Norton Sound Red King Crab SAFE2018

Sept 21 2017
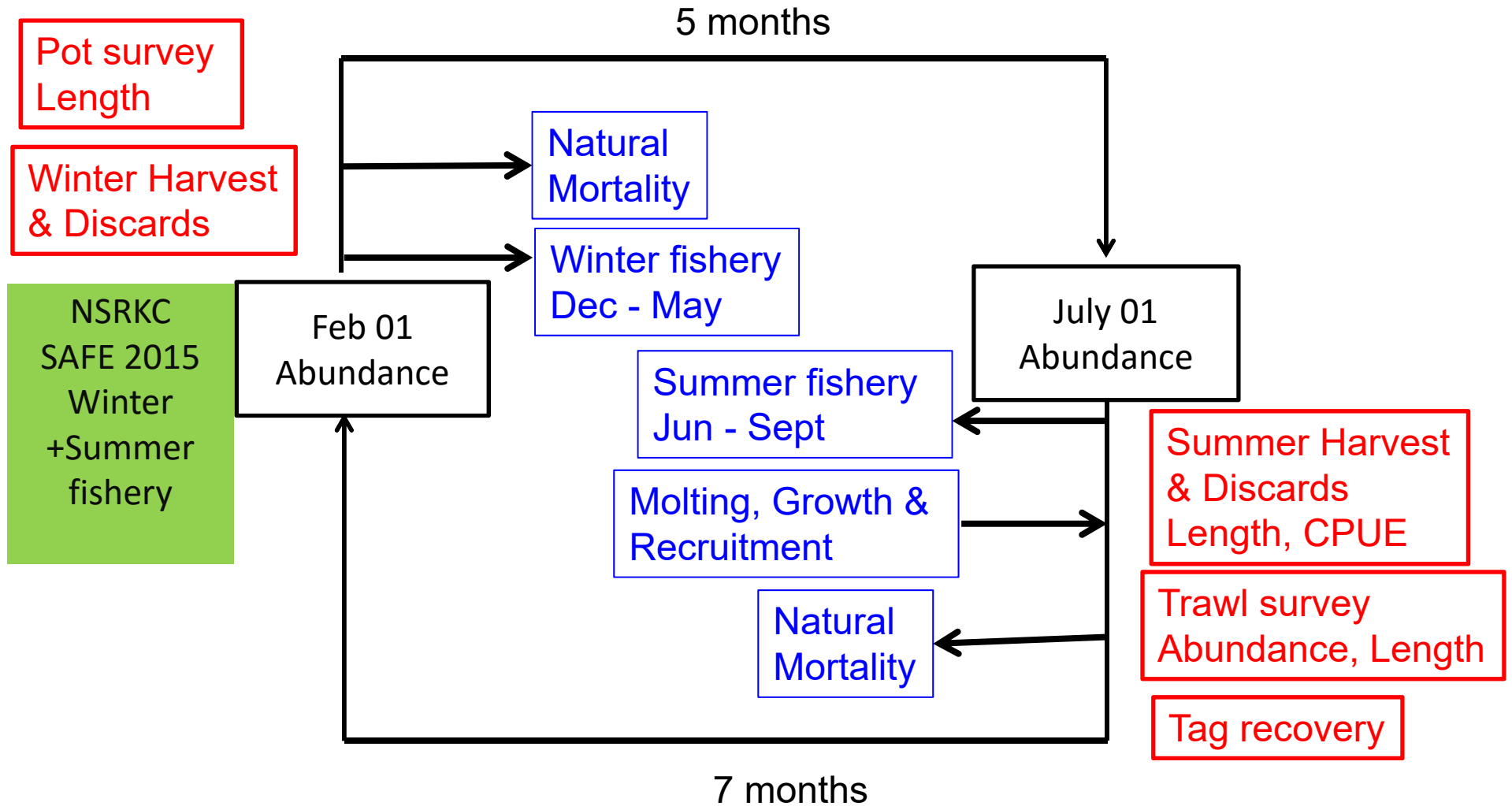
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Division of Commercial Fisheries

NSRKC Stock Assessment Model
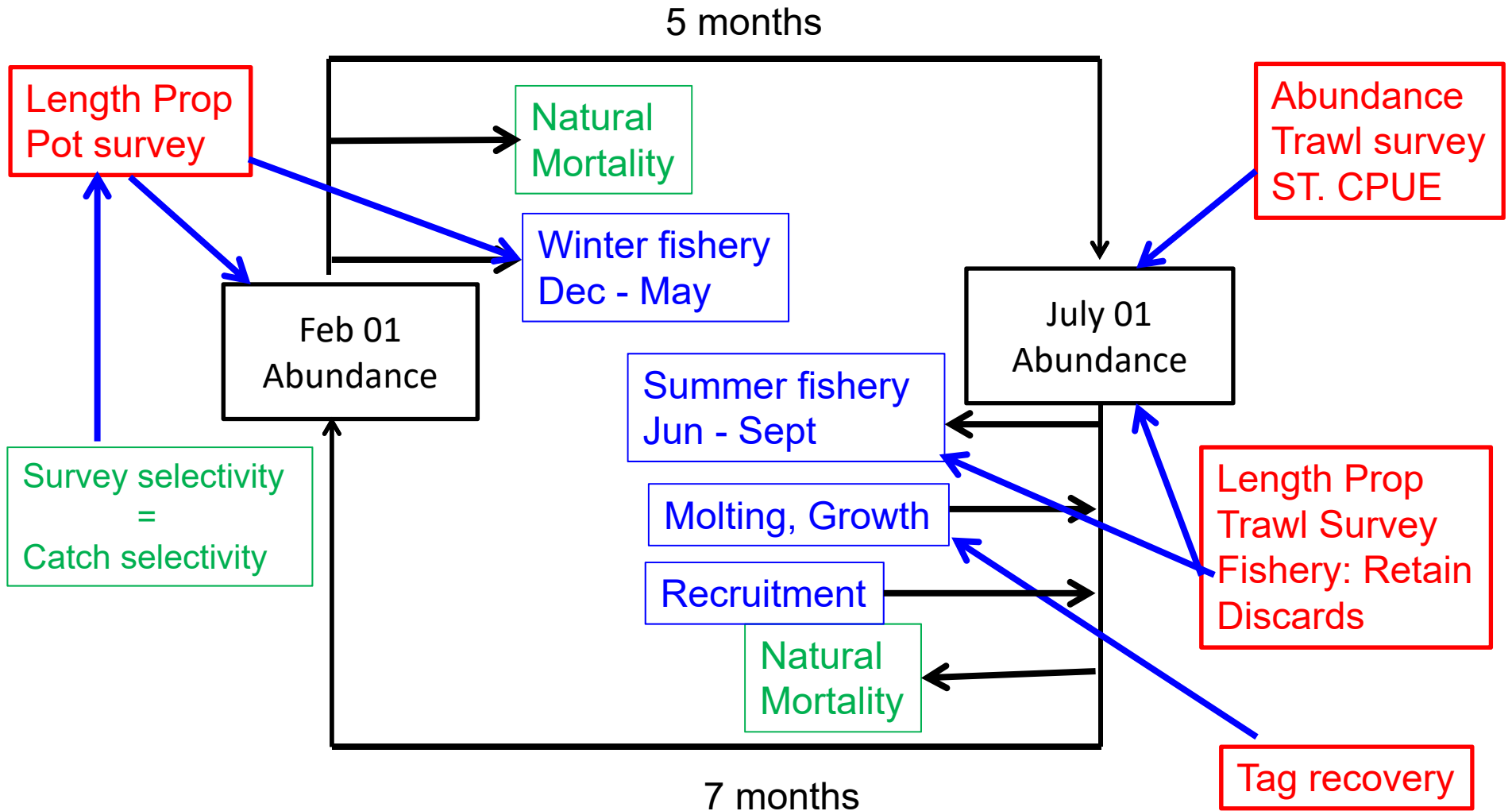## Modeling process
Available Data & model fit

Pot survey
Length

Winter Harvest
& Discards

NSRKC
SAFE 2015
Winter
+Summer
fishery

Feb 01
Abundance

5 months

Natural
Mortality

Winter fishery
Dec - May

July 01
Abundance

Summer fishery
Jun - Sept

Molting, Growth &
Recruitment

Summer Harvest
& Discards
Length, CPUE

Natural
Mortality

Trawl survey
Abundance, Length

Tag recovery

7 months

NSRKC Stock Assessment Model
Modeling process
Available Data & model fit

Available Data

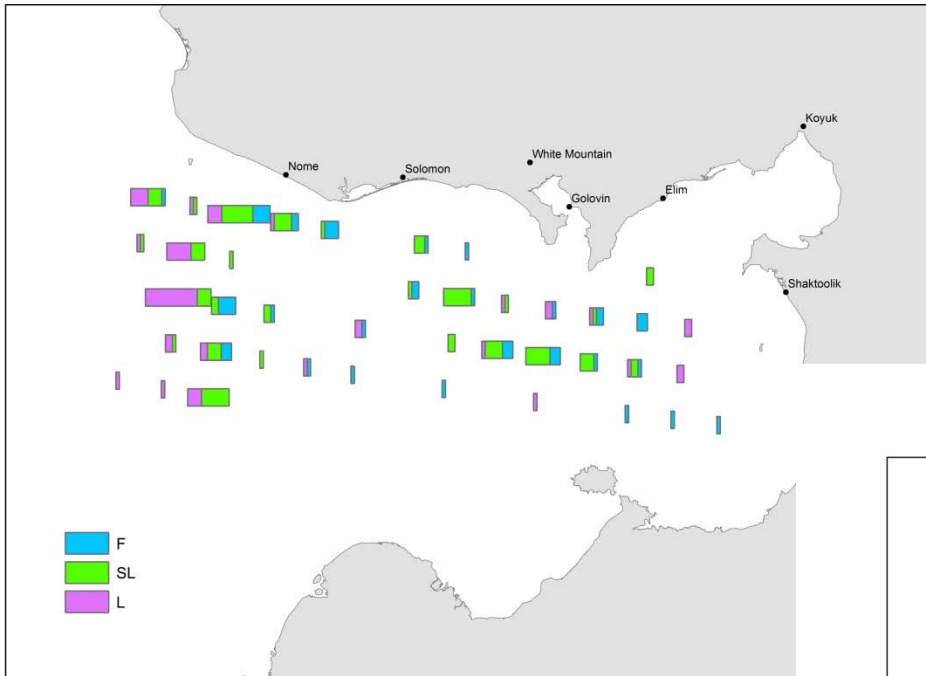|	Survey		Harvests			Tag	Data Not Used[3]				
	S. Trawl	W. Pot	S.Com	S.Com Discards	W. Com, Sub		S. Pot	Pre fish	Sp. Tag	F. Tag,	W. Com
N[1]	N		H, CPUE		H						
Length[2]	X	X	X	X		X	X	X	X	X	X
1976											
1977											
1978											
1979											
1980											
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2017											

Assumptions

- M = 0.18 for length class 1-6, higher mortality of classes 7 and 8
- Same selectivity and catchability for New and Old Shells
- Discards mortality = 0.2
- Fishery harvests occur instantly:
  - Winter fishery: Feb 01: Nov – May
  - Summer fisher: July 01:   Jun – Sept
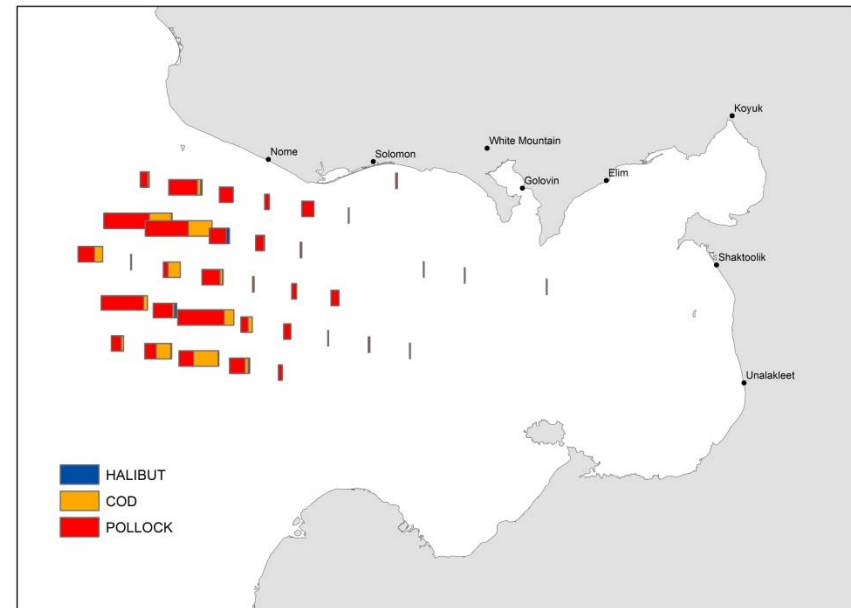- Winter catch selectivity = winter pot survey selectivity

Changes Fishery & Data

- Winter fishery 2017
  - Commercial: 26,008 (77,843 lb.) The highest ever.
  - Subsistence: 6,039 (15,097 lb.). About average.
- Summer commercial fishery 2015
  - 6/26-7/25: 135,322 (411,736 lb.)
- Total retained harvest: 167,369 (0.50 mill. lb.) < ABC (0.54 mill. lb.)
- All harvest data finalized.
- Standardized CPUE update (Appendix B)
- ADF&G 2017 Summer trawl survey
  - 7/28-8/08: 1503.8 k, CV =0.23
- Recalculation ADFG trawl survey abundance
- NOAA 2017 trawl survey : No data yet
- ADMB code cleaning up underway
  - Discards estimate equation was bit wrong (changed < 10%).
- Changes in fishery regulation: None
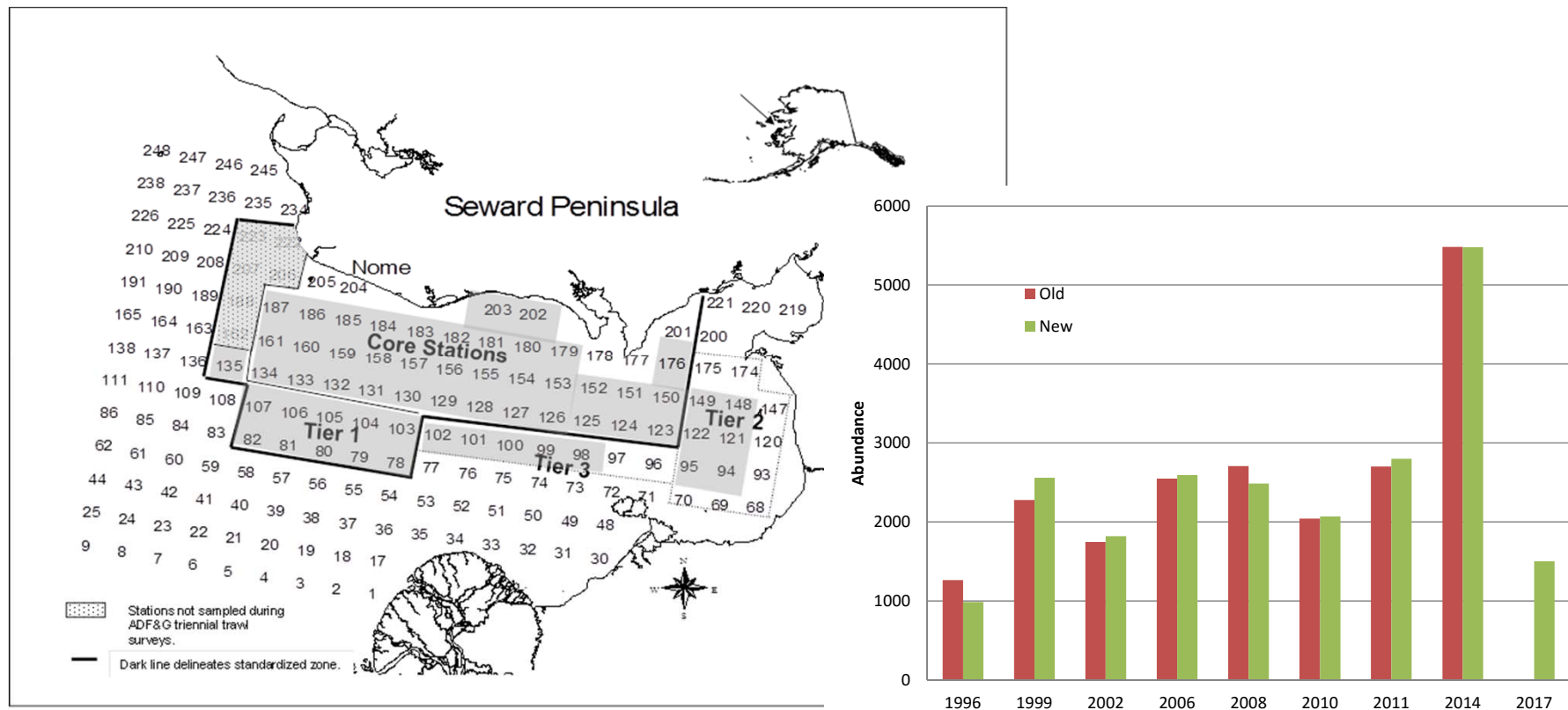
Changes Fishery & Data

- ADFG trawl survey 2017

Changes Fishery & Data

- ## Recalculation of ADFG trawl abundance
  - Standardize survey stations
  - Assume zero crab in unsurveyed stations
  - Remove re-towed survey data (original: take average)
  - Standardize calculation of tow area (NM, NM^2)

NSRKC Major Modeling Issues

- **Under the size invariant M, the model overestimate abundance of large sized (> 123mm) crab.**
  - Current Assumption: Higher M for large sized (> 123mm) crab
    - Pro: Model fits data better
    - Con: Biologically implausible
  - Alternative Assumptions
    - Gradual mortality increase (SSC suggestion)

Responses to CPT

- Breaking out natural mortality by size class for future model evaluation.

$$OFL = \sum_{l} \left[Legal\_B_{w,l} \left(1 - e^{-(F_{OFL}+0.42M_l)} - (1 - e^{-0.42M_l}) \left(\frac{1 - p(1 - e^{-(F_{OFL}+0.42M_l)})}{1 - p(1 - e^{-0.42M_l})} \right) \right) \right]$$

- Will be implemented for Jan 2018 Assessment

Responses to CPT and SSC

- Assess which (2017 NOAA vs. ADFG survey) data inputs are most influential

  – Waiting data from NOAA

- Assess which (discards length, survey) data inputs are most influential

  – Appendix C7-C13

- Explore bycatch data to see if it is possible to determine the OFL as total catch

  – Method estimating bycatch from discard length data?

Responses to CPT and SSC

- ## NSRKC observer program:
  - Ship on an available boat (by generosity of crabber)
  - Measure length-shell-sex of every catch (legal retain, legal discards, sublegal discards, female discards) from sampled pots
  - Data obtained
    - The number of sampled crab by length-shell-sex
    - CPUE (may be)
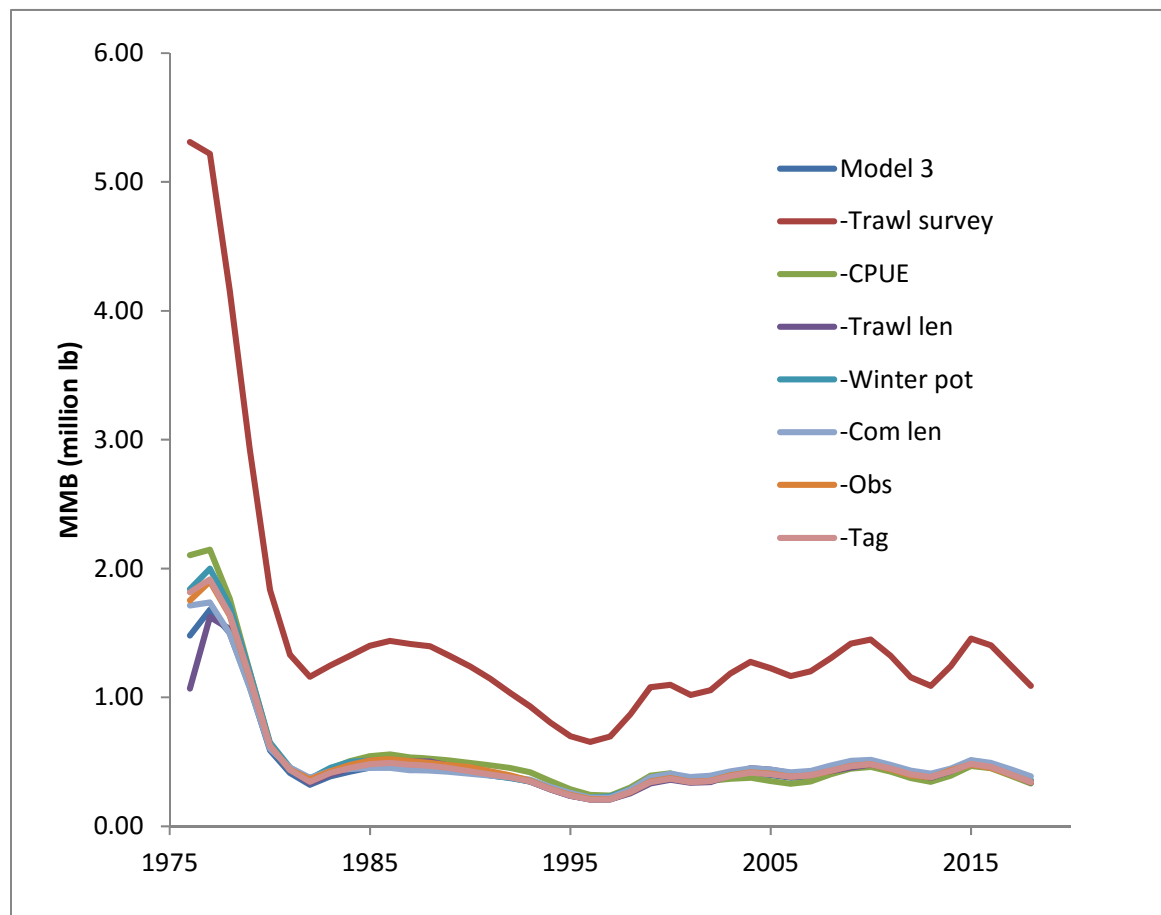 - Data location
    - ADFG NS shared hard drive. EXCEL files….

Responses to CPT and SSC

- alternative way to parameterizing higher mortality at age rather than a step change at the largest size class
  - Alternative models 1-5

Lenclass	M1	M2	M3	M4	M5	M6	M7	M8
Default	0.18	0.18	0.18	0.18	0.18	0.18	Est 1	Est 1
Alt 1	0.18	0.18	0.18	0.18	0.18	0.18	Est 1	Est 2
Alt 2	0.18	0.18	0.18	0.18	0.18	Est 1	Est 2	Est 3

Responses to CPT and SSC

- Assess which (discards length, survey) data inputs are most influential

Model	Model 3*	-TSA	-CPUE	-TLP	-WLP	-CLP	-OBS	-TAG
Total	260.0	244.8	283.6	159.2	215.8	193.9	222.3	182.7
TSA	8.5	ND	8.1	9.4	9.7	8.7	8.7	9.1
St.CPUE	-30.4	-31.8	ND	-33.7	-30.8	-29.3	-30.3	-29.8
TLP	84.0	83.0	81.6	ND	84.0	67.0	80.4	79.0
WLP	38.7	38.7	37.9	41.5	ND	38.2	39.4	22.0
CLP	50.2	49.0	49.0	39.2	46.5	ND	49.7	48.0
OBS	22.9	23.0	22.6	26.2	22.8	24.0	ND	22.0
REC	14.1	12.8	13.8	12.4	12.3	14.7	15.2	13.8
TAG	71.9	69.6	70.5	67.1	71.5	71.5	59.1	ND
MMB(mil.lb)	3.52	10.9	3.33	3.41	3.58	3.89	3.43	3.42
Legal (mil.lb)	3.05	9.1	2.80	2.87	3.03	3.39	2.87	2.88
Diff		-6.8	-6.8	-12.2	-5.7	-16.1	-12.7	+0.7

Responses to CPT and SSC

- Assess which (discards length, survey) data inputs are most influential:
  - Trawl abundance survey is the most influential

Alternative models

- ## Alternative model 1-5

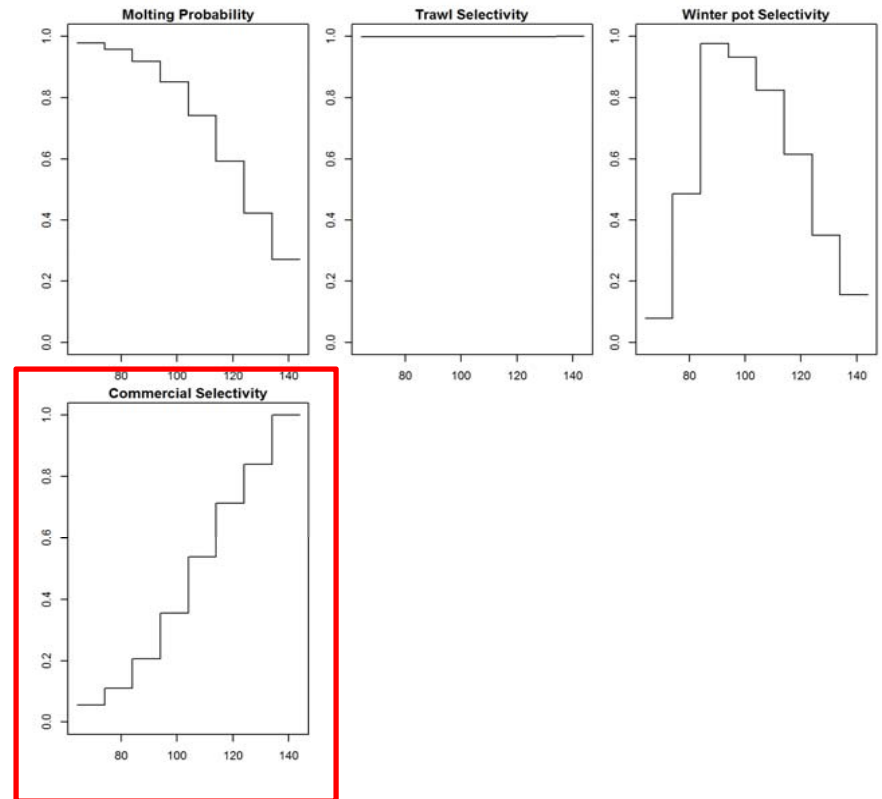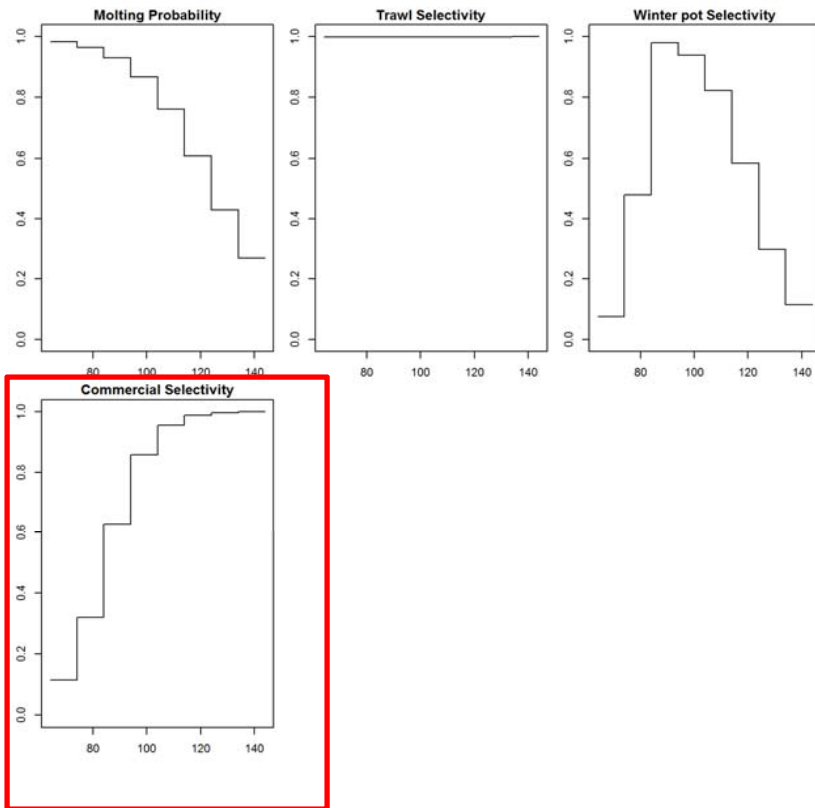| Lenclass	M1	M2	M3	M4	M5	M6	M7	M8	Fishery selectivity function parameter
Default Model 0	0.18	0.18	0.18	0.18	0.18	0.18	Est 1	Est 1	1
Alt 1	0.18	0.18	0.18	0.18	0.18	0.18	Est 1	Est 2	1
Alt 2	0.18	0.18	0.18	0.18	0.18	Est 1	Est 2	Est 3	1
Alt 3	0.18	0.18	0.18	0.18	0.18	0.18	Est 1	Est 1	2
Alt 4	0.18	0.18	0.18	0.18	0.18	0.18	Est 1	Est 2	2
Alt 5	0.18	0.18	0.18	0.18	0.18	Est 1	Est 2	Est 3	2

Alternative models

- ## 1 parameter vs. 2 parameters fishery selectivity

Default: Model 0

Alt Model 3

Alternative models: stepwise mortality increase

Lenclass	M1	M2	M3	M4	M5	M6	M7	M8	Fishery selectivity function parameter
Default Model 0	0.18	0.18	0.18	0.18	0.18	0.18	0.56	0.56	1
Alt 1	0.18	0.18	0.18	0.18	0.18	0.18	0.52	0.63	1
Alt 2	0.18	0.18	0.18	0.18	0.18	0.23	0.52	0.62	1
Alt 3	0.18	0.18	0.18	0.18	0.18	0.18	0.57	0.57	2
Alt 4	0.18	0.18	0.18	0.18	0.18	0.18	0.55	0.61	2
Alt 5	0.18	0.18	0.18	0.18	0.18	0.34	0.55	0.58	2

Alternative models

- ## Alternative model 1-5: NLL

Model	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5
No. Parameters	67	68	69	68	69	70
Total	272.5	272.1	271.7	260.0	259.9	256.5
TSA	8.4	8.4	8.6	8.5	8.4	9.0
St.CPUE	-30.4	-30.4	-30.3	-30.4	-30.4	-30.0
TLP	88.6	88.5	87.2	84.0	84.0	82.7
WLP	38.5	38.5	38.3	38.7	38.8	38.3
CLP	50.0	49.6	49.8	50.2	50.0	48.3
OBS	25.1	25.1	25.1	22.9	23.0	22.9
REC	13.6	13.7	13.7	14.1	14.1	14.5
TAG	78.6	78.7	78.6	71.9	72.0	70.8
MMB(mil.lb)	3.66	3.67	3.68	3.52	3.52	3.56
Legal (mil.lb)	3.21	3.21	3.21	3.05	3.06	3.03
OFL(mil.lb)						

Alternative models

- ## Alternative model 1-5: MMB projection