Revisions to the Kuskokwim River Chinook Salmon Run Reconstruction Model

Zachary Liller

Alaska Department of Fish and Game

Purpose

1. Total inriver abundance of Kuskokwim River Chinook salmon is estimated annually using a maximum likelihood model.

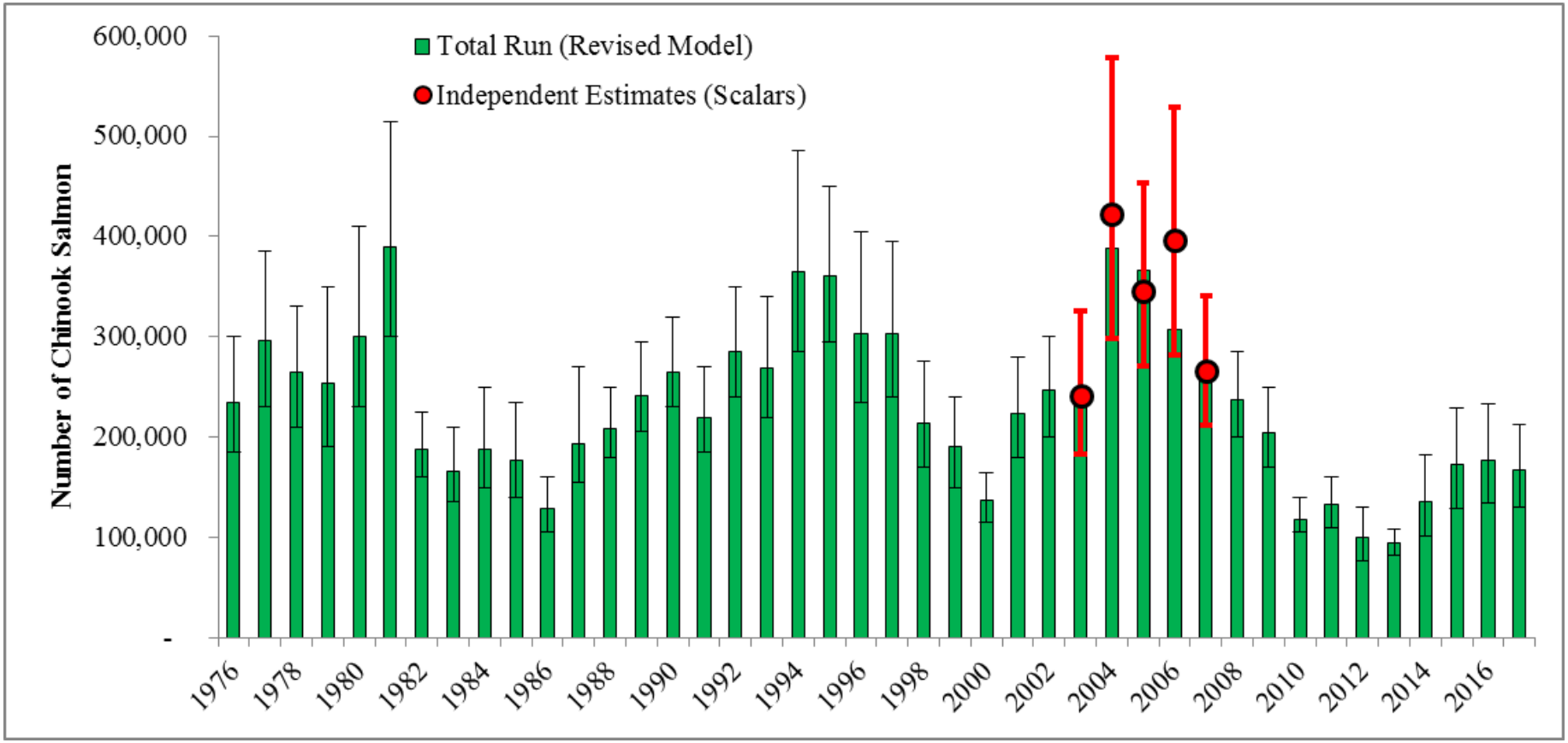
2. ADF&G has updated the model to incorporate new information and advise from two reviews.

3. ADF&G is recommending the Council adopt the revised model for use in the 3-system index of Western Alaska Chinook Salmon abundance.

Outline

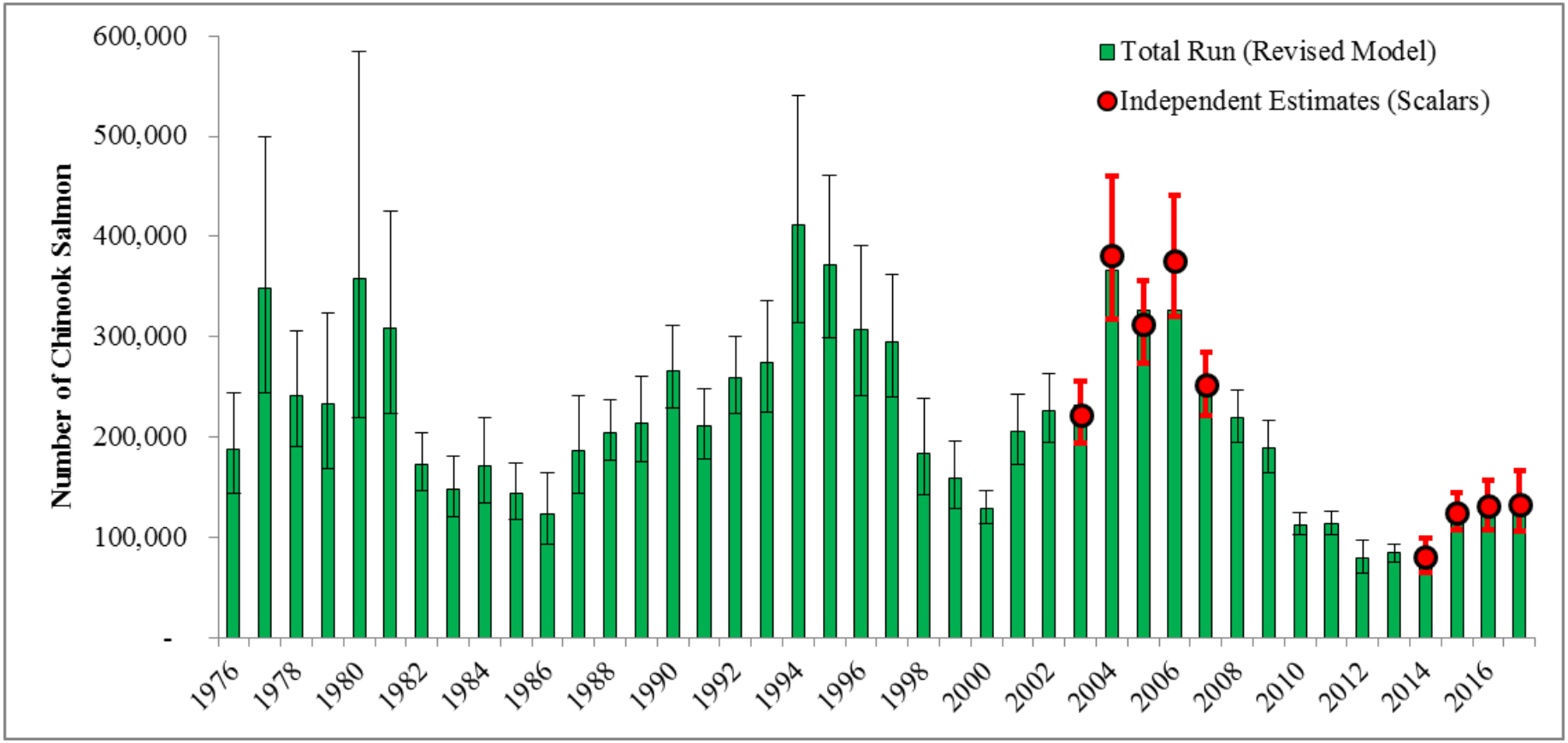
- Snapshot of the old and new model estimates
- Model review process
- Overview of the model structure and input data
- Summary of model revisions
- Effect on time series of total abundance

Old Model Output



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

Revised Model Output



Model Review Timeline

2012
- Publication – Bue et al. 201

2013
- ADF&G approves funding for three years of drainagewide mark-recapture and lower river tributary surveys.

2014
- Year 1: evaluation of model performance using mark-recapture.
- Stability issue reported in Hamazaki and Liller 2015.

2015
- Year 2: evaluation of model performance using mark-recapture.
- AYK SSI: developed plans to convene an independent expert panel to review the current model.

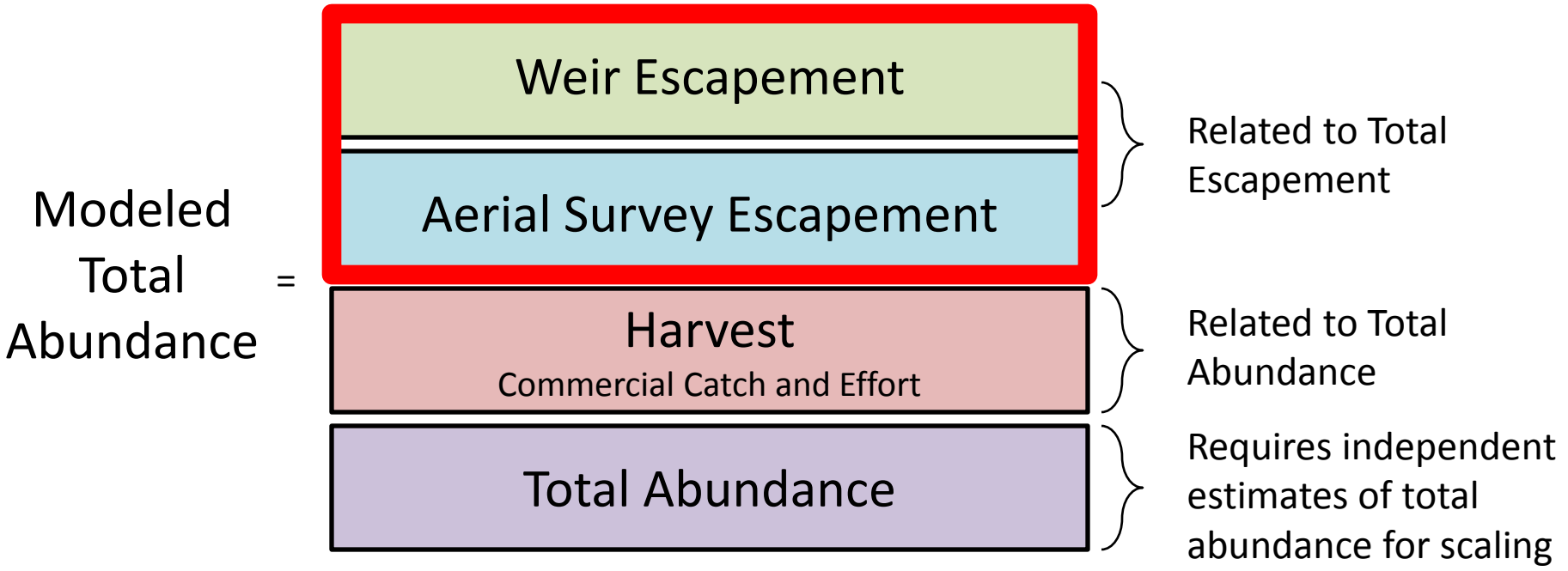
2016
- Year 3: evaluation of model performance using mark-recapture.
- ADF&G developed plans to convene an interagency model development team.

2017
- Year 4: additional year of funding to evaluate of model performance using mark-recapture.
- AYK SSI and ADF&G reviews ongoing.

2018
- AYK SSI and ADF&G model teams convene for a collaborative workshop.
- ADF&G revised model based on new information and recommendations.

Run Reconstruction

Model Framework



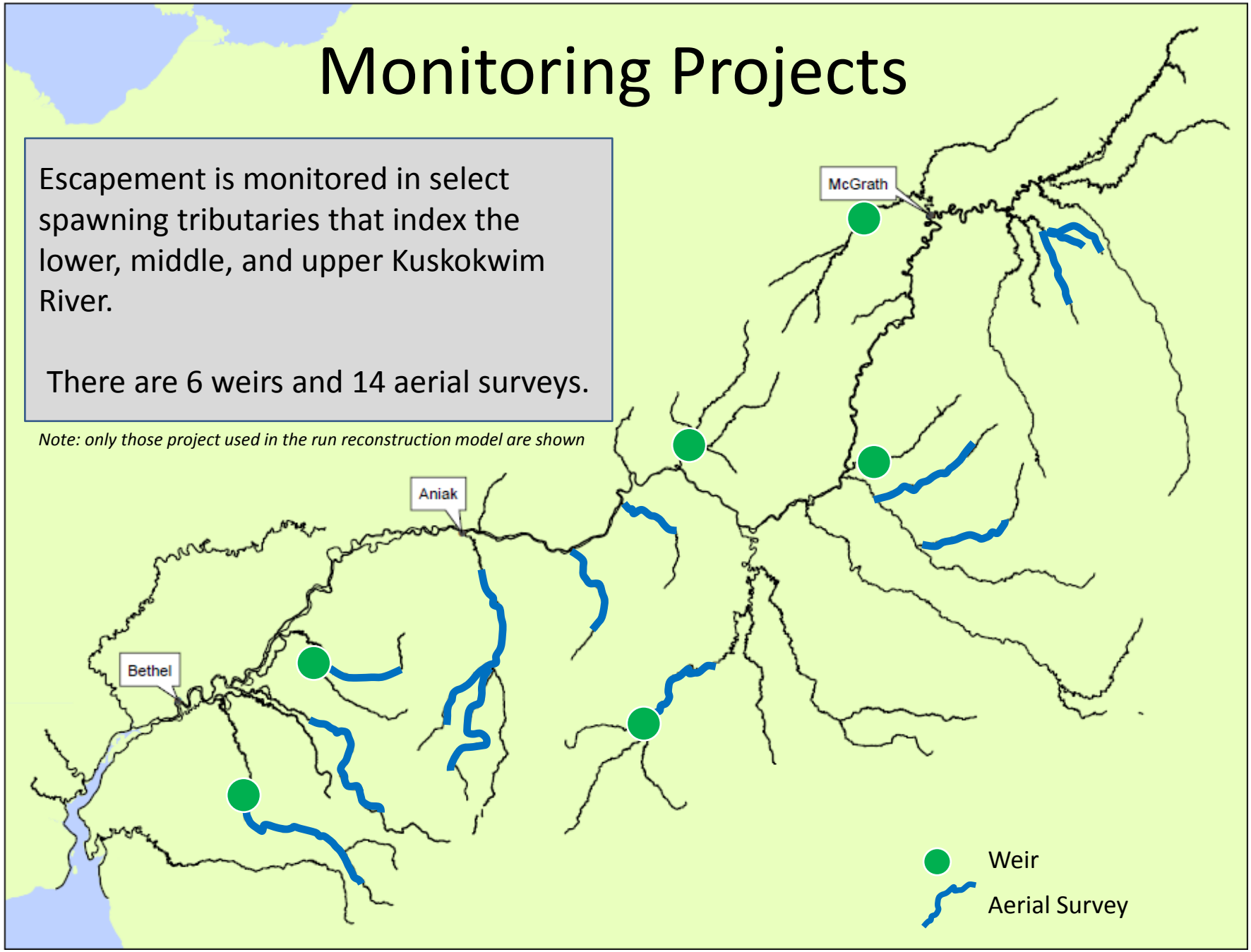
Maximum likelihood model simultaneously considers all available abundance information from 6 weirs, 14 aerial survey locations, harvest, and run-timing to arrive at an estimate of total run for each year, 1976–present.

Monitoring Projects

Escapement is monitored in select spawning tributaries that index the lower, middle, and upper Kuskokwim River.

There are 6 weirs and 14 aerial surveys.

Note: only those project used in the run reconstruction model are shown



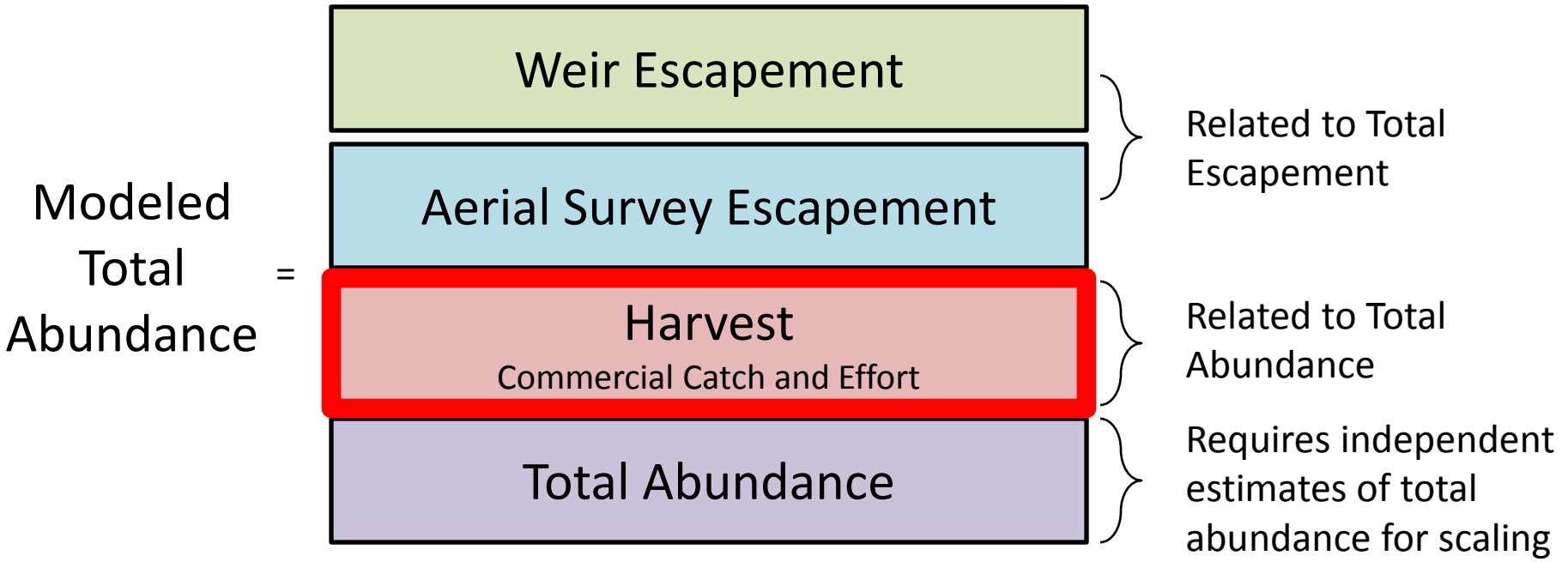
Assumptions and Changes

(Escapement component)

- Tributary escapement is a constant proportion of total escapement. **NO CHANGE**
- Old model - errors followed a negative-binomial distribution and a separate over dispersion parameter was estimated for each index project.
- New model - errors follow a lognormal distribution and variance was combined for each data type (weirs and air surveys).

Run Reconstruction

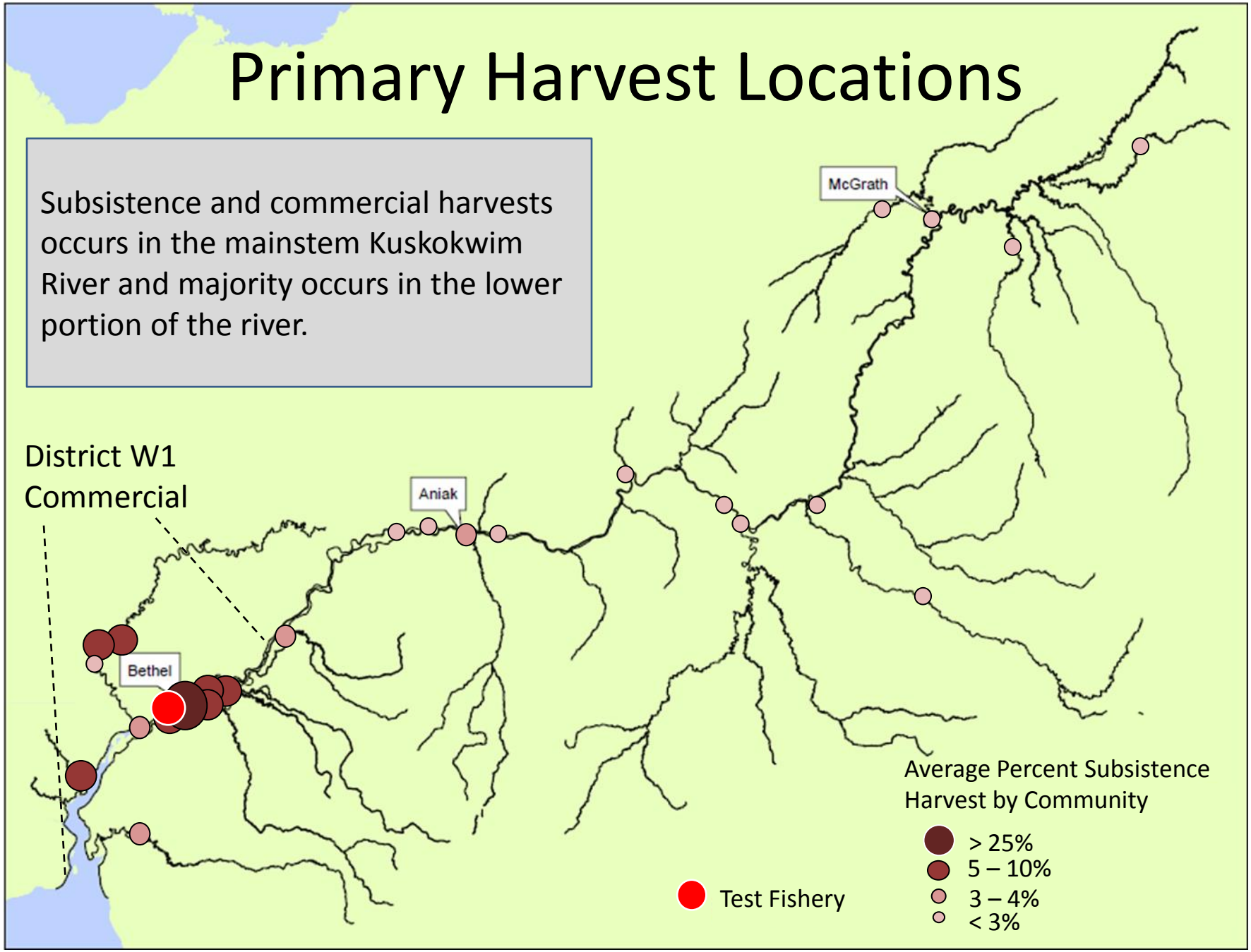
Model Framework



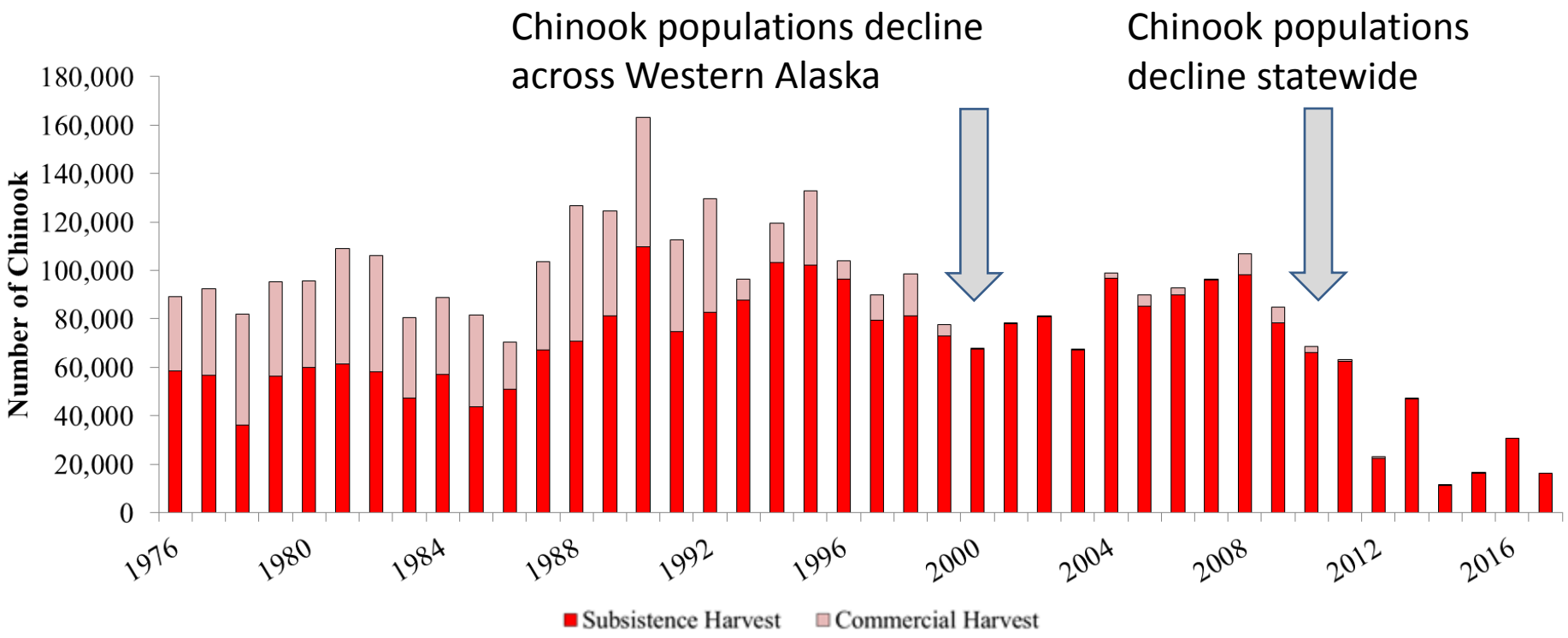
Maximum likelihood model simultaneously considers all available abundance information from 6 weirs, 14 aerial survey locations, harvest, and run-timing to arrive at an estimate of total run for each year, 1976–present.

Primary Harvest Locations

Subsistence and commercial harvests occurs in the mainstem Kuskokwim River and majority occurs in the lower portion of the river.



Harvest Patterns



Assumptions and Changes

(Commercial harvest component)

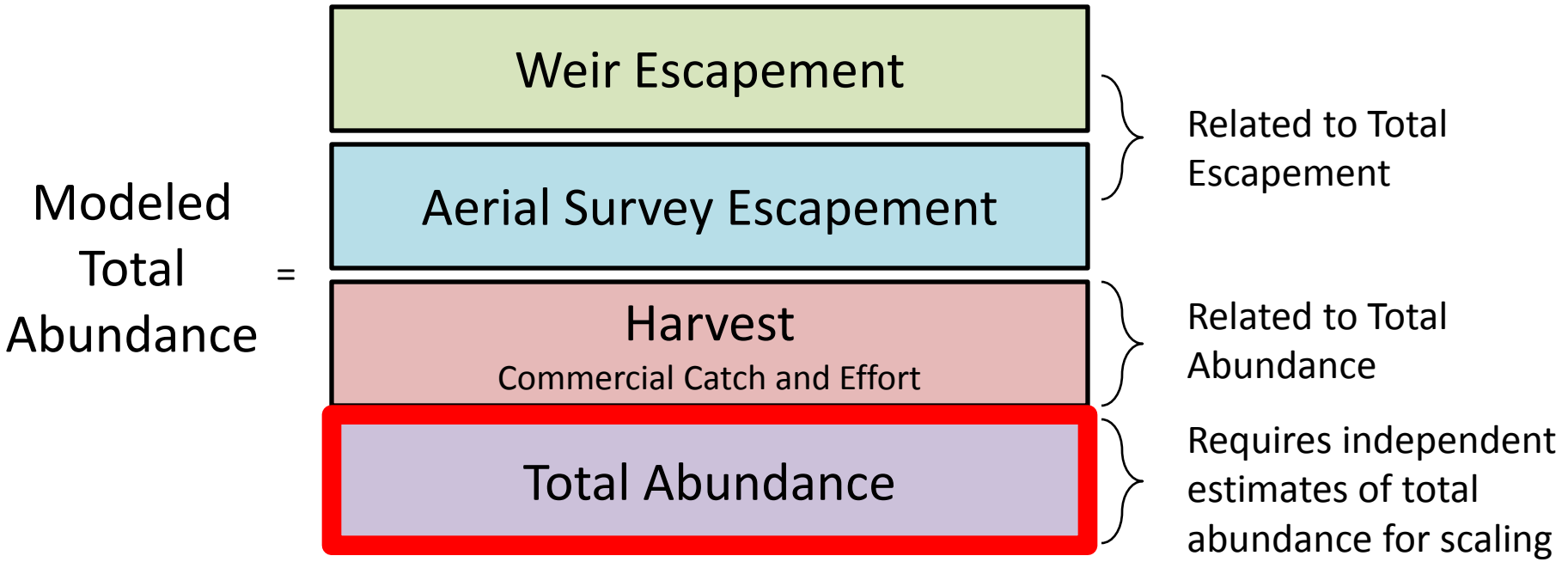
- Old model – assumed a non-linear relationship between catch and effort. The commercial catch and weekly run proportions indexed at the Bethel Test Fishery were assumed to be known without error. The data were fit to weekly effort.

- New model – assumes a linear relationship between catch and effort. The model was fit to annual CPUE which assumes error in catch, effort, and run proportions.

- Errors follow a lognormal distribution. **NO CHANGE**

Run Reconstruction

Model Framework



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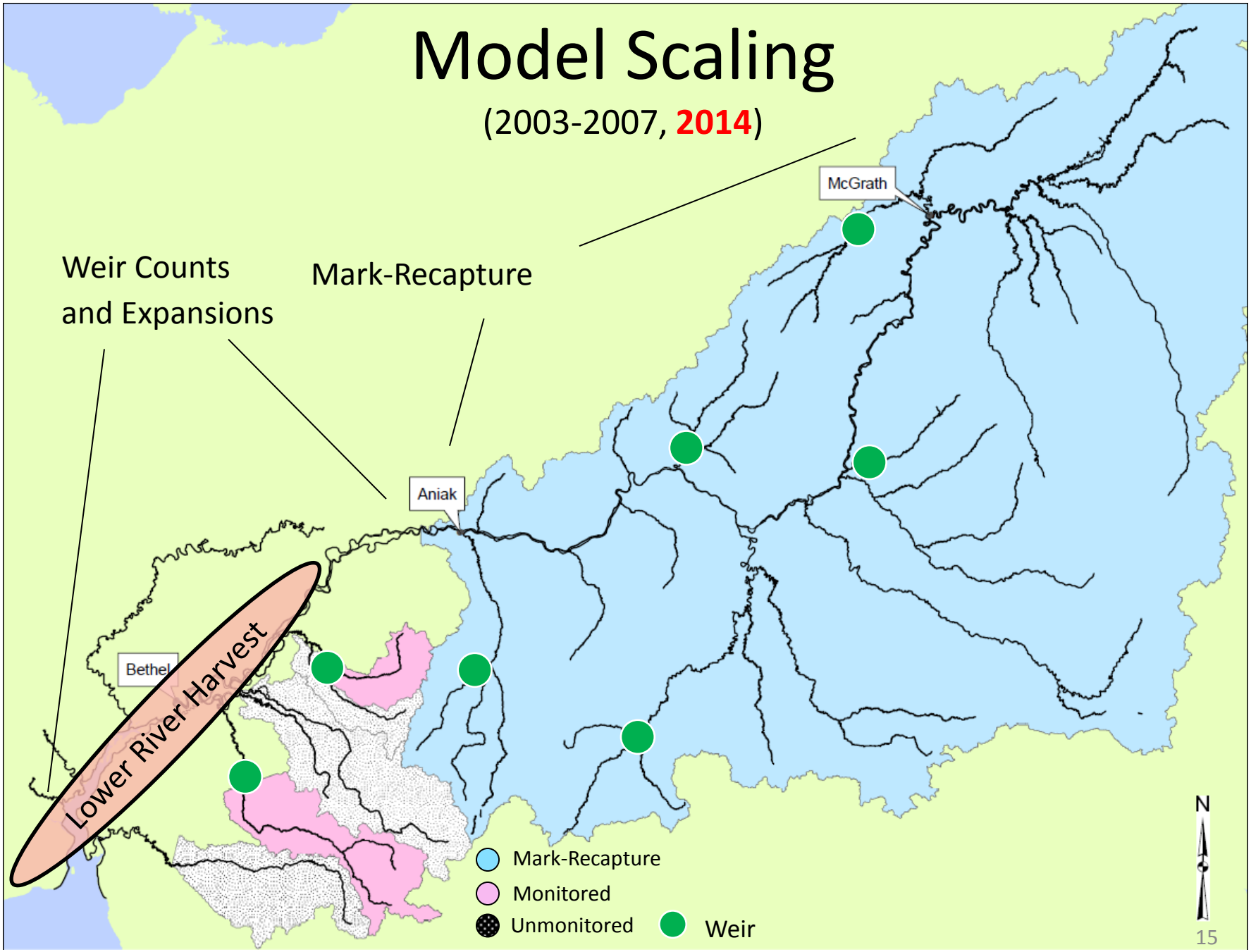
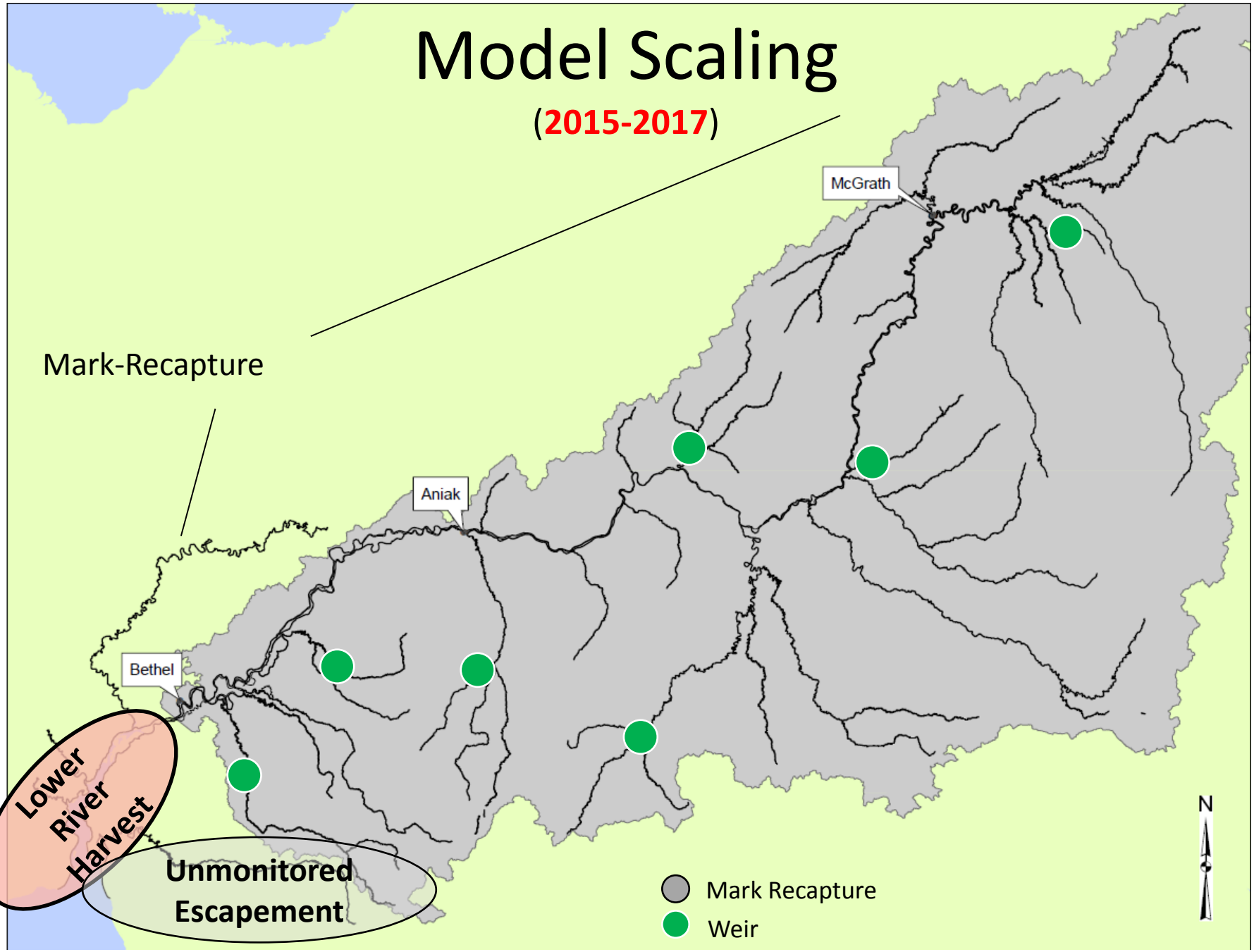

Model Scaling
(2003-2007, 2014)
Weir Counts
and Expansions
Mark-Recapture
McGrath
Aniak
Bethel
Lower River Harvest
Mark-Recapture
Monitored
Unmonitored
Weir
N


Model Scaling
(2015-2017)
Mark-Recapture
McGrath
Aniak
Bethel
Lower River Harvest
Unmonitored Escapement
Mark Recapture
Weir
N

Assumptions and Changes

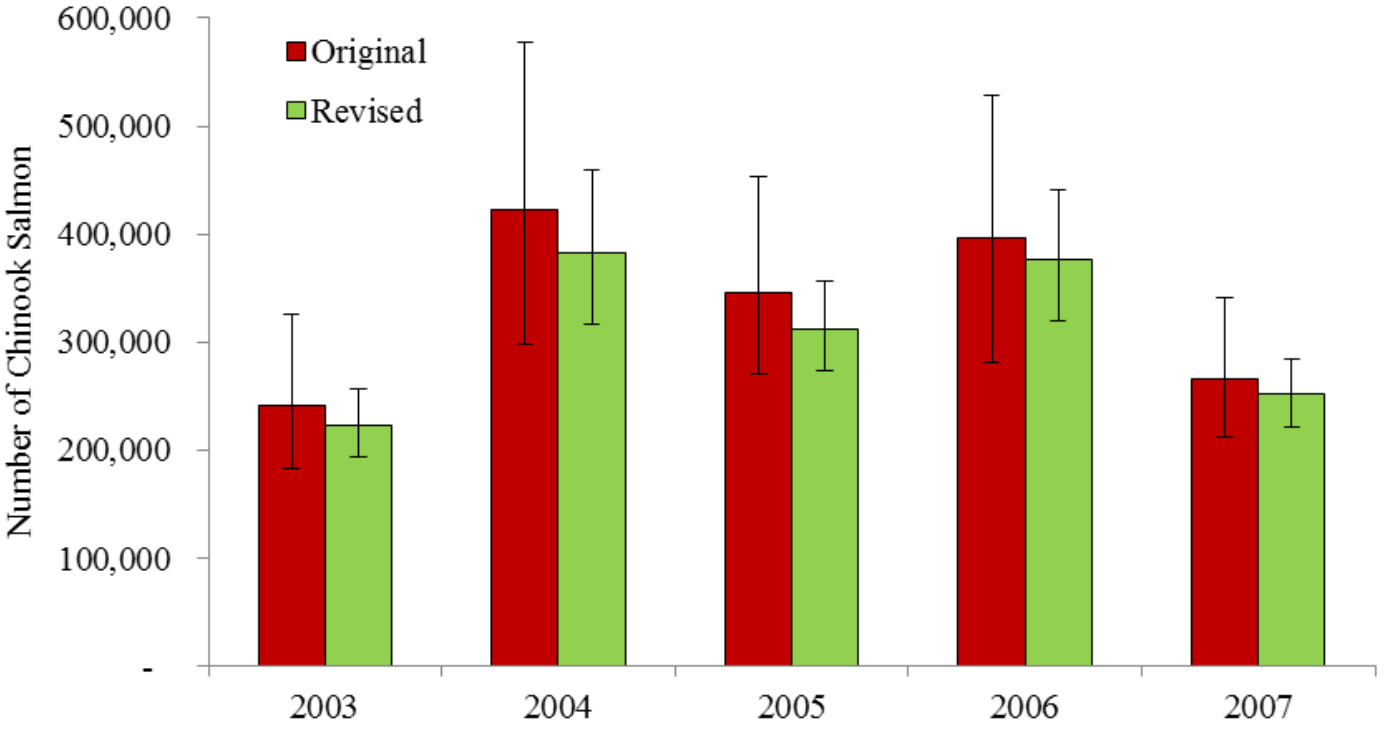
(Total run "scaling" component)

- Old model – errors follow a normal distribution.
- New model – errors follow a lognormal distribution.
- The total run estimates used to scale the model are accurate and uncertainty is properly estimated.

NO CHANGE …. but substantial effort to increase the contrast, improve accuracy, and better describe the uncertainty associated with model scalars.

Model Scaling Improvements

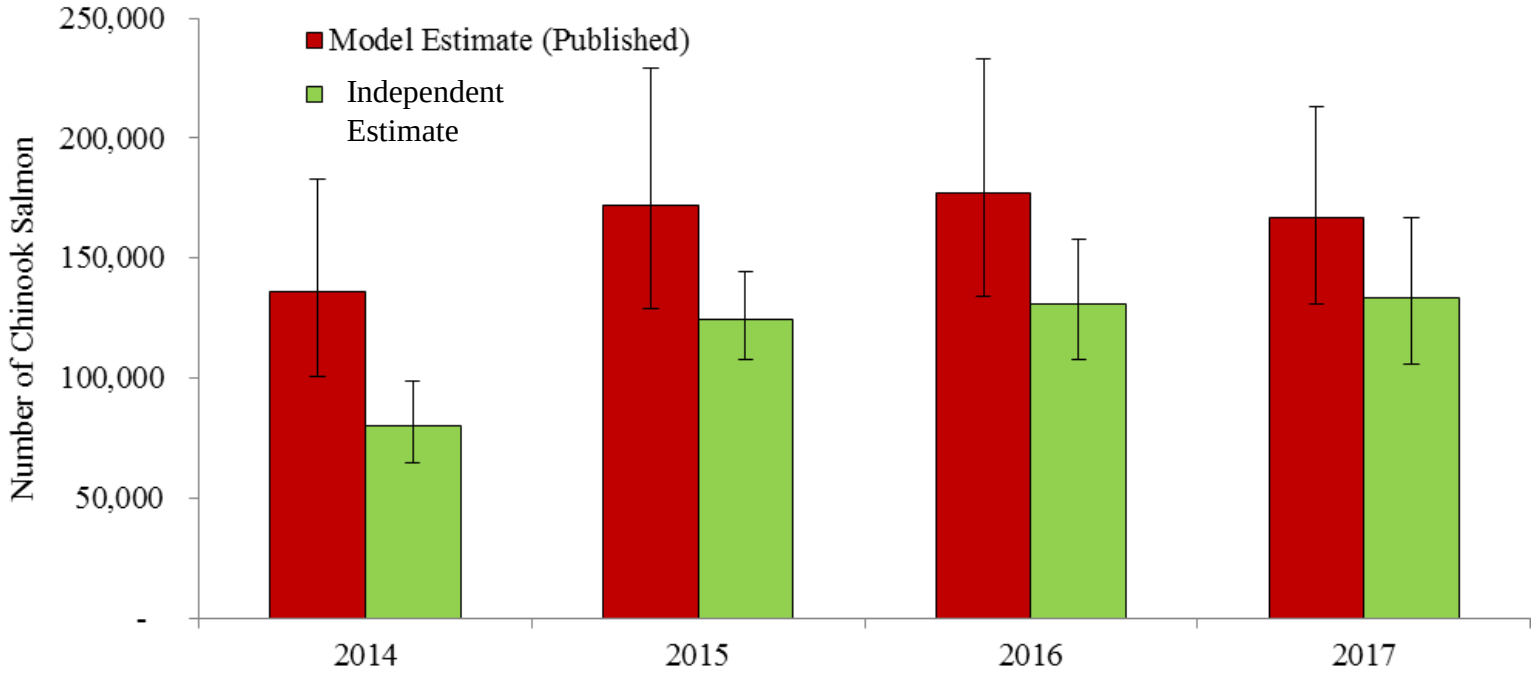
- Historical scalars (2003-2007) were biased high.



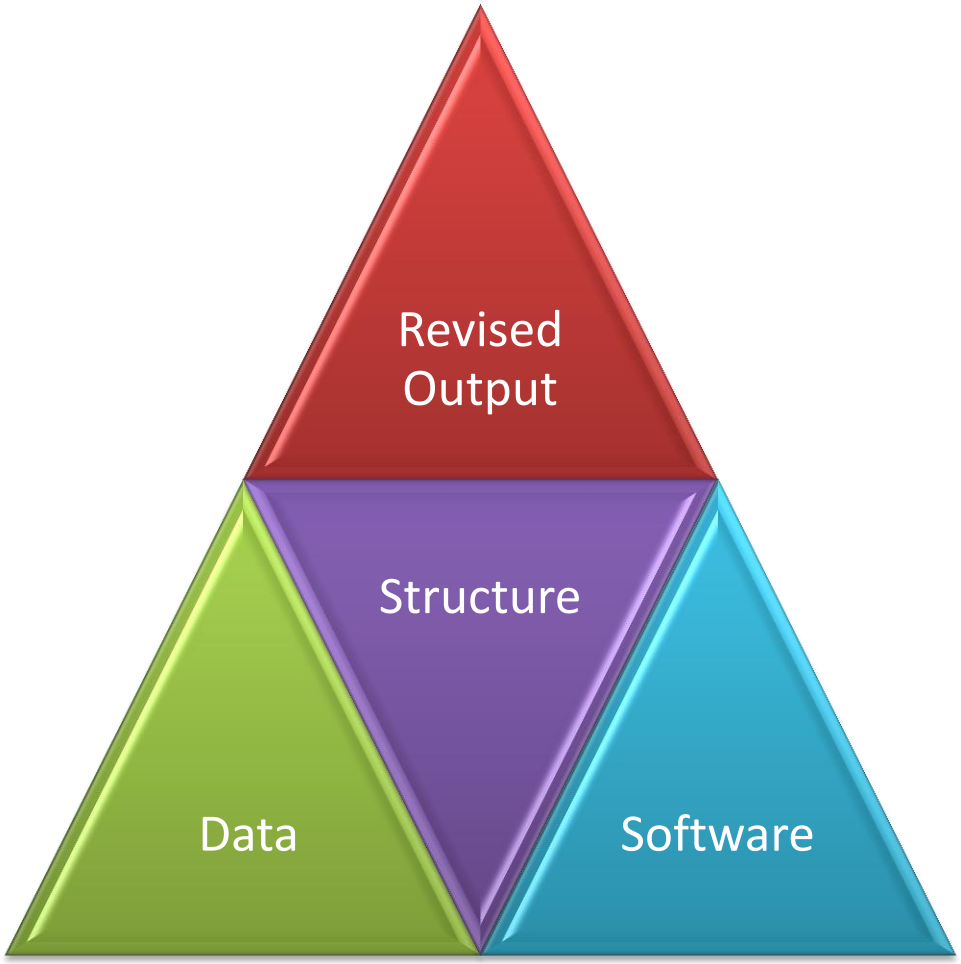
Change due to improved understanding of escapement to lower river spawning tributaries

Model Scaling Improvements

- 2014-2017 independent estimates showed the old model overestimated total run size during recent years of low run abundance.



Summary of Model Changes



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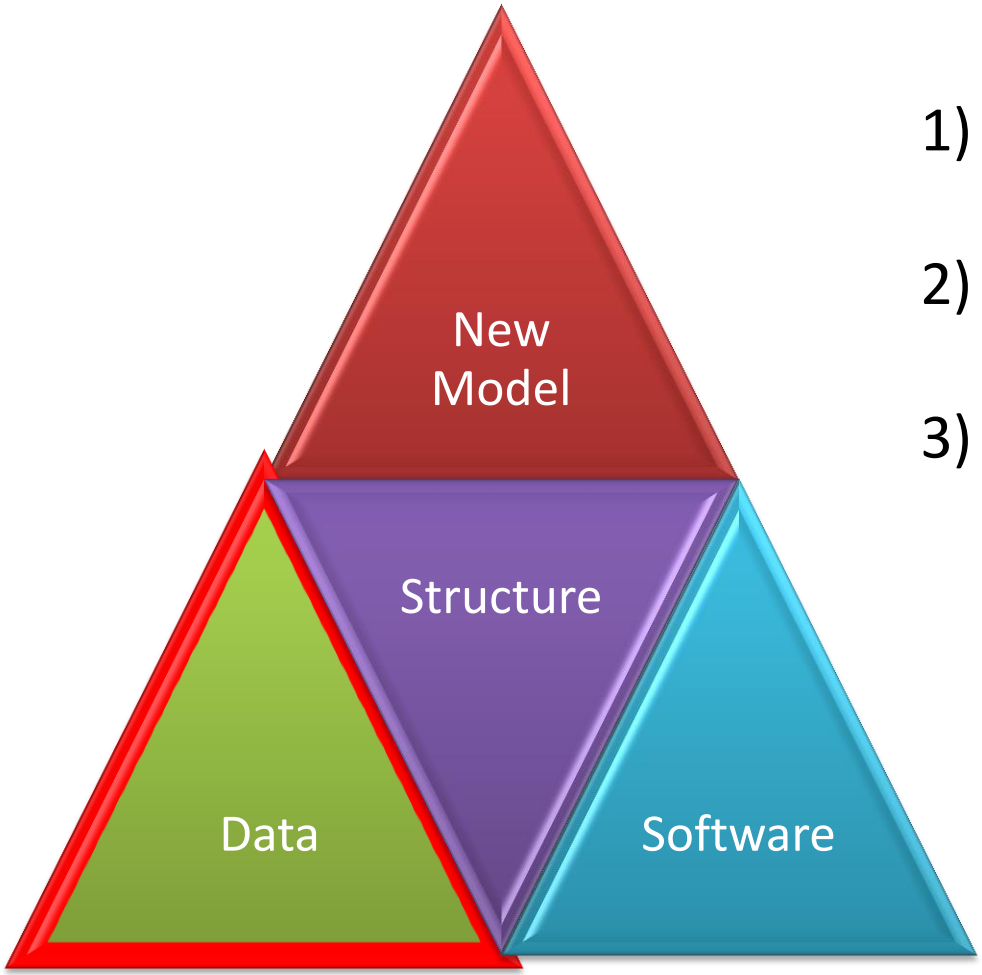
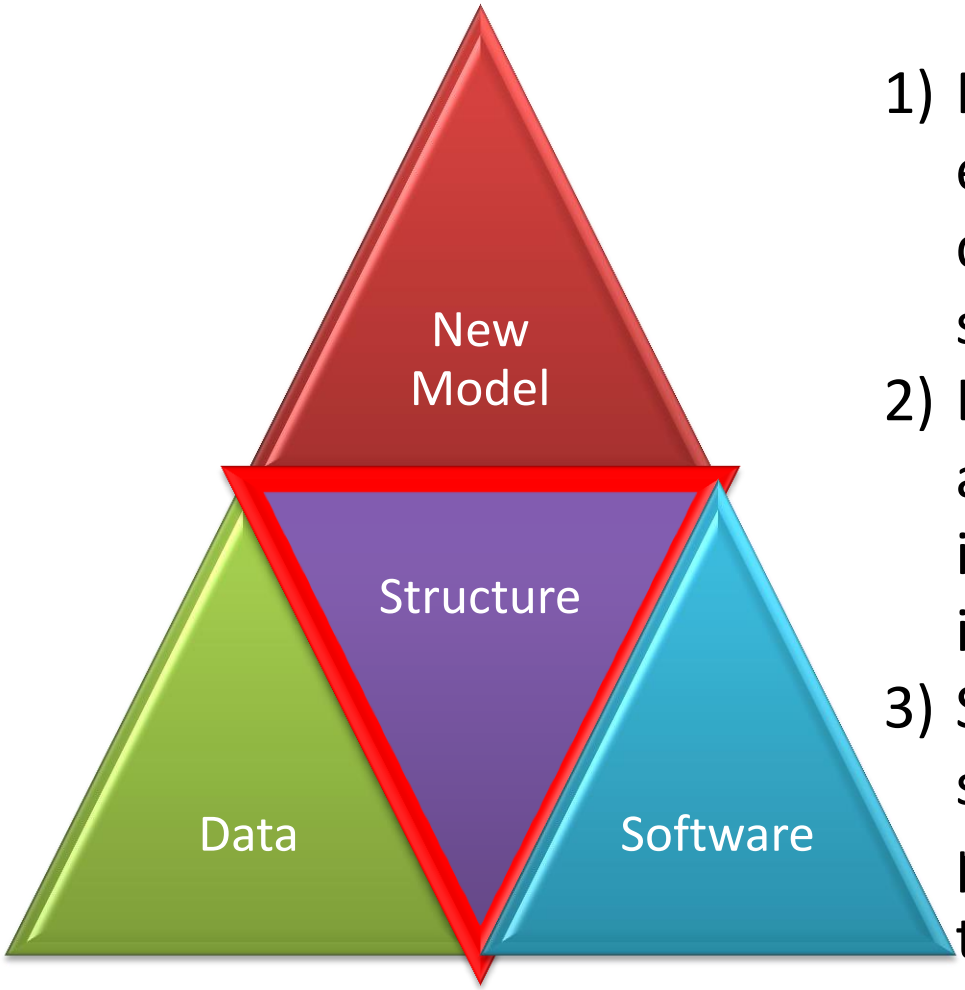


Data

1) Corrected biased scalars for years 2003-2007.
2) Nearly doubled scaling information.
3) Calibrated to large and small run sizes.

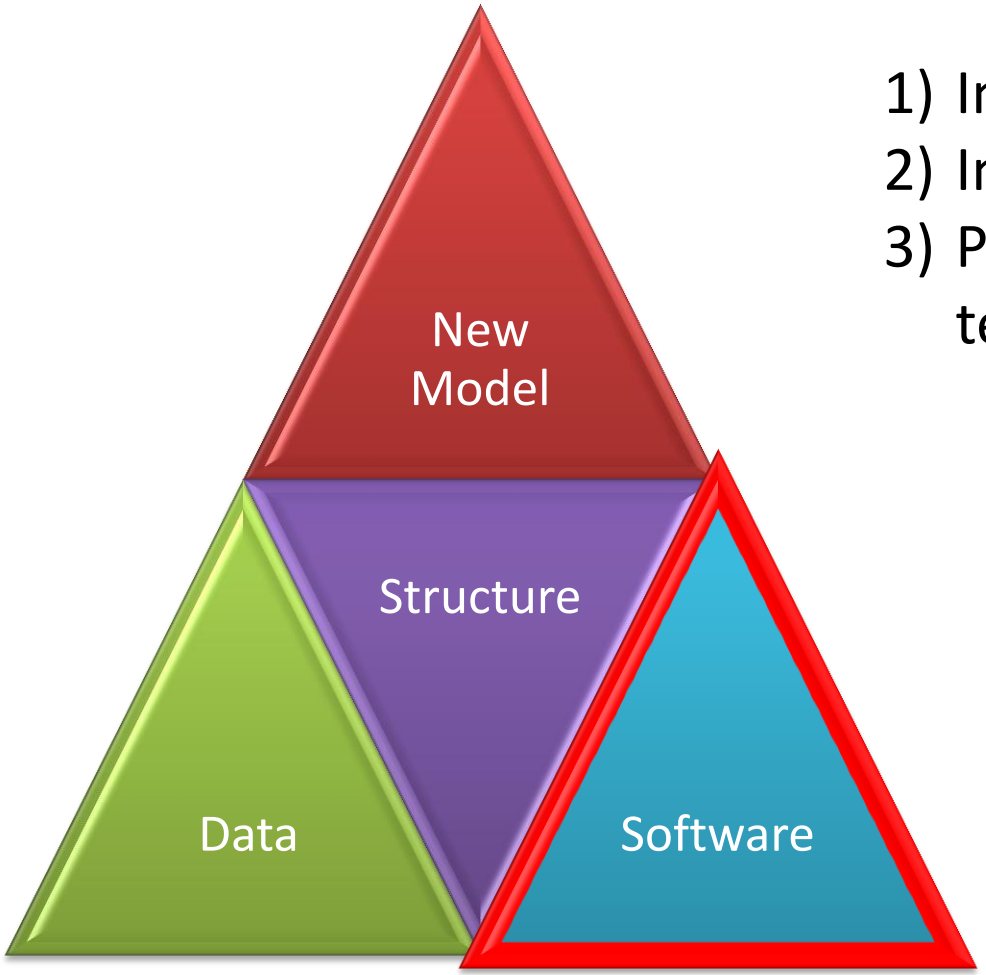
Summary of Model Changes



Structure

1) Revised commercial catch and effort component, which dramatically improved model stability.
2) Lognormal error structure appropriately used for all data and improved computation and interpretation.
3) Shared variance among data types simplified the model and prevented the potential to over-fit to the a single index project.

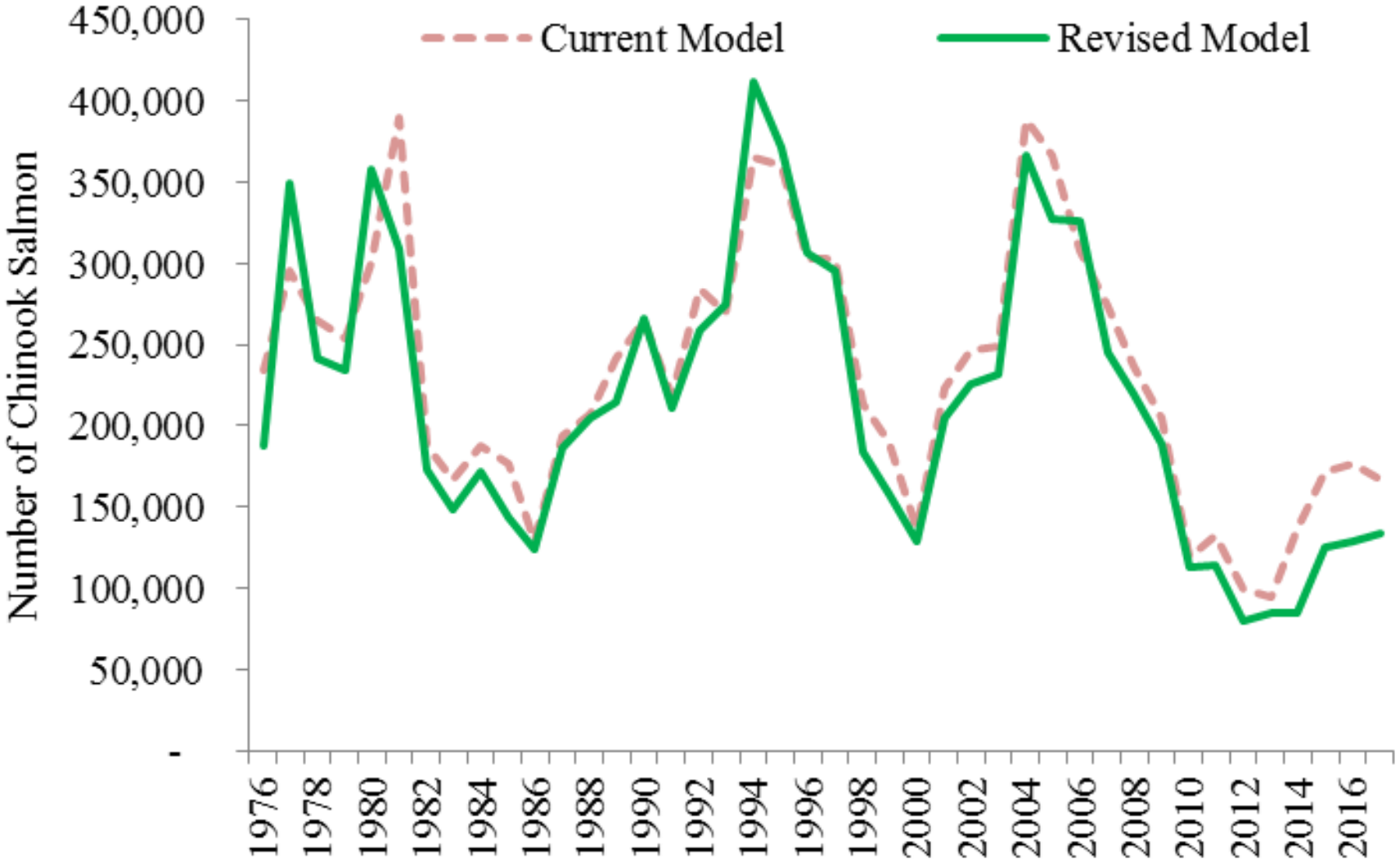
Summary of Model Changes



Software

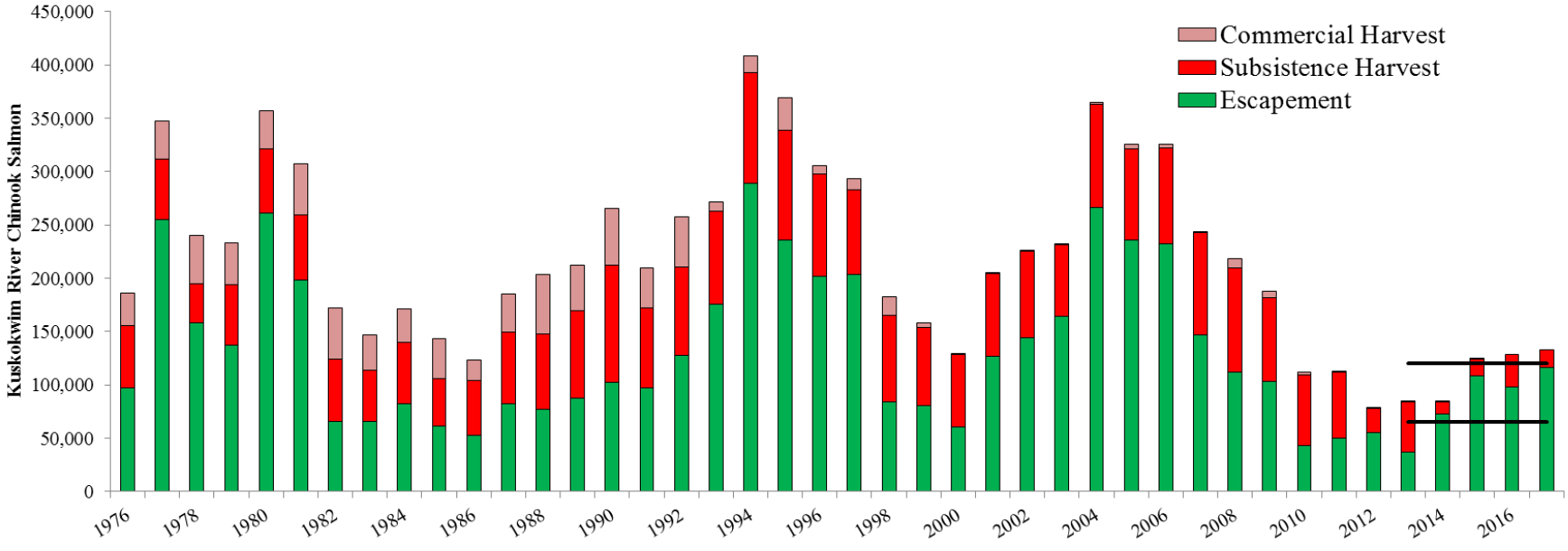
1) Improved parameter estimation
2) Improved model stability
3) Preferred language of model team(s)

Effect on Historical Time Series



Total Run Performance

(Harvest & Escapement)



Contributors

Kuskokwim River Interagency Model Development Team

- Hamachan Hamazaki (ADF&G)
- Gary Decossas (USFWS OSM)
- William Bechtol (Bechtol Research / KRITFC)
- Matthew Catalano (Auburn University)

AYK SSI Expert Panel

- Daniel Schindler (University of Washington)
- Timothy Walsworth (University of Washington)
- Milo Adkison (University of Alaska Fairbanks)
- Randall Peterman (Simon Fraser University)
- Andre Punt (University of Washington)

Others

- Nick Smith and many other ADF&G staff
- Ben Staton (Auburn University / USFWS YDNWR)
- Joe Spaedar (AYKSSI)

Questions