Chum salmon bycatch: analytical considerations

This paper provides an overview of the available data for potential use in the Council's upcoming chum salmon bycatch analysis, some specific considerations of current fleet conditions under implementation of Amendment 91, and some of the analytical frameworks, in relation to the potential data limitations, which might best address these limitations. A full review of the proposed methodological approach will be provided at the June 2010 SSC meeting. At the June meeting the Council will be refining draft alternatives in order to initiate the chum salmon bycatch analysis. Analysis by staff of the proposed alternatives is scheduled to begin in the summer of 2010. Preliminary review of the draft analysis is scheduled for February 2011 with initial review in June 2011.

Impact analysis elements

The recent impact analysis of Chinook salmon bycatch management measures (EIS for Amendment 91) was based on a retrospective approach that evaluated three aspects:

1) estimation of salmon 'saved' based on proposed sector/seasonal fishery constraints (i.e., hard-cap closures);
2) analogous potential forgone gross revenue by the pollock fishery; and
3) estimated change in bycatch impacts on adult equivalent (AEQ) returns in aggregate, and by regional river systems, to examine the biological and economic effects.

For the first two aspects (salmon saved and pollock forgone catch and revenue), a 5 year time frame was used. The most recent time frame at the time of the Chinook salmon analysis (2003-2007) was selected to best represent the current fleet, and biological, conditions. These years also have consistent reporting of bycatch data in the catch accounting system (CAS) by sector, which was necessary for that analysis. Fleet-wide and sector-specific constraints were then evaluated against the actual catch, by fleet and sector and by season over that time frame, to evaluate constraints that would be placed on the fishery by each of the alternatives. Chapter 3 of the EIS contains a detailed description of these calculations.

The third aspect, estimating adult equivalents via the AEQ model developed specifically for the Chinook salmon bycatch analysis, accounted for the fact that salmon bycaught in the pollock fishery were of different ages and hence had different impacts on adult salmon returns. Genetic stock composition estimates from bycatch during the 2005-2007 seasons were used to estimate AEQ mortality impact to individual regional river systems. Overall (i.e. aggregated) AEQ estimates were provided in addition to impacts broken out to the individual river systems in Western Alaska. Chapter 3 of the EIS contains a detailed description of these methods.

For chum bycatch analysis, several methods used for the Chinook analysis will require modification due to the characteristics of the chum salmon bycatch relative to fleet operations and data limitations.

Analytical time frame

A retrospective analysis over the more recent time frame is unlikely to reflect current fleet conditions. Specifically, amendment 91, which imposes a regulatory system of transferable Chinook bycatch caps on the fishery, with embedded incentive program agreements (IPAs), will modify fleet behavior. This program is due to be implemented in January 2011. Thus, by the time the initial review draft of the chum salmon bycatch analysis is available in June 2011, the first season (e.g. pollock A season) of operation under the new program will have occurred. A pilot program by catcher vessels may also be implemented voluntarily in 2010, and may provide additional information on fleet operations under the new system. It will be important to characterize operations under the Chinook program within the chum analysis in order to understand the impact of overlaying chum regulations on the existing, although quite new, Chinook bycatch regulations of Amendment 91.

In December 2009 the Council requested that industry participants develop these IPAs, in conjunction with the amendment 91 program, and provide staff with written details of the proposed program by mid-March of 2010. This request is designed to provide information useful for evaluating potential future management modifications in the context of the chum bycatch analysis.

Analysts are considering characterizing impacts of chum bycatch management alternatives by evaluating a range of scenarios of assumed bycatch and fleet dynamics. These scenarios would evaluate historical patterns within the fleet and categorize vessels according to their historic chum salmon bycatch amounts. The analysis could compare characteristics of high performers (i.e., those with low bycatch rates) with low performers (i.e. those with high bycatch rates) and evaluate the consequences of proposed management measures on each based on assumed spatial-temporal chum salmon bycatch patterns and observed performance history. Such fleet behavior modifications, in terms of higher and lower directed catch rates of pollock and bycatch rates of chum salmon, may characterize responses to existing proposed IPAs. This contrasts with the retrospective analysis (over a fixed time-frame) done for Chinook salmon bycatch and may be preferred, in this case of chum salmon bycatch, since it would account for likely changes in fleet behavior resulting from Chinook salmon bycatch management. Alternatively a retrospective analysis could be repeated, and possibly contrasted with the one season of actual observed behavior under the Amendment 91 regulations.

Adult equivalency analysis

The analysis will need to account for impacts on adult equivalent numbers of returning salmon (potential spawners) due to bycatch in the pollock fishery. The table below shows the main data requirements in developing an AEQ model for chum and a relative indication of the availability of such data. Additional biological needs for the impact analysis are then summarized further below.

Data	Availability	Other issues
Bycatch and pollock catch data (spatial and temporal) by sector	Yes	Time frame:
		1991-present (some CDQ data limited in early years)
		2003-present (more consistent treatment by sector)
Age data	Some	Time frame:
		1988-2005 [being processed, but available Spring 2010]
		2006-2009 [possible]
		Length at age data for Bering Sea [should be available in conjunction with age-data over same time period]
Maturity data	Some rivers?	Proxy available?
Stock of origin	Some	Time frame:
		2005, 2009 [to be available June 2010]
		[2006 available Oct 2010, 2007-2008 available Dec 2010]
		1994, 1995 [published reports]
Other data needs (not necessarily for AEQ):	**Availability**	**Other issues**
Run size estimates	Some	Insufficient, in aggregate, to develop appropriate comparisons with stock of origin breakouts (e.g., WAK aggregate)
Oceanic abundances by region	Modeled (Mantua et al. 2009)	Estimates may serve as background over time (run size estimates to regions, possible with estimates of stock composition uncertainty)

Main limitations:

Bycatch stock of origin availability:
A report to the Council by Guyon et al. (2010) reviews the chum salmon genetic information, limitations given current sampling and genetic data availability, and estimates of genetic origin of chum salmon bycatch in the pollock fishery in 2005. Genetic data for chum salmon bycatch from 2005 and 2009 will be available to analysts by June of 2010. Additional years of data (2006-2008) are anticipated to be available in October (2006 data) and December (2007-2008 data) of 2010. Additionally, some data from 1994-96 may be available from published reports.

Aggregate level impact analysis:
Evaluation of impacts of returning adult chum salmon must be consistent with the genetics information available at this time. Stock of origin will be aggregated for most western Alaska stocks according to genetic data as presented in Guyon et al., 2010 (i.e., three groups: Upper/middle Yukon, the Alaska Peninsula, and then one aggregate Western Alaska grouping of the remaining WAK stocks). Thus impacts of chum salmon returning to individual streams in western Alaska will not be estimated. As a

result, and directly due to limitations of chum salmon genetic information, some of the comparative information that was included by river system in the Chinook EIS (i.e., comparison of AEQ estimates by year with commercial, subsistence and sport catches) is not possible in the chum salmon analysis.

Proposed approaches for AEQ impact analysis:

Unlike the Chinook salmon analysis, broad oceanic estimates of chum salmon abundances by region and in-river runs have been modeled, and estimates (with uncertainty) are available that may help provide a backdrop for potential sources of chum bycatch (Mantua et al. 2009; Nathan Taylor pers. comm.). This model, called the "Model for Assessing Links Between Ecosystems" (MALBEC), is designed as a policy gaming tool with the potential to explore the impacts of climate change, harvest policies, hatchery policies, and freshwater habitat capacity changes on salmon at the North Pacific scale (Mantua et al. 2009; Mantua et al. 2007). The model apportions run reconstructions, as depicted in Figure 1, to oceanic regions (Figure 2) and estimates are available over time (Figure 3). The MALBEC model may also provide some insight on plausible oceanic survival rates for chum salmon. The approach for the chum salmon AEQ analysis will, at a minimum, use an estimated mean difference in age of chum taken as bycatch and chum returning to rivers to derive a crude estimate of the impact of chum salmon bycatch to all rivers in aggregate. Depending on the extent and availability of age data, bycatch length frequencies recorded by observers will be used to estimate the seasonal and area age composition information and used to refine estimates of AEQ values for chum salmon.

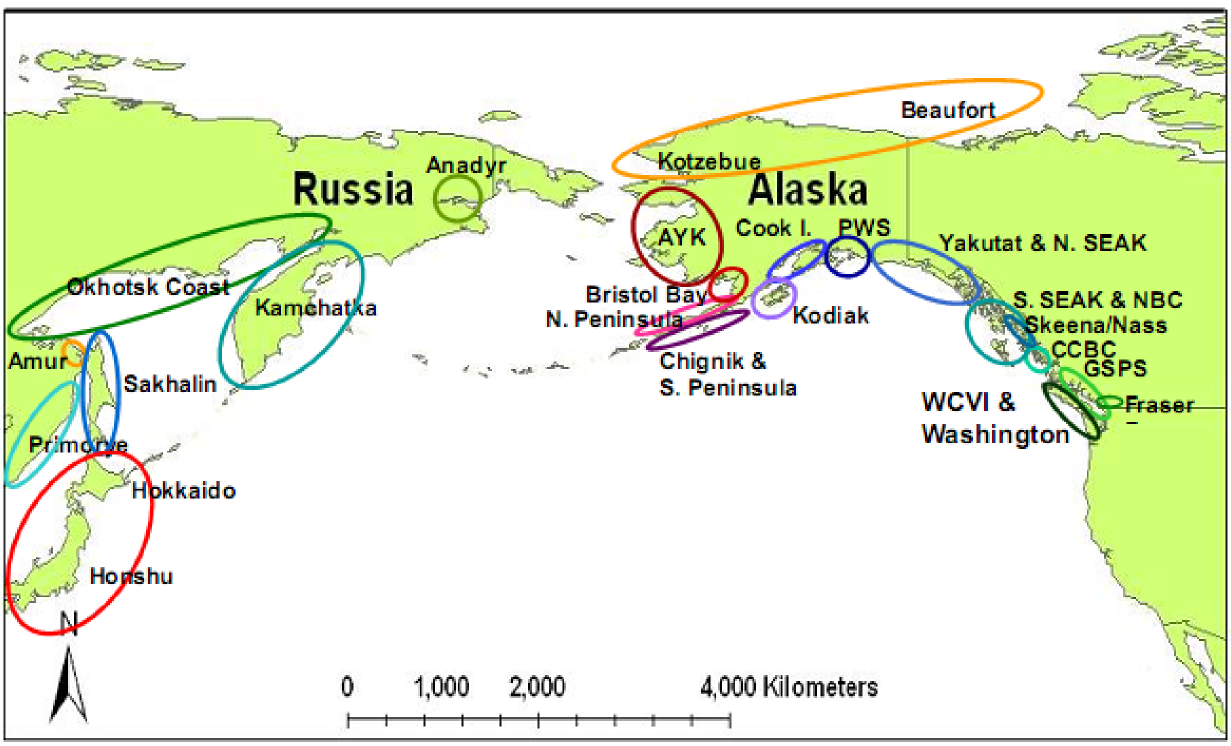

Figure 1. The approximate geographic locations of regional stock groups used in MALBEC. Stock groups are listed in Table 1. Korea is not shown. AYK= Arctic-Yukon-Kuskokwim CCBC=Central Coast British Columbia, GSPS=Georgia St. (BC) & Puget Sound (WA), PWS= Prince William Sound, SEAK=Southeast Alaska, WCVI=West Coast Vancouver Island (BC). *From Mantua et al. 2009.*

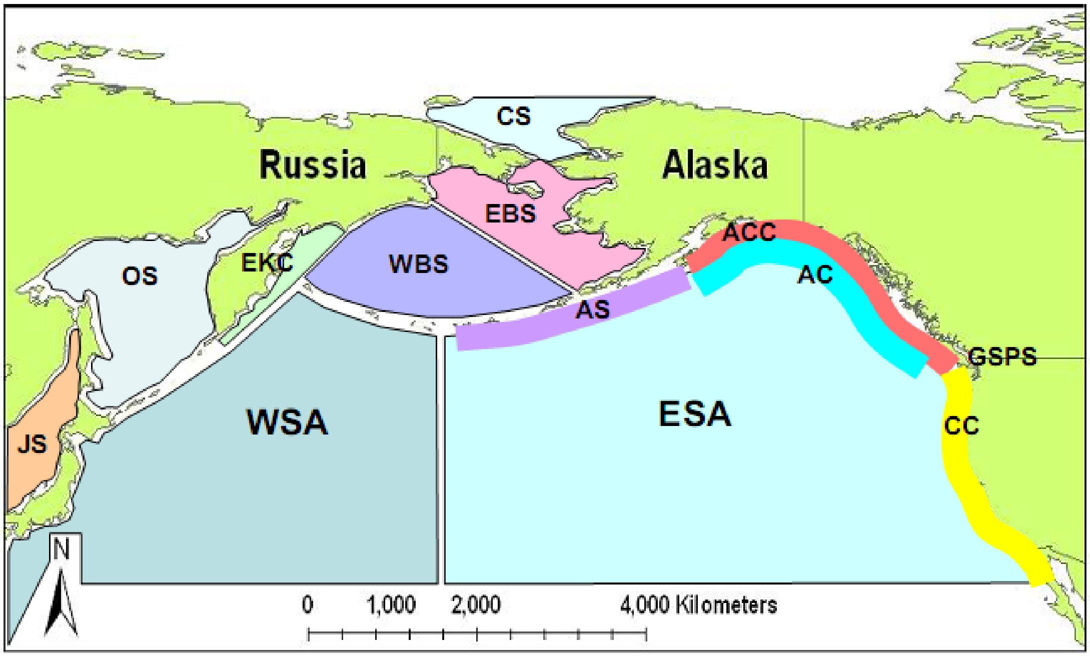

Figure 2. Extent of spatial dis-aggregation of the MALBEC model estimates of abundances of chum salmon from different river systems around the North Pacific (from Mantua et al. 2009). AC = Alaska Current, ACC = Alaska Coastal Current, AS = Alaska Stream, CC = California Current, CS = Chukchi Sea, EBS = Eastern Bering Sea, EKC = Eastern Kamchatka Current, ESA = Eastern Sub-Arctic, GSPS = Georgia St. & Puget Sound, JS = Japan Sea, OS = Okhotsk Sea, WBS = Western Bering Sea, WSA = Western Sub-Arctic.

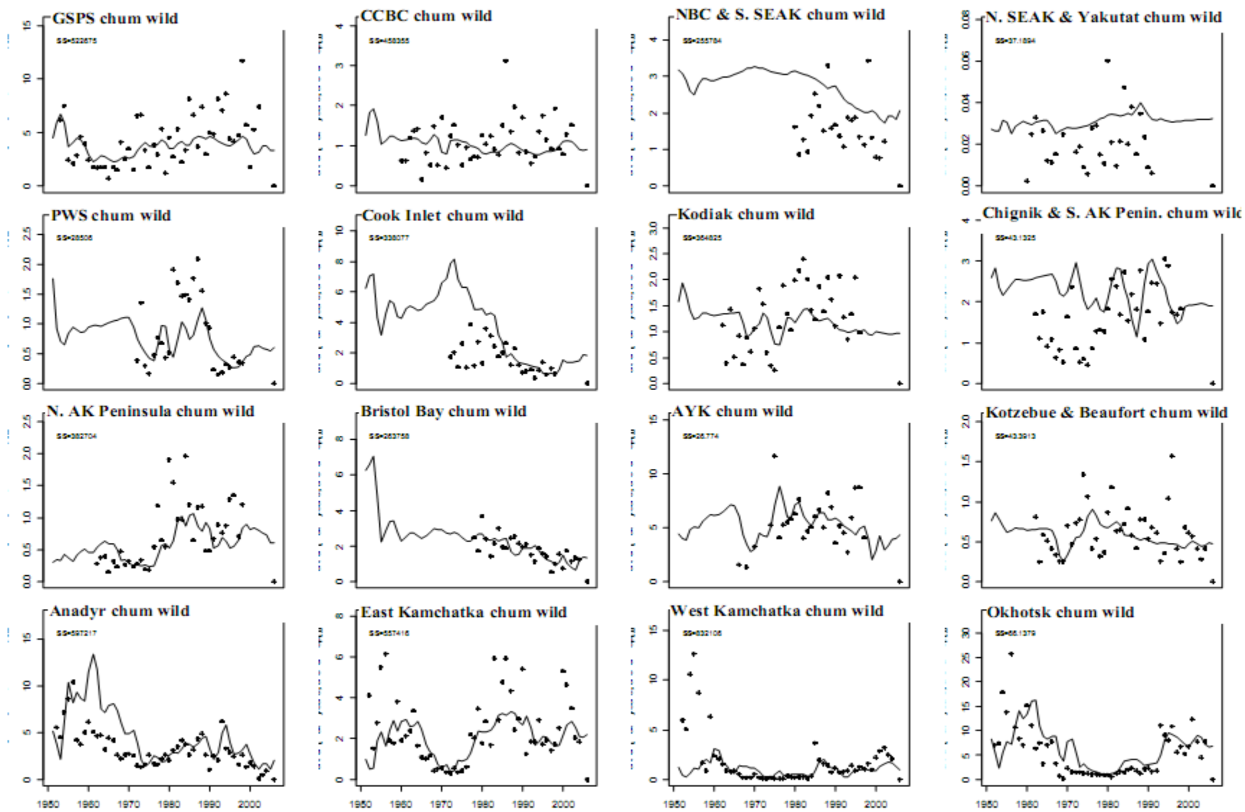

Figure 3 Model fit to total run size for wild chum salmon. *From Mantua et al. 2009.*

References

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