Issues and staff recommendations for assessing impacts to Western Alaska chum stocks from bycatch[1]

May 2022

In conjunction with the October 2021 motion on salmon bycatch information requests, the Council requested the following:

> 1. An updated bycatch impact (AEQ) analysis which includes current genetic stock identification information and an updated age/length composition for Chinook salmon along with estimates of how many Chinook salmon taken as bycatch in the Bering Sea pollock fishery would have returned to Western Alaska Chinook salmon reporting groups. The analysis should include a PSC harvest rate analysis and an estimate of the Chinook salmon bycatch impacts to each specific reporting group at the current cap levels and at actual bycatch levels in recent years. *The Council also requests that the report include recommendations to evaluate impacts of chum salmon bycatch in the pollock fishery with currently available data.*

Genetics reports as well as an updated AEQ analysis are available on the Council agenda to address the majority of this request. In order to meet the latter aspect of the request (in italics) regarding how best to assess impacts of chum salmon bycatch in the pollock fishery with available data, staff from the Council, ADF&G and NMFS compiled the following summary of available data, caveats regarding the limitations of these data, and suggested recommendations for current and potential future analyses to help inform the estimation of impacts.

1 Current data and background information

Total chum salmon bycatch, called prohibited species catch (PSC), in the BSAI pollock fishery ranged from 24,000 to 535,000 total catch annually between 2011-2021. Typically, over 99% of chum PSC occurs during the pollock B season (June 10 - November 1). Scientists use genetic information from chum salmon PSC samples taken in the pollock fishery to estimate the number and proportion of chum salmon originating from six genetic groups: Southeast Asia, Northeast Asia, W. Alaska, Upper/Middle Yukon (Yukon River fall chum), Southwest Alaska, and Eastern Gulf of Alaska/Pacific Northwest. On average 15% (ranged from 8-19%) of chum PSC in each year was from W. Alaska stocks (coastal western Alaska populations from Kotzebue south through Bristol Bay) and 4% (ranged from 0-9%) was from Upper/Middle Yukon (Yukon River fall) chum salmon stocks. Here "W. Alaska" refers to the genetic reporting group including coastal western Alaska populations from Bristol Bay to Kotzebue, and "Western Alaska" refers to the broader populations of chum salmon in the region, including fall chum salmon from the Upper and Middle Yukon River. Chum salmon PSC in the last two years (2020-2021) showed lower proportions of W. Alaska and Yukon River fall chum salmon (~9% total) compared to the previous nine (~16-25%). Contributions from the Yukon River fall chum stocks were especially low in 2020 and 2021 (1% or less of total PSC).

Figure 1 presents estimates of the number and proportion of chum salmon PSC in the pollock fishery by genetic group from 2011-2021. The figure shows that the estimated proportion of each genetic group in

[1] Prepared by staff from the Council, ADF&G and NMFS Alaska Fisheries Science Center

total chum PSC varies from year to year. NOAA Fisheries is working to determine if spatial and temporal patterns can be identified in pollock fishery encounters of Western Alaska chum salmon. Early work shows that in general, the proportion of Western Alaska chum salmon caught as PSC is higher later in the pollock B season and further east, but these are initial estimates and further modeling is necessary to determine if these patterns are supported by available data. Figure 1 shows that between 2011-2021 annual estimates of chum salmon PSC from W. Alaska ranged from 3,061 to 66,199 with an average of 39,904 and estimates from Yukon River fall stocks ranged from 1,044 to 28,061 with an average of 9,448.

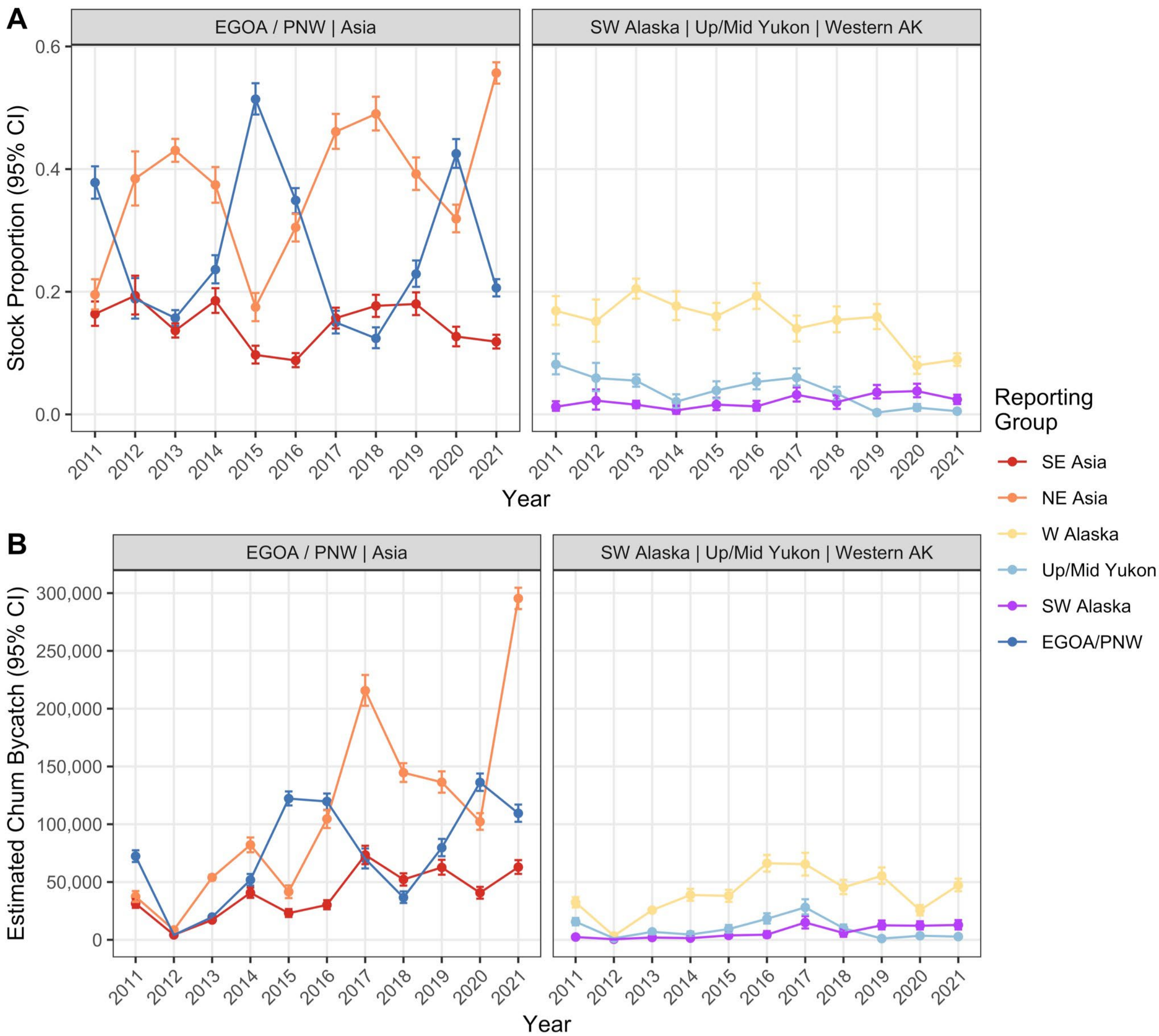

Figure 1. Estimates of B season chum salmon PSC (A. stock proportions, B. estimated number of chum salmon) from 2011 to 2021.

Note: SW Alaska genetic reporting group (inclusive of Kodiak, South Alaska Peninsula, North Alaska Peninsula, and Aleutian Islands stocks) is not included in the discussion of "Western Alaska" chum salmon elsewhere in this document.

It is important to note that an estimated number of chum salmon PSC is larger than the number of chum salmon adults that would have returned to Western Alaska rivers. To estimate the number of adult chum salmon that would have returned to Western Alaska rivers, an adult equivalency analysis, or AEQ, could be done to consider factors other than PSC that affect salmon returns. Because the pollock fishery catches a range of chum PSC ages (and years before maturity) and chum salmon mature and return to the rivers at multiple ages in a given run year, the AEQ of the PSC in a given calendar year is spread over multiple run (maturity) years. An AEQ for Western Alaska chum salmon would consider (1) chum salmon caught may not be maturing and returning to their river in the year they were caught as PSC; and (2) natural mortality would have occurred in the year(s) between the catch as PSC and when those fish would have otherwise returned to their rivers. Due to data limitations and other factors described below, a chum salmon AEQ is not currently available. This document provides staff recommendations for an analytical approach to develop an AEQ.

The second component of determining the impacts of chum salmon PSC in the pollock fishery on Western Alaska chum salmon stocks is to use chum salmon adult equivalency estimates to estimate the impact rate of the PSC on adult salmon runs. The impact rate of chum salmon PSC is the chum salmon AEQ divided by the total estimated abundance of aggregate Western Alaska chum salmon.

2 General recommendations for estimating impacts:

- It is possible to do a coarse estimate of an AEQ, or the adult equivalent of the number of chum salmon caught as PSC that would have returned to Western Alaska rivers, but several assumptions would need to be made where data are not available (i.e., maturity and natural mortality rate). However, the number of adult equivalent chum salmon returning to the river is not a complete impact analysis as described above. For a full impact analysis, analysts must calculate an 'impact rate' of PSC on chum salmon stocks. Calculating this impact rate for the W. Alaska stock group is not possible at this time for reasons that are described below. Future ability to estimate impact rate for the W. Alaska stock group may be possible (see potential future solutions section below).
- An AEQ and impact rate could be estimated for the Upper/Mid Yukon chum salmon stock reporting group (Yukon River fall chum salmon) since this is a genetically distinguishable stock and has an existing estimate of total run size that can be used for impact rate analysis. It should be noted that this is a small population and therefore, using an impact rate estimate for this stock as a proxy for impacts to all Western Alaska chum salmon may not be appropriate.

3 Additional recommended analyses:

- Summarize spatial and temporal location of Western Alaska chum stocks in bycatch. This would provide clarity to whether spatial restrictions could be used to better avoid chum salmon PSC of these stocks.
- Work toward developing estimates of the chum ages in PSC for each of W. Alaska and Upper/Middle Yukon (Yukon River fall chum salmon) stock genetic reporting groups. Estimating the run year that chum salmon caught as PSC would have otherwise matured, in order to calculate an AEQ, is complex. This requires knowledge of the ages that fish of a given stock are caught as PSC and ages when fish of those stocks typically mature and return as adults. While we may know what proportion of the 3-year-old chum PSC were Western Alaska stocks, we do not know how much of the Western Alaska chum PSC was age 3 (the age composition of the stock). The

latter is what is actually needed for an AEQ analysis, and this data limitation presents a weakness for any AEQ analysis.

4 Why it is not currently advisable to calculate an impact rate with existing run size information for W. Alaska chum salmon stocks

Run reconstructions that provide an estimation of total run size are more limited for chum salmon than for Chinook salmon in Western Alaska. A scientifically defensible run reconstruction includes a fairly thorough estimate of escapements (the number of fish that are not caught by fisheries and contribute to the spawning population) and harvests. Run reconstructions are currently only available for Yukon River summer and fall chum salmon and Kwiniuk River chum salmon. This excludes large populations in Kuskokwim River and throughout Bristol Bay, Kotzebue Sound, and Norton Sound. Unlike Chinook salmon, the lack of run reconstructions for large populations of W. Alaska chum salmon means that a good approximation of total W. Alaska chum salmon abundance cannot be provided at this time.

While some indices of abundance are available for chum salmon populations without run reconstructions (e.g., aerial surveys, weirs, counting towers, sonars, harvest), a simple summation of these indices of abundance is not equivalent to a run reconstruction and would not provide a scientifically defensible accounting of the total abundance of chum salmon for the W. Alaska stock reporting group. Indices may only provide a partial accounting, with some unmeasured and uncertain components of the run missing, or they may be designed to only provide relative abundance rather than absolute abundance information. For example, aerial surveys provide a relative index of abundance because they assess a standardized portion of the spawning area and not the entire spawning area; they do not provide a census or estimate of total abundance. As another example, in large river systems, it may only be possible to operate sonars upriver of important chum salmon habitats, leaving spawning stretches of the population downstream from the sonar entirely unassessed.

Some of these challenges for estimating total run abundance in the many large river systems in Western Alaska have been overcome for Chinook salmon in this region thanks to a tremendous amount of funding and years of effort to create scientifically defensible run reconstructions. Improving and refining these run reconstructions and developing run reconstructions for other species is an ongoing effort, and this work is prioritized based on current information needs for salmon fishery management. It would be possible to provide a reasonable total estimate of abundance for the W. Alaska chum salmon stock reporting group, but this would require substantial time, staff resources, and the development of a number of important assumptions.

The lack of run reconstructions is an impairment beyond abundance estimates, these run reconstructions also include unbiased estimates of ages at maturity for each run year. Since different stocks have different maturity patterns and trends, this information is important to AEQ and impact rate analyses. Less information on in-river age estimates is available for the W. Alaska chum salmon reporting group to underpin maturation estimates than for Chinook salmon stocks.

5 Potential future solutions:

- Request a minimum aggregated run size estimate for the W. Alaska chum salmon genetic reporting group. A minimum W. Alaska chum salmon run size estimate would be less precise than the run reconstruction-derived abundance estimates for Chinook salmon, and could include unknown biases based on assumptions used to develop the estimate. However, it would allow a *maximum impact rate* to be estimated. This is not a small request as information is not readily available to be used for an impact analysis and would require a number of assumptions and intermediate analyses to construct. This would require significant ADF&G staff work and would need to be prioritized over current staff efforts, without knowing how good the end result (product) would be.
- A possible solution for a lack of age at maturity information (without incurring significant staff resources) would be to use a range of high and low estimates that could bracket assumed “true” maturation rates across Western Alaska rivers as a proxy for more precise information.