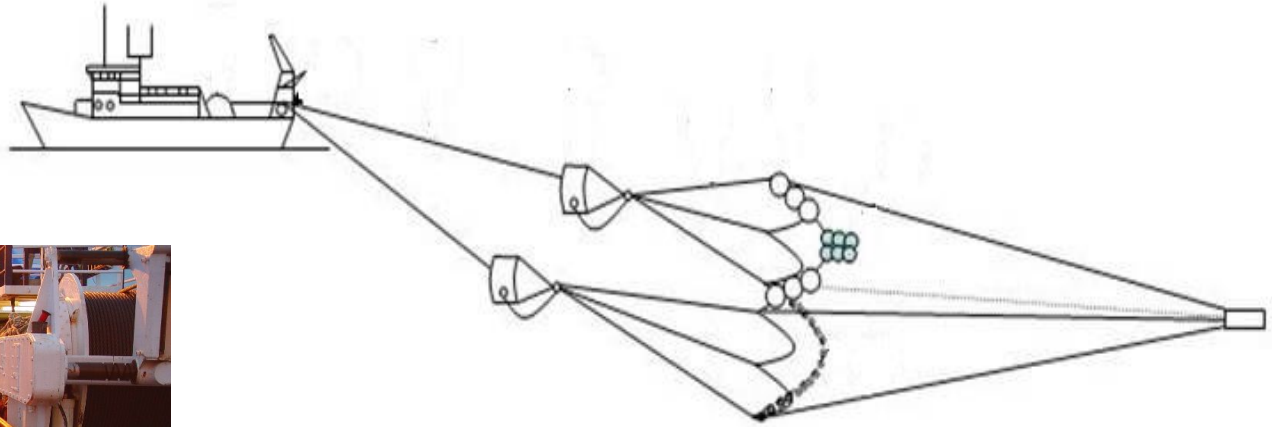


Juvenile Salmon Research in the Northern Bering Sea

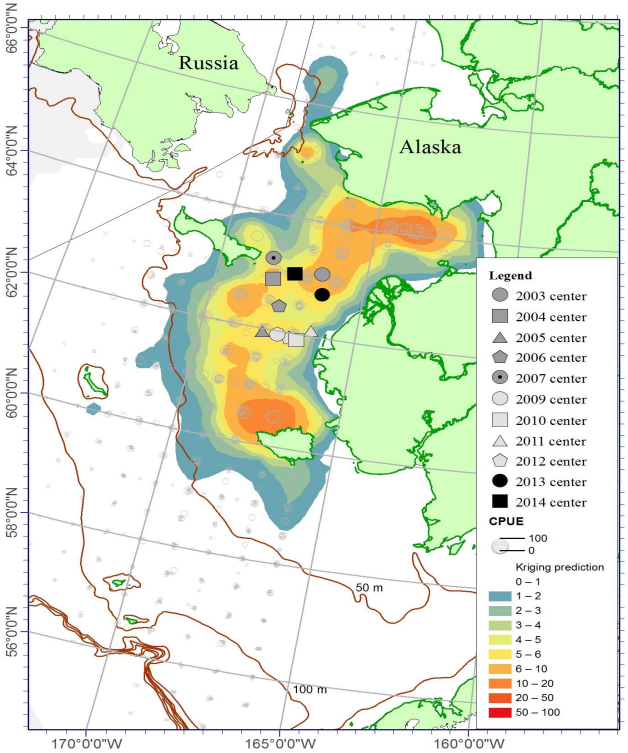
- **Juvenile assessment**
  - Distribution and abundance: surface trawl catch and effort data
  - Juvenile habitat: Mixed-layer depth is part of the definition of juvenile habitat
  - Juvenile Origin: Single nucleotide polymorphism (SNP) genetic baseline

- **Juvenile ecology**
  - Size, age, and growth
  - Diet and feeding ecology
  - Condition and nutritional status

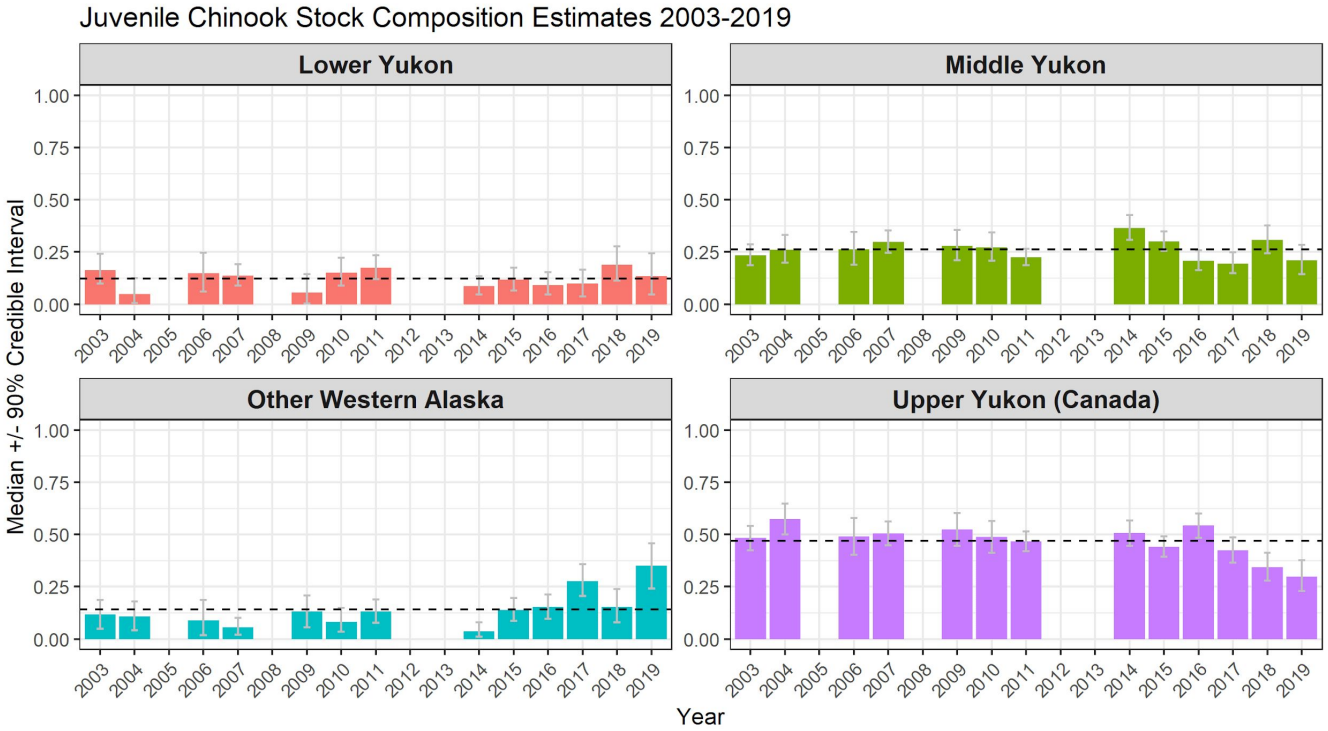
Surface Trawl



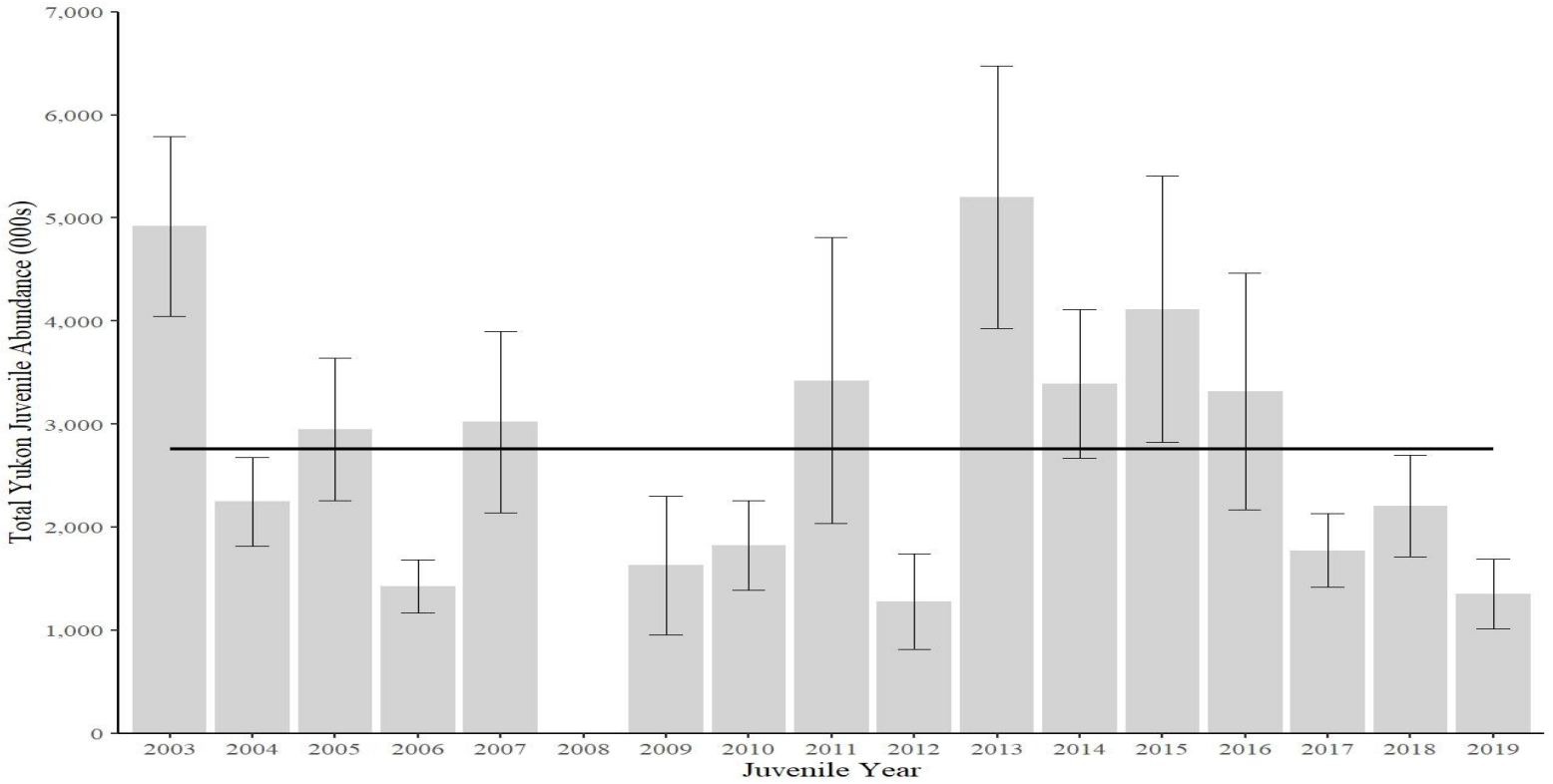
Juvenile Chinook salmon distribution in the Northern Bering Sea



Juvenile Chinook salmon stock composition estimates in the northern Bering Sea, 2003-2019.

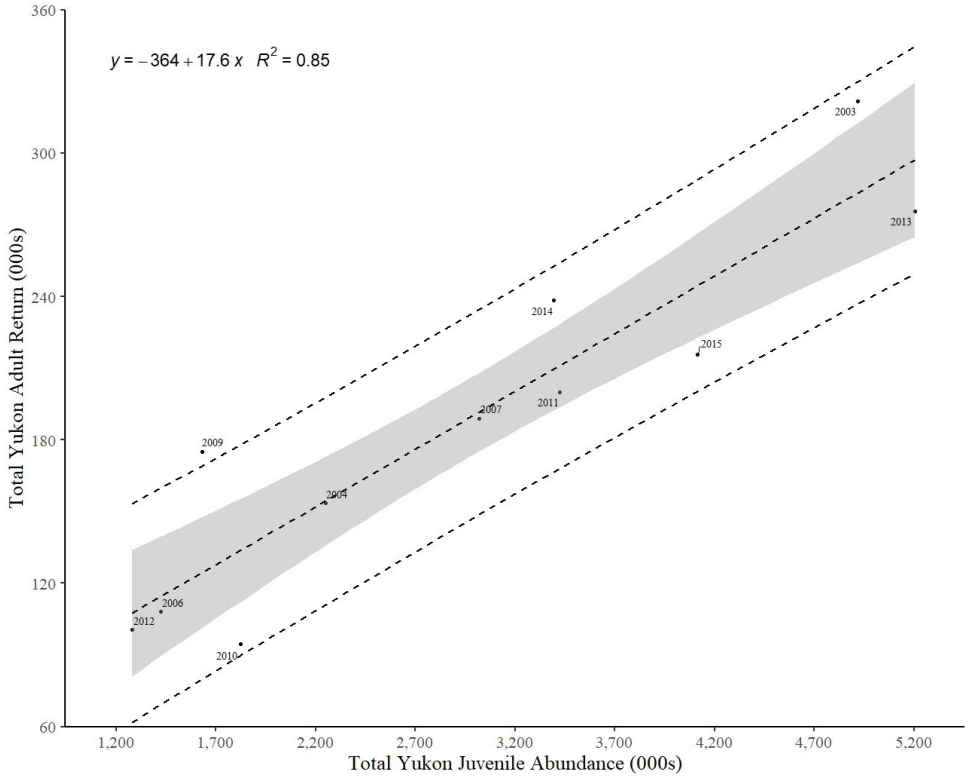


Total Yukon River juvenile Chinook salmon abundance in the northern Bering Sea, 2003-2019.

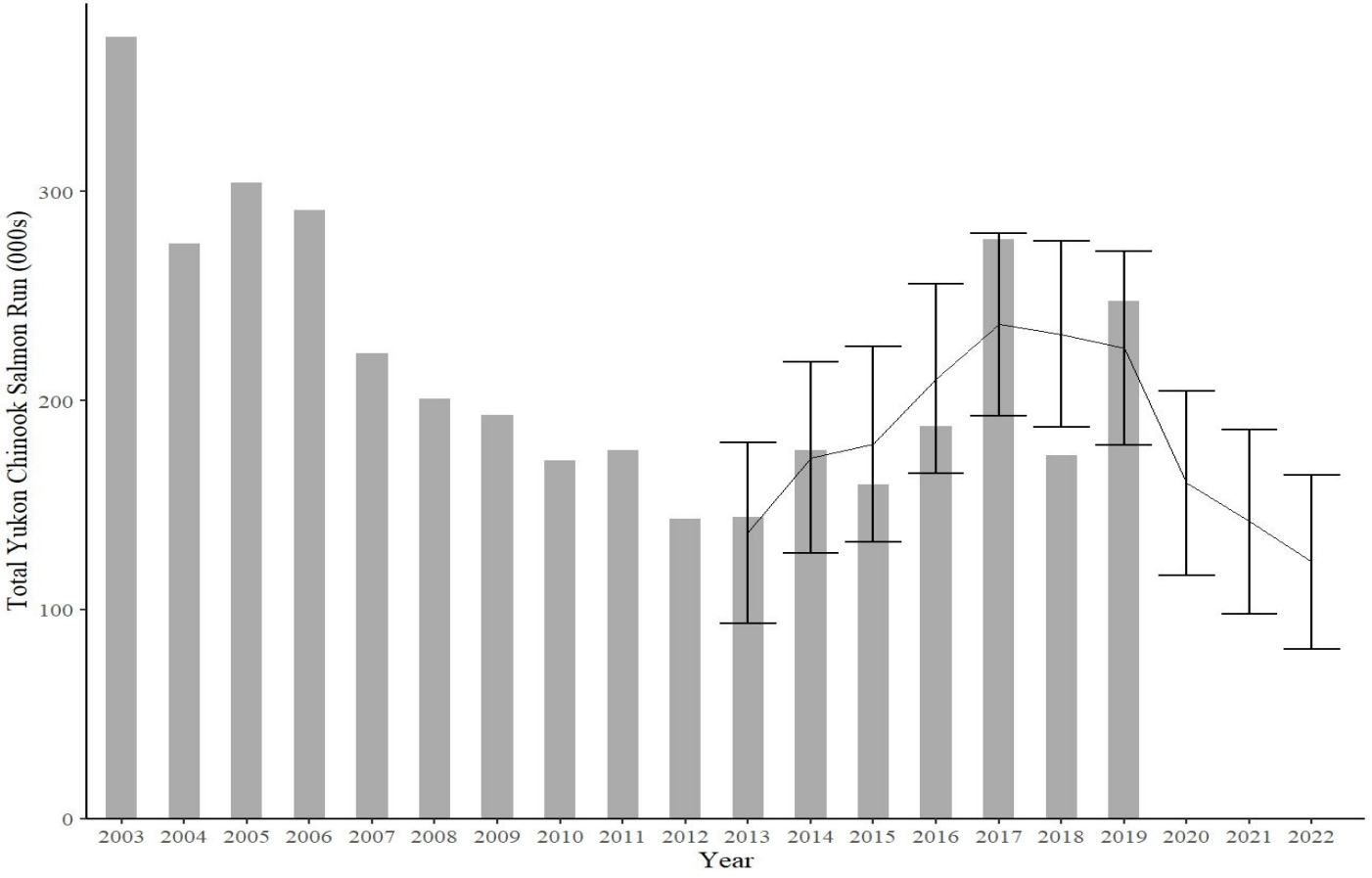


Chinook salmon run projections

- A linear model of juvenile and adult abundance is used to project future returns.
- The model indicates that much of the year-to-year variation in returns occurs during the early life-history stages of Yukon River Chinook salmon
- Variation in this relationship is what determines the range of expected run sizes.

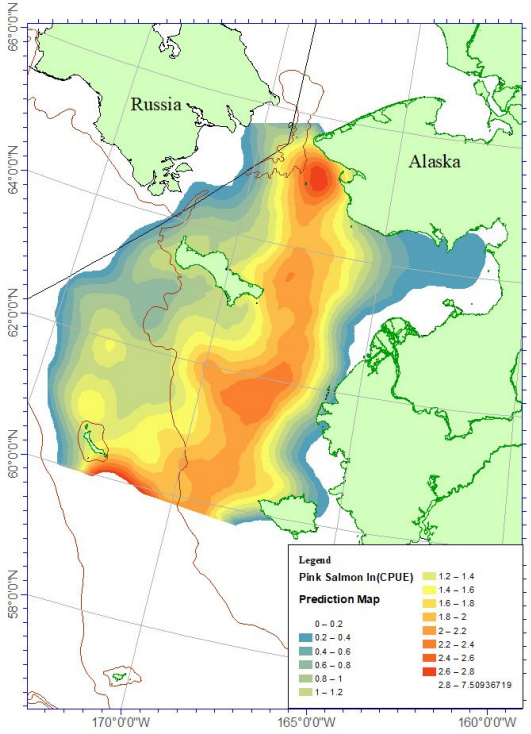


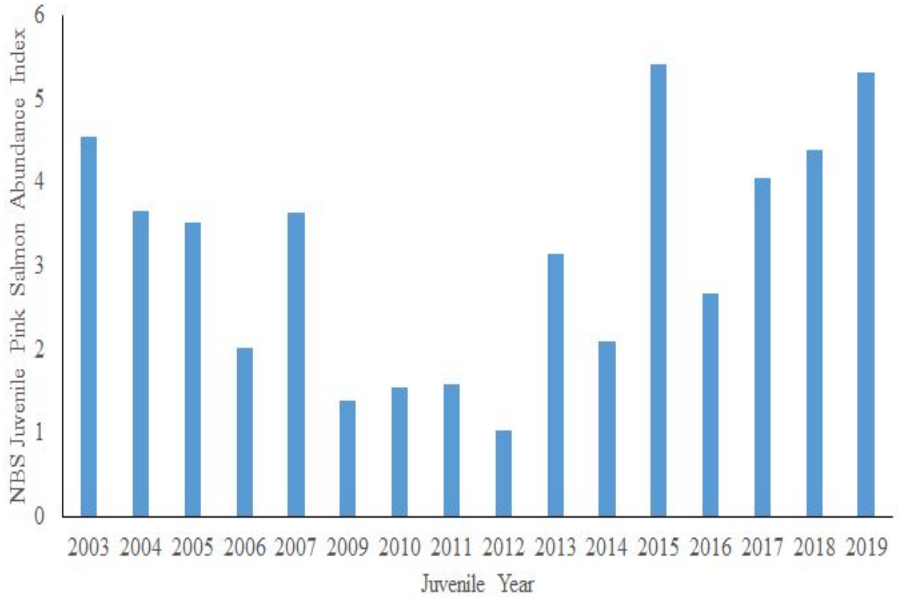
Total Yukon River juvenile Chinook salmon run outlook, 2020-2022



Juvenile pink salmon distribution and abundance

Farley et al. (2020)

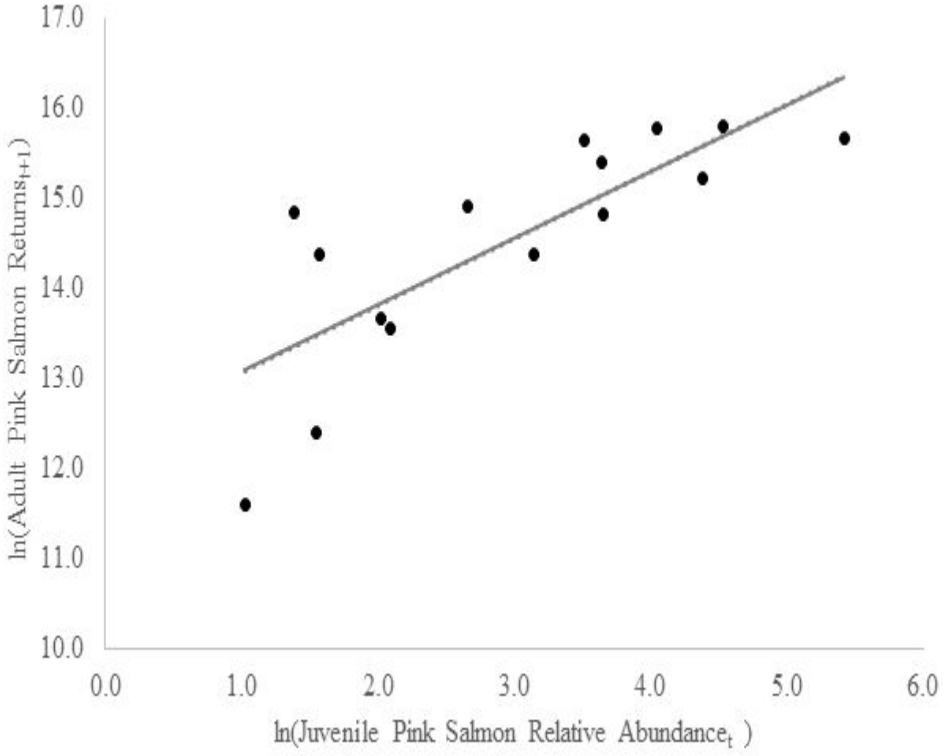




Pink Salmon Outlook

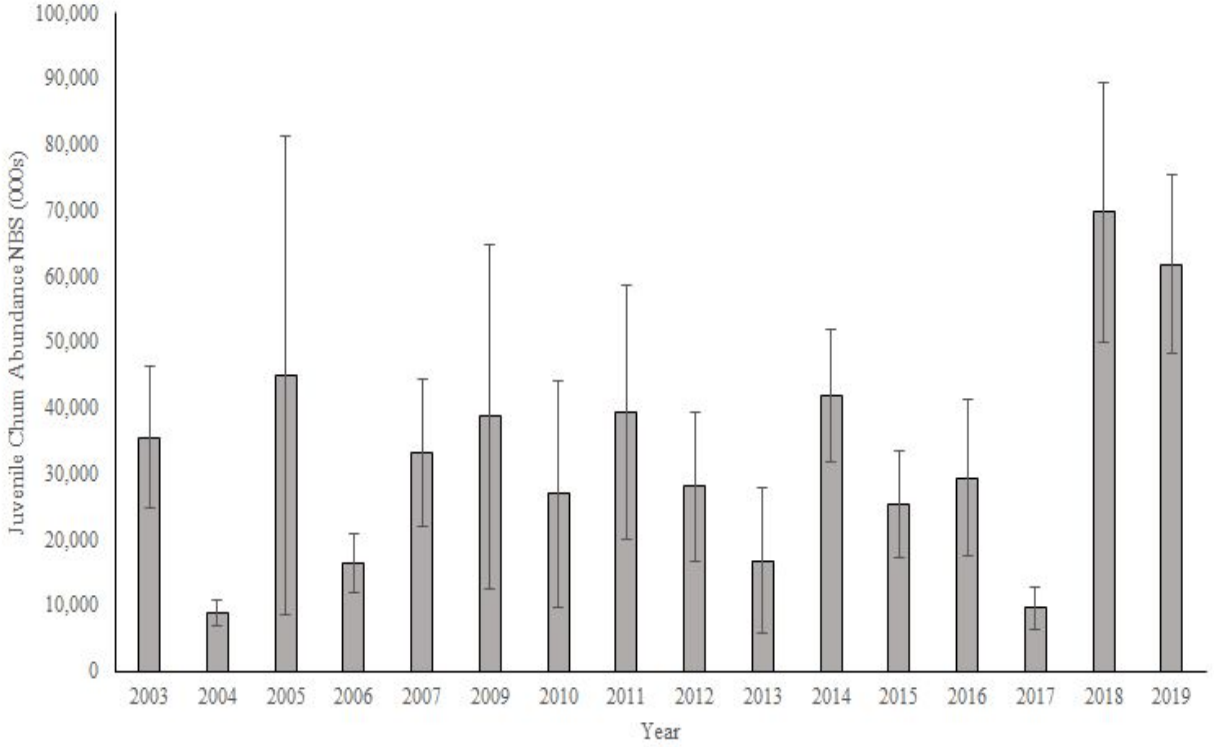
Farley et al. (2020)

- Adult pink salmon returns to the northern Bering Sea (Yukon River and Norton Sound) are consistent with juvenile abundance.
- Juvenile and adult pink salmon abundance has increased with warming of the northern Bering Sea.
- Continued loss of Arctic sea ice and warming of the northern Bering Sea is expected to increase the production of Norton Sound and Yukon River pink salmon.



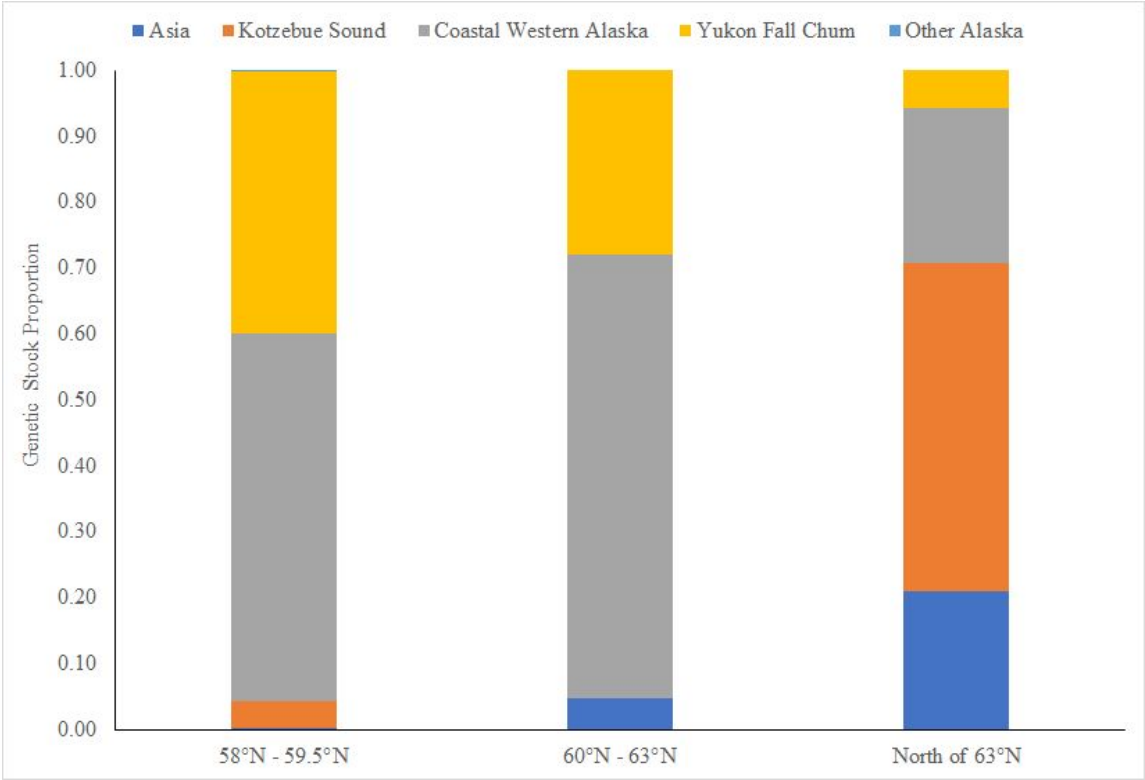
Juvenile chum salmon abundance

- Preliminary model outputs
- 2017 juvenile chum salmon abundance was 2nd lowest since 2003
  - 2017 juveniles would have returned in 2020 as age-4
- Juvenile abundance reached record high levels in 2018 and 2019 and should contribute to improved run sizes over the next few years.



Juvenile chum salmon stock composition

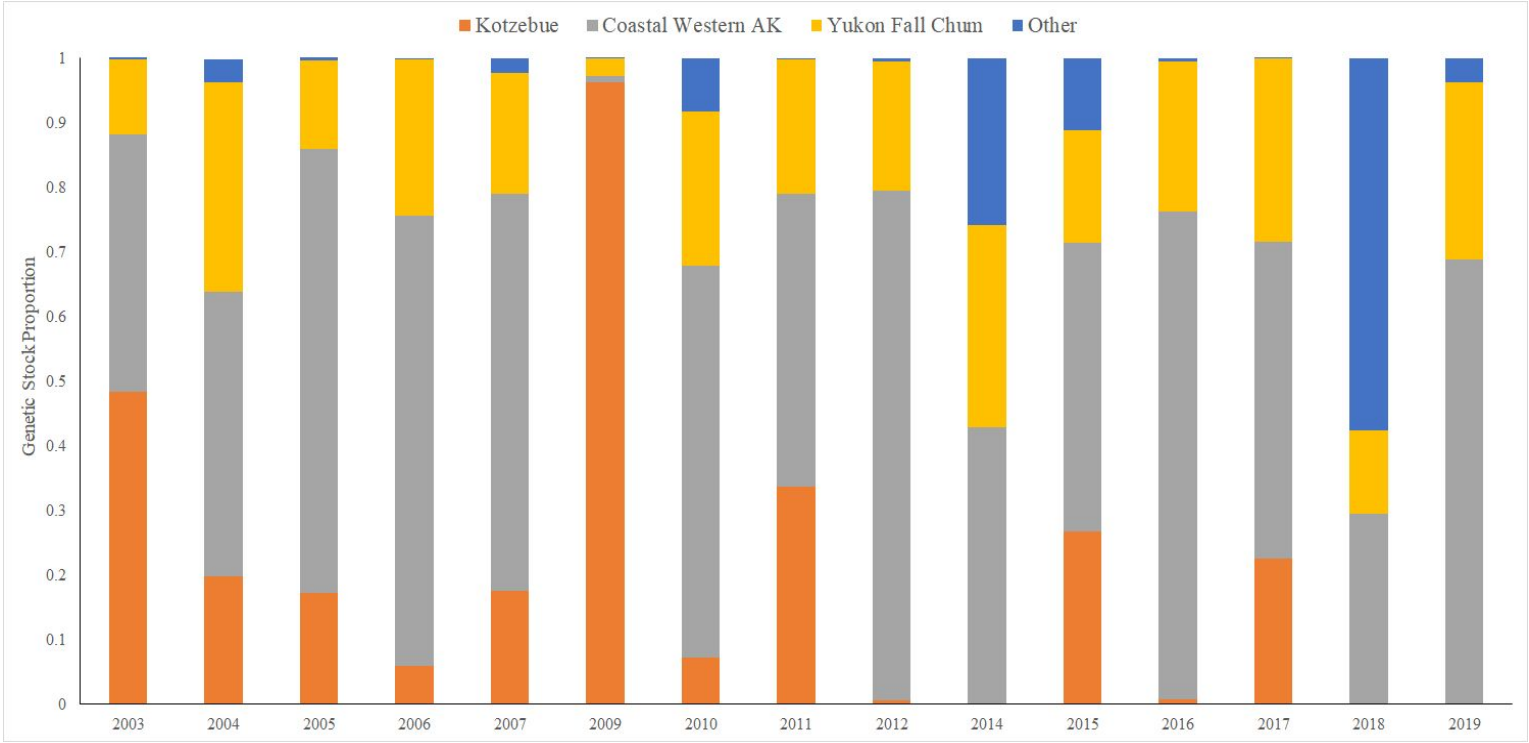
- Juvenile chum salmon caught in the NBS and SBS from 2009-2019 were genotyped
  - Adds to existing genetic data from 2003 - 2007[1]
- First genetic analysis was to determine the distribution of juvenile chum salmon by latitude
- Fall chum salmon (yellow) are found in higher proportions between 58°N and 59°N



[1] Konzela et al. 2016. NPAFC, Bulletin No. 6.

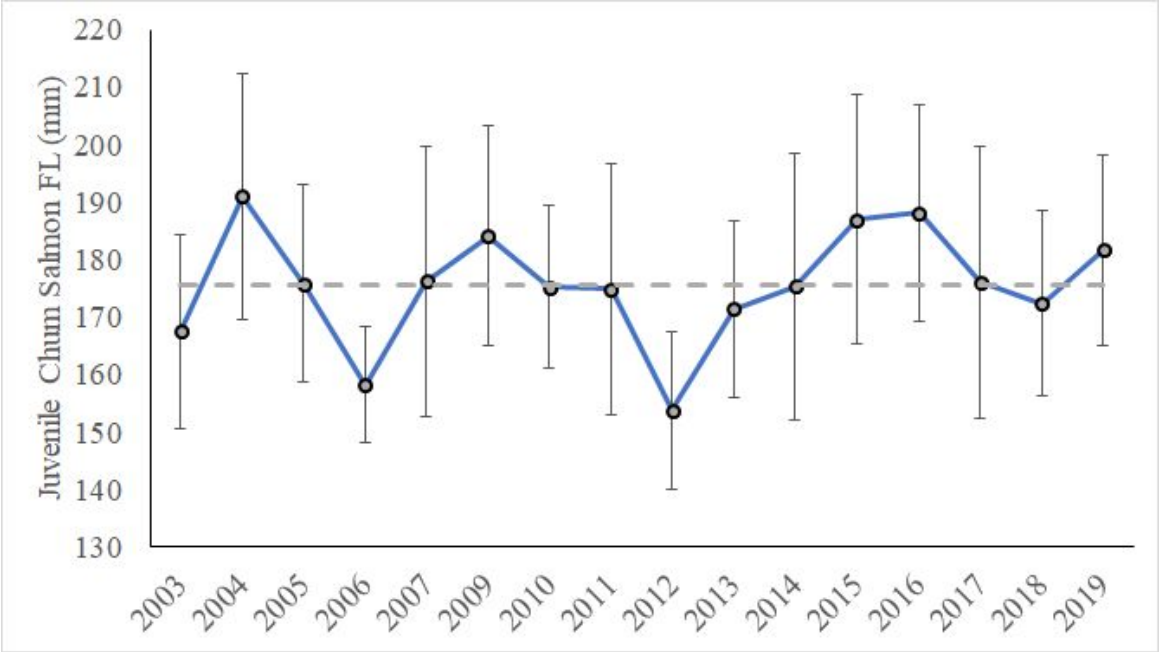
Juvenile chum salmon stock composition

- Juvenile chum salmon stock proportions from 2003-2019 are variable



Early marine ecology of chum salmon: average size

- Both size and condition of juveniles play an important role in their survival.
- Larger chum salmon tend to have more fat and are often considered to be in better condition than smaller chum salmon.
- The size (length) of juvenile chum salmon was above average in 2019 and was higher than 2018.



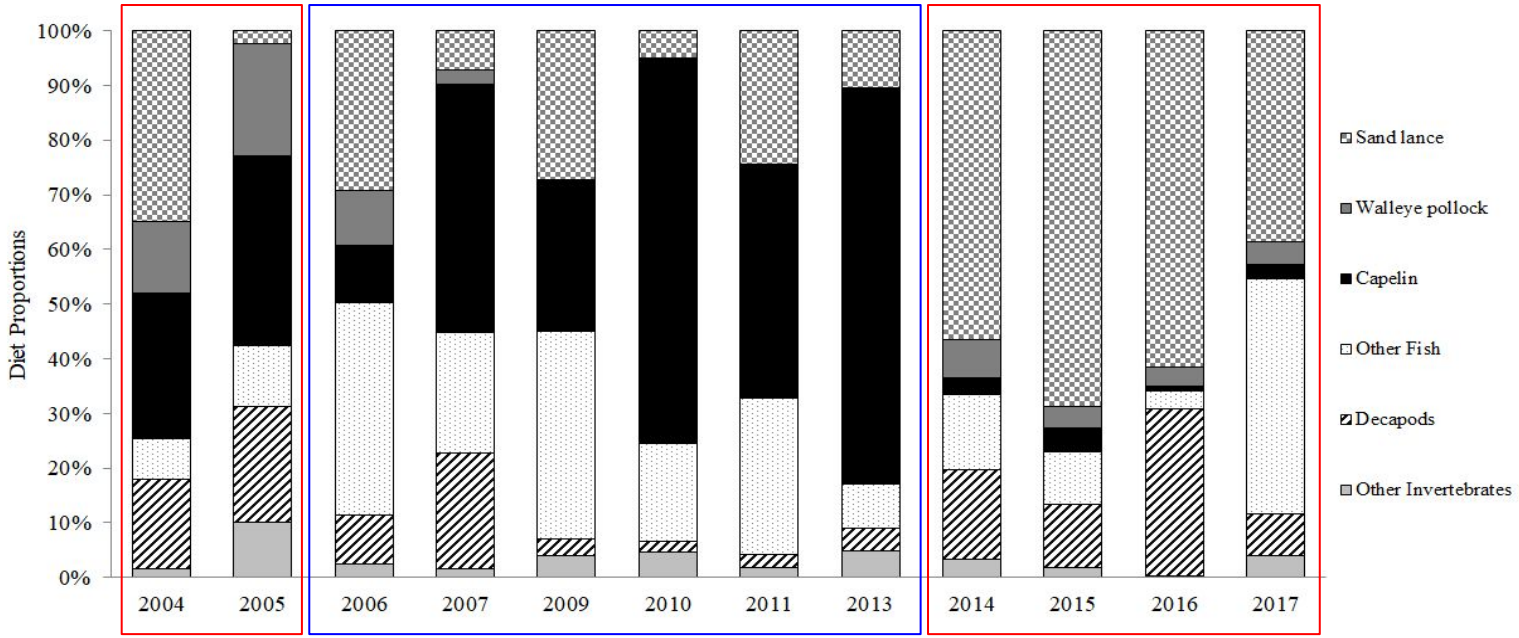
Juvenile chum salmon

Next steps:

1. Need to look at the relationship between juvenile chum salmon and adult salmon returns
    - If there is a relationship (like with Chinook and pinks), we may be able to forecast adult runs

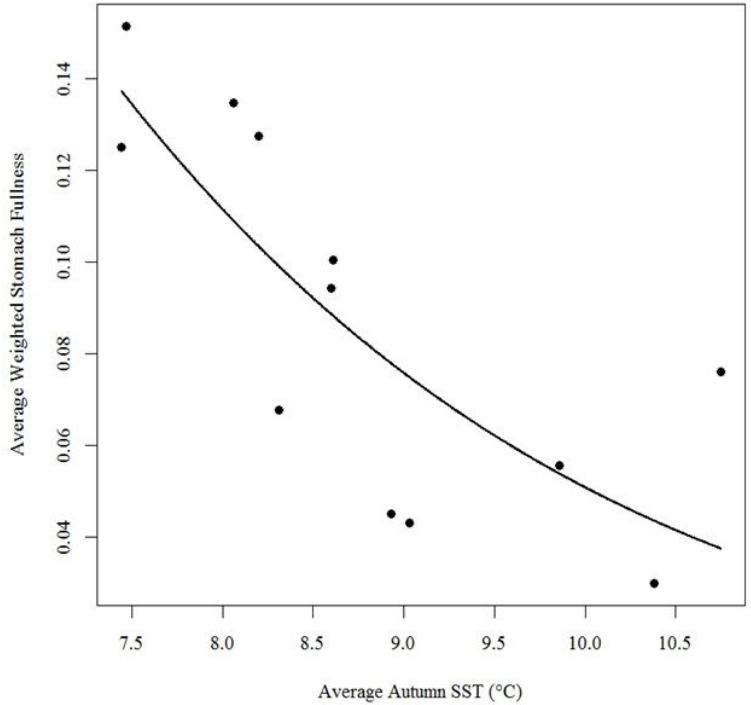
2. Continue to study aspects of early marine ecology such as growth, diet, and energetic density

Early marine ecology of Chinook salmon: diets 2003 - 2017



- Juvenile Chinook salmon mostly eat fish but also eat crab and other small invertebrates
- Juvenile Chinook salmon diets shift with temperature
  - Warm (2004-2005, 2014-2017) = Sand lance and crab (red boxes)
  - Cold (2006-2013) = capelin (blue boxes)

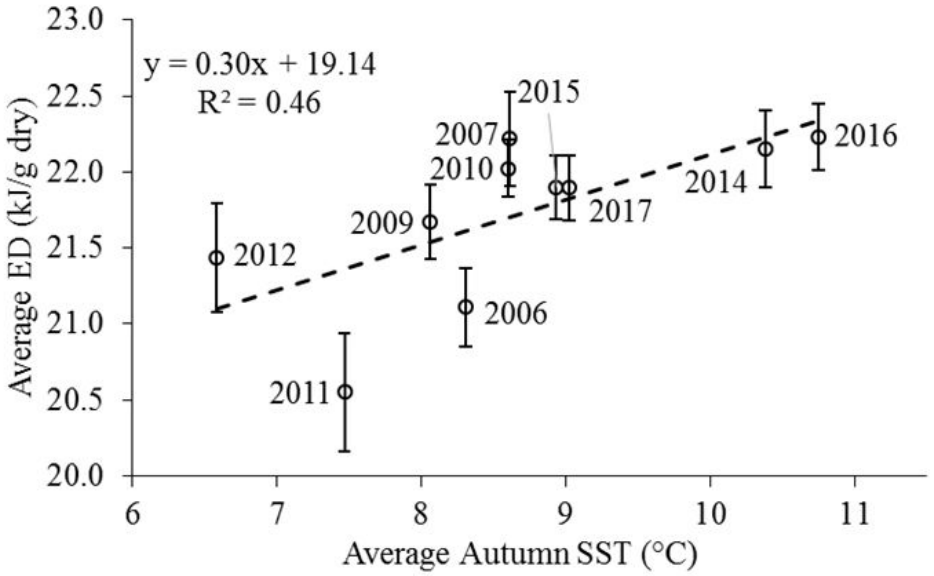
Juvenile Chinook salmon stomach fullness, 2003 - 2017



- Juvenile Chinook stomachs had less prey in warmer waters, but...

Juvenile Chinook salmon energetics, 2003 - 2017

- Energetic density was higher in warm years than colder years
- Even with emptier stomachs and less piscivory, juveniles were able to maintain higher energy
  - Prey quality must still be good in warm years
- We don't know what will happen in waters warmer than what we have experienced



Northern Bering Sea summary

- **Chinook salmon:** The abundance of juvenile Chinook salmon has declined in the northern Bering Sea since 2017, and is contributing to a declining outlook for Yukon River Chinook salmon through at least 2022.
    - Warming climate in the northern Bering Sea impacts the early marine ecology of juvenile Chinook salmon:
        - Juvenile Chinook salmon from the Southern Bering Sea appear to be moving into the northern Bering during the warmest years.
        - Juvenile Chinook salmon eat less fish in warm years, likely due to lower abundance of fish prey.
        - The energetic condition of juvenile Chinook salmon has remained high during warm years, which indicates that prey are of sufficient quality for both growth and energy storage.
- **Chum salmon:** reached record high abundance levels in 2018 and 2019 and this is expected to contribute to improved run sizes improve over the next few years; however, juvenile models are still in progress.
- **Pink salmon:** Juvenile and adult abundance have increased with warming climate conditions in the northern Bering Sea and their production is expected to continue to increase.

Thank you!

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