

Kuskokwim River Escapement Goal Review and Chinook Salmon Run Reconstruction Model Review



Kuskokwim River Working Group Meeting
May 16, 2018

ESCAPEMENT GOAL OVERVIEW

ADF&G is responsible for establishing escapement goals consistent with state policy. An escapement goal review team made up of research and management biologists and biometricians from the divisions of Commercial Fisheries and Sport Fish reviews escapement goals every three years concurrent with the Board of Fisheries (BOF) regulatory cycle. In preparation for the 2019 BOF meeting, Kuskokwim Area escapement goals have been reviewed with new data since the last escapement goal review (i.e., 2015). A summary of potential changes to existing escapement goals are in Table 1.

Table 1.—Escapement goals and potential changes for Kuskokwim Management Area salmon stocks.

| Stock unit | Assessment method | Escapement goal | | | Potential change |
|---------------------------------------|-------------------|-----------------|------|------------------|------------------------------|
| | | Goal | Type | Year established | |
| Chum salmon (2 Goals) | | | | | |
| Kuskokwim Bay rivers | | | | | |
| Middle Fork Goodnews River | Weir | > 12,000 | SEG | 2005 | No Change |
| Kuskokwim River tributaries | | | | | |
| Kogruluk River | Weir | 15,000–49,000 | SEG | 2005 | No Change |
| Sockeye salmon (4 goals) | | | | | |
| Kuskokwim Bay rivers | | | | | |
| Kanektok River | Aerial Survey | 15,300–41,000 | SEG | 2016 | No Change |
| Middle Fork Goodnews River | Weir | 18,000–40,000 | BEG | 2007 | Revise to SEG: 21,200-42,000 |
| North Fork Goodnews River | Aerial Survey | 9,600–18,000 | SEG | 2016 | No Change |
| Kuskokwim River / tributaries | | | | | |
| Kogruluk River | Weir | 4,400–17,000 | SEG | 2010 | No Change |
| Coho salmon (3 goals) | | | | | |
| Kuskokwim Bay rivers | | | | | |
| Middle Fork Goodnews River | Weir | > 12,000 | SEG | 2005 | Discontinue |
| Kuskokwim River / tributaries | | | | | |
| Kogruluk River | Weir | 13,000–28,000 | SEG | 2005 | No Change |
| Kwethluk River | Weir | > 19,000 | SEG | 2010 | No Change |
| Chinook salmon (14 Goals) | | | | | |
| Kuskokwim Bay rivers | | | | | |
| Kanektok River | Aerial Survey | 3,900–12,000 | SEG | 2016 | No Change |
| Middle Fork Goodnews River | Weir | 1,500–2,900 | BEG | 2005 | Revise to SEG: 1,300-3,300 |
| North Fork Goodnews River | Aerial Survey | 640–3,300 | SEG | 2005 | No Change |
| Kuskokwim River / tributaries | | | | | |
| Aniak River | Aerial Survey | 1,200–2,300 | SEG | 2005 | No Change |
| Cheeneetnuk River | Aerial Survey | 340–1,300 | SEG | 2005 | No Change |
| Gagarayah River | Aerial Survey | 300–830 | SEG | 2005 | No Change |
| Kisaralik River | Aerial Survey | 400–1,200 | SEG | 2005 | No Change |
| Salmon River (Pitka Fork) | Aerial Survey | 470–1,600 | SEG | 2005 | No Change |
| Salmon River (Aniak Drainage) | Aerial Survey | 330–1,200 | SEG | 2005 | No Change |
| Holitna River | Aerial Survey | 970–2,100 | SEG | 2005 | Discontinue |
| Run | | | | | |
| Kuskokwim River Drainage ^a | Reconstruction | 65,000–120,000 | SEG | 2013 | Pending Review |
| George River | Weir | 1,800–3,300 | SEG | 2013 | Pending Review |
| Kogruluk River | Weir | 4,800–8,800 | SEG | 2013 | Pending Review |
| Kwethluk River | Weir | 4,100–7,500 | SEG | 2013 | Pending Review |

^a Run reconstruction is conducted postseason using a model to estimate total run from harvest and escapement monitoring projects.

OVERVIEW OF MODEL REVIEWS AND UPDATES

Like many tools, the run reconstruction model requires regular review and when necessary updates to ensure the estimates of total run and escapement are reasonable. Colleagues from USFWS, Bechtol Research, Auburn University, and others have investigated several issues related to the run reconstruction model. These issues include data weighting, model scaling, and model uncertainty to name a few. In addition, The Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative (AYKSSI) commissioned an independent peer review of the Kuskokwim Chinook Salmon run reconstruction model. ADF&G has encouraged and facilitated external reviews by providing fishery and assessment orientations, filling data requests, and providing model codes. Additionally, ADF&G has convened a collaborative Kuskokwim River Interagency Model Development Team (KRIMDT) to consider options for incorporating new abundance data and improving the model. Finally, ADF&G undertook a four-year (2014–2017) effort to evaluate performance of the Kuskokwim River Chinook salmon model during years of low run abundance and develop additional independent estimates of the total run for model scaling purposes. The following is an overview of changes that have been made to the existing run reconstruction model and how these changes impact the historical interpretation of total run and escapement of Kuskokwim River Chinook salmon.

What refinements were made to the model and input data:

- Changed software used to run the model
- Changed underlying distribution for input data
- Change individual project variance to pooled variance by data type (e.g., aerial, weir).
- Revised 2003–2007 model scalars
- Added 2014–2017 model scalars
- Changed commercial catch formula

What are the effects:

- Improved estimation of total run and escapement
- Increased model stability
- Model changes resulted in smaller annual estimates (average approximately 11% or about 14,800 fish) of Kuskokwim River Chinook salmon run size compared to the published model (Table 1)
- Revised estimates decreased in 34 (81%) of 42 years (1976–2017) and increased in eight years (19%, Figure 1)
- The revised model produced total run size estimates that are on average 45,000 fish (28%) smaller for years 2014–2017
- Historical trends in abundance were similar between the two models, showing three distinct periods of high abundance followed by periods of low abundance (Figures 2 and 3)

Next Steps:

- Integrate revised total run and escapement estimates into management decisions.
- Escapement Goal Analysis
 - Preliminary analysis does not indicate a dramatic change in the goal
 - Follow up meeting with Kuskokwim River residents to discuss drainagewide goal
- Submit revised model and data to NPFMC for meeting on June 4–11, 2018 in Kodiak

Information on the upcoming NPFMC meeting that will be held in Kodiak can be found at:
<https://www.npfmc.org/upcoming-council-meetings/>

Table 1. – Comparison of published and revised total run size estimates for Kuskokwim River Chinook salmon based on the published (old) model (Bue et al. 2012; Hamazaki and Liller 2015) and the revised (new) model.

| Year | Old Model | | New Model | | Percent | |
|------|-----------|-----|-----------|-----|------------|------------|
| | Total Run | CV | Total Run | CV | Difference | Difference |
| 1976 | 233,967 | 13% | 187,584 | 13% | -46,383 | 20% |
| 1977 | 295,559 | 13% | 348,824 | 18% | 53,265 | 18% |
| 1978 | 264,325 | 12% | 241,781 | 12% | -22,544 | 9% |
| 1979 | 253,970 | 16% | 233,787 | 17% | -20,183 | 8% |
| 1980 | 300,573 | 15% | 357,950 | 25% | 57,377 | 19% |
| 1981 | 389,791 | 14% | 308,660 | 16% | -81,131 | 21% |
| 1982 | 187,354 | 9% | 173,072 | 9% | -14,282 | 8% |
| 1983 | 166,333 | 12% | 148,278 | 10% | -18,055 | 11% |
| 1984 | 188,238 | 14% | 171,853 | 12% | -16,385 | 9% |
| 1985 | 176,292 | 14% | 143,568 | 10% | -32,724 | 19% |
| 1986 | 129,168 | 11% | 123,452 | 15% | -5,716 | 4% |
| 1987 | 193,465 | 15% | 186,184 | 13% | -7,281 | 4% |
| 1988 | 207,818 | 9% | 204,824 | 7% | -2,994 | 1% |
| 1989 | 241,857 | 9% | 214,081 | 10% | -27,776 | 11% |
| 1990 | 264,802 | 9% | 266,353 | 8% | 1,551 | 1% |
| 1991 | 218,705 | 10% | 210,525 | 9% | -8,180 | 4% |
| 1992 | 284,846 | 10% | 259,154 | 7% | -25,692 | 9% |
| 1993 | 269,305 | 11% | 274,830 | 10% | 5,525 | 2% |
| 1994 | 365,246 | 14% | 411,724 | 14% | 46,478 | 13% |
| 1995 | 360,513 | 11% | 371,079 | 11% | 10,566 | 3% |
| 1996 | 302,603 | 14% | 307,072 | 12% | 4,469 | 1% |
| 1997 | 303,189 | 13% | 295,259 | 10% | -7,930 | 3% |
| 1998 | 213,873 | 13% | 184,356 | 13% | -29,517 | 14% |
| 1999 | 189,939 | 12% | 158,770 | 11% | -31,169 | 16% |
| 2000 | 136,618 | 9% | 129,138 | 7% | -7,480 | 5% |
| 2001 | 223,707 | 11% | 205,152 | 9% | -18,555 | 8% |
| 2002 | 246,296 | 10% | 226,106 | 8% | -20,190 | 8% |
| 2003 | 248,789 | 9% | 232,282 | 6% | -16,507 | 7% |
| 2004 | 388,136 | 10% | 366,725 | 6% | -21,411 | 6% |
| 2005 | 366,601 | 9% | 326,904 | 5% | -39,697 | 11% |
| 2006 | 307,662 | 10% | 326,067 | 6% | 18,405 | 6% |
| 2007 | 273,060 | 8% | 244,754 | 5% | -28,306 | 10% |
| 2008 | 237,074 | 9% | 219,709 | 6% | -17,365 | 7% |
| 2009 | 204,747 | 10% | 189,370 | 7% | -15,377 | 8% |
| 2010 | 118,507 | 8% | 112,975 | 5% | -5,532 | 5% |
| 2011 | 133,059 | 10% | 113,749 | 6% | -19,310 | 15% |
| 2012 | 99,807 | 14% | 79,238 | 10% | -20,570 | 21% |
| 2013 | 94,166 | 7% | 84,311 | 5% | -9,855 | 10% |
| 2014 | 135,749 | 15% | 84,326 | 8% | -51,423 | 38% |
| 2015 | 172,055 | 16% | 125,058 | 6% | -46,997 | 27% |
| 2016 | 176,916 | 16% | 128,855 | 7% | -48,061 | 27% |
| 2017 | 166,863 | 13% | 133,267 | 8% | -33,596 | 20% |
| | | | Average | | -14,775 | 11% |

Source: Bue et al. 2012; Hamazaki and Liller 2015; Liller and Hamazaki 2016; Liller 2017; Smith and Liller 2018.

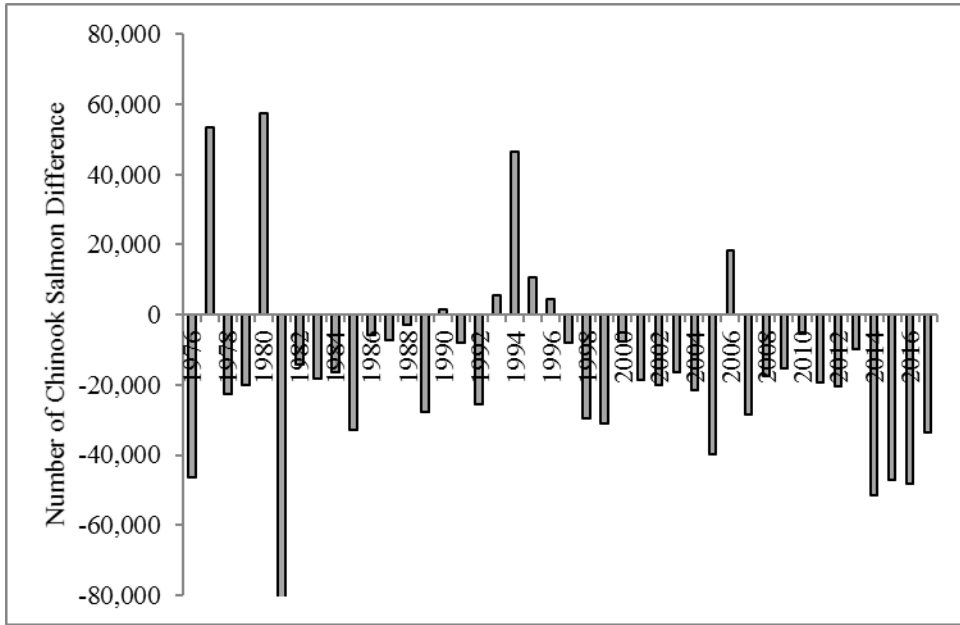


Figure 1. –Difference in the number of Chinook salmon estimated using the revised (new) maximum likelihood model compared to the published (old) model.

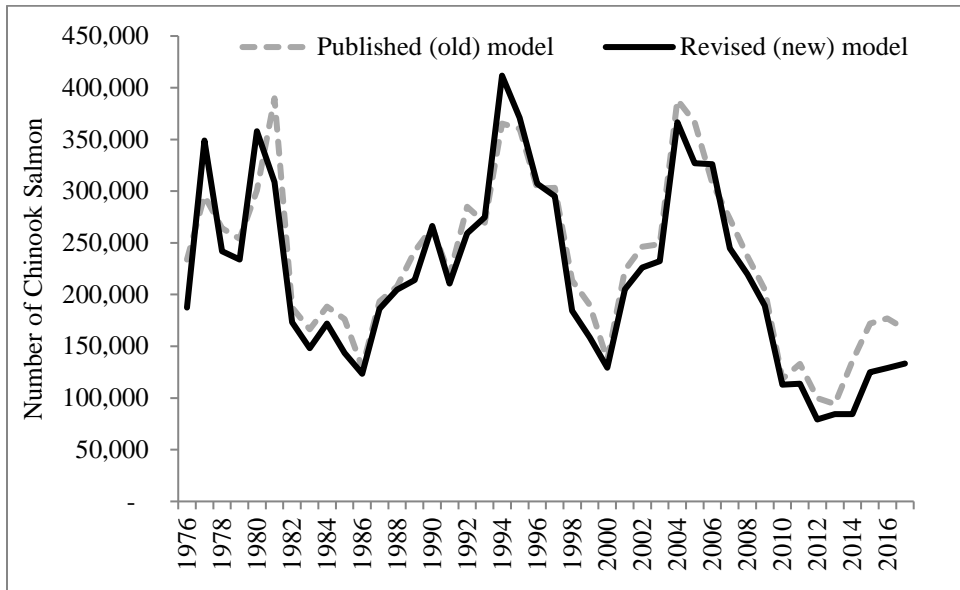


Figure 2.– Total abundance of Kuskokwim River Chinook salmon estimated using the revised (new) and published (old) maximum likelihood model.

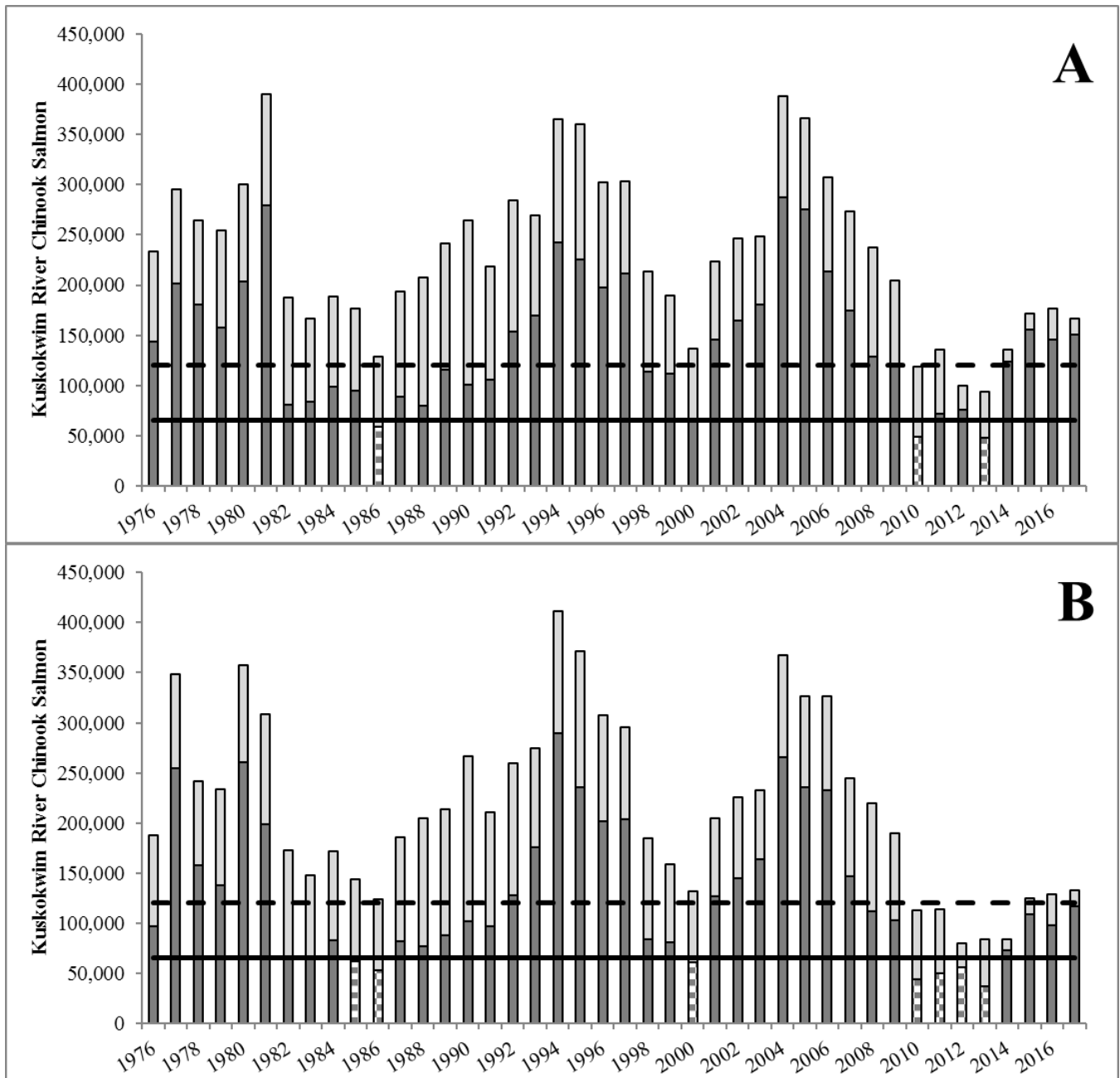


Figure 3.– Total run size of Kuskokwim River Chinook salmon based on the A) published (old) model and B) revised (new) model. Total run size is the sum of drainagewide escapement (dark gray bars) and total harvest (light gray bars). Escapements that fall below the lower bound of the drainagewide escapement goal of 65,000 fish (solid blackline) are highlighted with a checkered pattern. The upper bound of the drainagewide escapement goal of 120,000 is shown as the black dashed line. Note that the drainagewide escapement goal was established in 2013 and is shown for reference.