Saint Matthew Island Blue King Crab 2014 SAFE Overview

William Gaeuman
ADF&G Kodiak

2013/14 Management Performance

OFL = 1.24 million lb

FISHERY CLOSED

Overfishing did not occur.

2014 Trawl Survey Results

Male abundance = 4.738 million (0.47)
[2.097 in 2013]

Male biomass = 13.818 million lb (0.44)
[5.441 in 2013]

Female abundance = 2.379 million (0.48)
[3.090 in 2013]

Female biomass = 0.225 million lb (0.54)
[0.248 in 2013]

Stock probably not overfished; probably not nearing overfished condition.

Base-model

- Three male size classes
  stage 1: 90-104 mm CL
  stage 2: 105-119 mm CL
  stage 3: 120 mm+ CL (legal)

- Default stage-transition matrix

$$\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix}$$

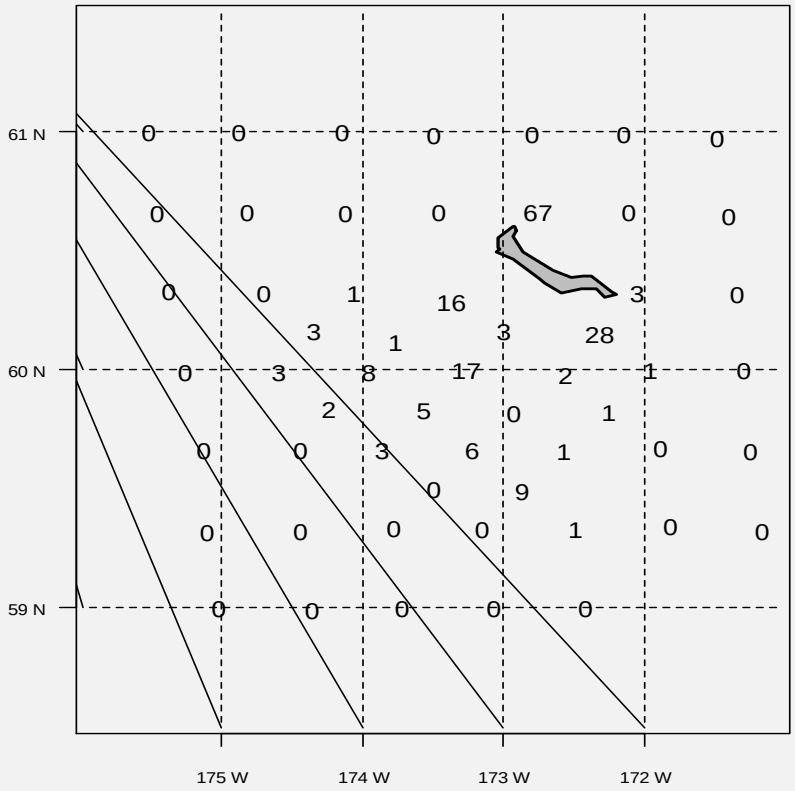
- M = 0.18 1/yr, except model estimated for 1998/99

- Q (trawl-survey) = 1

- Fitted data
  catch number
  NMFS trawl-survey biomass and stage composition
  ADF&G triennial pot-survey CPUE and stage composition
  observer directed-fishery stage composition
  groundfish bycatch biomass

- Estimation via minimization in AD Model Builder

2014 Trawl-Survey Model Quantities



181 male crab ≥ 90 mm CL

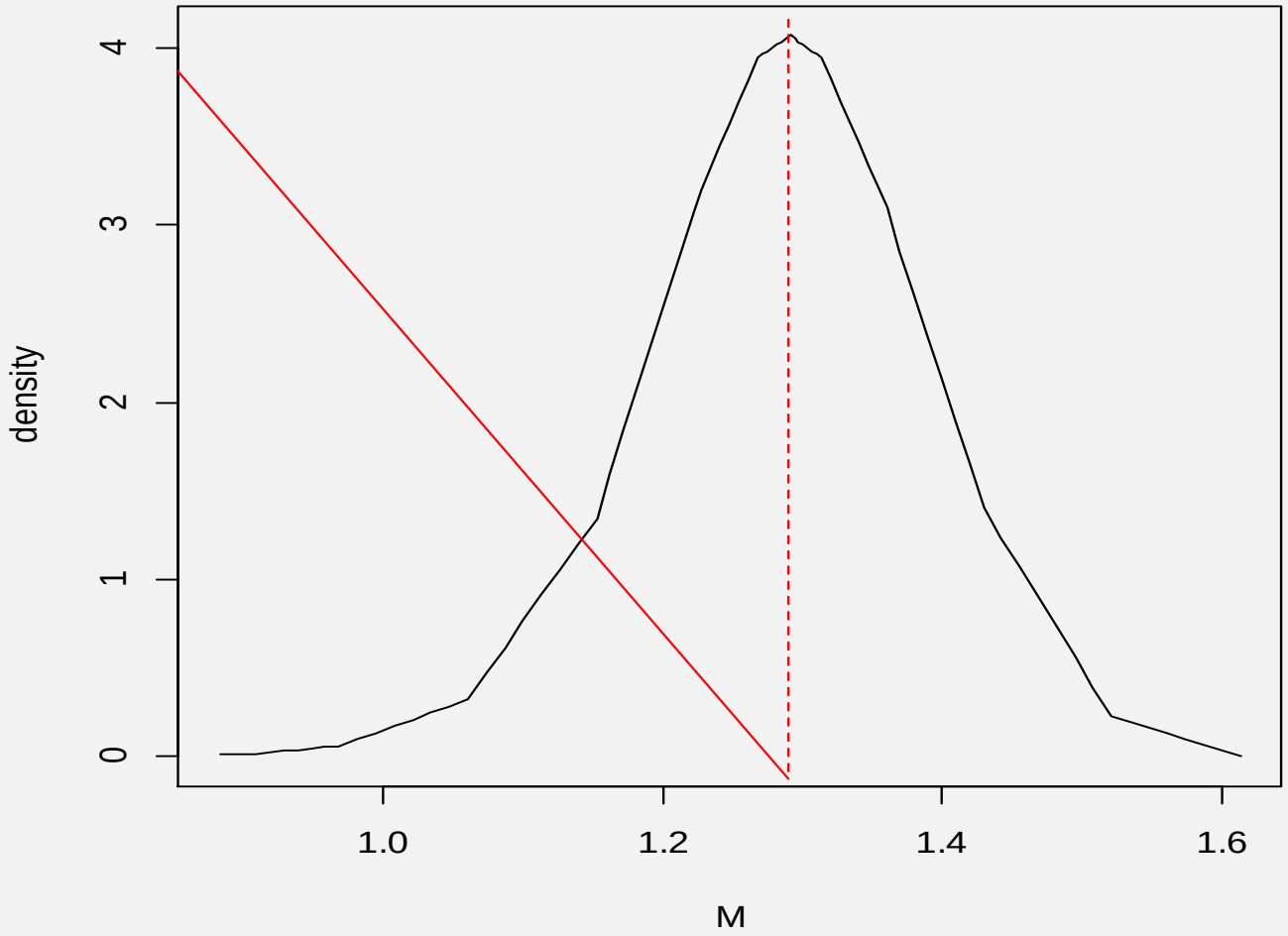
Area Swept Estimates

Stage-1 abundance	0.723 10^6
Stage-2 abundance	1.627 10^6
Stage-3 abundance	1.809 10^6
Model Male Biomass	13.292 10^6 lb (0.45)

CPT/SSC Concerns

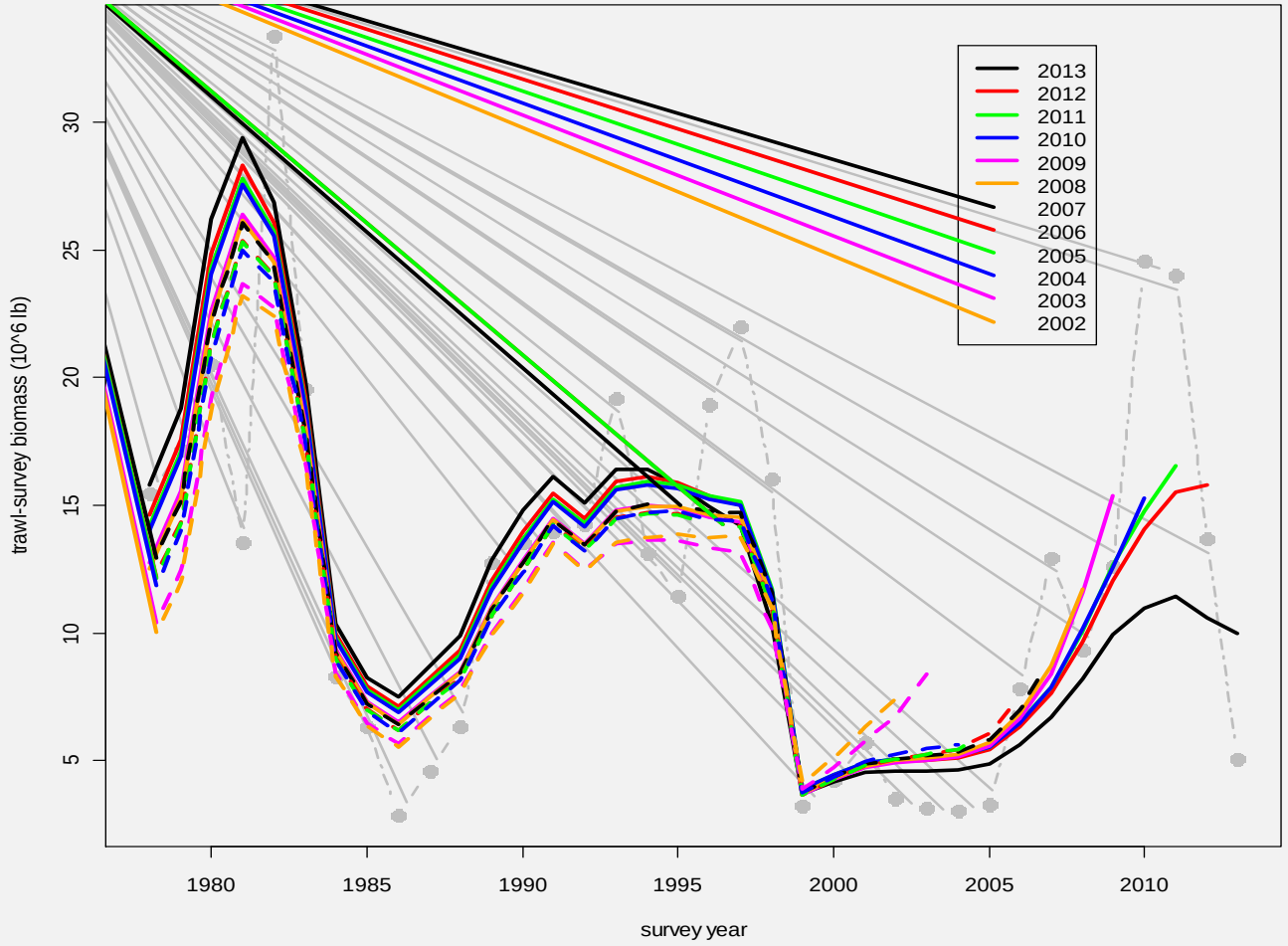
1. Observed 2013 assessment model (base model) retrospective pattern
2. Misspecification of natural mortality as possible source of model problems associated with retrospective pattern
3. Biologically implausible model stage-transition matrix

CPT/SSC Concerns



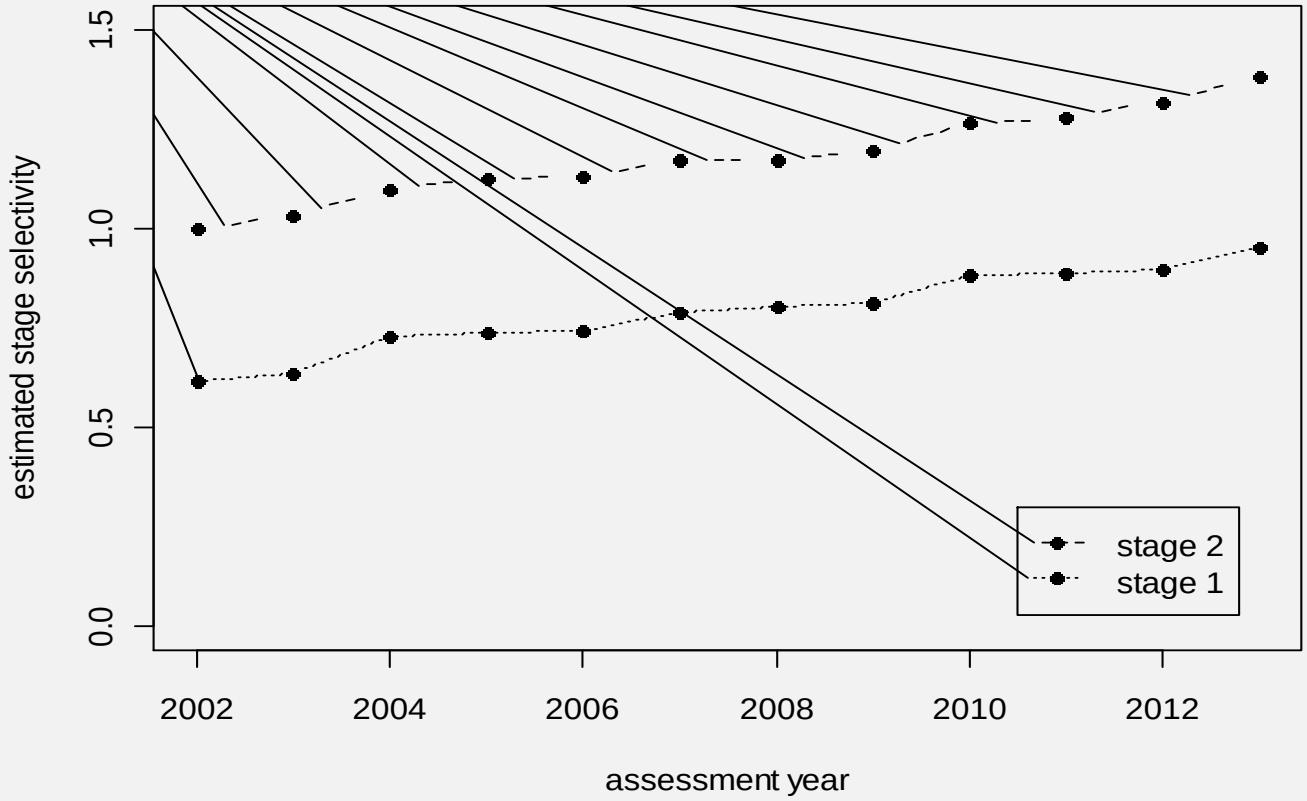
Base-model ADMB profile likelihood for natural mortality parameter M with 2014 dataset. M = 0.18 yr^{-1} is assumed for assessment.

CPT/SSC Concerns



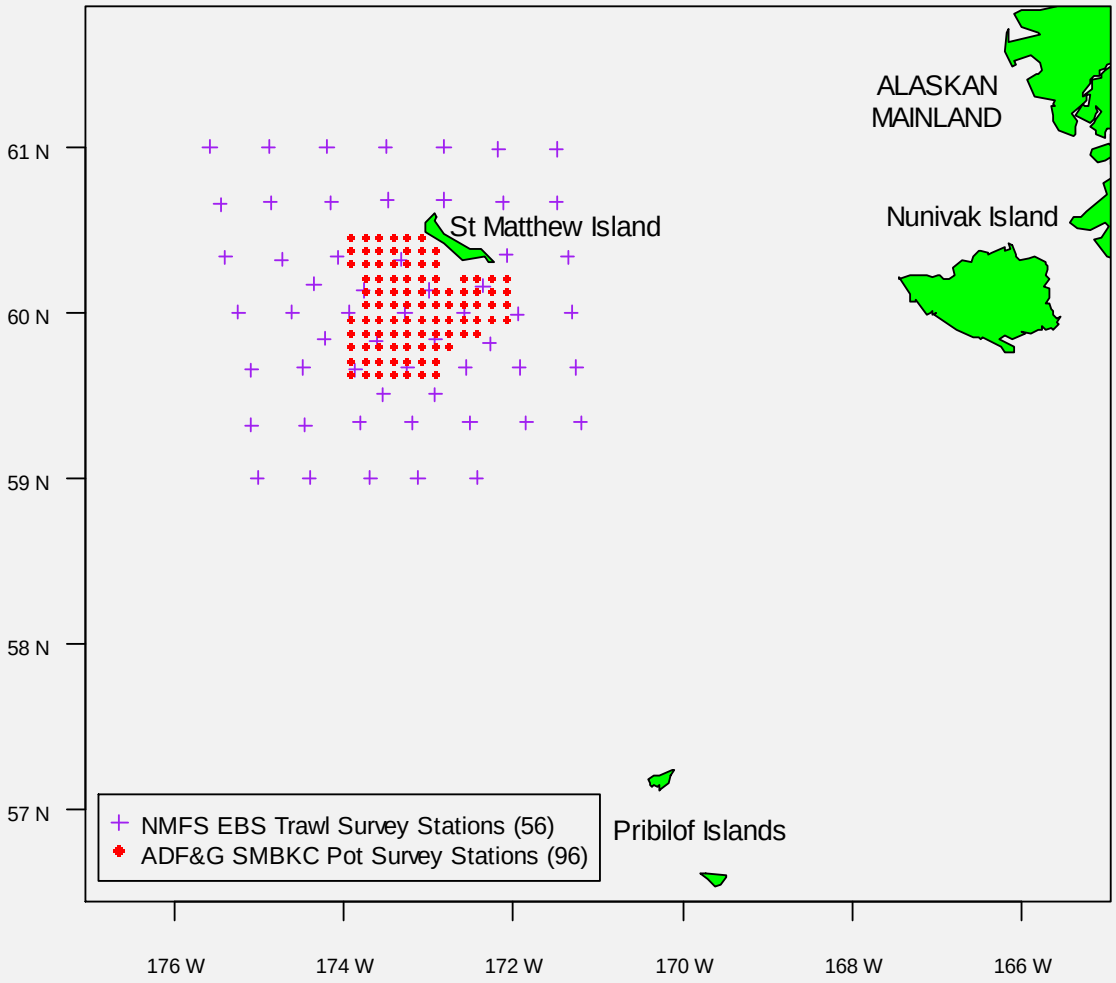
Retrospective plot of trawl-survey model-male (90mm+ CL) biomass for 2013 base-model configuration and terminal years 2002 – 2013. Estimates are based on all available data up to and including terminal-year trawl and pot surveys. (From 2013 SAFE.)

CPT/SSC Concerns



Base-model retrospective estimates of stage-1 and stage-2 trawl-survey selectivity for terminal years 2002/02-2013/14. Estimates are based on all available data up to and including terminal-year trawl and pot surveys.

CPT/SSC Concerns



Trawl and pot-survey stations used in the SMBKC stock assessment.

Model Selection

Four model configurations

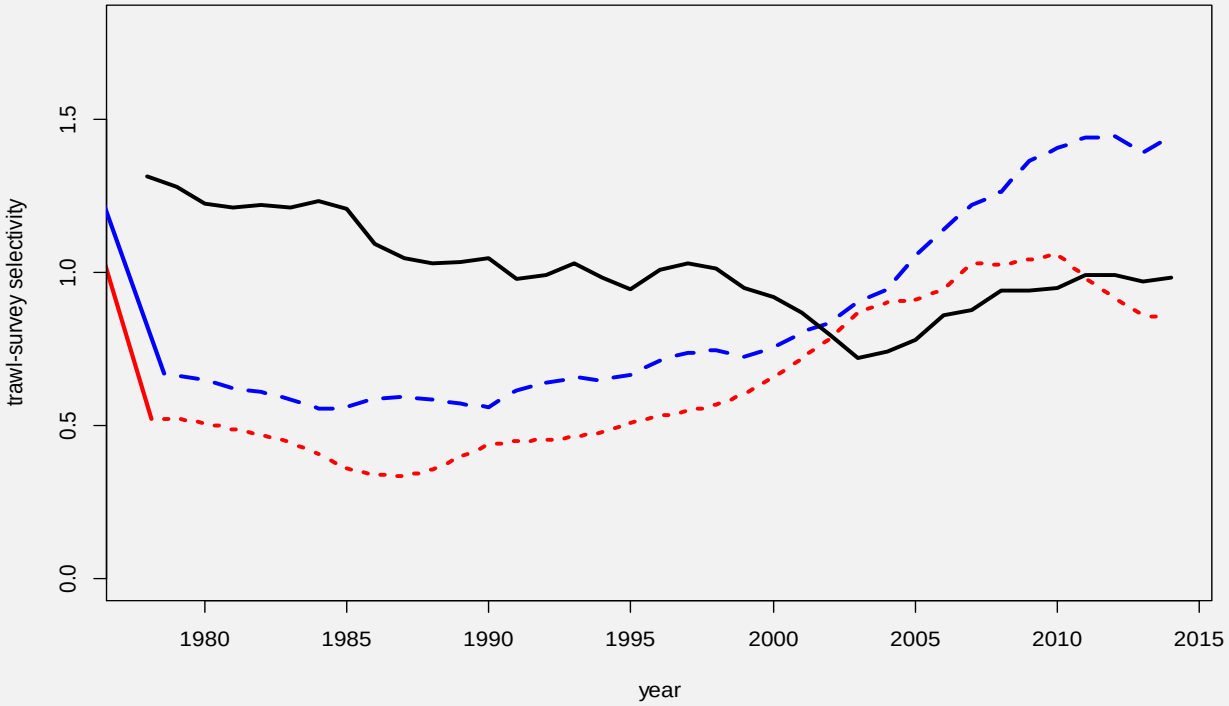
1. Base Model, used in 2012-2013

2. S: time-varying trawl-survey selectivity

3. T: alternative stage-transition matrix

4. ST: time-varying trawl-survey selectivity and alternative stage-transition matrix

Model ST Trawl-Survey Selectivity



Model ST stage-1(dotted red curve), stage-2 (dashed blue curve) and stage-3 (solid black curve) trawl-survey selectivities. Geometric means are respectively 0.60, 0.80 = (0.89 + 1)/2 and 1 (Q). Only the first is model estimated.

Alternative Stage-Transition Matrix

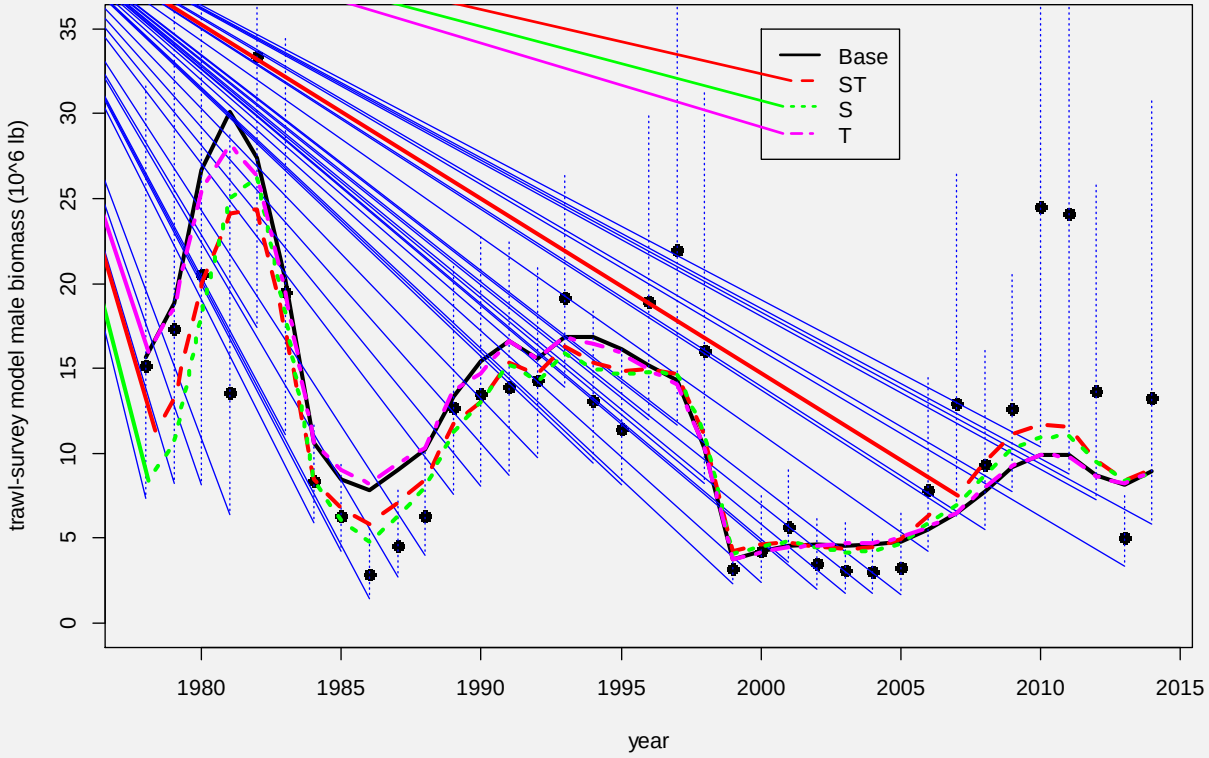
$$\begin{bmatrix} 0.2 & 0.7 & 0.1 \\ 0 & 0.4 & 0.6 \\ 0 & 0 & 1 \end{bmatrix}$$

Based on Otto and Cummiskey (1990). They report estimated molting probabilities of about 95% and 70% for crab measuring 97.5 and 112.5 mm CL, respectively, and model CL molt increment using a normal p.d.f. with mean 14.1 mm and standard deviation 3.1 mm.

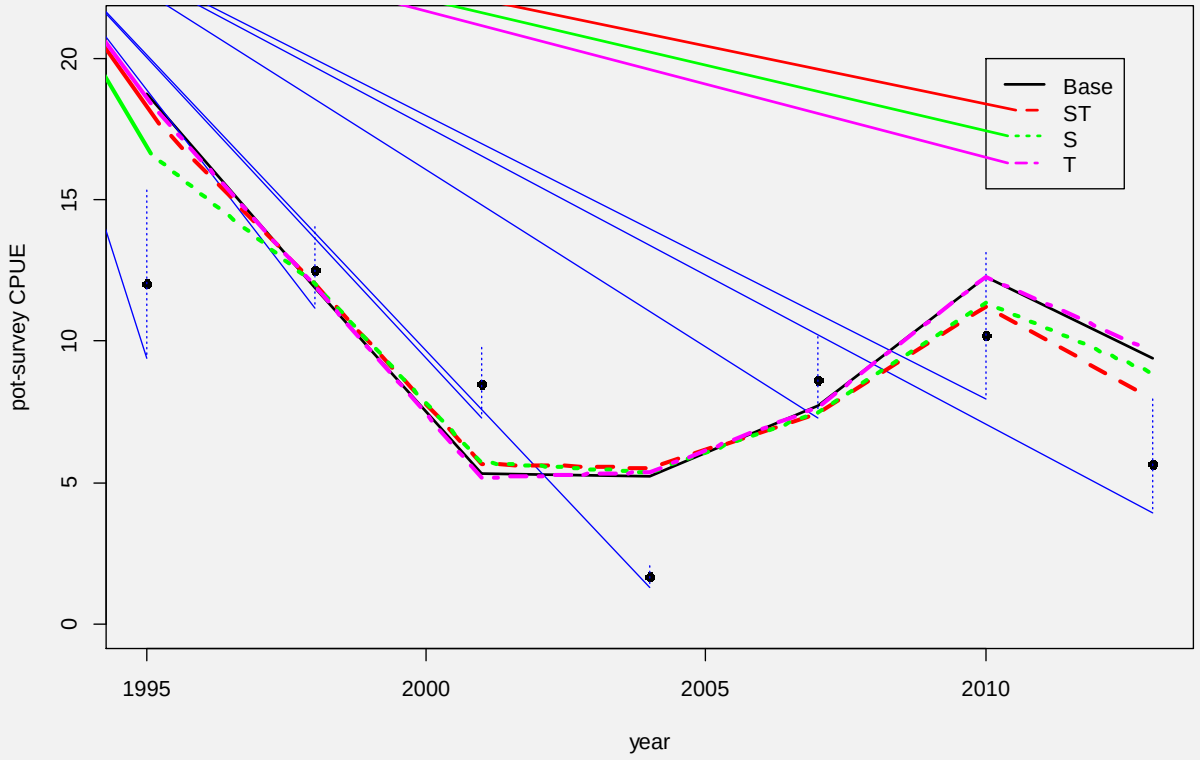
Model Comparison

	model estimated trawl-survey selectivity			survey-index RMSE		objective function		management quantities (10^6 lb)		
model	stage 1	stage 2	stage 3	trawl	pot	min[a]	K[b]	Bmsy[c]	OFL[d]	MMB[e]
base	0.98	1.44	Q = 1	1.43	6.12	3,888	122 - 4	6.656	0.943	5.906
ST	0.60[f]	0.80[f]	Q = 1	1.10	6.29	3,845	232 - 7	7.243	0.820	5.968
S	0.89[f]	0.95[f]	Q = 1	1.08	6.06	3,858	232 - 7	6.139	1.303	6.846
T	0.62	0.86	Q = 1	1.47	6.33	3,890	122 - 4	7.781	0.940	6.711

Trawl-survey biomass data

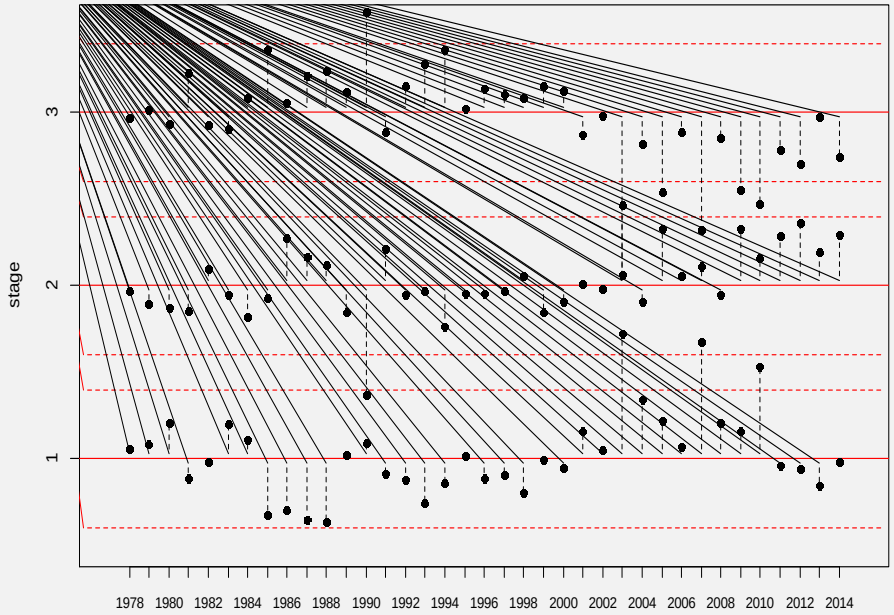


Pot-survey CPUE data

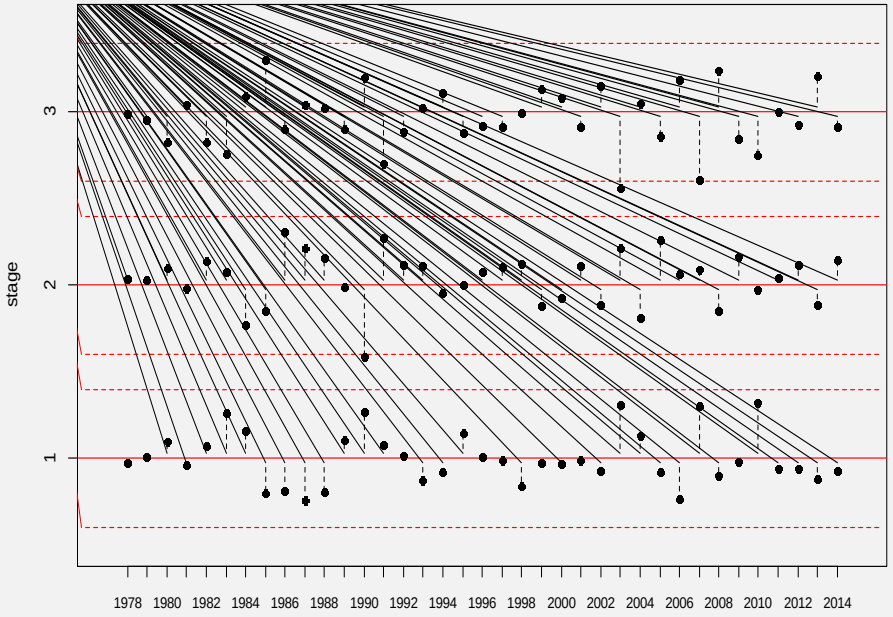


Trawl-survey composition data

Base model

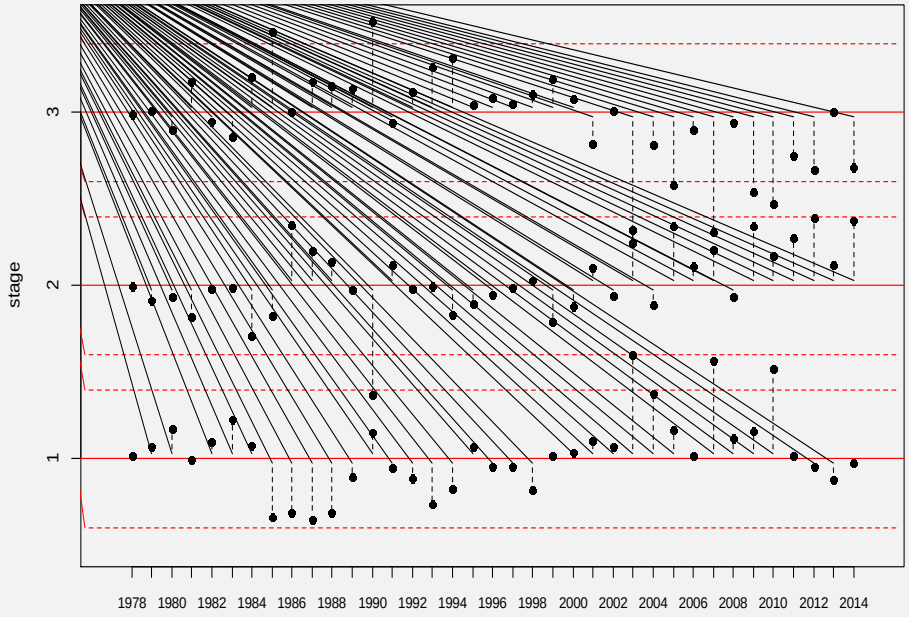


Model ST

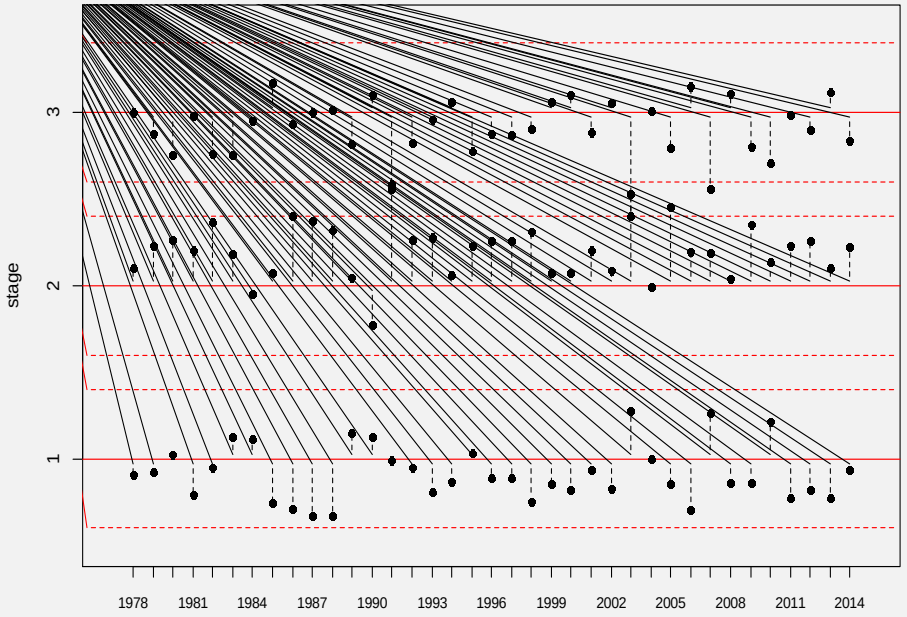


Trawl-survey composition data

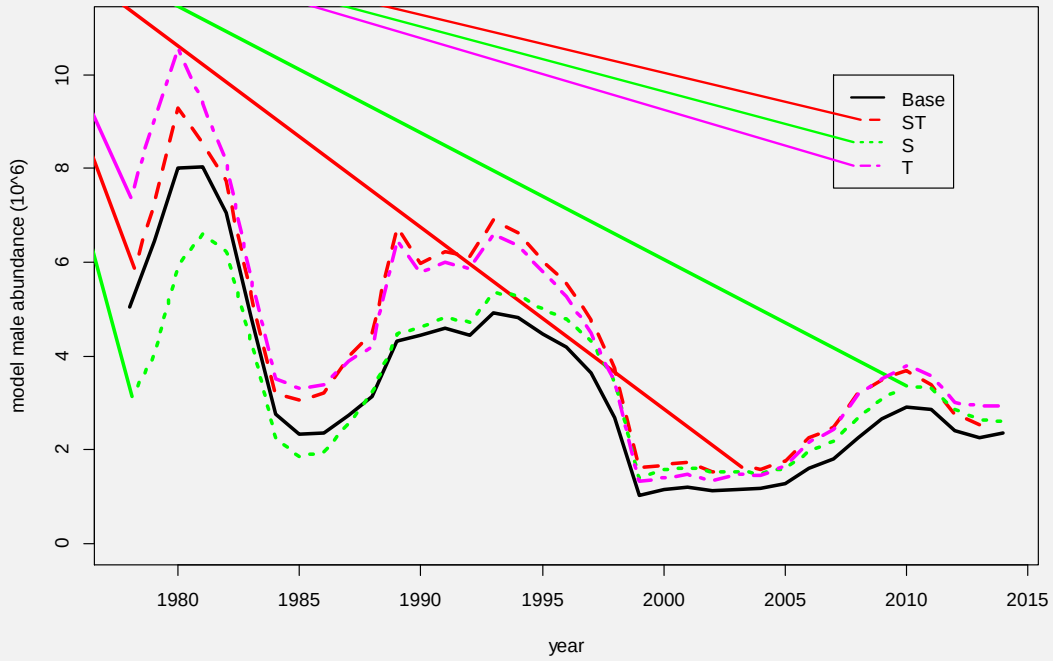
Model T



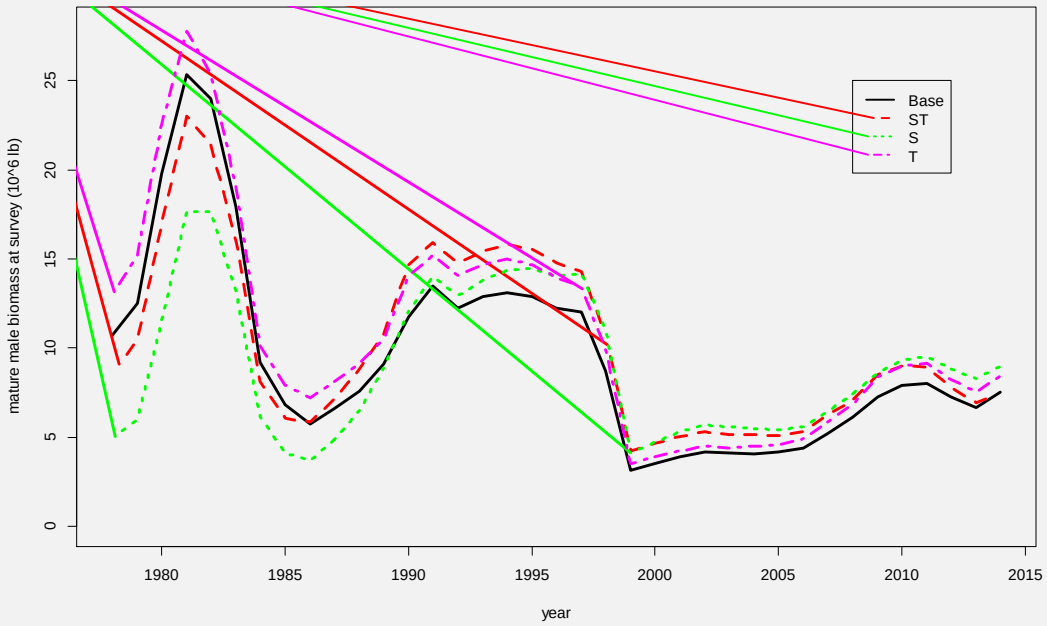
Model S



Model-male abundance



Mature-male biomass



Model ST Parameter Estimates

parameter	estimate	standard error
1998/99 natural mortality	0.86	0.136
pot-survey proportionality constant	4.34	0.434
geometric mean trawl-survey stage-1 selectivity	0.60	0.053
pot-survey stage-1 selectivity	0.31	0.048
pot-survey stage-2 selectivity	0.71	0.077
pot-fishery stage-1 selectivity	0.33	0.038
pot-fishery stage-2 selectivity	0.50	0.047
log initial stage-1 abundance	7.96	0.238
log initial stage-2 abundance	7.56	0.290
log initial stage-3 abundance	6.67	0.449
mean log recruit abundance	6.83	0.073
mean log recruit abundance deviations (36)	[-1.96, 1.36]	[0.156, 0.530]
mean log pot-fishery fishing mortality	-1.08	0.102
log pot-fishery fishing mortality deviations (25)	[-3.03, 1.75]	[0.146, 0.647]
mean log GF trawl-gear fishing mortality	-10.39	0.233
log GF trawl-gear fishing mortality deviations (23)	[-1.76, 1.63]	[0.695, 0.713]
mean log GF fixed-gear fishing mortality	-9.61	0.230
log GF fixed-gear fishing mortality deviations (23)	[-2.25, 2.57]	[0.688, 0.702]
log trawl-survey s1 selectivity deviations (37)	[-0.59, 0.57]	[0.142, 0.225]
log trawl-survey s2 selectivity deviations (37)	[-0.37, 0.59]	[0.133, 0.224]
log trawl-survey s3 selectivity deviations (37)	[-0.33, 0.27]	[0.131, 0.302]

Model ST Objective Function

Negative Loglikelihood Component	Weight	Contribution (%)
retained catch number	1,000	0.00
trawl-survey biomass	1	0.56
pot-survey CPUE	1	1.39
trawl-survey stage composition	1	47.98
pot-survey stage composition	1	15.95
directed pot-fishery stage composition	1	31.94
groundfish trawl mortality biomass	1	0.42
groundfish fixed-gear mortality biomass	1	0.46
log recruit deviations	1.25	0.33
log directed pot fishery fishing mortality deviations	0.001	0.00
log groundfish trawl fishing mortality deviations	1	0.33
log groundfish fixed-gear fishing mortality deviations	1	0.41
log trawl-survey selectivity deviation first differences	64	0.24

Contribution of negative loglikelihood and penalty components to minimized value of the objective function under model configuration ST. Relative contributions include weights.

Recommended Model ST
Management Implications

Bmsy = 7.24 million lb
projected MMBmating under OFL catch = 5.98 million lb
Tier 4b OFL = 0.820 million lb (Fofl = 0.14/yr)
Retained Catch OFL = 0.79 million lb

Max ABC (P*=0.49) = 0.99 x 0.82 million lb
= 0.81 million lb

Recommended ABC (0.20% buffer) = 0.80 x 0.81 million lb
= 0.65 million lb