41. ADULT CHINOOK SALMON DIETS AS AN INDICATOR OF SPATIAL AND TEMPORAL VARIATION IN COASTAL FOOD WEBS

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41.1. Highlights

- Chinook Salmon stomach fullness in the Salish Sea was fairly stable from 2017-2020.
- The quantity of Pacific Herring in stomachs increased from 2017-2020.
- Northern Anchovy were more important from 2017-2018 than from 2019-2020.

41.2. Description of the time series

Predator diet sampling can provide insights into dynamics of lower trophic levels that may not be available through other research methods (Thayer et al. 2008) and can be a valuable complement to traditional fishery-independent surveys. Since 2017, the Adult Salmon Diet Program (ASDP) has been developed as a low-cost, citizen science-based program to sample adult Chinook and Coho Salmon diets throughout the year in British Columbia (Quindazzi et al. 2020). In the short term, the ASDP seeks to characterize spatial and seasonal variation in adult salmon diets and to determine if diets have changed since historical diet studies (the most recent published adult salmon diet data for British Columbia are from the 1960s; Beacham 1986). In the long term, the program will provide a novel perspective on variability and trends in forage fish communities and their implications for salmon trophic ecology.

Digestive tracts of Chinook and Coho Salmon captured in the public fishery were submitted by individual fishers or collected at fish cleaning stations or derbies. Samples were frozen with a catch card indicating species, capture location, capture date, adipose fin status (clipped or unclipped) and length and/or weight along with additional capture observations. Gravimetric diet compositions were determined in the lab.

Provisional indices of interannual changes in diet composition were developed using only Chinook Salmon samples from the Canadian Salish Sea as this was the only region for which samples were available in all years (2017-2020). The indices were based on mean “partial fullness scores” (Magnussen 2011) for each prey category. These scores were proportional to prey category weight divided by the cube of salmon length. To account for different seasonal and spatial distributions of samples between years, data were stratified into season by region groups. Seasons were defined as winter (October to March) and late summer (August to September). To prevent splitting the winter between calendar years, the months of October to December were considered part of the following calendar year. The April to July period was excluded from analysis as retention of Chinook Salmon was closed during this period in much of the sample region beginning in 2019. Regional groupings were based on a cluster analysis of a Bray-Curtis dissimilarity matrix of mean percent weight of prey categories in Pacific Fishery

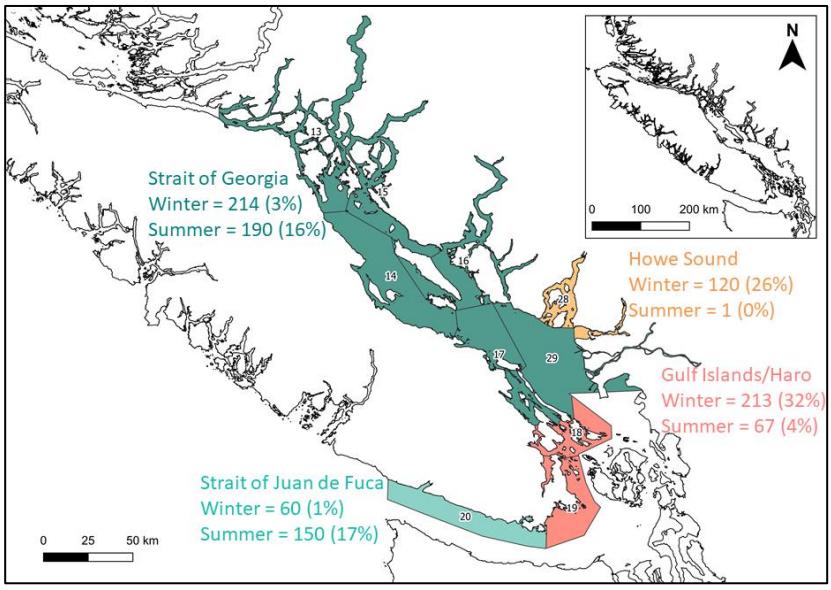

Figure 41-1. PFMA groupings for Chinook Salmon prey partial fullness indices. The total sample size available for each region and season combination is indicated with its weighting in the annual indices indicated in parentheses.

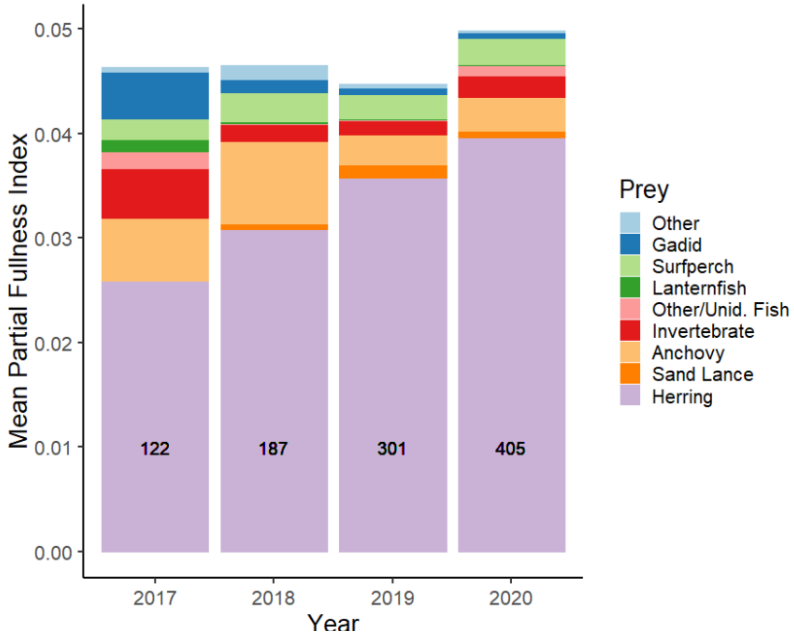

Figure 41-2. Mean prey group-specific partial fullness indices for Salish Sea Chinook Salmon stomachs from 2017-2020. Total sample size is overlayed and region by season weightings are provided in Figure 41-1.

Management Areas (PFMAs) within the Salish Sea from April to September. This approach resulted in identification of four regions (Figure 41-1). Pacific Herring overwhelmingly dominated diets in the Strait of Georgia and Strait of Juan de Fuca while Northern Anchovy were important in Howe Sound and Pacific Sand Lance were important in the Southern Gulf Islands and Haro Strait. This regionalization is provisional and its suitability for stratifying year-round data is currently being assessed. Partial fullness scores were calculated as weighted averages where region-by-season groupings were weighted based on their minimum sample size across years. Of the 2238 Chinook Salmon diet samples processed to date by the ASDP, 1014 were used for this time series.

41.3. Status and trends

Pacific Herring dominated Salish Sea Chinook salmon diets across years and increased in importance from 2017 to 2020 (Figure 41-2). Overall, stomach fullness was similar across years. Northern Anchovy were less than half as important in 2019 and 2020 than in the preceding two years. The low partial fullness values observed for Pacific Sand Lance in this time series were likely a consequence of the omission of April to July data due to fisheries closures. These months are when most Sand Lance occur in diets. Interannual differences also varied among regions of the Salish Sea.

41.4. Factors influencing trends

With only four years of data, it is too early for meaningful trend analysis. As the time series develops, comparison to fishery independent data including Pacific Herring spawn surveys and age-0 abundance surveys will facilitate analysis of whether herring recruitment and spawning stock biomass regulates availability to Chinook Salmon. Northern Anchovy increased in abundance in the Salish Sea during the anomalously warm conditions of 2015 and 2016 (Duguid et al. 2019). It is possible that the decline in the importance of Anchovy in 2019 and 2020 reflects the end of this pulse of reproduction. A similar decline has been observed in the frequency of occurrence of anchovy in age-0 Pacific Herring surveys (Boldt et al. 2020). While we present spatially aggregated time series here, trends varied strongly among regions of the Salish Sea. Future analysis should occur at a sub basin level.

41.5. Implications of those trends

Changes in the partial fullness scores for different prey groups may reflect both changes in the abundance of that prey group and in the abundance of alternative prey. Given the importance of Pacific Herring to Chinook Salmon diets, one of the key questions is whether salmon would find adequate alternative prey should herring become less abundant. Recent spawning stock biomass of Pacific Herring in the Strait of Georgia has been above average (Cleary et al., Section 21) while age-0 herring abundance has been low but relatively stable (Boldt et al. 2020). Should an event, such as the Pacific Herring recruitment failure of 2007 occur, this adult Chinook Salmon diet index will provide valuable insights into the implications for higher trophic levels. As climate change results in expansions or contractions of the range or abundance of species such as Northern Anchovy (Duguid et al. 2019) this index will provide information on the importance of changes in food web composition.

41.6. References

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