

# Norton Sound Red King Crab SAFE2019

Sept 12 2018

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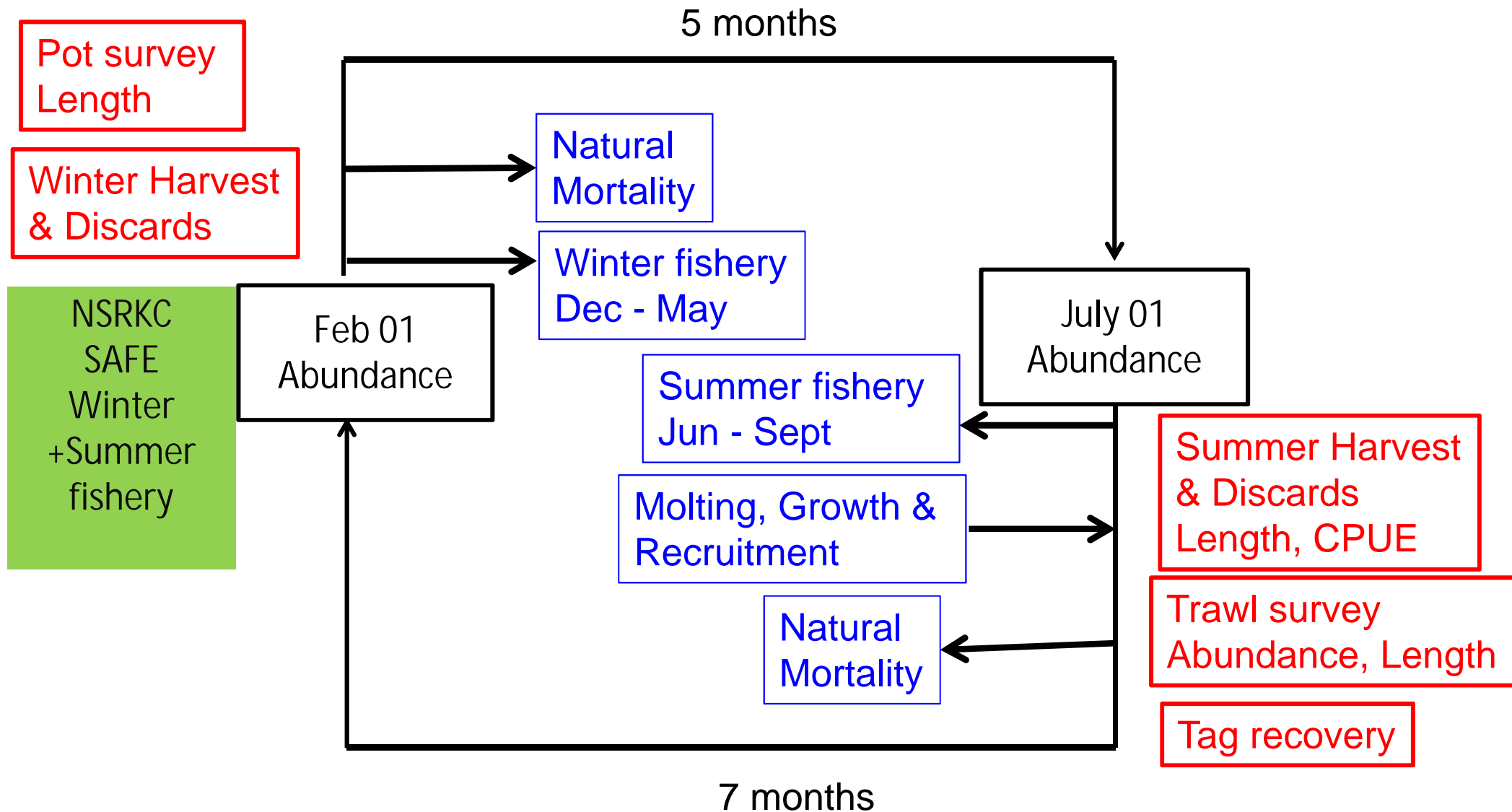
Alaska Department of Fish & Game

Division of Commercial Fisheries

# NSRKC Stock Assessment Model

## Modeling process

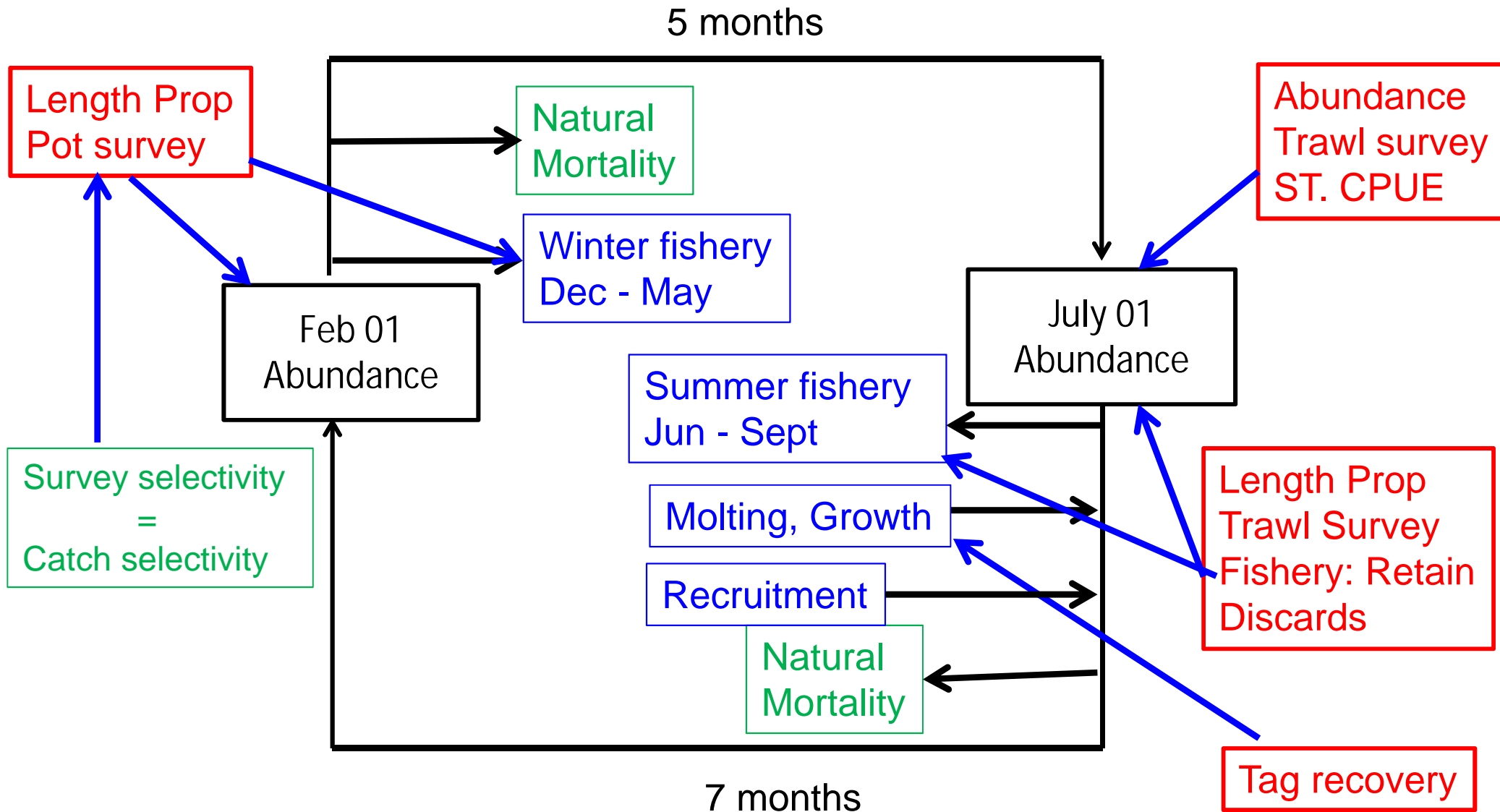
### Available Data & model fit



# NSRKC Stock Assessment Model

## Modeling process

### Available Data & model fit



# 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 fishery: July 01: Jun – Sept
- Winter catch selectivity = winter pot survey selectivity



# Changes Fishery & Data

- Winter fishery 2018
  - Commercial: 9,189 (20,118 lb.) **Down 65% from 2018**
  - Subsistence: 4,424 (8,848 lb.) **Down 27% from 2018**
- Summer commercial fishery 2018
  - 6/24-7/29: 89,613 (298,396 lb.)
- Total retained harvest: 103,217 (0.34 mill. lb.) < ABC (0.35 mill. lb.)
- All harvest and Observer data finalized.
- Standardized CPUE update (Appendix B)
- **ADF&G 2018 Summer trawl survey**
  - 7/22-7/29: 1108.9 k, CV =0.25
- **Winter Commercial Retained length-shell (2017-18)**
- Data waiting: tag recovery data
- Changes in fishery regulation: None

## Responses to CPT (Jan 9 2018)

- Evaluate methods to improved ADF&G bottom trawl survey biomass estimation, including model based approaches.
  - Tried VAST: Jocelyn?
- Quantitatively evaluate the representativeness of observer sampling.
  - Sampling distribution differed from harvests. Further data analyses needed if length-comp differ by stat-area

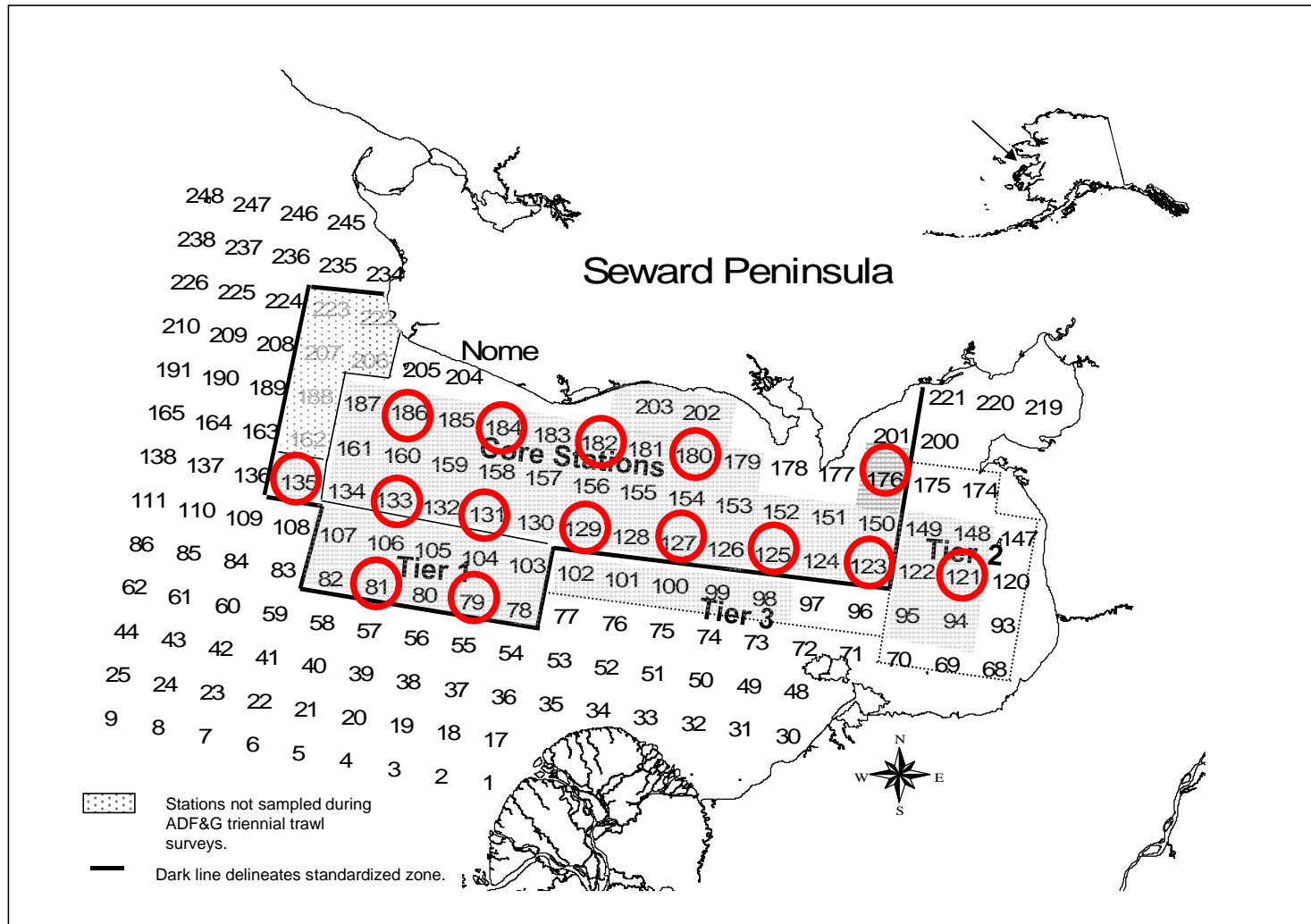
## Responses to CPT (Jan 9 2018)

- Estimate fishery retention curve. Consider alternative curves (1-parameter vs. 2-parameter logistic) for both retention and selectivity
  - Alternative Model 1
- Tier 3 Calculation
  - Done



# Responses to SSC (Feb 5 2018)

- Recommend a spatial comparison of the ADFG and NMFS trawl survey 2017.



# Responses to SSC (Feb 5 2018)

- CPUE comparison

	Female		Male < 64mm CL		Male ≥ 64mm CL	
Station	ADFG	NOAA	ADFG	NOAA	ADFG	NOAA
79	0	0	0	0	0	0
81	0	42.96	0	0	44.29	21.48
121	0	0	0	0	0	0
123	44.28	381.53	44.29	178.05	88.58	50.87
125	132.86	259.80	221.44	129.90	88.58	0
127	0	0	88.58	0		0
129	0	22.94	0	0	88.58	0
131	44.29	0	0	27.16	88.58	81.47
133	0	22.21	132.86	22.21	708.60	111.04
135	0	0	0	0	0	125.47
176	0	48.34	44.29	120.84	0	0
180	44.29	99.67	0	124.58	0	224.24
182	0	0	0	0	0	0
184	0	0	265.73	0	88.58	24.07
186	0	0	0	0	88.58	23.85
<b>Average</b>	17.72	58.50	56.94	40.18	91.74	47.32

- Difference due to: net configuration, survey protocol, timing?

## Responses to SSC (Feb 5 2018)

- Requests more information on the evidence of biennial mating and some consideration of the implications, if any, on fishery harvest strategy.
  - One of hypotheses that need to be explored.
- Consider whether switch of commercial buyers in 2005 may have affected the apparent CPUE and its standardization.
  - No effects
- Request to include Quantitative Baseline of Annual Community Engagement and Dependency.
  - Economic SAFE is appropriate.

# 2018 Trawl Survey

## 2018

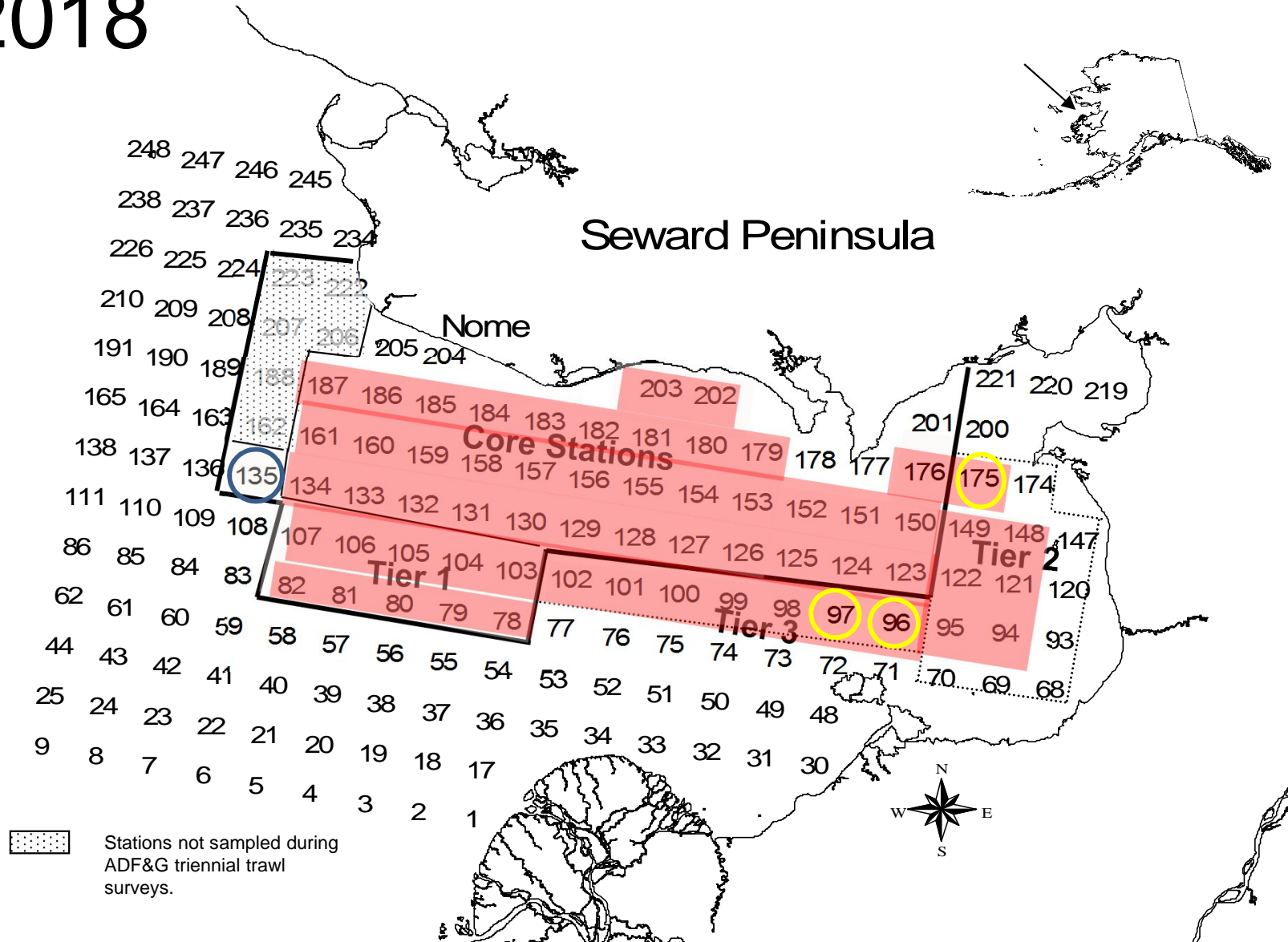


Figure 2- Station Map

# 2018 Trawl Survey legal red king crab catch (Total 20)



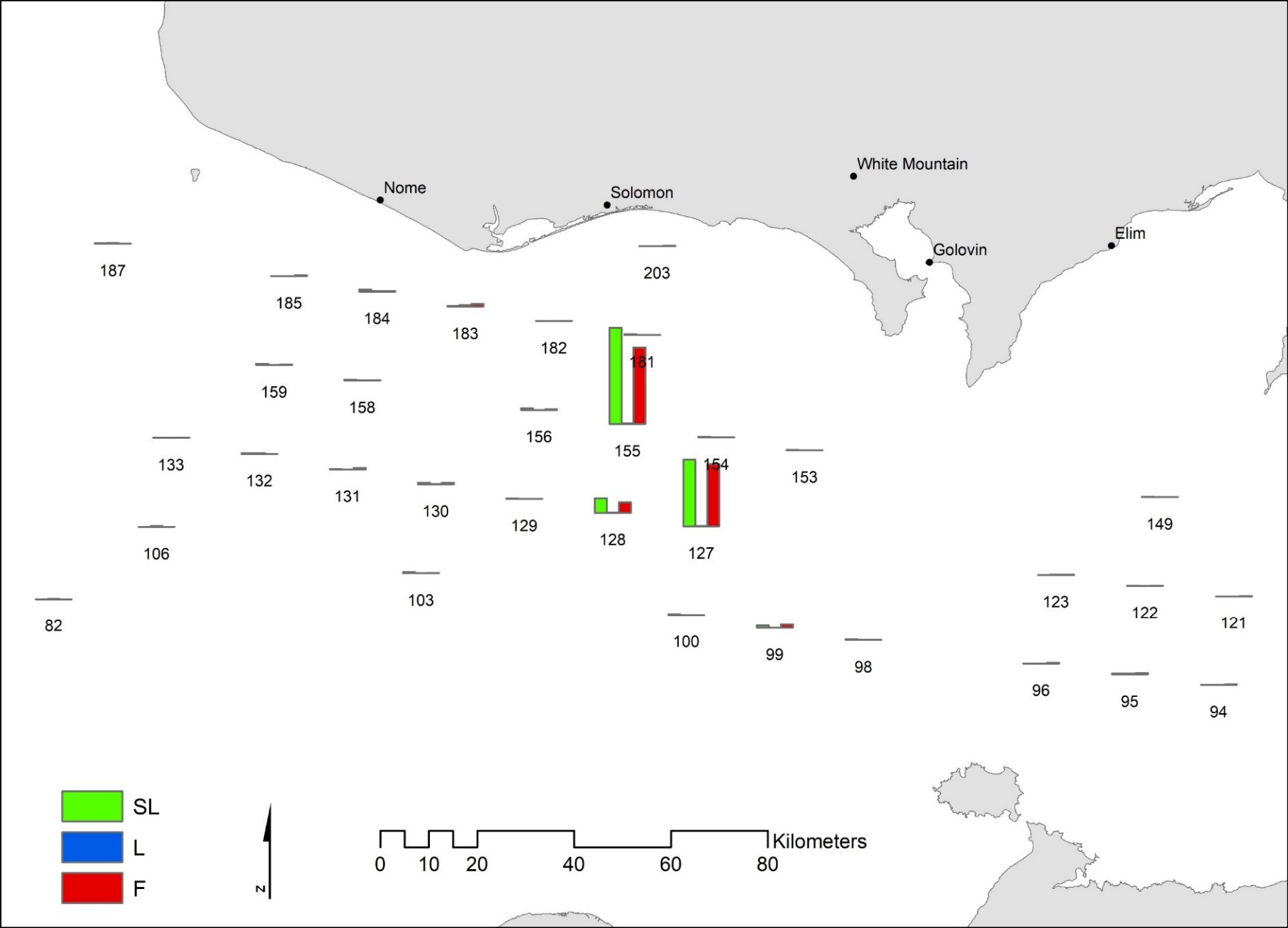
# 2018 Trawl Survey sublegal red king crab catch (Total: 497)



# 2018 Trawl Survey female red king crab catch (Total: 423)



# 2018 Trawl Survey red king crab distribution





Year	Agent	Female	Legal (>104)	Pre1 (90-104)	Pre2 (76-89)	Pre3 (<76)
1976	NMFS	1,021,572	1,976,523	1,485,909	591,973	165,849
1979	NMFS	302,601	771,002	39,180	8,101	185,336
1982	NMFS	2,097,511	702,561	941,075	330,374	1,513,300
1985	NMFS	1,221,058	1,119,285	850,338	526,338	690,060
1988	NMFS	1,653,212	1,051,009	568,578	638,630	792,923
1991	NMFS	877,035	1,416,006	387,234	320,579	1,033,641
1996	ADFG	643,247	567,639	249,011	156,842	468,697
1999	ADFG	915,135	1,718,561	682,813	155,992	467,877
2002	ADFG	1,373,860	786,389	512,964	413,754	646,672
2006	ADFG	2,361,646	862,993	565,242	1,093,104	1,501,881
2008	ADFG	1,715,846	1,016,407	727,488	848,561	1,044,702
2010	NMFS	829,599	806,809	840,798	330,033	688,283
2011	ADFG	1,678,631	1,790,972	455,708	446,136	1,380,161
2014	ADFG	901,391	1,746,881	2,109,261	1,546,795	830,240
2017	ADFG	653,182	941,797	288,615	258,235	713,943
2017	NMFS	1,325,065	746,137	322,684	327,242	1,007,975
2018	ADFG	6,438,063	303,806	151,903	212,664	7,169,809

The lowest legal crab abundance  
The highest female and Pre3 abundance

## Alternative model selection for 2019 SAFE

- Model 0: Baseline 2018 model with updated data
- Model 1: Estimate Summer com retention curve
  - 1-parameter for selectivity and 2-parameter for retention
  - Total and retained length-shell Likelihoods: 2012-2018
- Model 2: Estimate Winter com retention curve (Explorative, not considered as alternative).
  - 2-parameter logistic
  - 3 years (2016-18) of data

## Alternative Model 1 response to CPUT

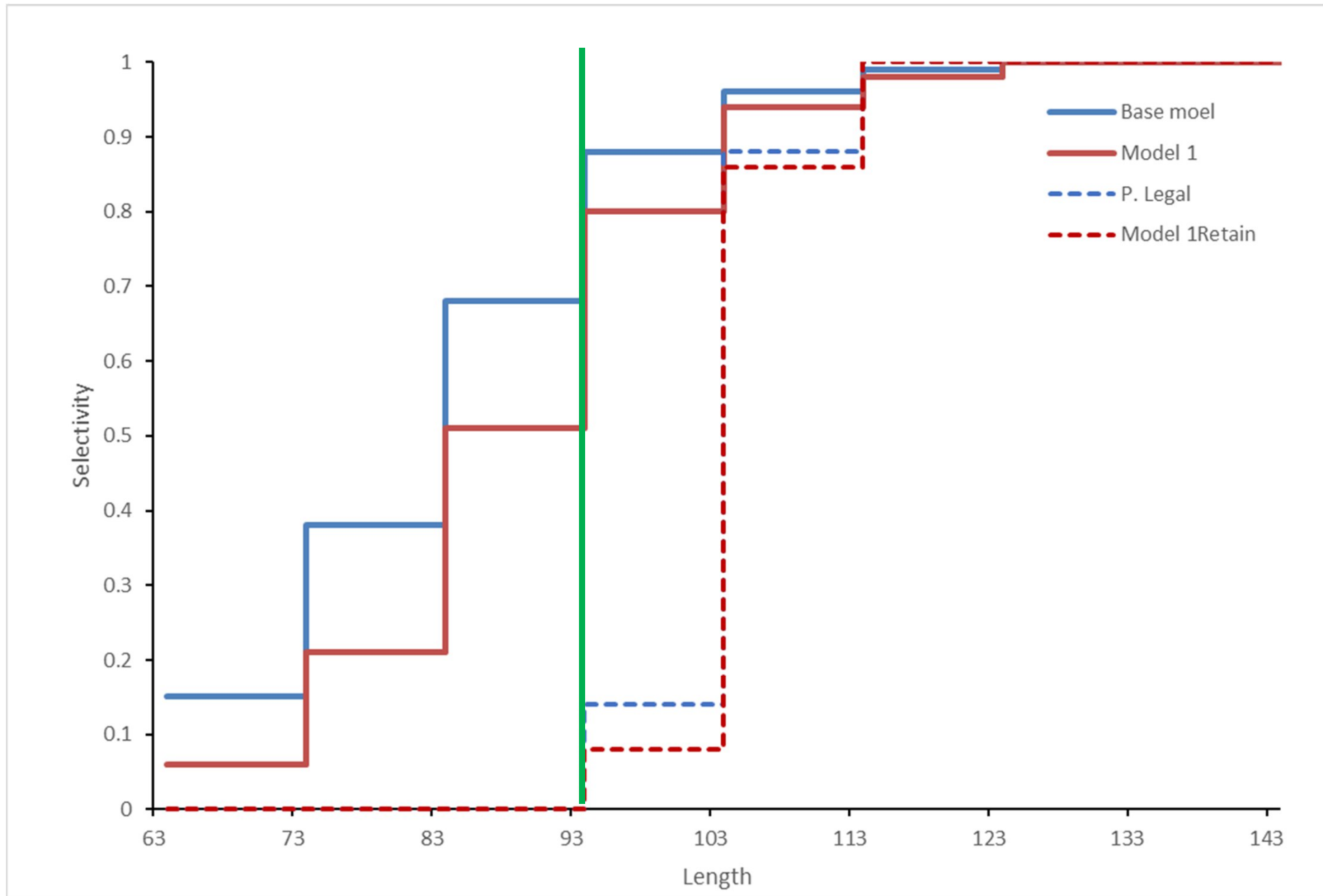
- Estimate fishery retention curve. Consider alternative curves (1-parameter vs. 2-parameter logistic) for both retention and selectivity
  - Only 1-parameter for selectivity and 2-parameter for retention was considered
    - CPT chose 1-parameter logistic for selectivity (SAFE 2018)
    - Empirical retention curve was similar to 2-parameter logistic
  - 1986-1995 Observer data
    - Survey Objective: describe length-shell comp of retained and discards.
    - Sampling Objective: 1000 discards, 1000 retained
    - Total catch, retained, discards: Not well reported

# Likelihood

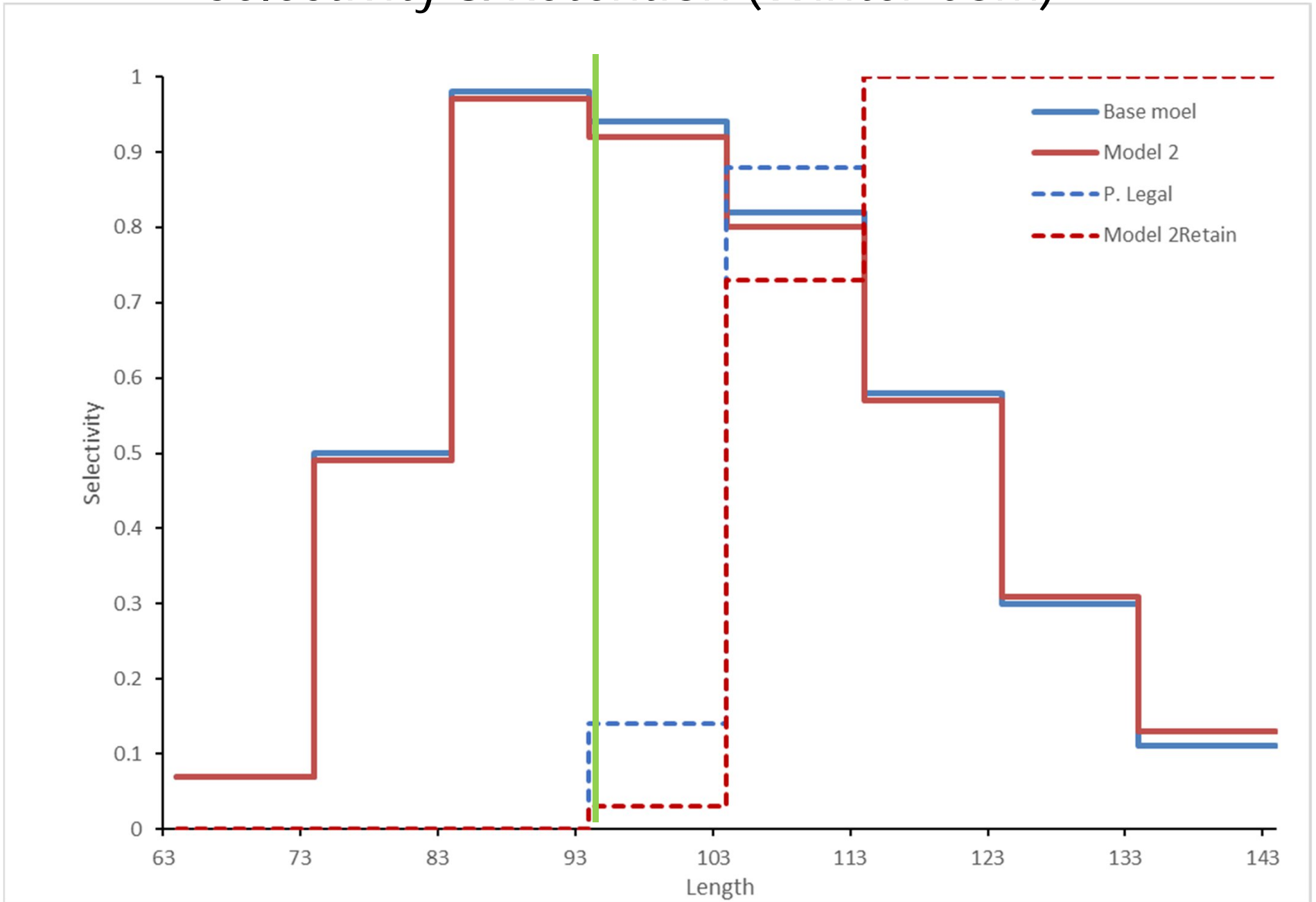
Model	Model 0	Model1	Model2
No. Parameters		+2	+2
Total	299.7	272.5	304.4
Trawl	9.5	9.6	9.7
St.CPUE	-29.2	-29.2	-28.9
Trawl LSP	103.3	103.6	104.7
Winter Pot LSP	38.7	38.5	39.0
Summer Com retain LSP	52.0	49.9	50.6
Observer LSP	30.7	8.2	30.8
Recruit	14.6	15.2	14.0
Tag	80.1	76.7	80.0
Winter Com retain LSP			4.4
2019 MMB(mil.lb)	3.11	3.09	3.12
Legal (mil.lb)	2.50	2.47	2.50
OFL(mil.lb)	0.24	0.24	0.25
B35%(mil.lb)	1.22	<1.39	1.24
F35%	1.86	>2.0	1.92
F40%	1.18	1.34	1.21

Sufficient model improvement?

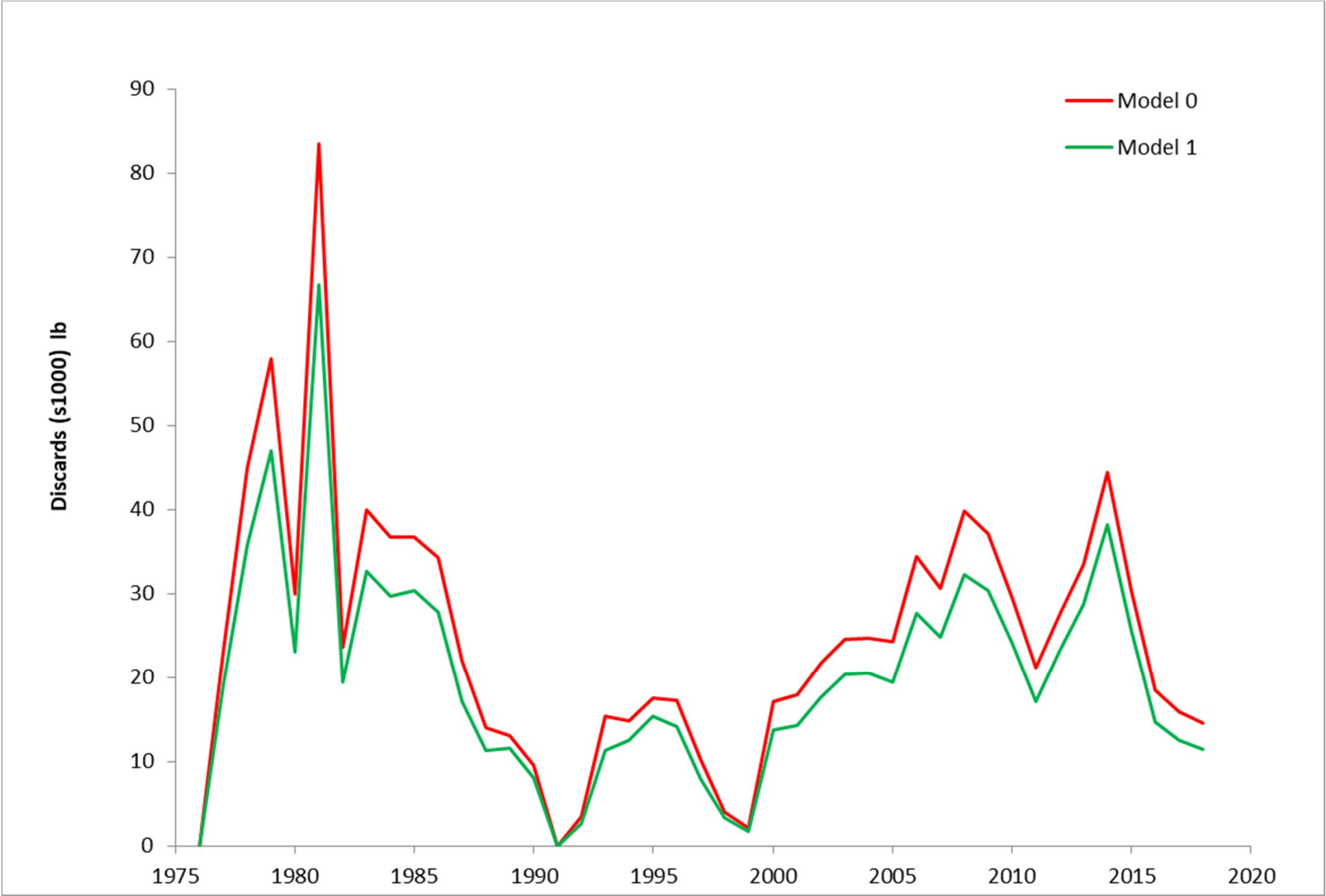
# Selectivity & Retention (Summer Com)



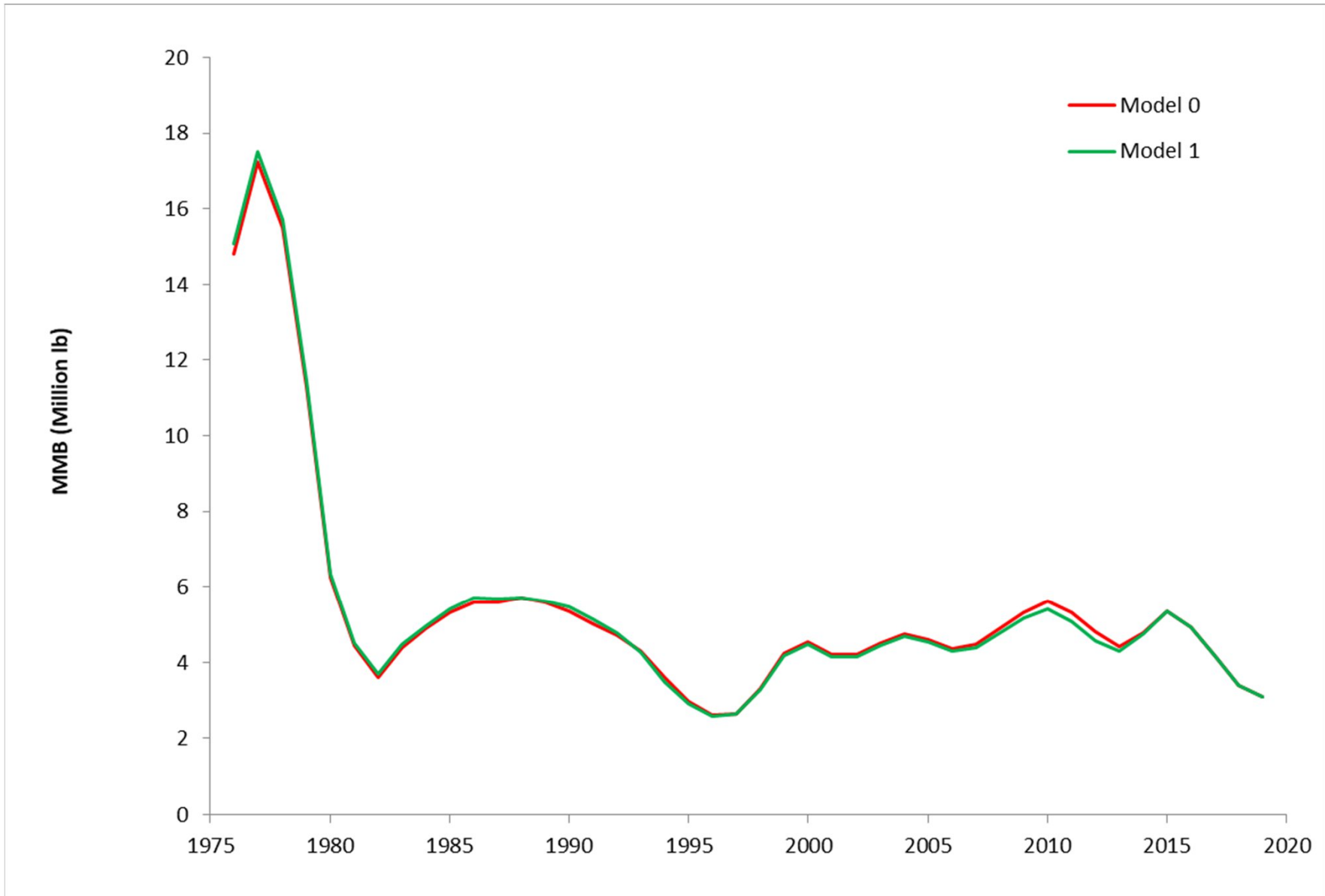
# Selectivity & Retention (Winter Com)



# Discards



# MMB

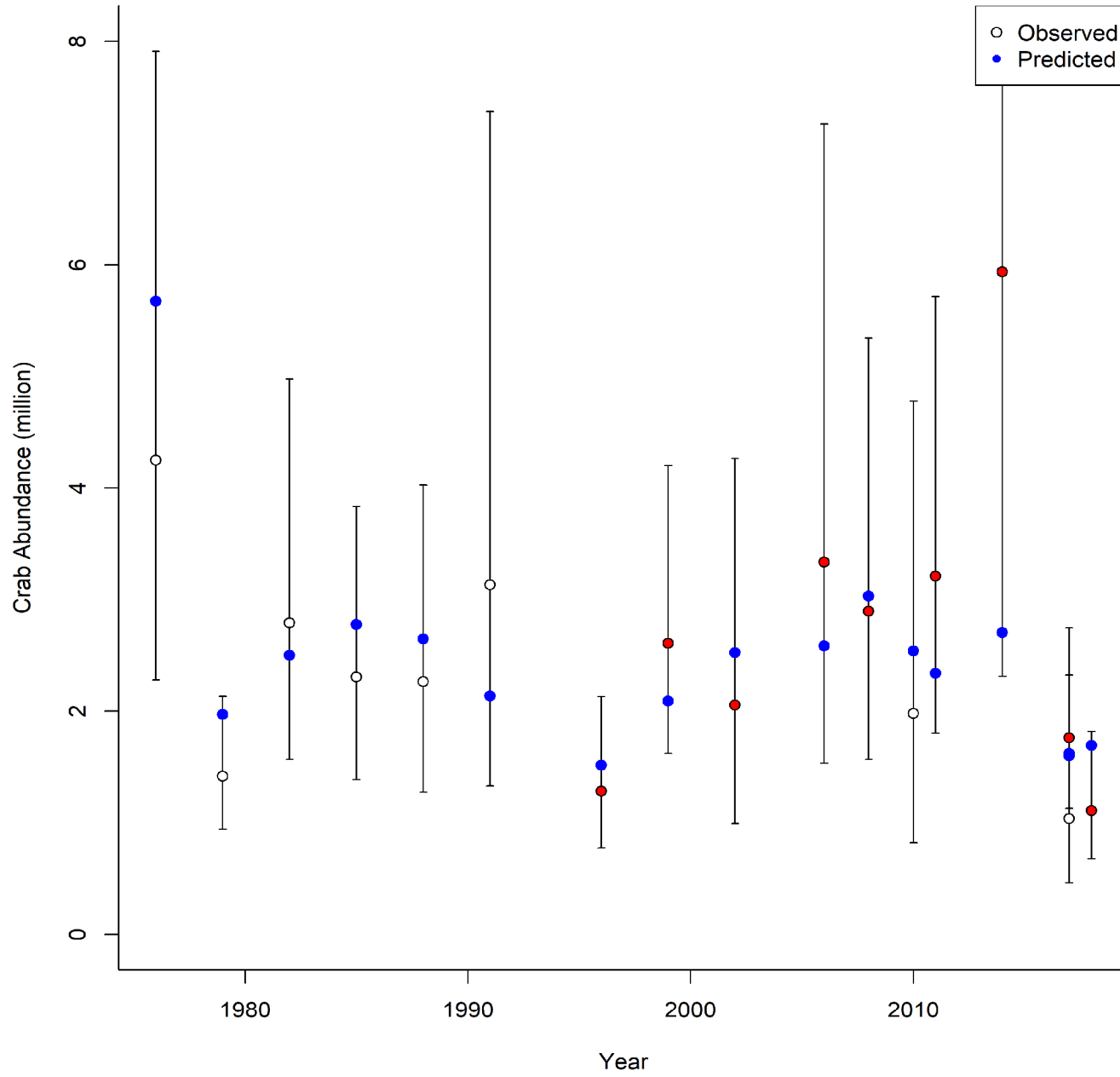




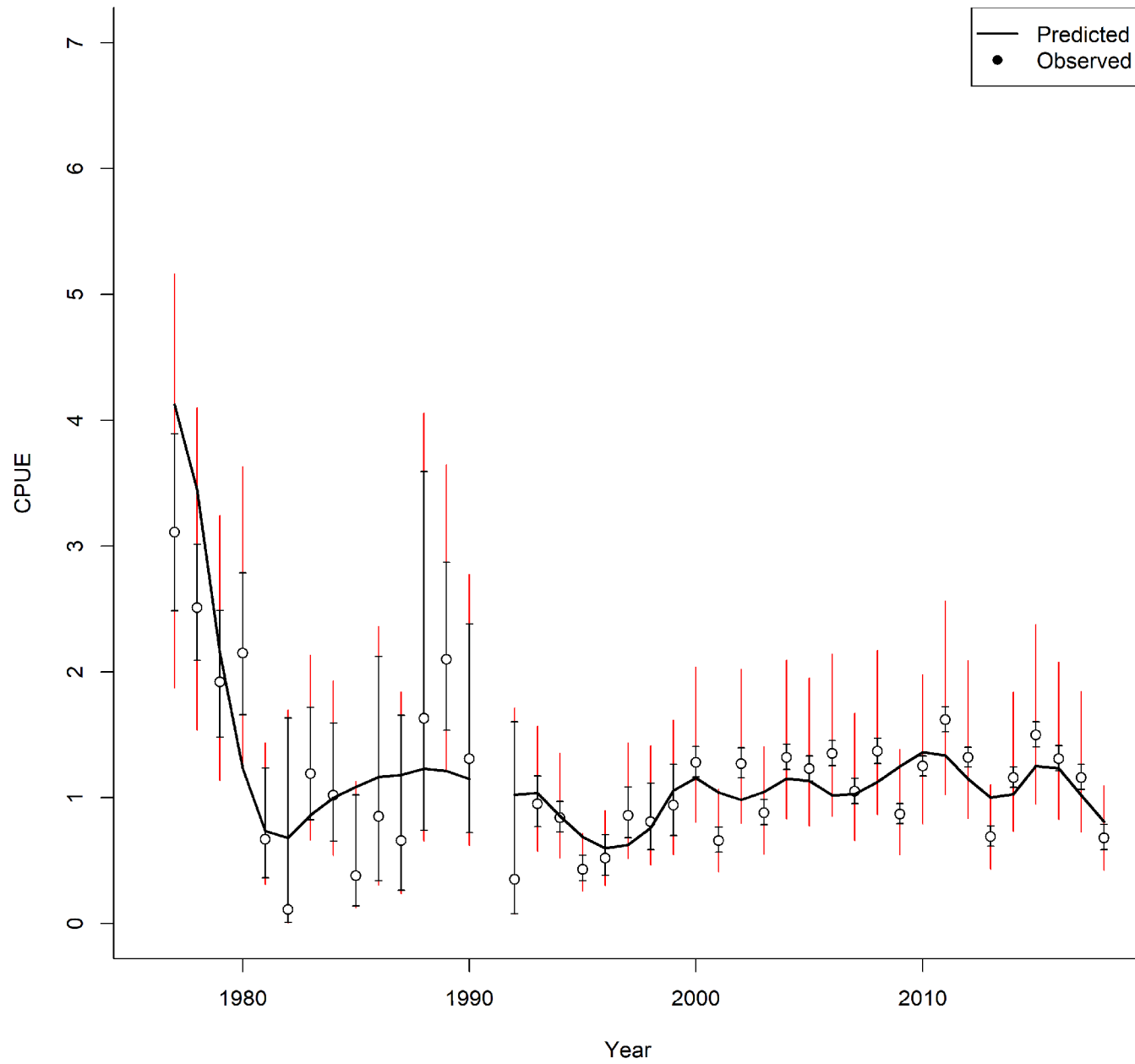
# Model Recommendation for 2019 SAFE

- Model 0: Baseline 2018 model with updated data
  - Marginal decline in likelihood
  - No difference in MMB
  - Use of 1986-1995 data (though did not contribute much).

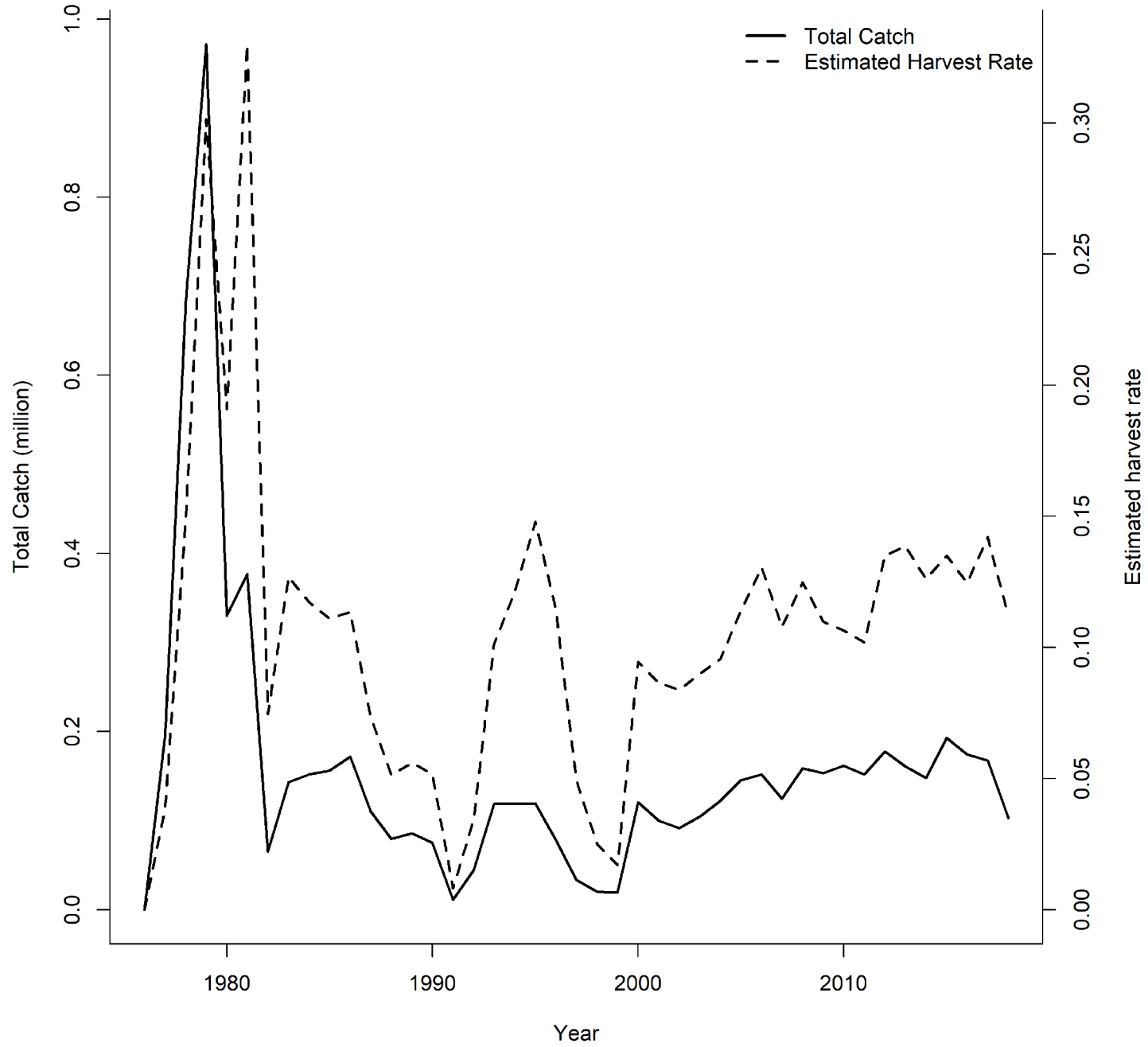
### Trawl survey crab abundance



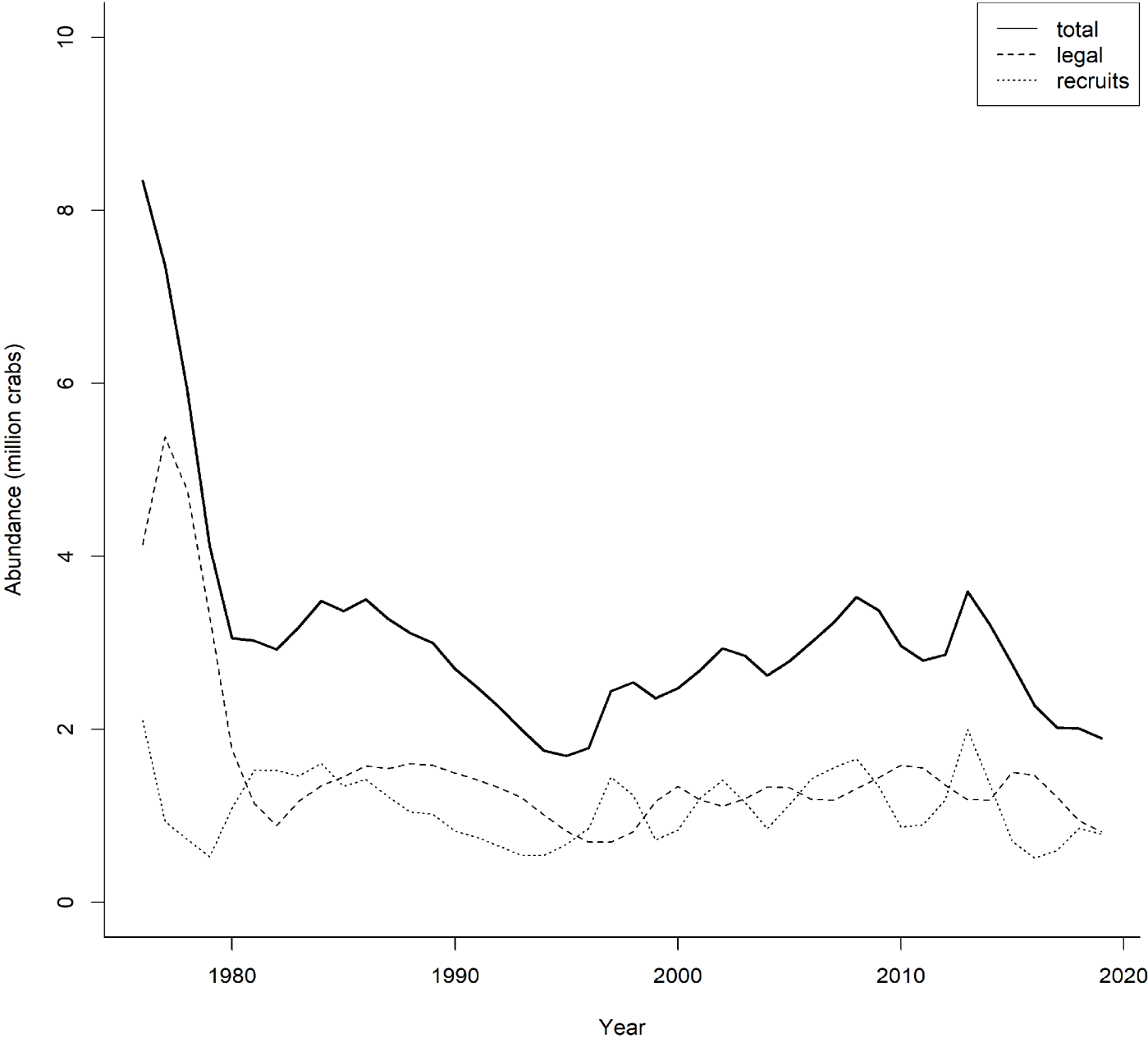
### Summer commercial standardized cpue



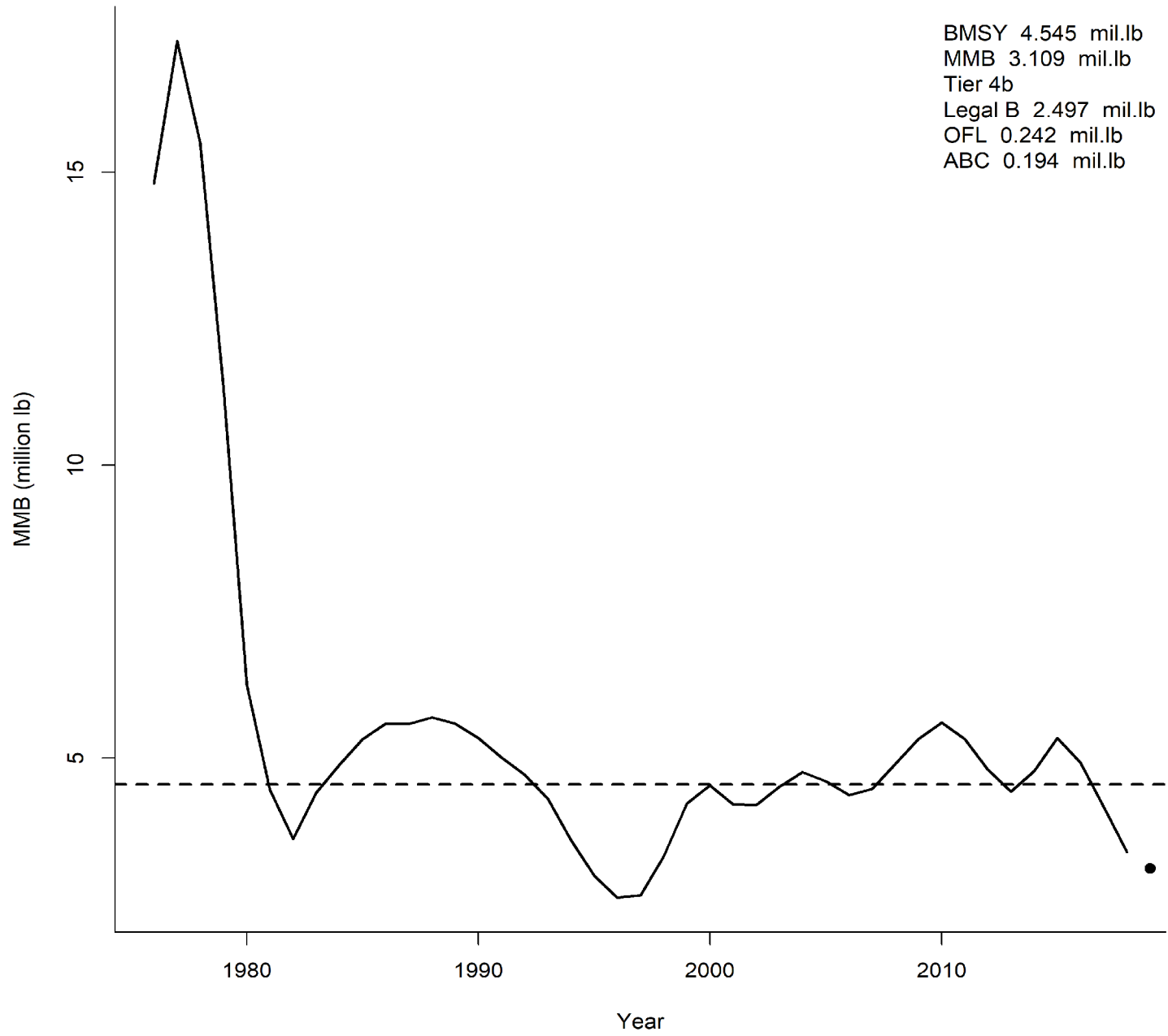
### Total catch & Harvest rate

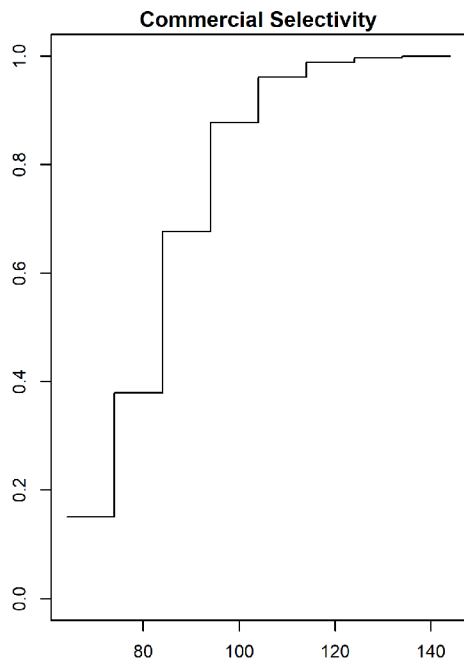
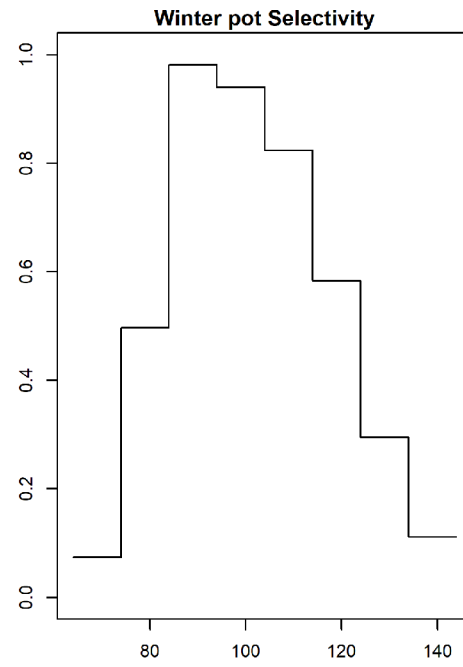
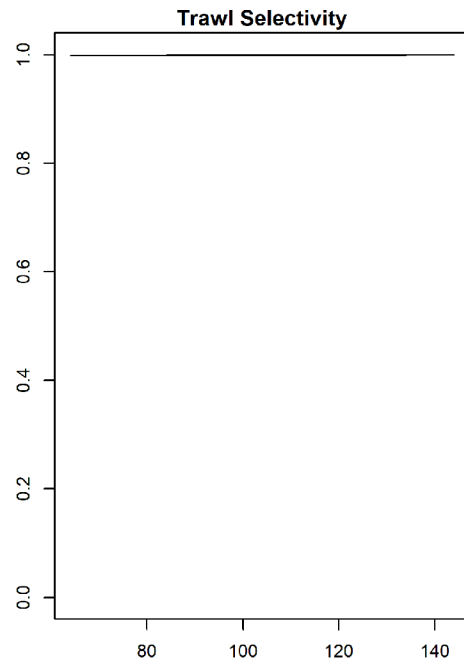
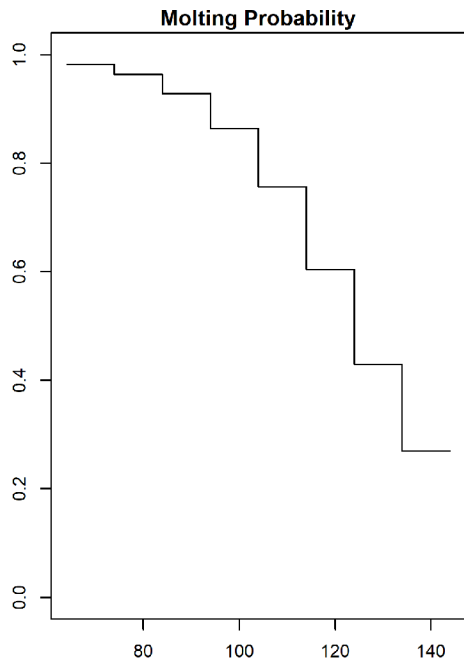


Modeled crab abundance Feb 01

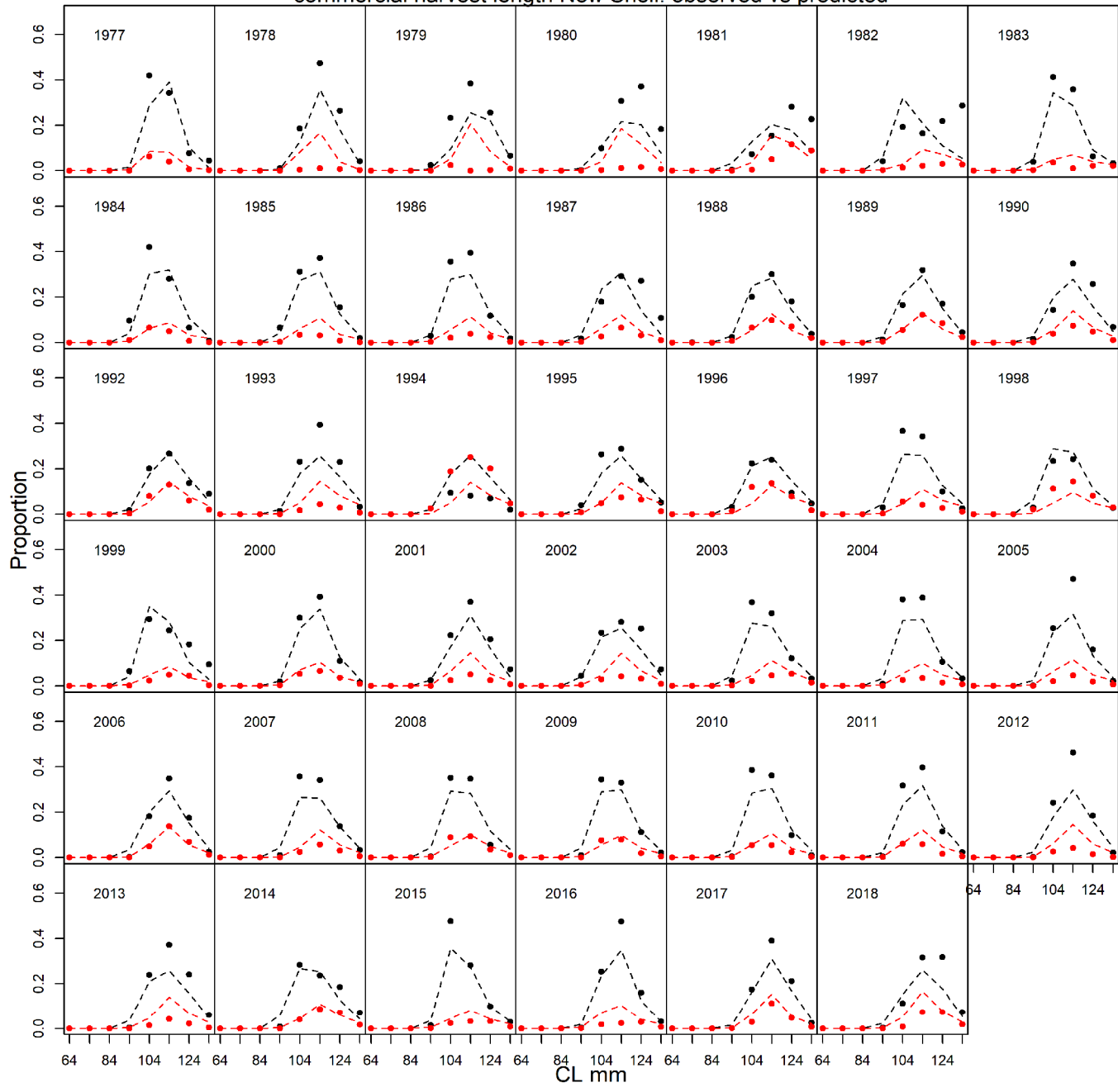


# MMB Feb 01



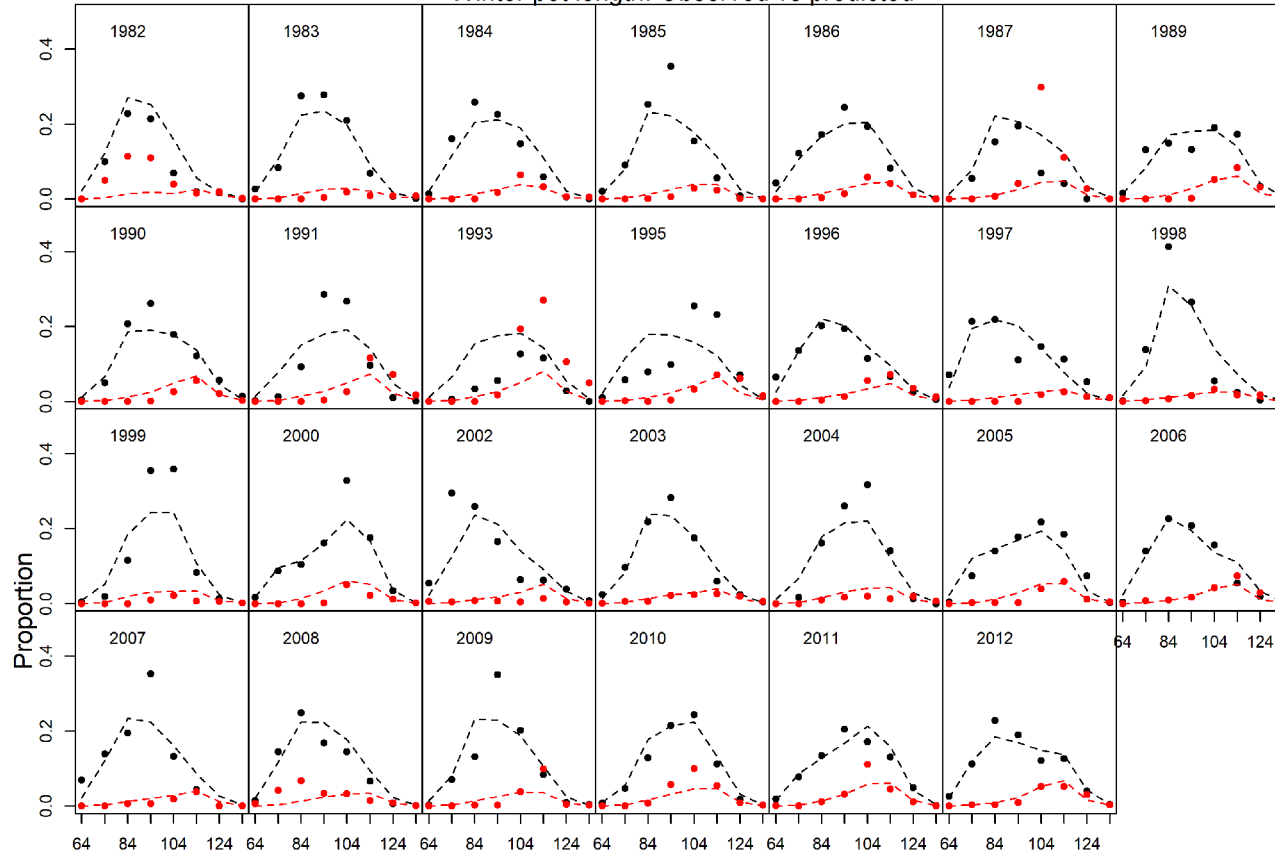


commercial harvest length New Shell: observed vs predicted



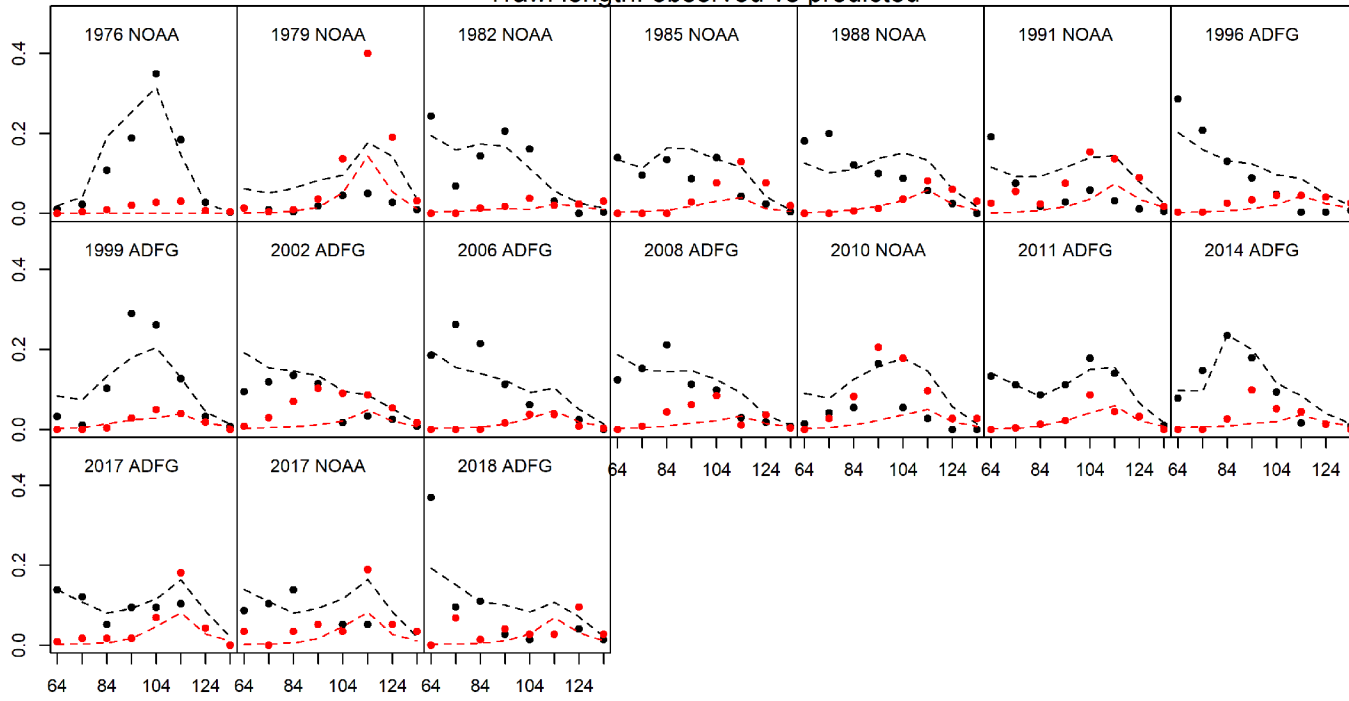


Winter pot length: Observed vs predicted

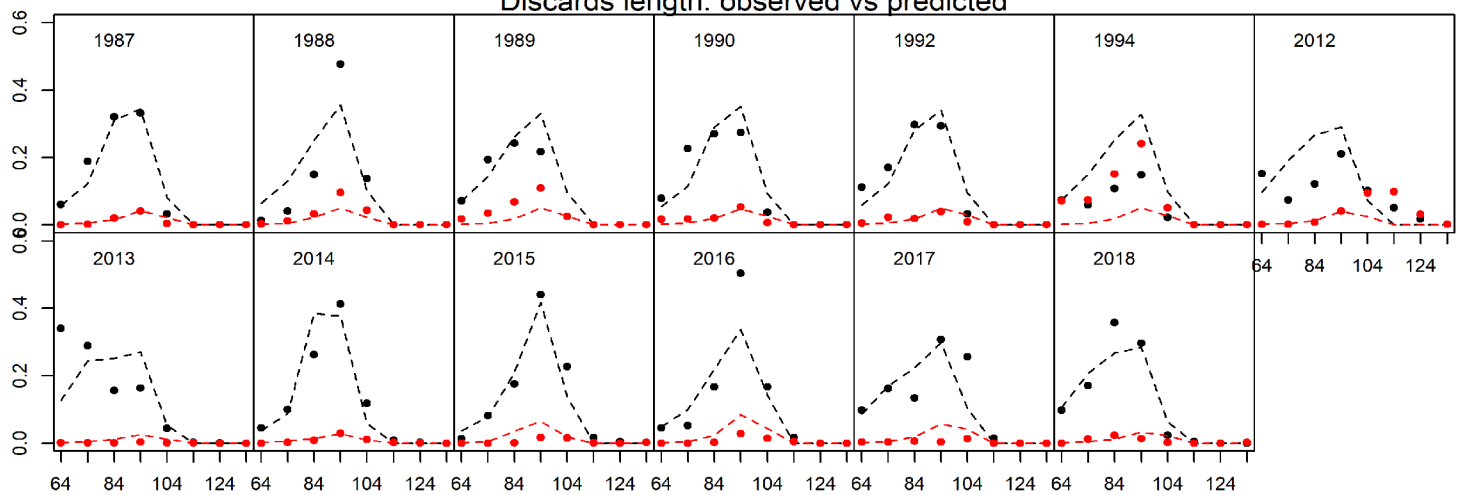


CL mm

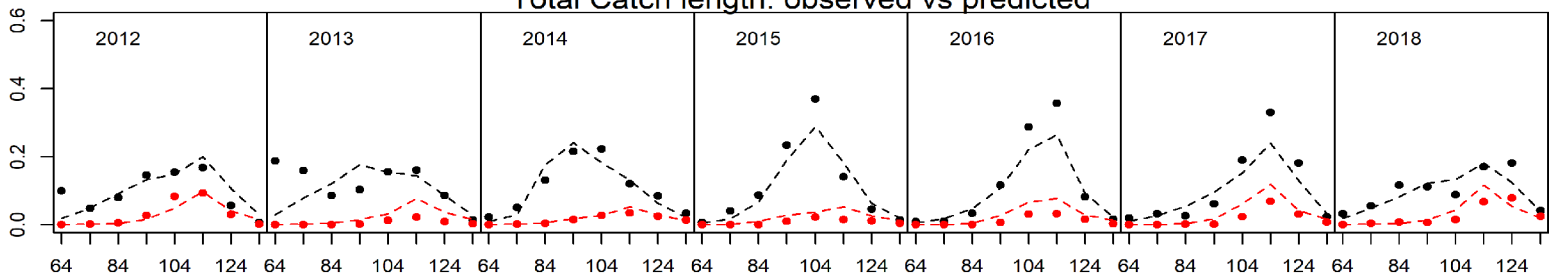
Trawl length: observed vs predicted



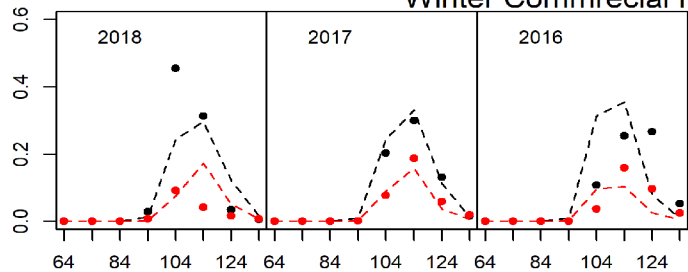
Discards length: observed vs predicted



Total Catch length: observed vs predicted



Winter Commercial Retain length: observed vs predicted



# Responses to CPT (Jan 9 2018)

- Tier 3 calculation

- Baseline model:

- 2019 MMB: 3.11 million lb.

- 2019 BMSY: 4.55 million lb

- 2019 Legal Biomass: 2.50 million lb

- B35% 1.22 million lb.

- F35% 1.86

- Tier 3: OFL = 1.86 million lb.

- Tier 4: OFL = 0.24 million lb.

# Selectivity & Retention

