

Norton Sound Red King Crab SAFE2015

Sept 17 2015

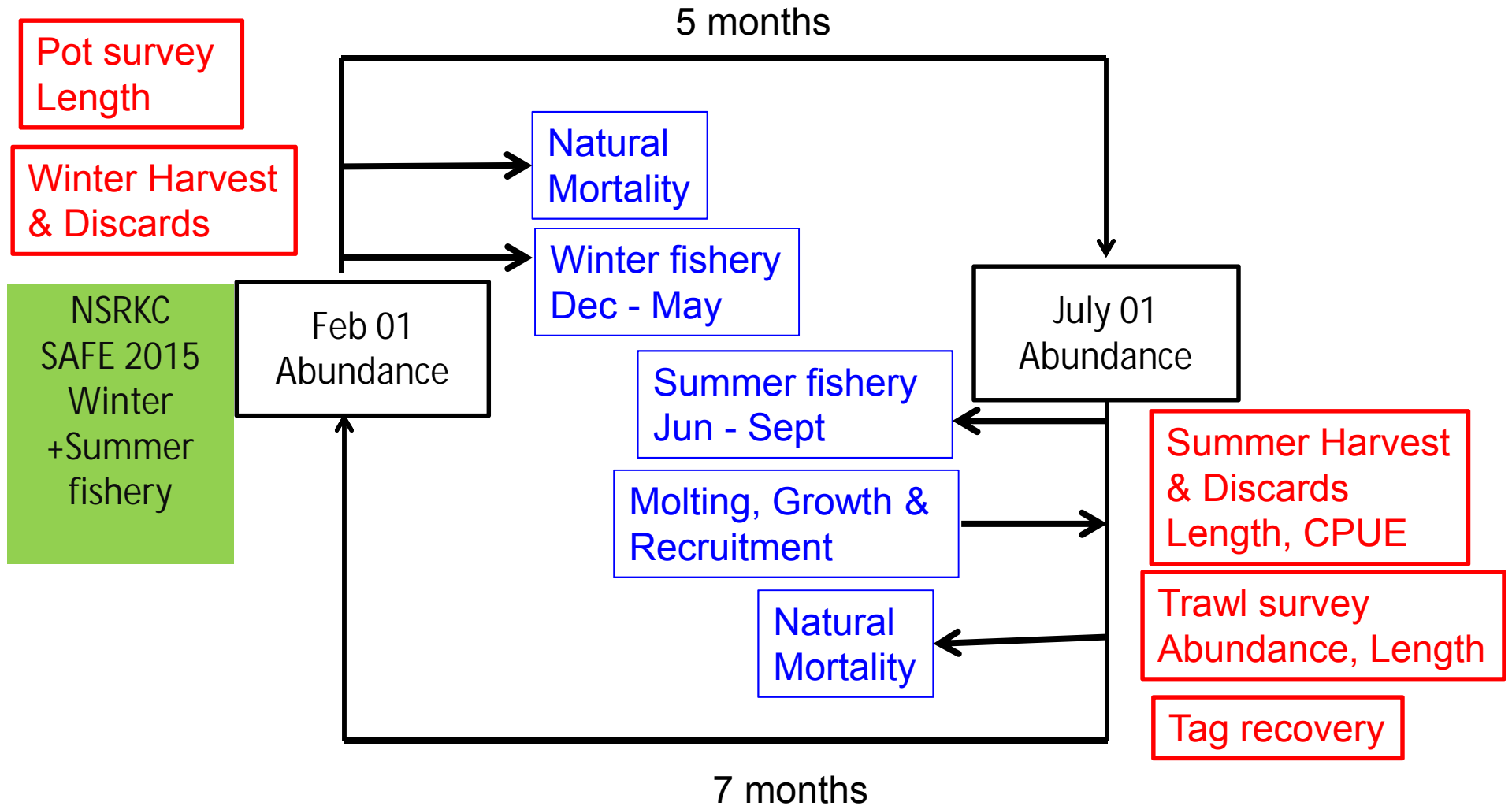
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Alaska Department of Fish & Game
Division of Commercial Fisheries

NSRKC Stock Assessment Model

Modeling process

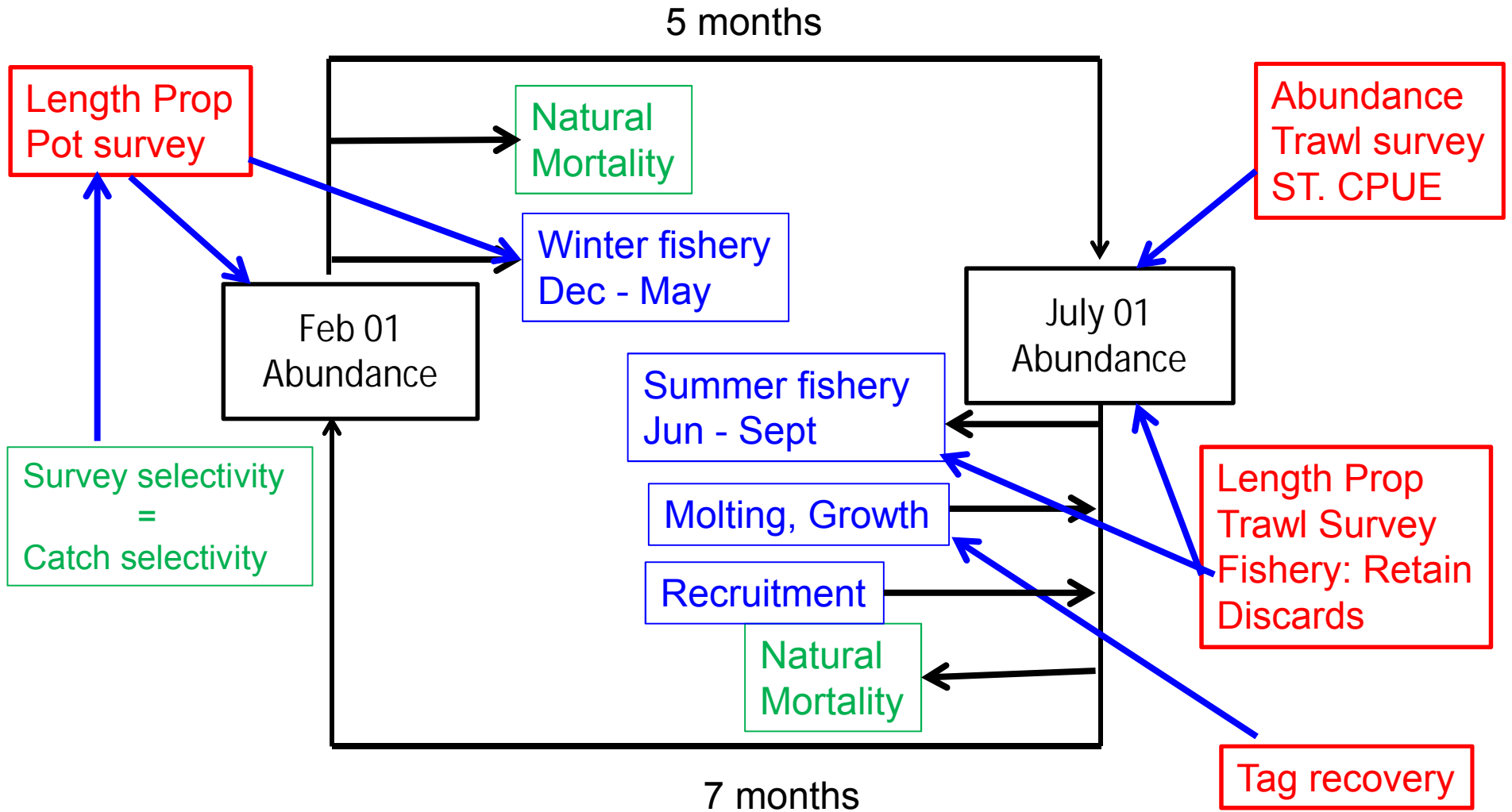
Available Data & model fit



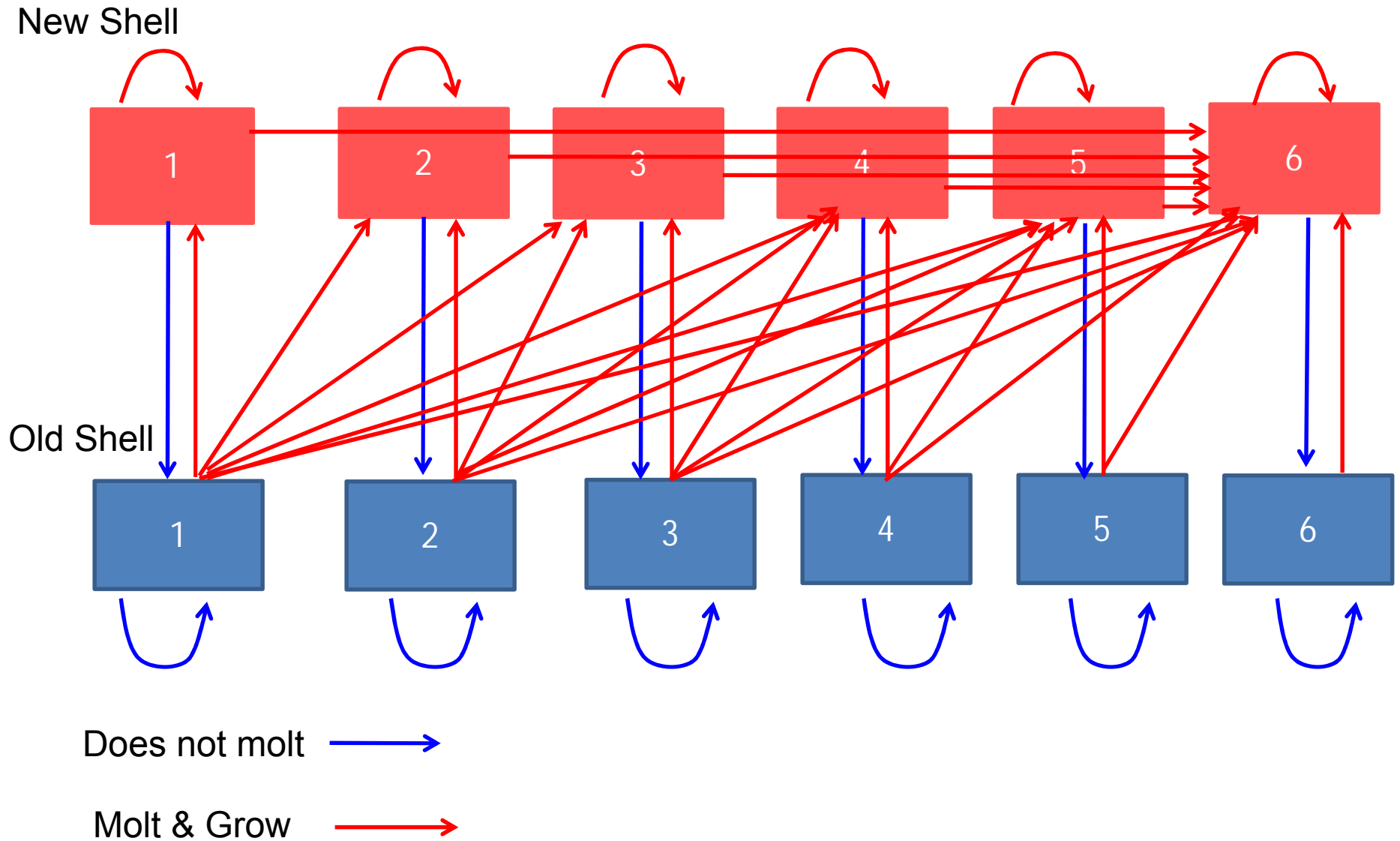
NSRKC Stock Assessment Model

Modeling process

Available Data & model fit



NSRKC Stock Assessment Model Molting and Growth Transition



Assumptions

- $M = 0.18$ for length class 1-5, and 0.648 for class 6
- Same selectivity and catchability for New and Old Shells
- Discards mortality = 0.2
- Fishery harvests occur instantly:
 - Winter fishery: Feb 01: Nov – May
 - Summer fishery: July 01: Jun – Sept
- Winter catch selectivity = winter pot survey selectivity

Changes Fishery & Data

- Winter fishery 2015
 - Commercial: 41,046 (98,750 lb.) The highest ever.
 - Subsistence: 7,651 (15,302 lb.). About average.
- Summer commercial fishery 2015
 - 6/29-7/24: 144,255 (401,115 lb.) The shortest fishery season ever.
- Total retained harvest: 192,952 (0.52 mill. lb.) < ABC (0.58 mill. lb.)
- All data were finalized.
- Changes in fishery regulation
 - GHL for winter commercial: 8% of total GHL (in effect for 2016 season).

Responses to CPT and SSC

- **No requests for model revisions**
 - No alternative models for SAFE2016?
- Provide trawl survey documentation
 - Trawl survey report will be published in fall 2015 (Close to final report is provided).
- Provide documentation of the survey CPUE standardization.
 - See Appendix A. How detail this section should be? (original report: SAFE 2013 Appendix ~ 75 pages).

Responses to CPT and SSC

- Provide an explanation and legend for figures comparing input sample sizes with effective sample.
 - Followed CPT's instruction: SAFE report guide 072612.doc,
 - Under 4. Results (best model), 4. Evaluation of the fit to the data, f: Plots of implied versus input effective sample sizes and time-series of implied effective sample sizes.
 - Request sample figures and captions.

Responses to CPT and SSC

- Potential for moving NSRKC to Tier 3.
- CPT: **Possibly**, provided that we obtain stock-specific maturity information
- SSC: **Problematic**, until finding out the fate of large males (dying off or moving out?)
 - We appreciate a list of stock-specific information needed and research expertise for getting the data.
 - Stock specific maturity determine by CL - Chela height relationship?
 - Field methods for finding out the fate of large males?

Standardized CPUE: Data update (G. Bishop, SAFE 2013)

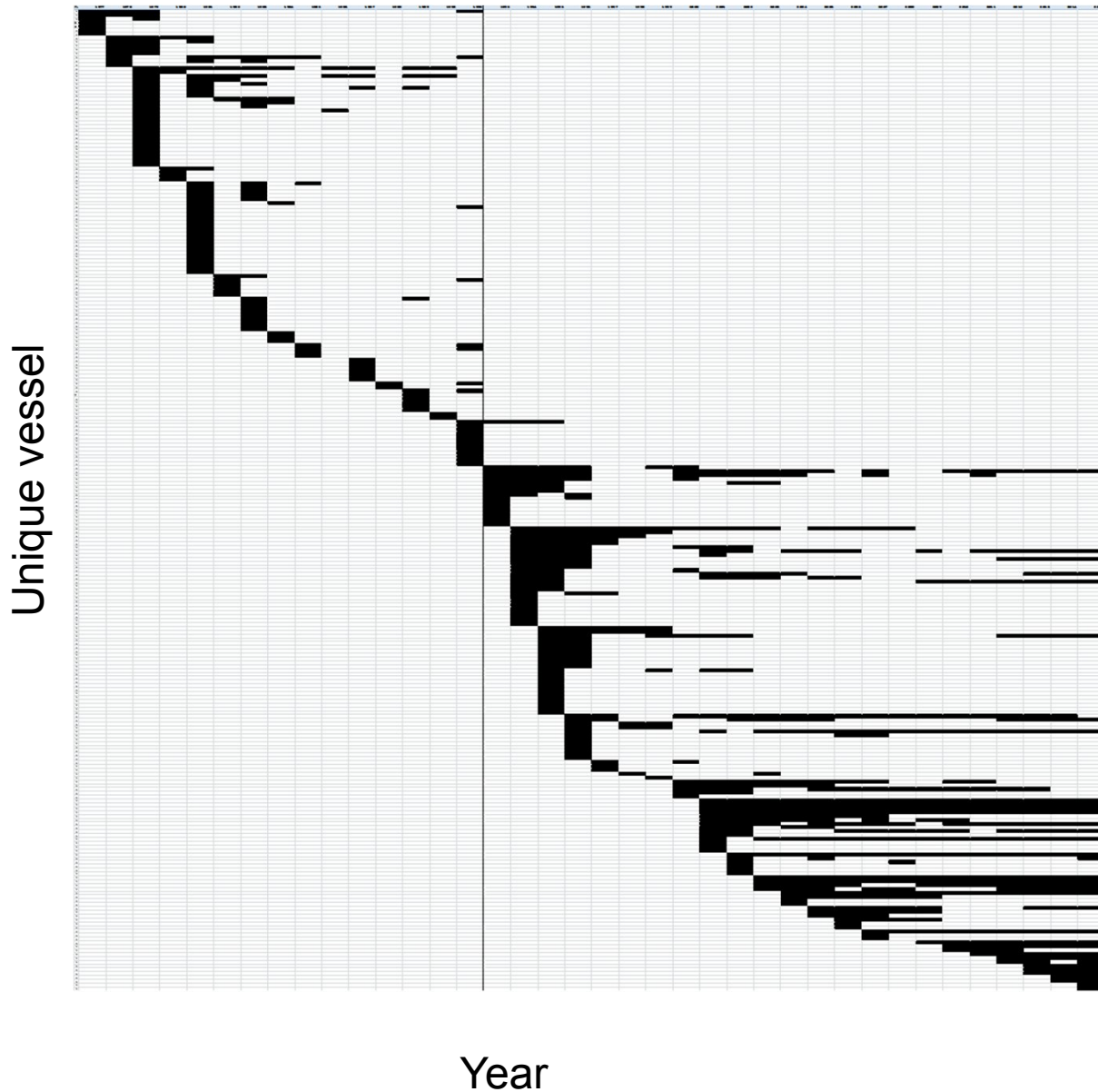
- Model
 $\ln(\text{CPUE}) = \text{year} + \text{vessel ID} + \text{Modified Stat Area} + \text{Week of Year} + \text{Permit fishery}$
- Separate data 1976-1992, 1993-2015.
- Select the best model after step-wise variable selection method.

Data censoring criteria:

of years participation (the longer, the better)

of delivery per year (the more, the better)

Standardized CPUE: Data update (G. Bishop, SAFE 2013)



1976-1992

Many vessels participated only one year- one delivery

Data censor: ≥ 2 years, ≥ 1 delivery

1993-2015

Many vessels participated > 5 years and made > 5 deliveries

Data censor: ≥ 5 years, ≥ 5 deliveries

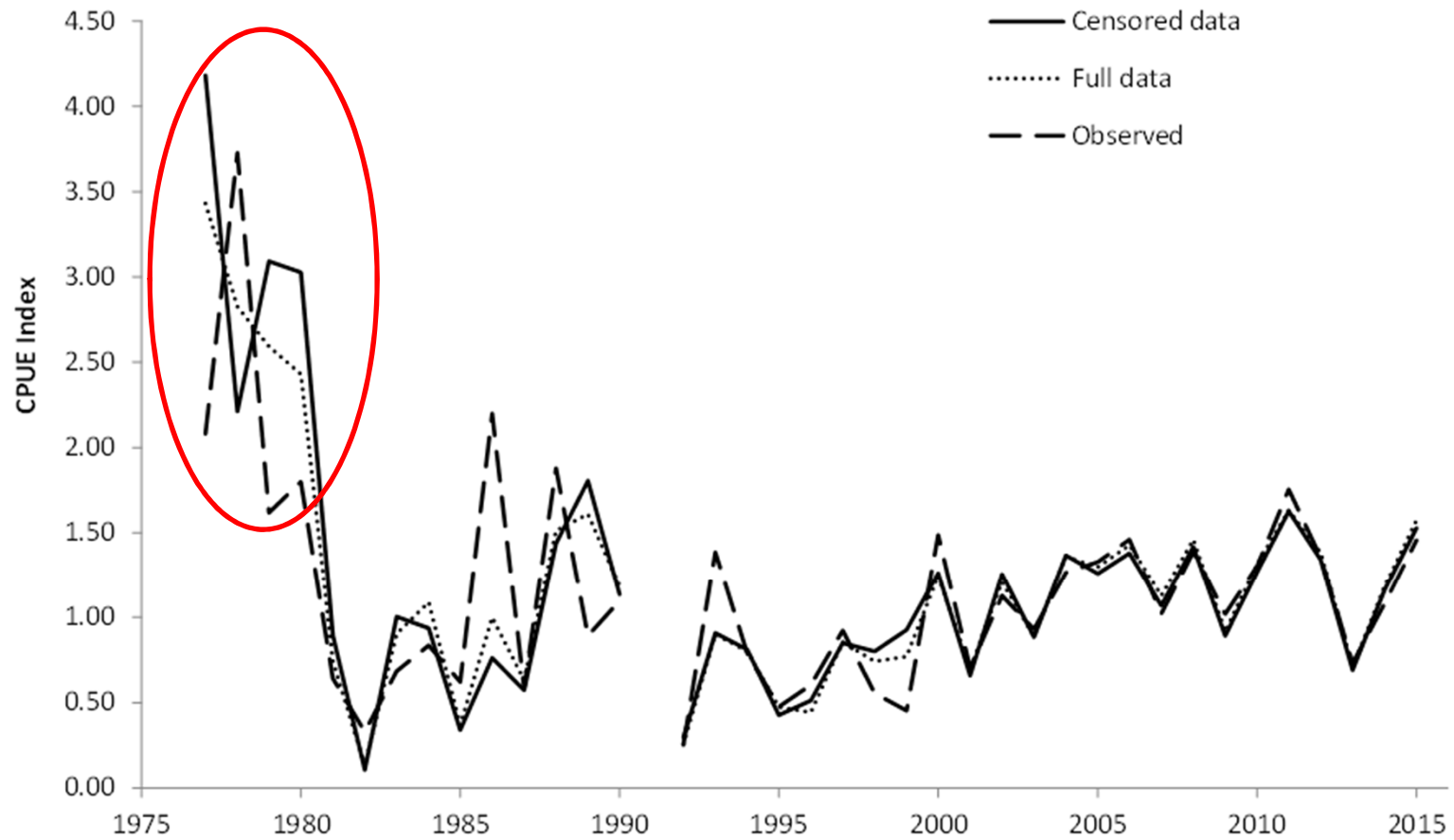
Standardized CPUE: Data update (G. Bishop, SAFE 2013)

Table A1. Final generalized linear model formulae and associated R^2 selected for Norton Sound summer commercial red king crab fishery. The dependent variable is $\ln(\text{CPUE})$ in numbers.

Time series	Years	Deliveries	Explanatory variables	Null dev.	Null df	Resid. dev.	Resid. df	AIC	R^2
1977–	All	All	YR+VSL+WOY+MSA	1163.1	797	445.4	653	2091	0.68
1992	≥ 2	≥ 1	YR+VSL+WOY+MSA	703.7	483	379.9	420	1188	0.60
1993–	All	All	YR+VSL+WOY+MSA+PF	5363.0	6309	3050.3	6127	13688	0.50
2015	≥ 5	≥ 5	YR+VSL+WOY+MSA+PF	3374.1	4767	2175.0	4678	9971	0.46

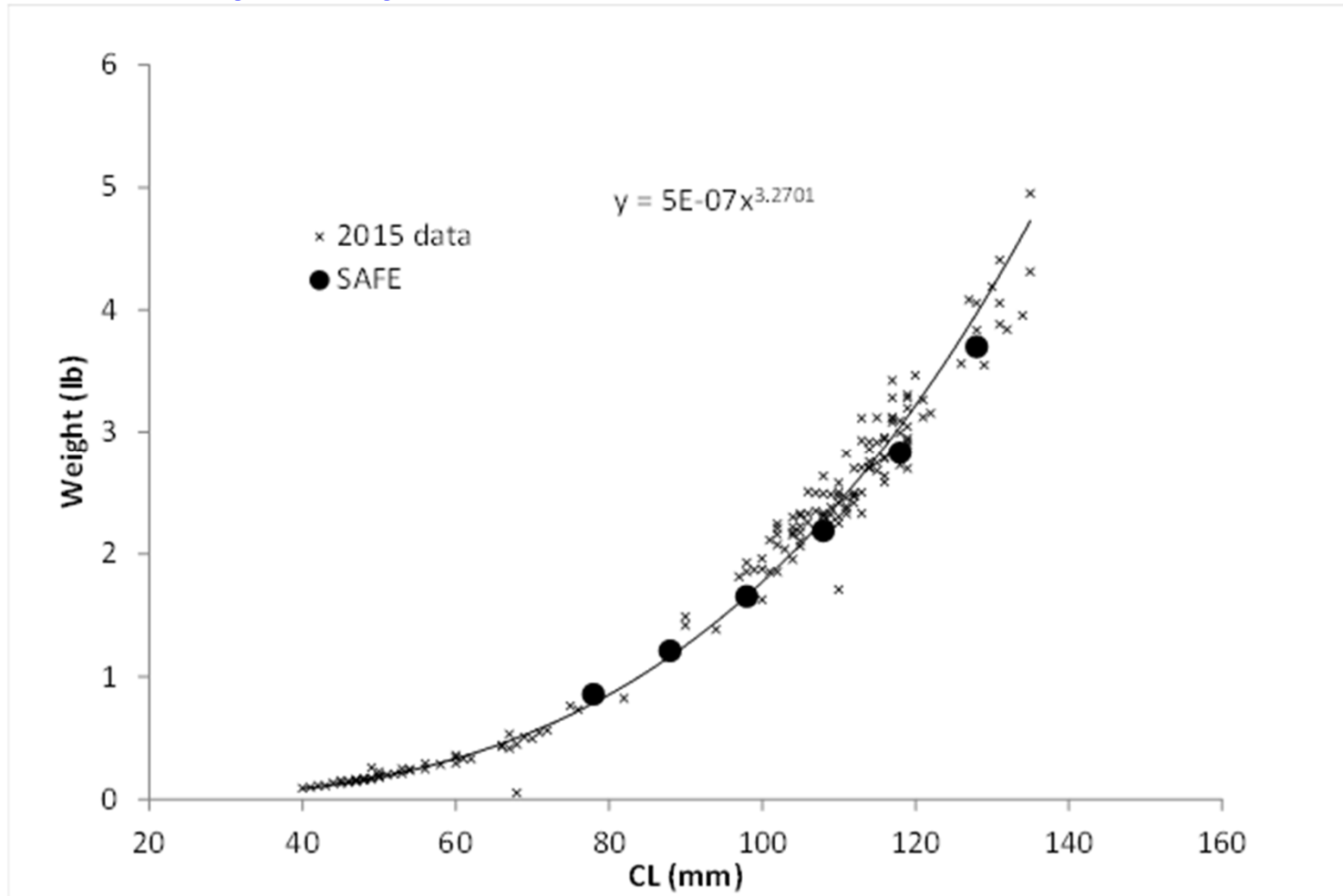
Year

Standardized CPUE: Data update (G. Bishop, SAFE 2013)



Jen Bell's studies to NSRKC model

Length-weight relationship

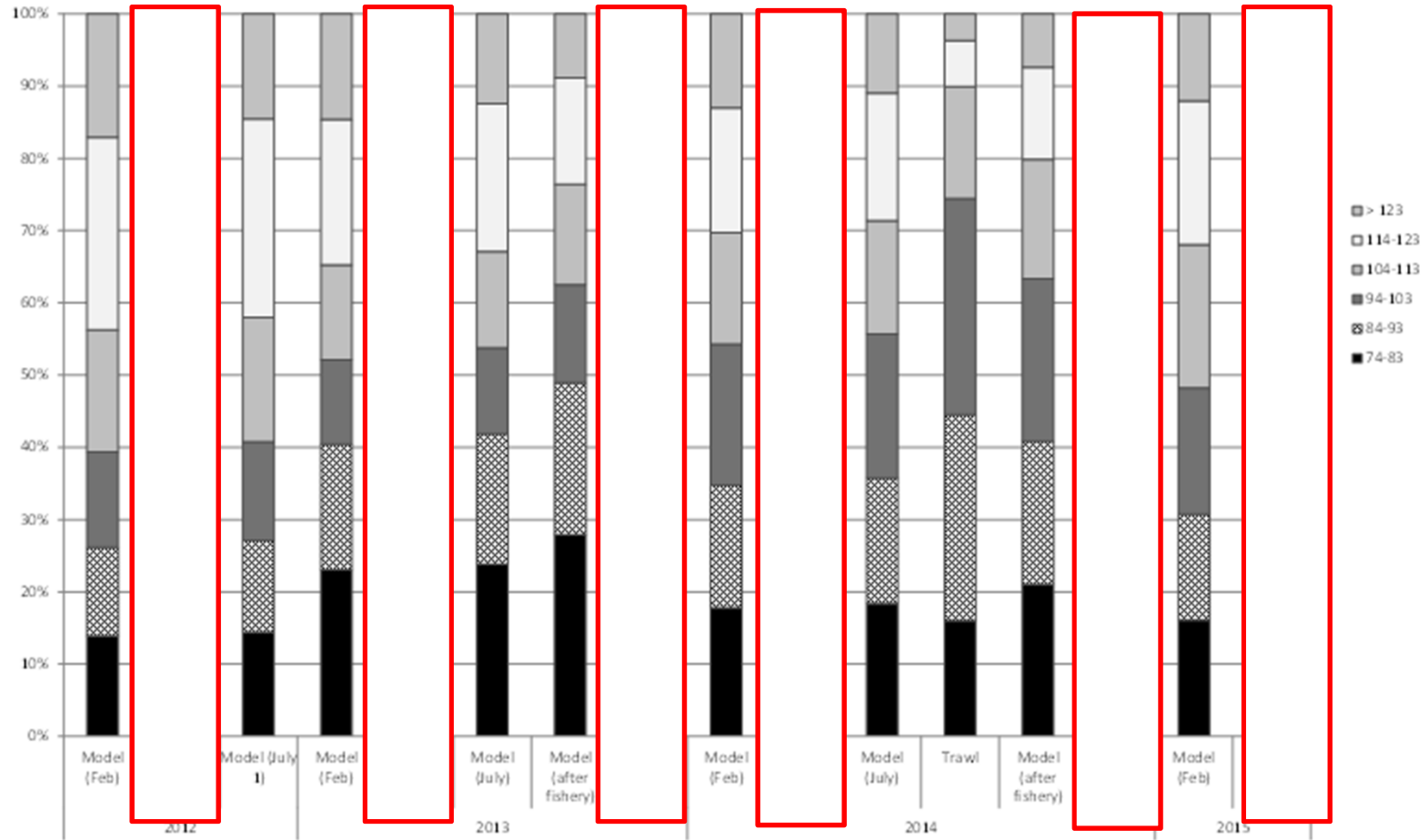


Jen Bell's studies to NSRKC model

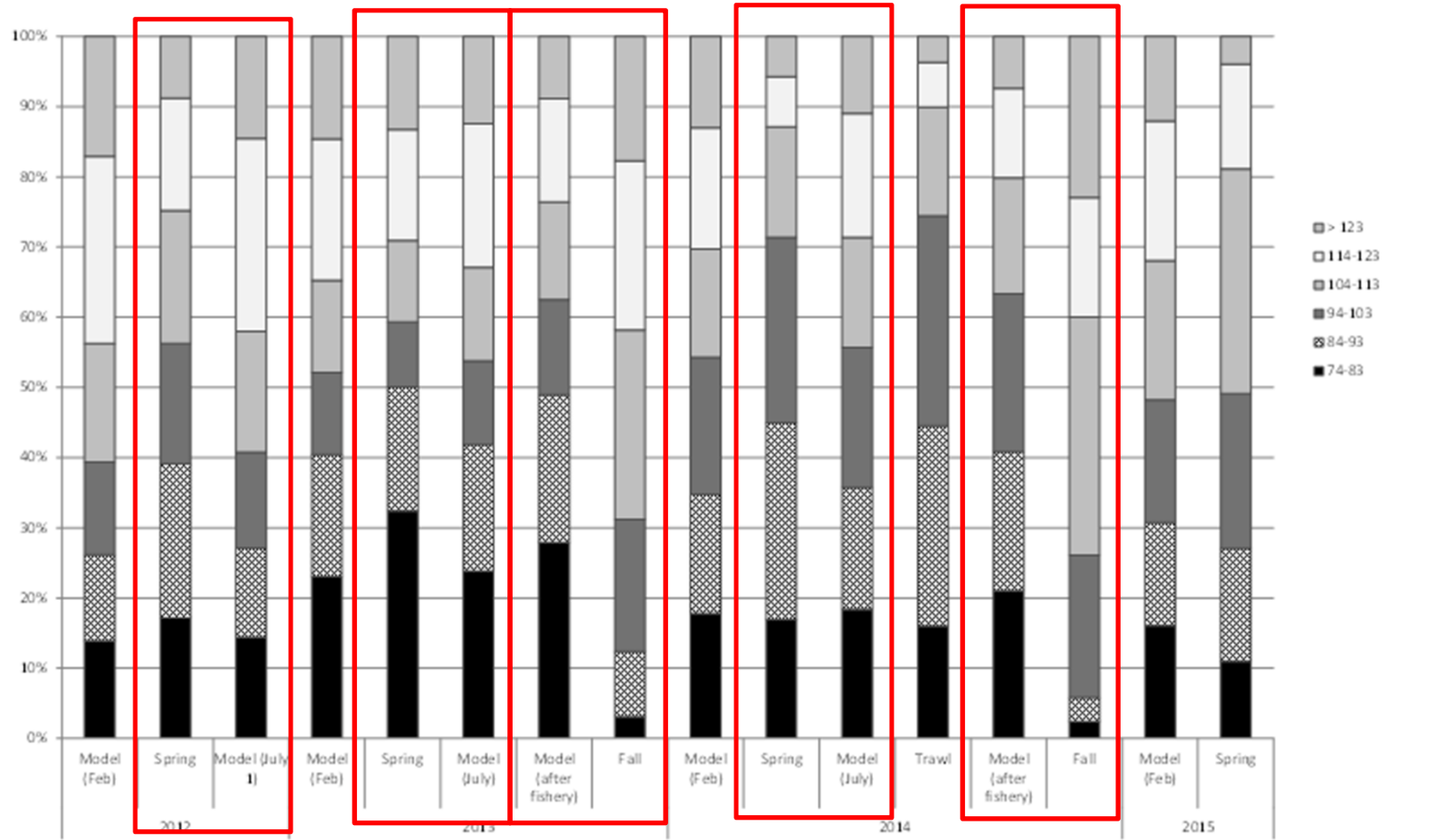
- Maturity size: No new info
- Molt timing: consistent with model assumption
- Movement: No model assumptions
- Molting probability:
 - True: Unmolted crab remains the same length crab
 - May not be true: Newshell & Oldshell having identical molting probability.
 - Separate molting probability functions for new and old shells?

Release Class	Shell	number	Recap New	Recap Old	Molting P	Model
1	New Old	21 0	21	0	1.0	1.0
2	New Old	28 2	28 2	0 0	1.0 1.0	1.0
3	New Old	54 7	49 7	5 (0) 0	0.91 1.0	0.97
4	New Old	30 29	14 26	16 (16) 3 (1)	0.47 0.90	0.87
5	New Old	23 52	10 47	13 (12) 5 (3)	0.30 0.90	0.56
6	New Old	19 19	3 14	16 (16) 5(5)	0.15 0.74	0.2

Jen Bell's studies to NSRKC model



Jen Bell's studies to NSRKC model

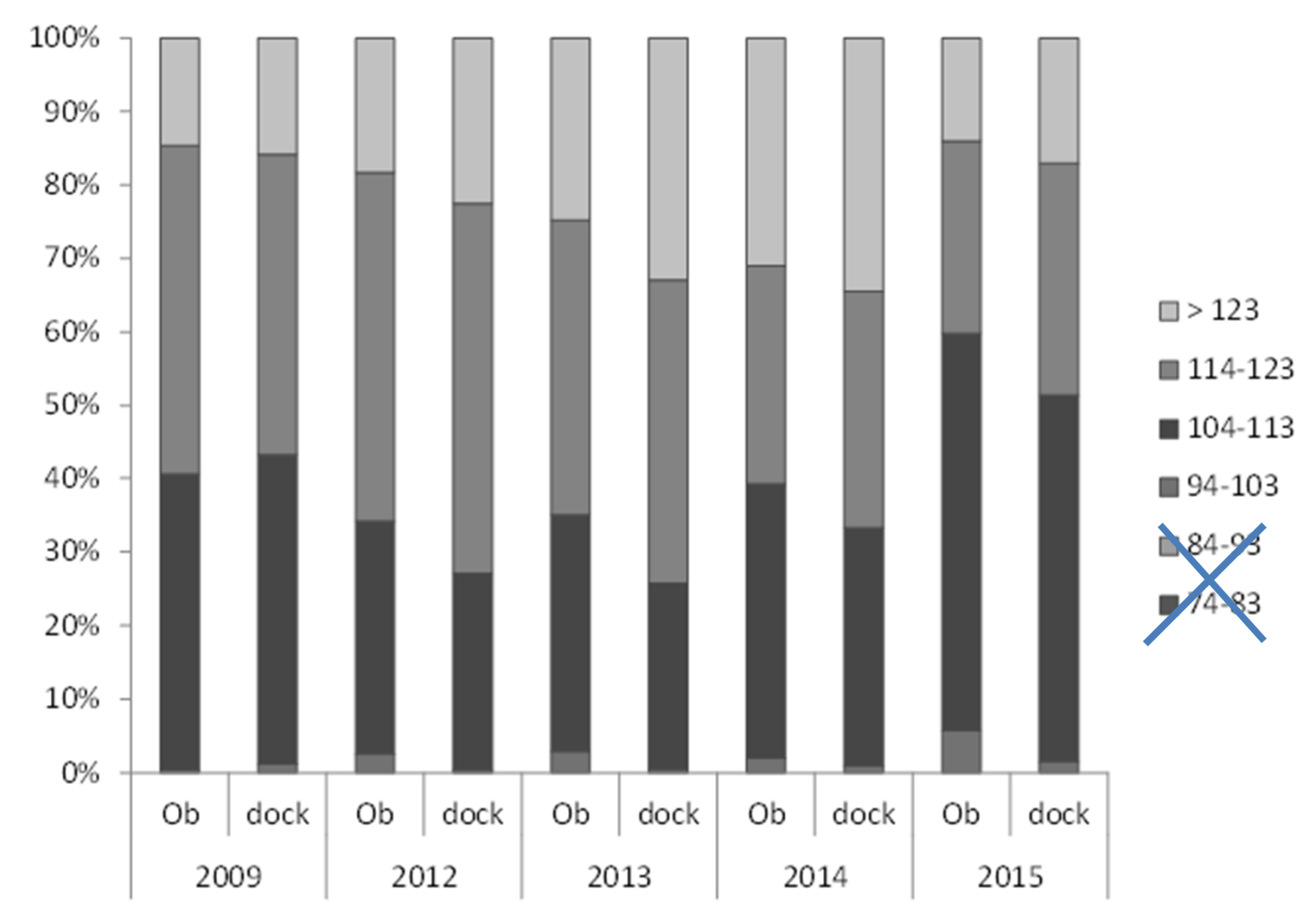


Spring: Higher immature proportion than model

Fall: Higher mature proportion than model

BTW: both surveys used the same pots.

Comparison of retained catch: observer vs. dock sample



Observed com fishermen tend to keep more smaller legal crabs.

% of retained but not sold crab < 2%.

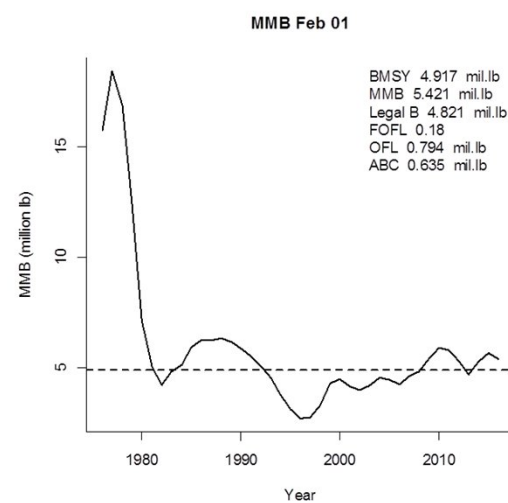
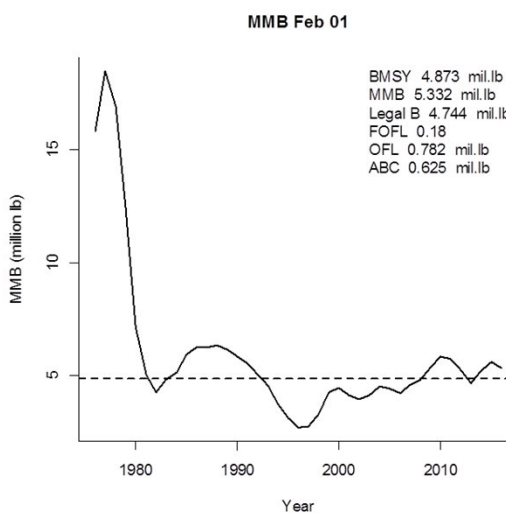
Observer discards data may not be representative of fisheries.

Modeling discussion for Jan 2016 SAFE

- Option 1: Use 2015 approved model (baseline for 2016)
 - Issue: High SD of trawl survey selectivity parameter (because selectivity is 1.0)
 - Alt. model: SSC recommendation: Fix trawl survey selectivity to 1.0 (no selectivity parameter estimate).
- Close to final model results:

Scenario	2015 SAFE	Fixed Trawl
Parameters	58	57
Total NLL	302.5	302.5
TBA	9.6	9.7
CCPUE	-21.4	-21.4
TLP (N)	-20.3	-19.6
TLP (O)	119.2	118.7
WLP (N)	2.2	2.1
WLP (O)	33.4	33.4
CLP (N)	68.2	68.3
CLP (O)	-4.5	-4.5
OBS (N)	2.3	2.3
OBS (O)	46.4	46.4
REC	12.4	12.3
TAG	54.9	54.9
MMB (2015)	5.33	5.42

Little changes in likelihood (Expected)

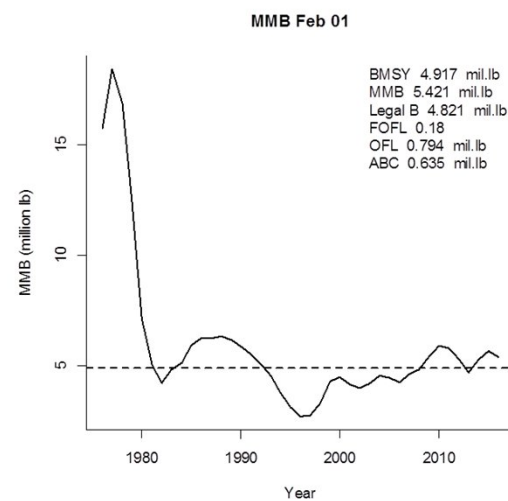
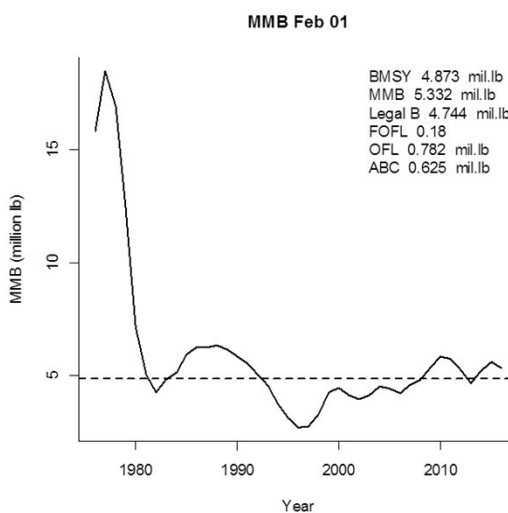


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Responses to CPT and SSC

- Include a discussion of the relative uncertainty in model parameters and data employed in the model as well as relative weightings in model configuration for use in best approximating the uncertainty in the OFL.
 - Parameters bounds, estimate with SD, weights, RMSE, MCMC of OFL have been on the SAFE.
 - Request examples of discussion on “relative uncertainty”