Norton Sound Red King Crab SAFE 2024

Sept 13 2023

Crab Plan Team:
NOAA-Online
Seattle WA

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Division of Commercial Fisheries

Issues to Determine
Model Selection for Jan 2024

- Final model selection for Jan 2024

    - Model 21.0: Default baseline model
        - Length dependent M: 0.18 < CL 124mm, Estimate > 123mm
    - Model 23.0: SSC requested alternative model
        - Length independent model estimate M.
    - The same model selection discussion in 2013, 2016, 2017...

- Other Issues to discuss (as time allows)

New Data: Catch (Winter, Summer), CPUE , and Trawl abundance

- Winter Com: 3,580 (10,013 lb)
- Winter Subsistence (To be reported: Assume the same as 2022)
- Summer Com: 146,087 (413, 327 lb)
- Bycatch from other fisheries (??? Lb)
- Discards mortality 21,350 lb (model estimate)
- Total Catch 0.446 million lb < ABC (0.450).
- ADF&G Trawl abundance
  - 3.44 million (CV 0.325)
- NOAA NBS abundance
  - To be reported

Response to the CPT-SSC (Jan-Feb 2023)

Einstein did not say…

(   ) is doing the same thing over and over again and expecting (   ) results

- *SSC: Test the sensitivity of the assessment model to a lower size at maturity*

- Author Reply
  - Evaluated in SAFE 2019, 2022
  - No impacts: Tier 4 F_{OFL} determination is insensitive to size at maturity

Response to the CPT-SSC (Jan-Feb 2023)

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- *SSC: One estimated value of M for all sizes.*

- Author Reply
  - Evaluated in SAFE 2013, 2016, 2017
  - Higher M (0.3- 0.42)
  - Lower model fit (i.e. higher nll value)
  - Rejected by CPT-SSC
  - Alternative model 23.0

Response to the CPT-SSC (Jan-Feb 2023)

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- *SSC: A small-scale observer program should be considered.*
- Author Reply
  - All the previous observer programs were small-scale. (further smaller-scale programs?)
  - Welcome observer survey experts' input
    - Survey design, bias correction, etc.
  - ADF&G and NSEDC agree:
    - Previous observer programs did not work (for the purpose of estimating discards mortality)
    - Biased survey, biased data, biased discards estimates.

Response to the CPT-SSC (Jan-Feb 2023)

Einstein did not say…

(   ) is doing the same thing over and over again and expecting (   ) results

- *SSC: Update the Standardized Com fish CPUE model.*

- Author Reply
    – Worthy consideration.
    – Welcome model improving suggestions and consultations from experts.
    – The updates will unlikely improve the assessment model performance.
    – Little difference between arithmetic and standardized CPUE.
    – High additional variance estimate
    – Removing CPUE data had little effect on model performance and projection (SAFE 2018)
    – Included as supplemental to triennial trawl survey, but trawl survey is becoming annual (NBS)

Response to the CPT-SSC (Jan-Feb 2023)

Einstein did not say…

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- *SSC: Update the Standardized Com fish CPUE model.*

Summer commercial standardized cpue
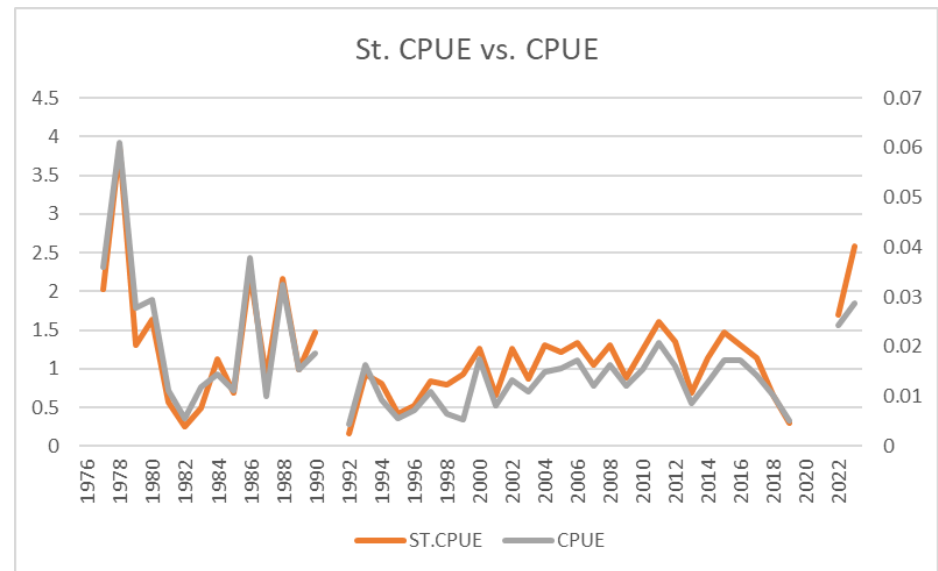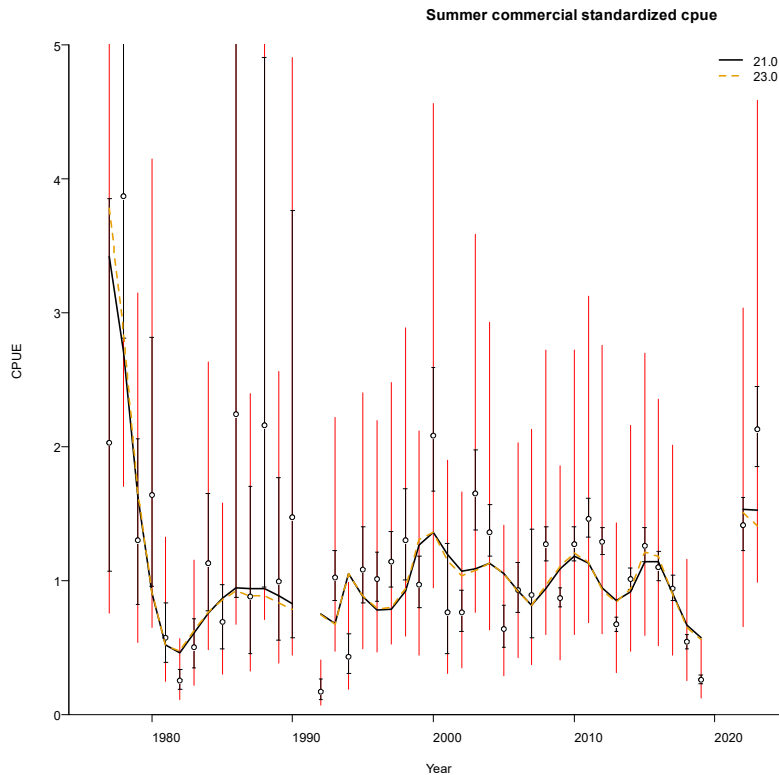
Response to the CPT-SSC (Jan-Feb 2023)

- *SSC: LK-TK, VAST, GMACS Updates and progresses*

- Author Reply
  - Look forward to seeing progress in LK-TK and VAST
    - LK-TK: LTK Task force
    - VAST: Jon R. (NOAA)

  - GMAC in progress….
    - Feb 2023: model ran with 2022 data.
      - Transition matrix, molting prob similar to the assessment model
      - Large crab M: 0.40 (GMACS) vs. 0.64 assessment model
      - GMACS MMB: 25% lower than assessment model (model weight issue: Andre)

    - Updated Input files .dat, .ctl, .prj to 2023.
    - GMACS did not run
    - Welcome any assistances

ADF&G Trawl Survey

- July 21 – July 30, 50 stations: Core, Tier 1, 2, 3

Figure 1. Stations trawled (in bold, n=50) during the 2023 red king crab bottom trawl survey. Note: stations in gray boxes have never been successfully trawled.
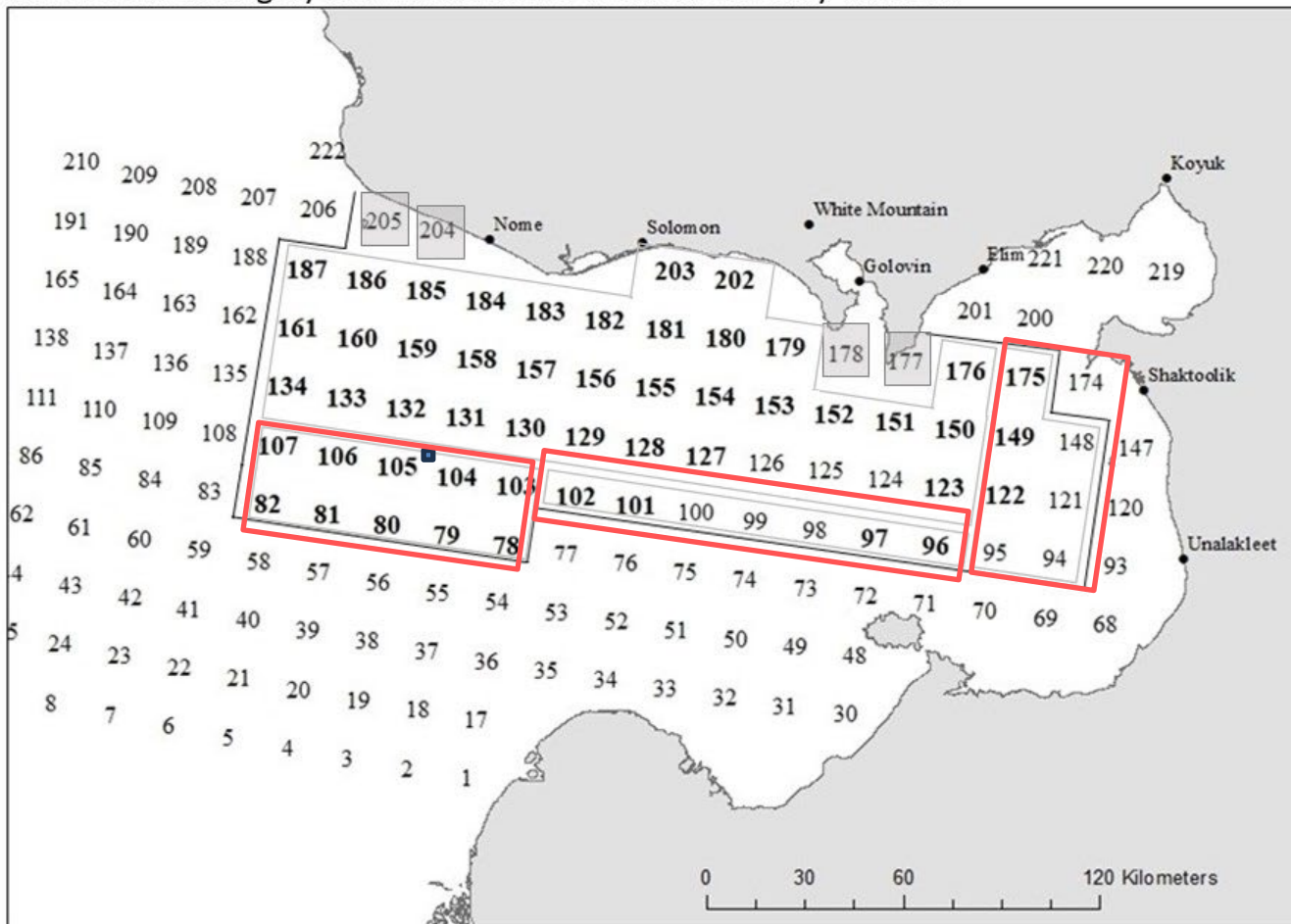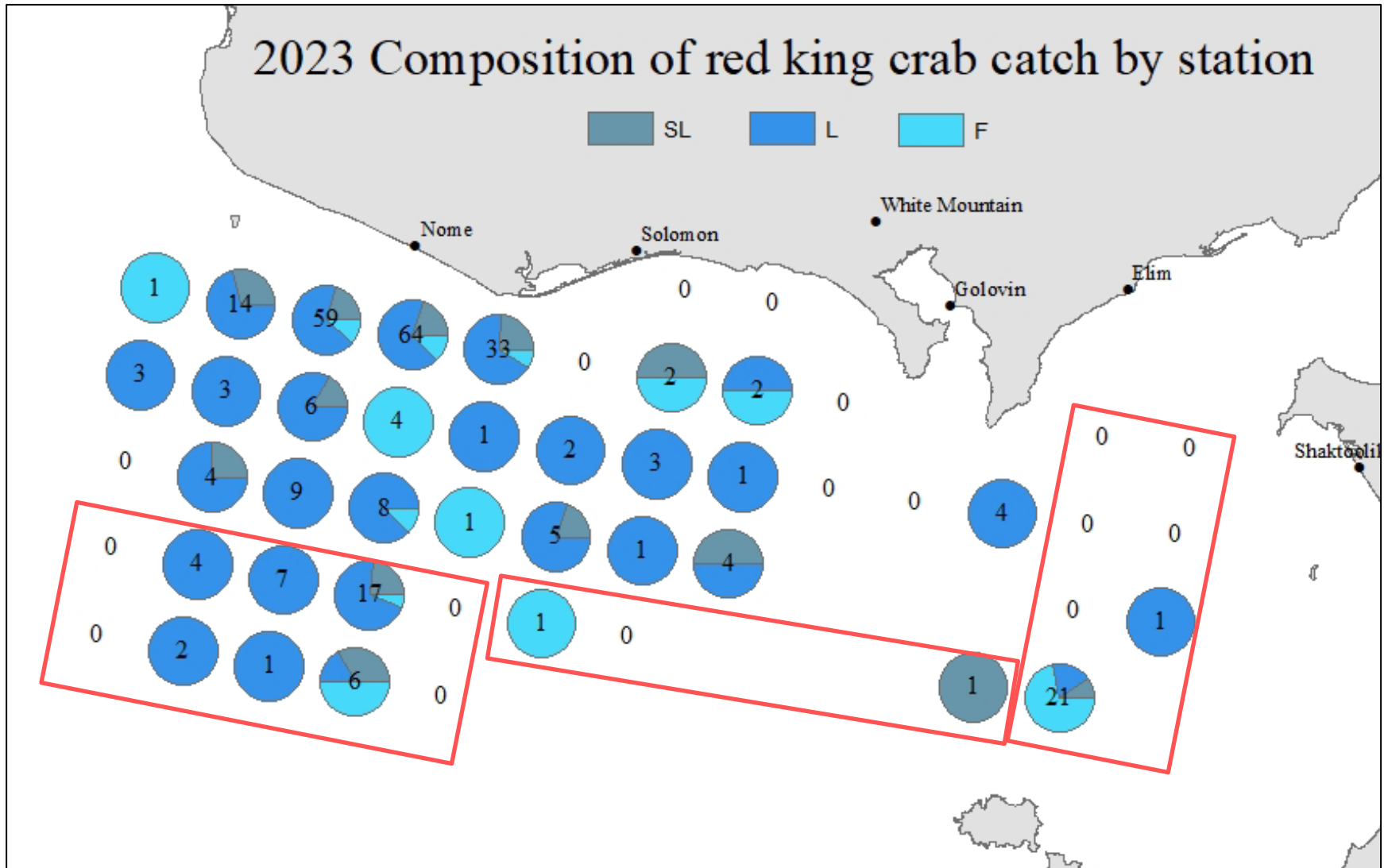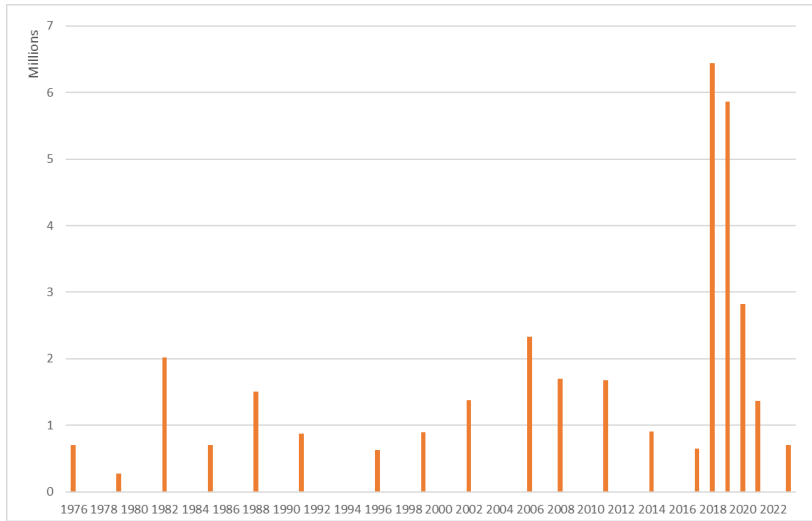
ADF&G Trawl Survey
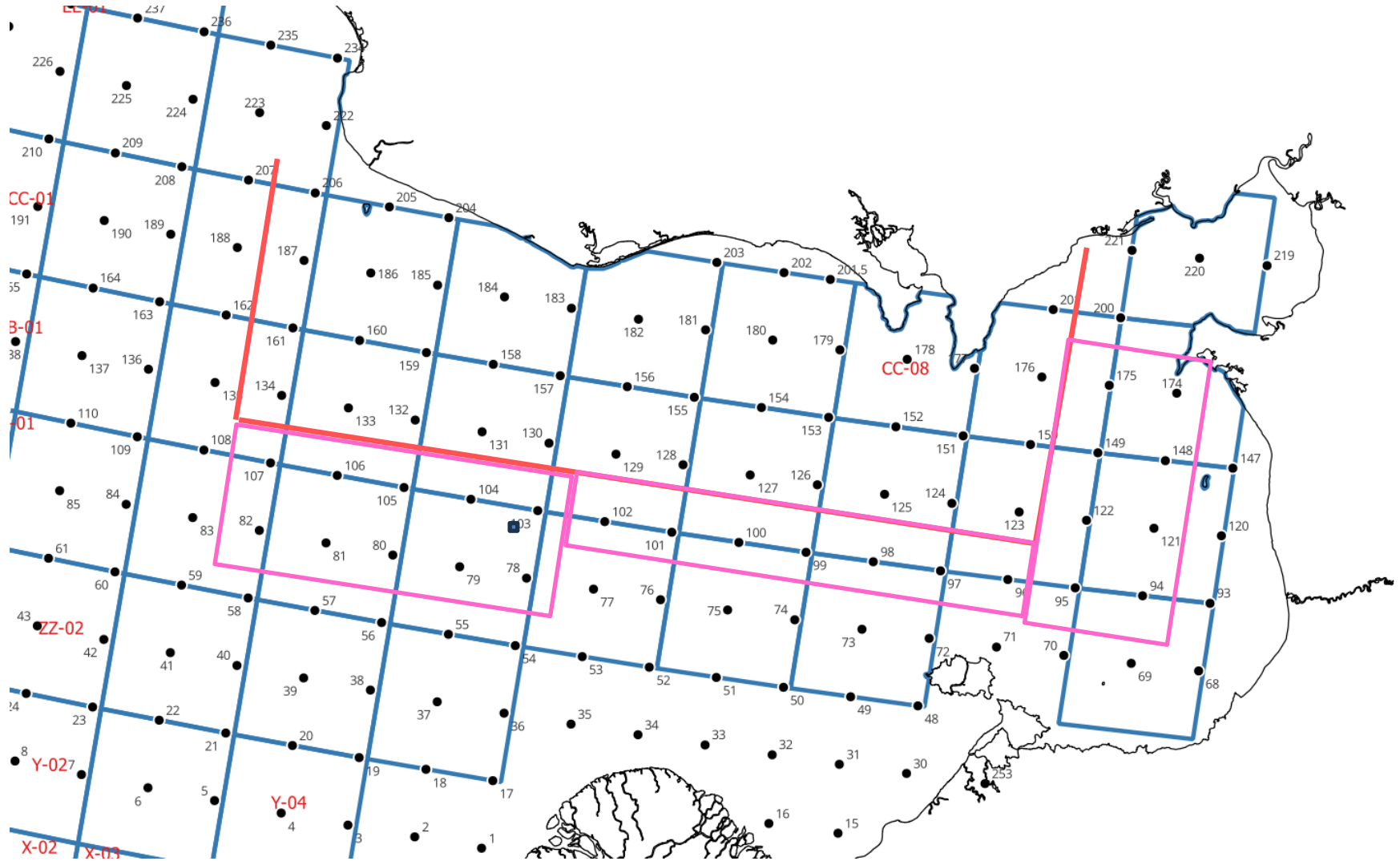
ADF&G Trawl Survey

- High female catch outside the core area.
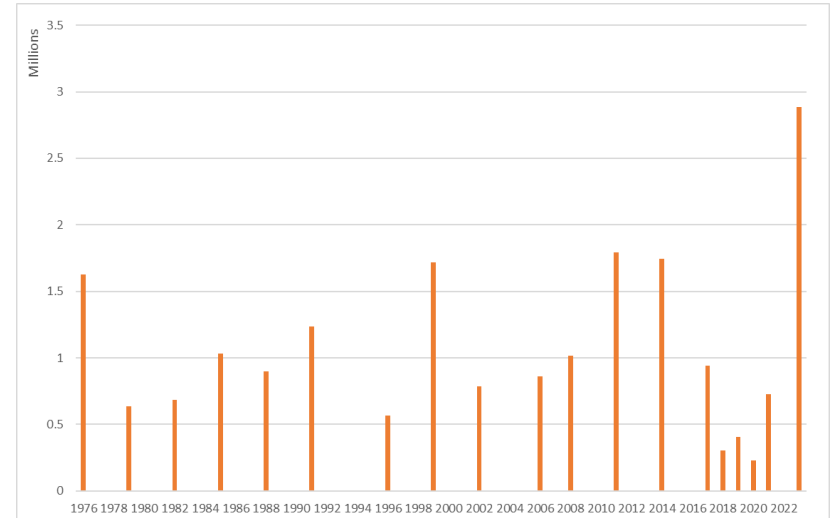-

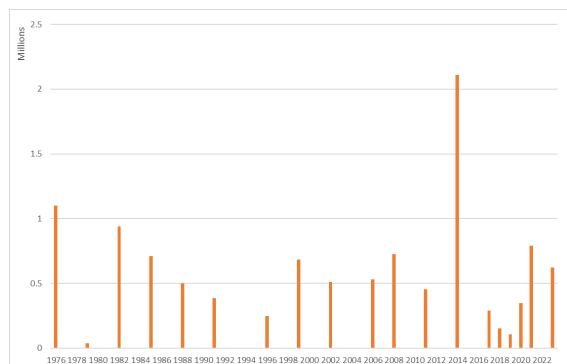
2023 Composition of red king crab catch by station
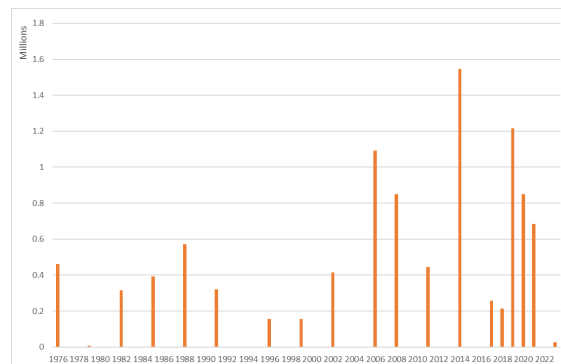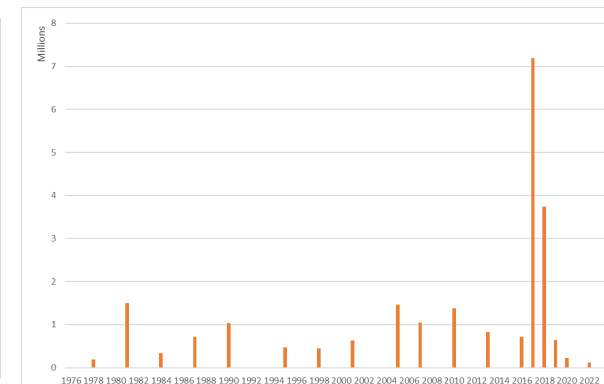
ADF&G Trawl Survey

Female

Legal Male

Pre1 Male

Pre2 Male

Pre3 Male

ADF&G Trawl Survey

- July 21 – July 30, 50 stations: Core, Tier 1, 2, 3
- High abundance of Legal Male
  - Fewer Pre1 males (legal next year)
  - Very few Pre2, Pre3 males, and Females
- Expecting abundance decline in 2-3 years?

NSRKC Kodiak Lab Study
Leah Zacher: NOAA

- All but a few NSRKC died after ~ 2 years of holding.
- After 1 year holding: 10 out of 23 died (M = 0.57).

Large crab survived!!
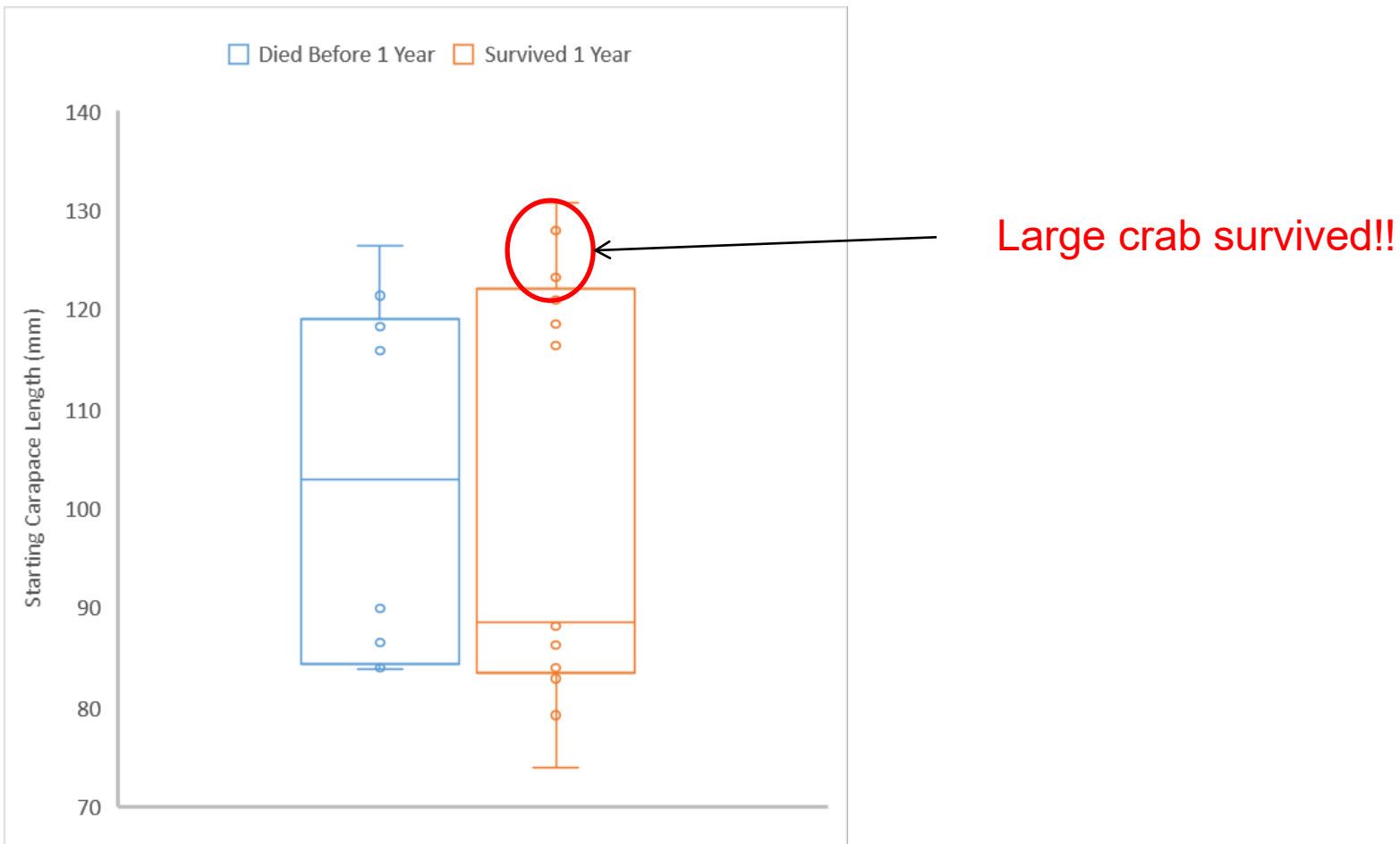
NSRKC Draft Assessment Models

Einstein did not say…

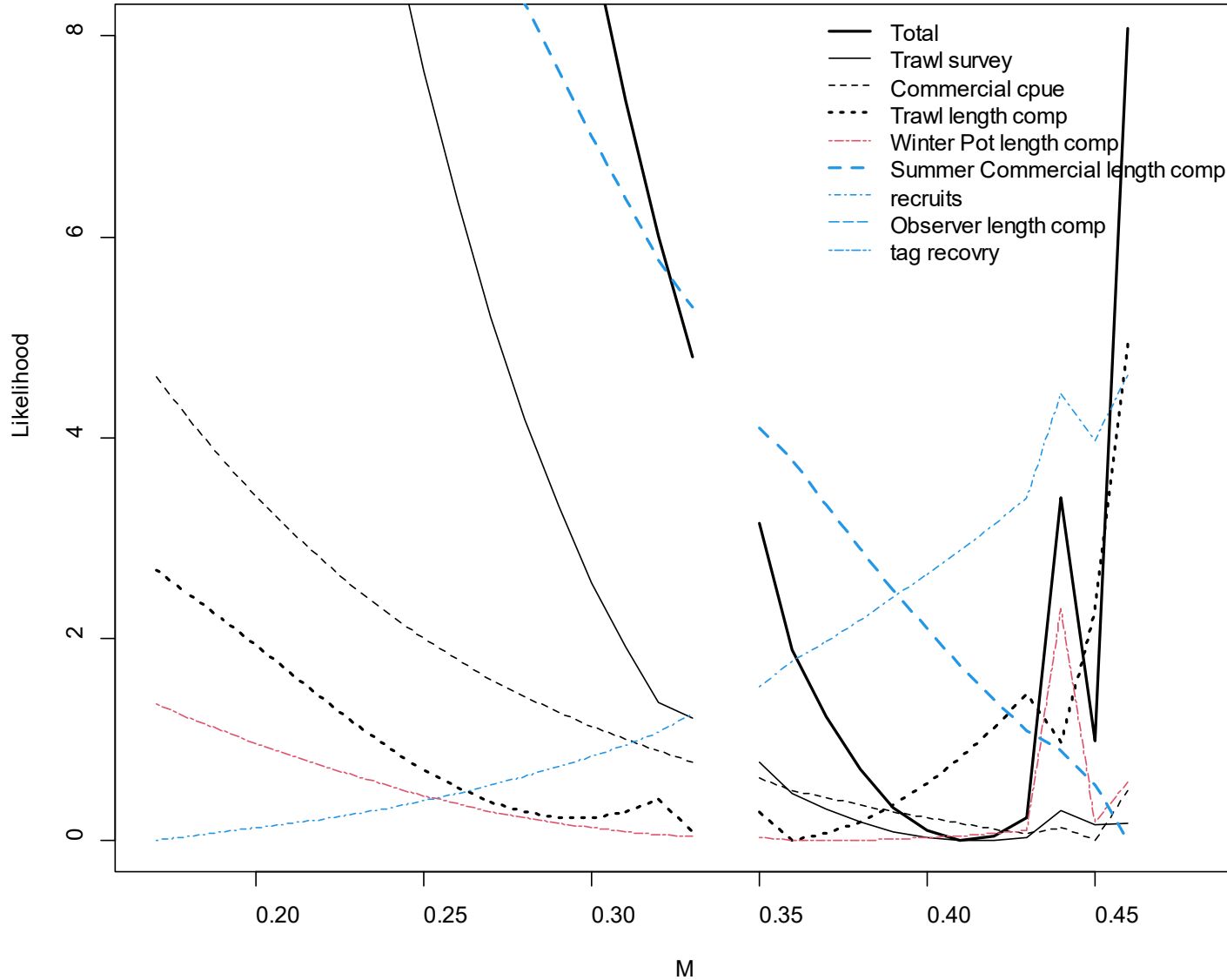(   ) is doing the same thing over and over again and expecting (   ) results

The same model exercise performed in 2013,2016,2017

- Model 21.0: 2023 final model with data update
- Model 23.0:
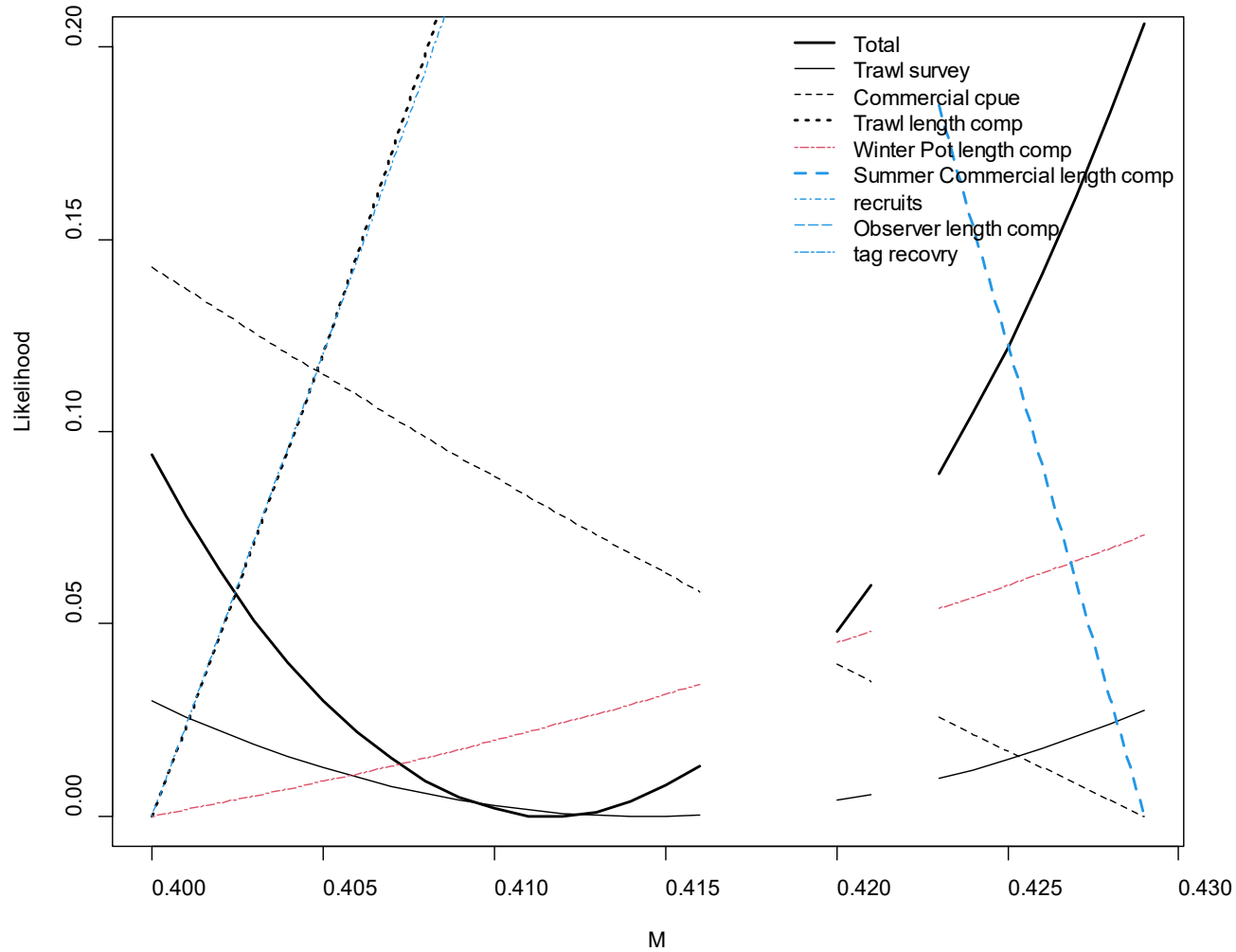 - SSC: Single M estimate for all lengths

Model 23.0 Profile Analysis

Total negative log likelihood

Model 23.0 Profile Analysis

Total negative log likelihood


M= 0.4116

NSRKC Draft Assessment Model parameters

Name	21.0 Estimate	21.0 std.dev	23.0 Estimate	23.0 std.dev
$\log\_q_1$	-7.310	0.194	-7.174	0.191
$\log\_q_2$	-6.721	0.165	-6.575	0.169
$\log\_q_3$	-6.850	0.151	-6.740	0.157
$\log\_N_{76}$	9.128	0.137	9.461	0.158
R_0	6.448	0.080	7.091	0.150
a_1	1.002	4.445	2.605	4.511
a_2	1.734	4.174	2.903	4.316
a_3	3.477	3.914	4.370	4.077
a_4	3.966	3.891	4.674	4.056
a_5	4.232	3.883	4.820	4.047
a_6	3.493	3.911	3.905	4.079
a_7	2.054	4.183	2.037	4.368
r1	5.000	0.002	5.000	0.003
r2	4.635	0.162	4.508	0.166
$\log\_a$	-2.746	0.088	-2.765	0.094
$\log\_b$	4.833	0.015	4.816	0.016
$\log\_f_{st1}$	-5.000	0.035	-2.392	0.080
$\log\_f_{wa}$	-2.400	0.424	-1.858	0.425
$\log\_f_{wb}$	4.772	0.069	4.860	0.028

Model 23.0
Better trawl survey
selectivity parameter

NSRKC Draft Assessment Model parameters

Name	21.0 Estimate	21.0 std.dev	23.0 Estimate	23.0 std.dev
Sw1	0.061	0.034	0.045	0.022
Sw2	0.424	0.147	0.373	0.088
Sw3	0.732	0.237	0.733	0.141
$\log\_f_1$	-2.056	0.043	-1.942	0.041
$\log\_fra1$	-0.854	0.143	-0.886	0.142
$\log\_frb1$	-0.496	0.270	-0.484	0.266
$\log\_fra2$	4.641	0.008	4.648	0.009
$\log\_frb2$	4.654	0.013	4.655	0.013
$\log\_fwra$	-0.951	0.559	-0.922	0.589
$\log\_fwrb$	4.654	0.038	4.651	0.039
w^2_t	0.142	0.039	0.144	0.040
q.1	0.719	0.128	0.712	0.124
q.2	0.812	0.157	0.796	0.154
σ	3.801	0.207	3.792	0.202
β_1	11.874	0.692	12.807	0.721
β_2	7.795	0.169	7.557	0.176
M			0.412	0.027
m8	3.416	0.262		

Selectivity, Molting probability
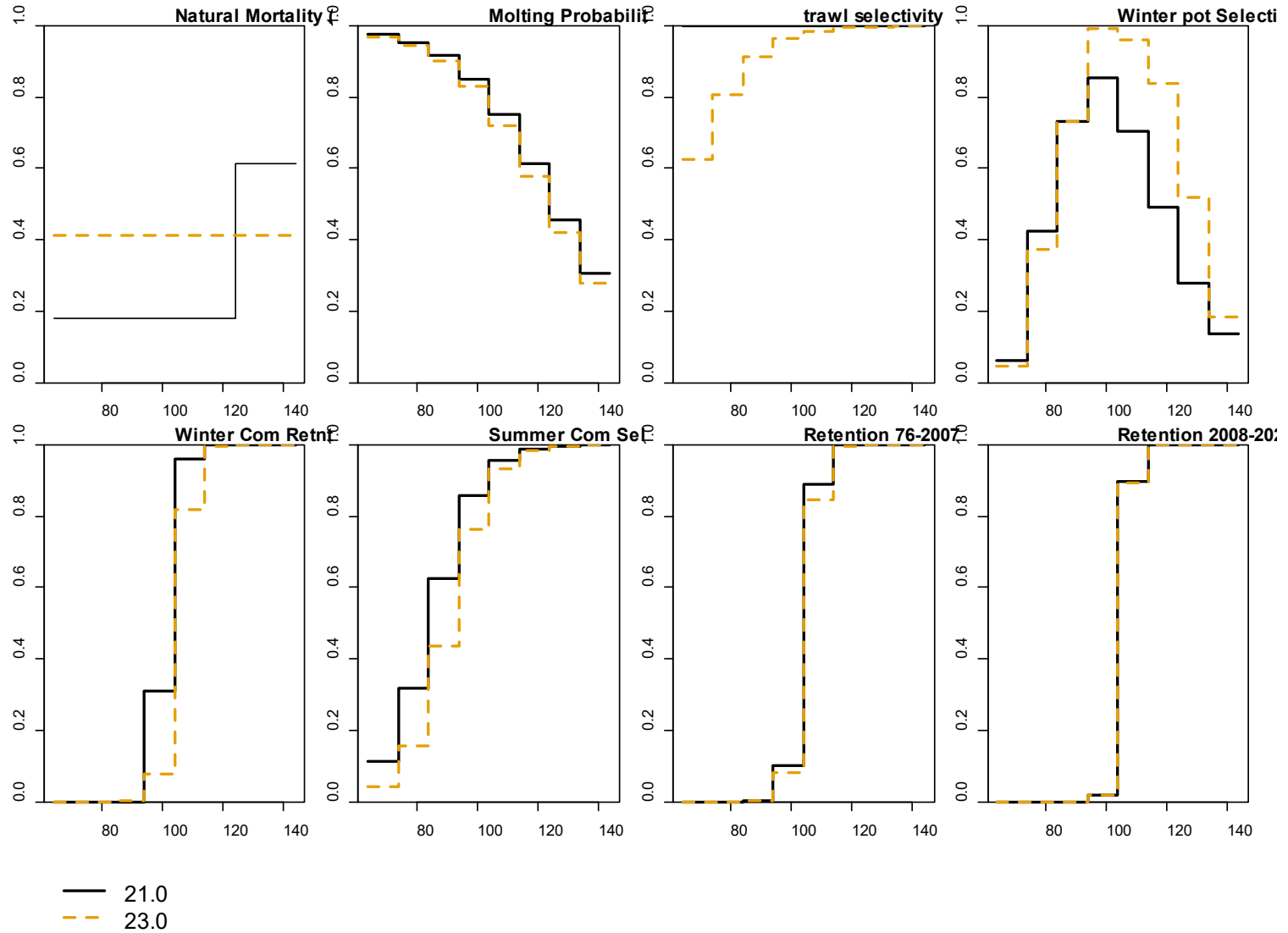
Size transition probability
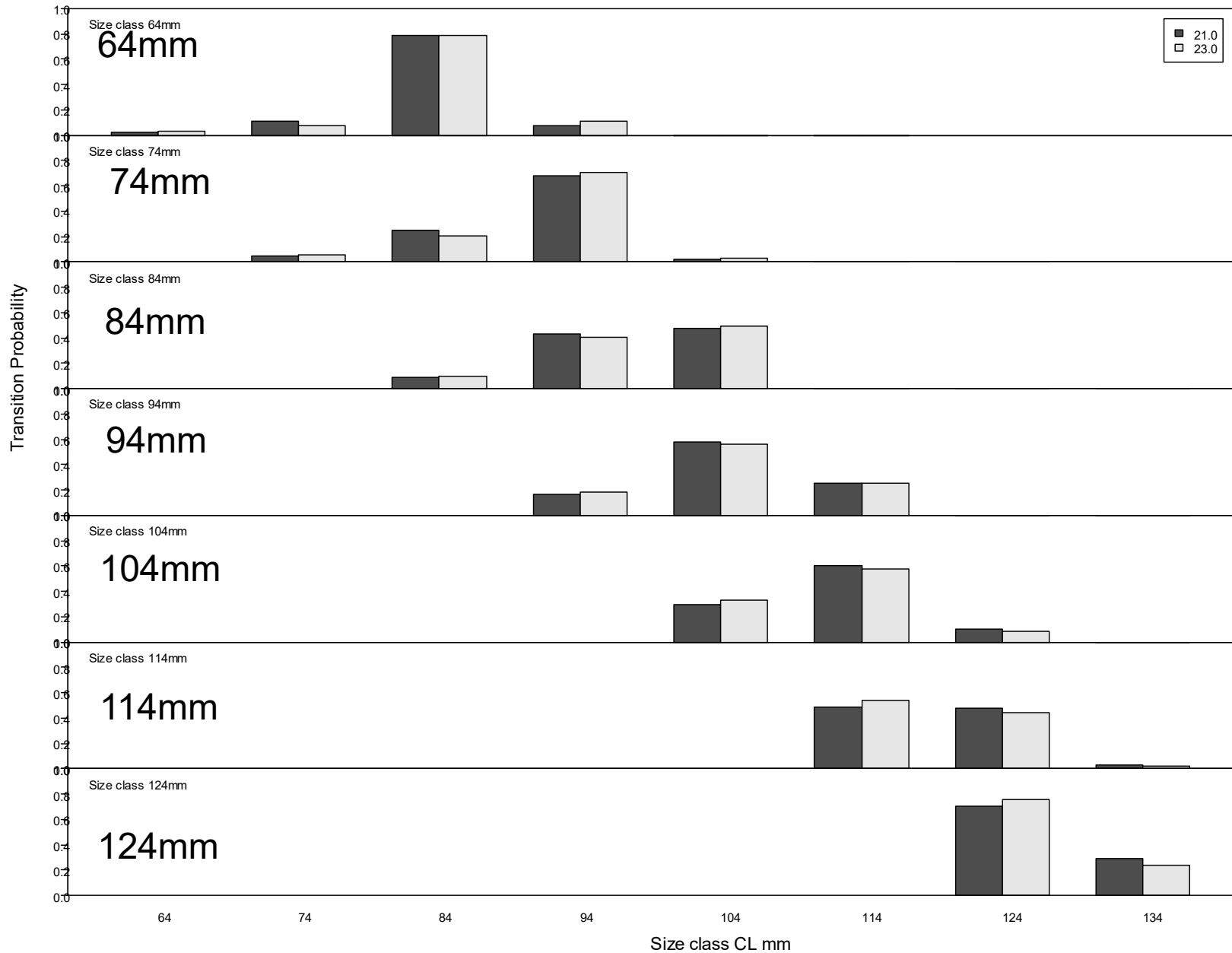
NSRKC Draft Assessment Models Likelihood

Model	21.0	23.0
Additional Parameters		0
AIC change		
Total	362.3	375.9
TSA	11.0	12.1
DIS	3.4	3.2
St.CPUE	-14.8	-14.8
TLP	134.0	142.2
WLP	39.6	40.1
CLP	49.5	54.4
OBS	24.3	28.0
WCLP	2.8	2.2
REC	19.4	20.7
TAG	85.0	87.8
M	0.18 0.615	0.4116
RMSE Trawl	0.34	0.33
RMSE CPUE	0.44	0.44
Total OFL	0.72	1.21

NSRKC Trawl Survey
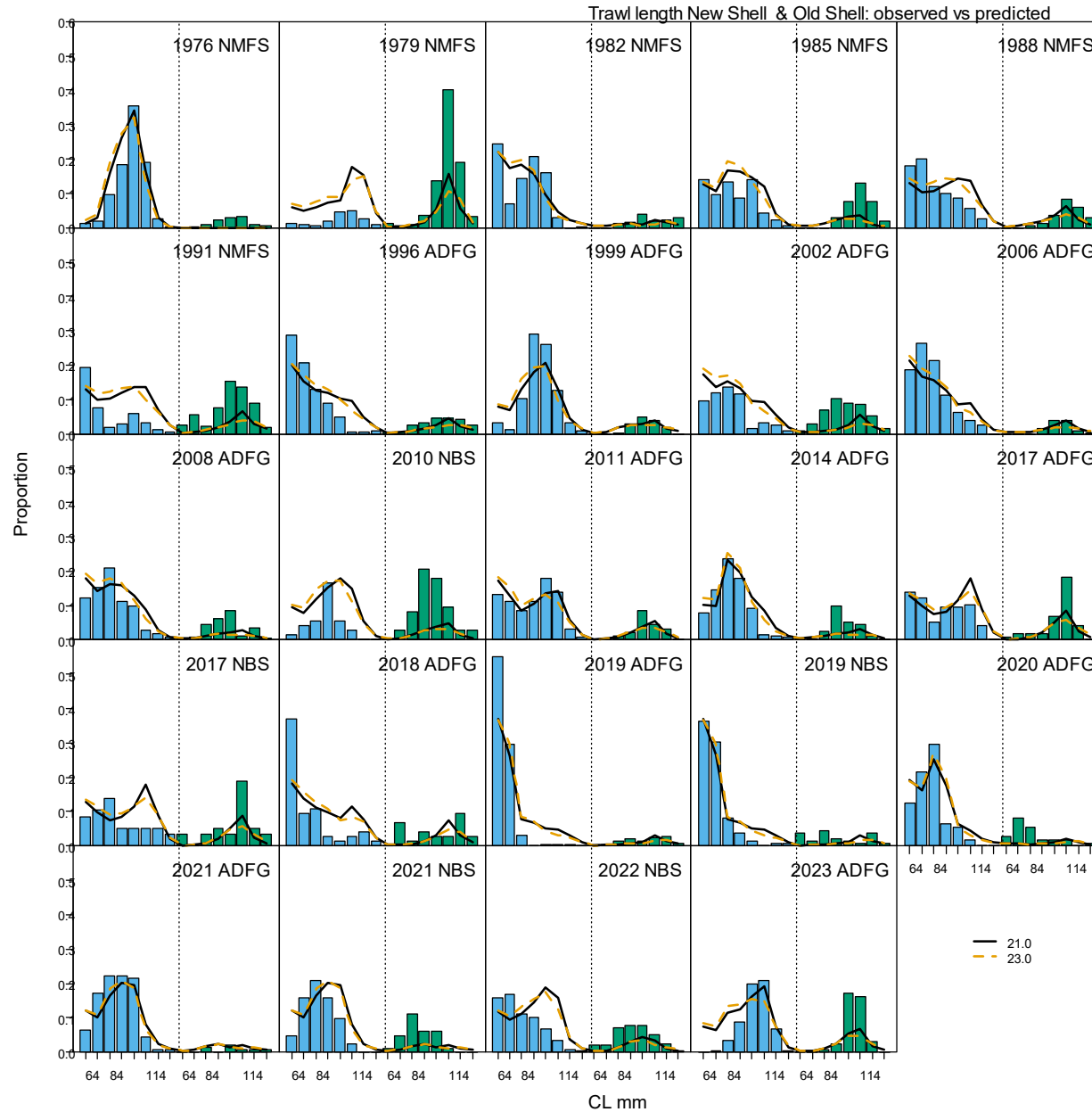
NSRKC Commercial Catch

Commercial harvest length New Shell: observed vs predicted
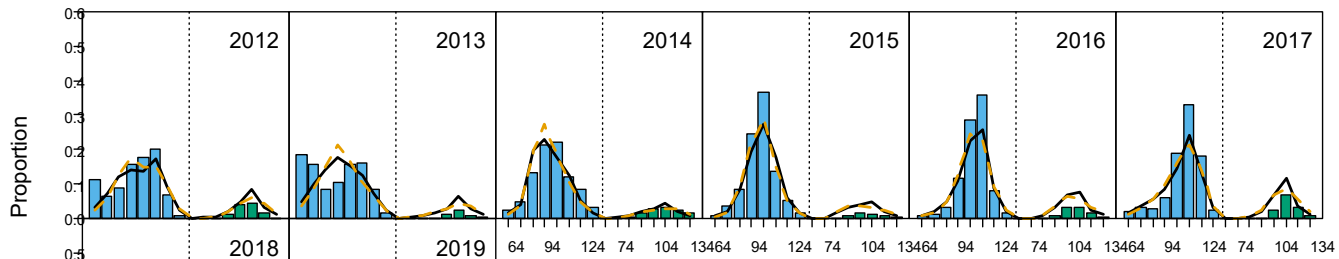

Proportion
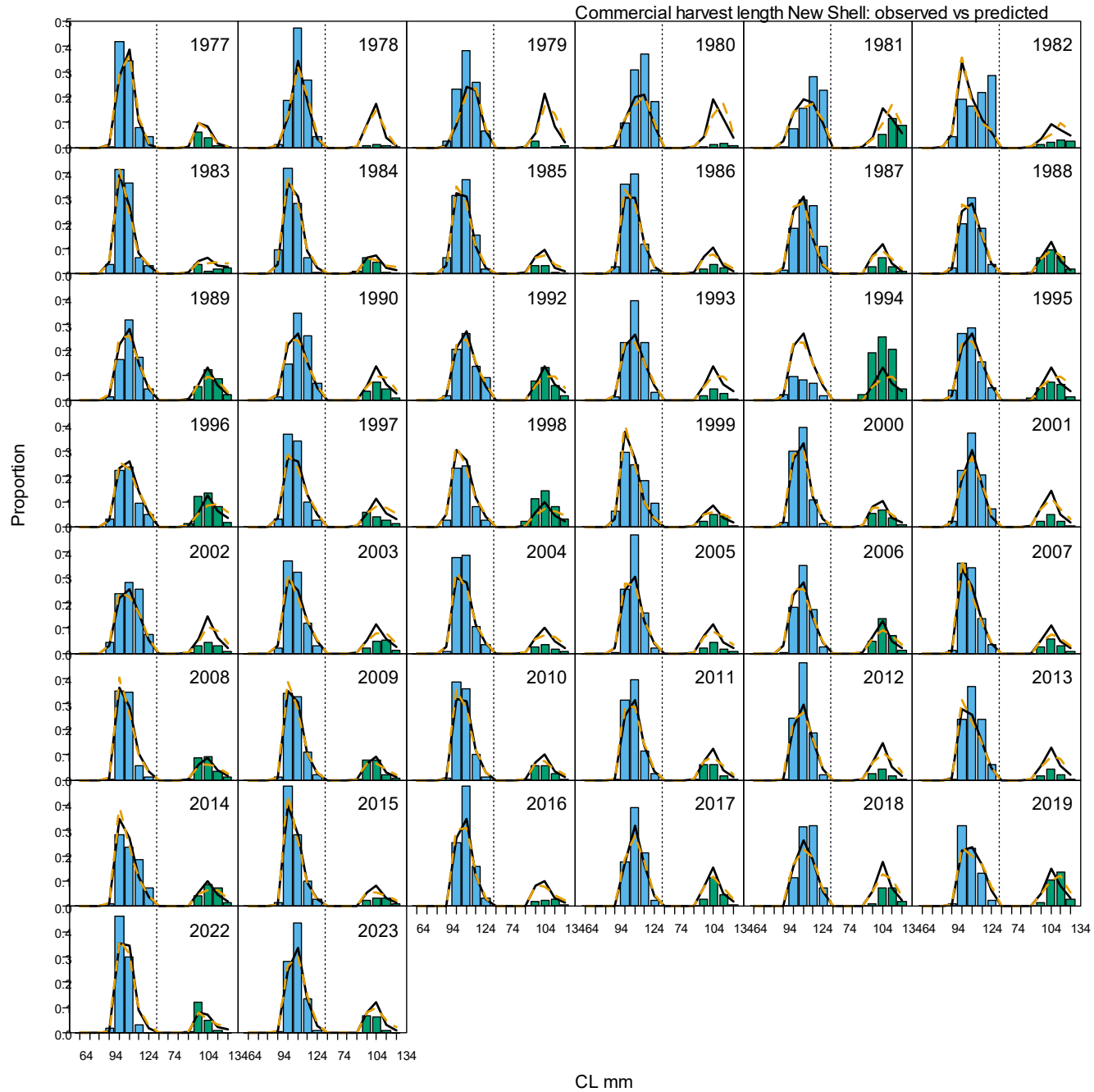
CL mm

NSRKC Observer

Summer discards, total, winter retain: observed vs predicted

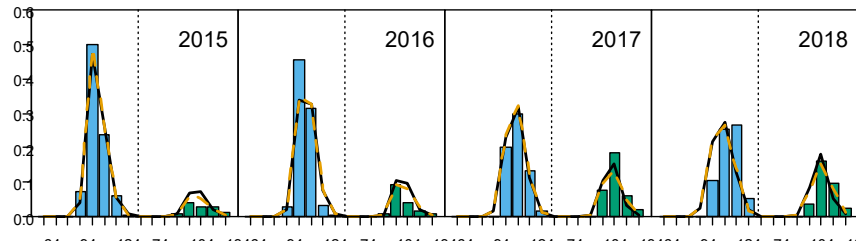Summer discards
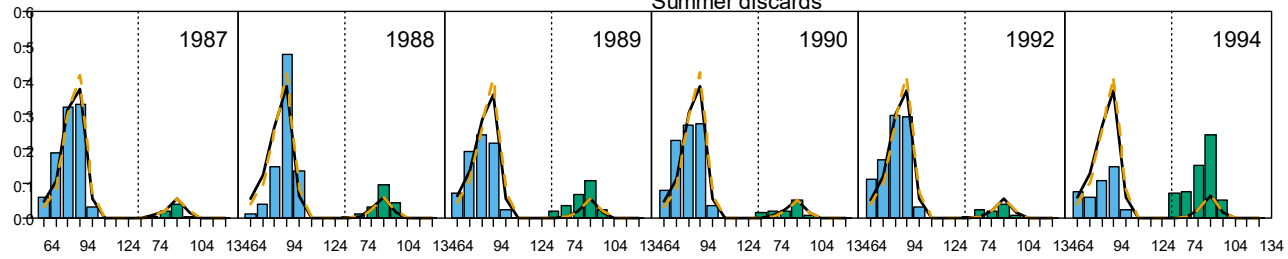
Summer total

Winter retain

Proportion

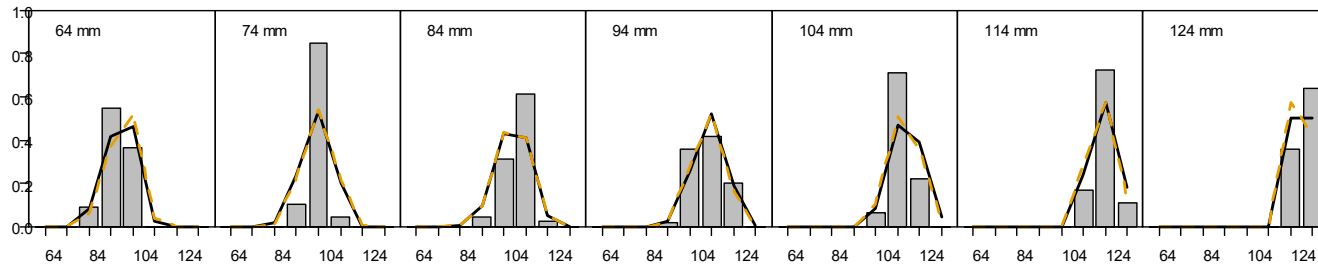# NSRKC Tag recovery size distribution

Tag recovery data observed vs predicted
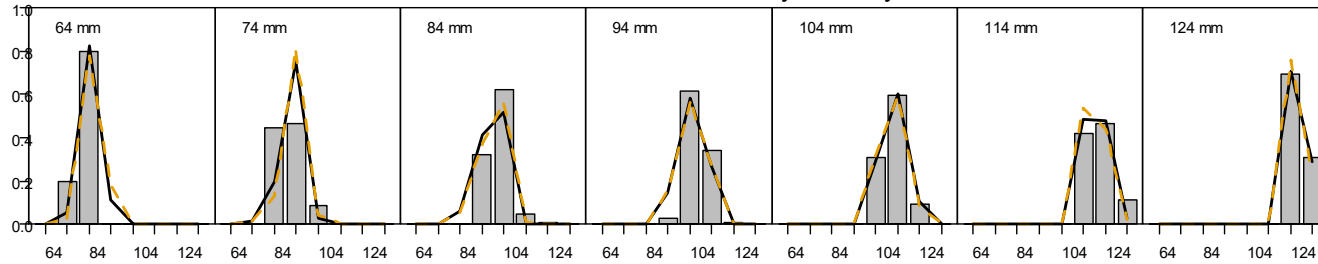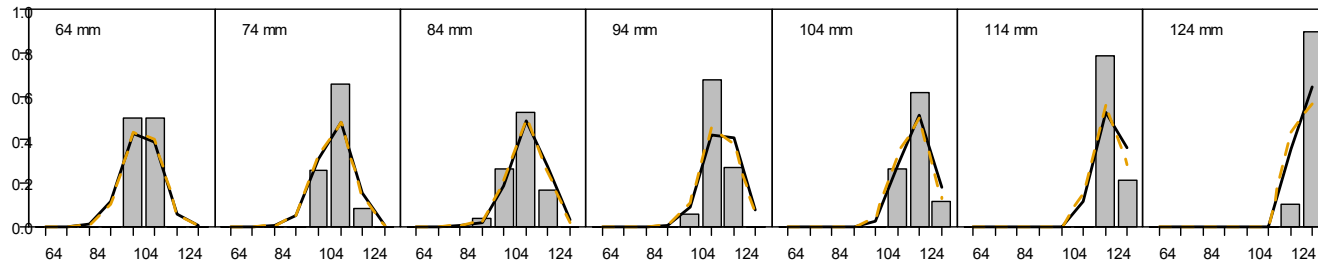
Abundance

Trawl survey crab abundance
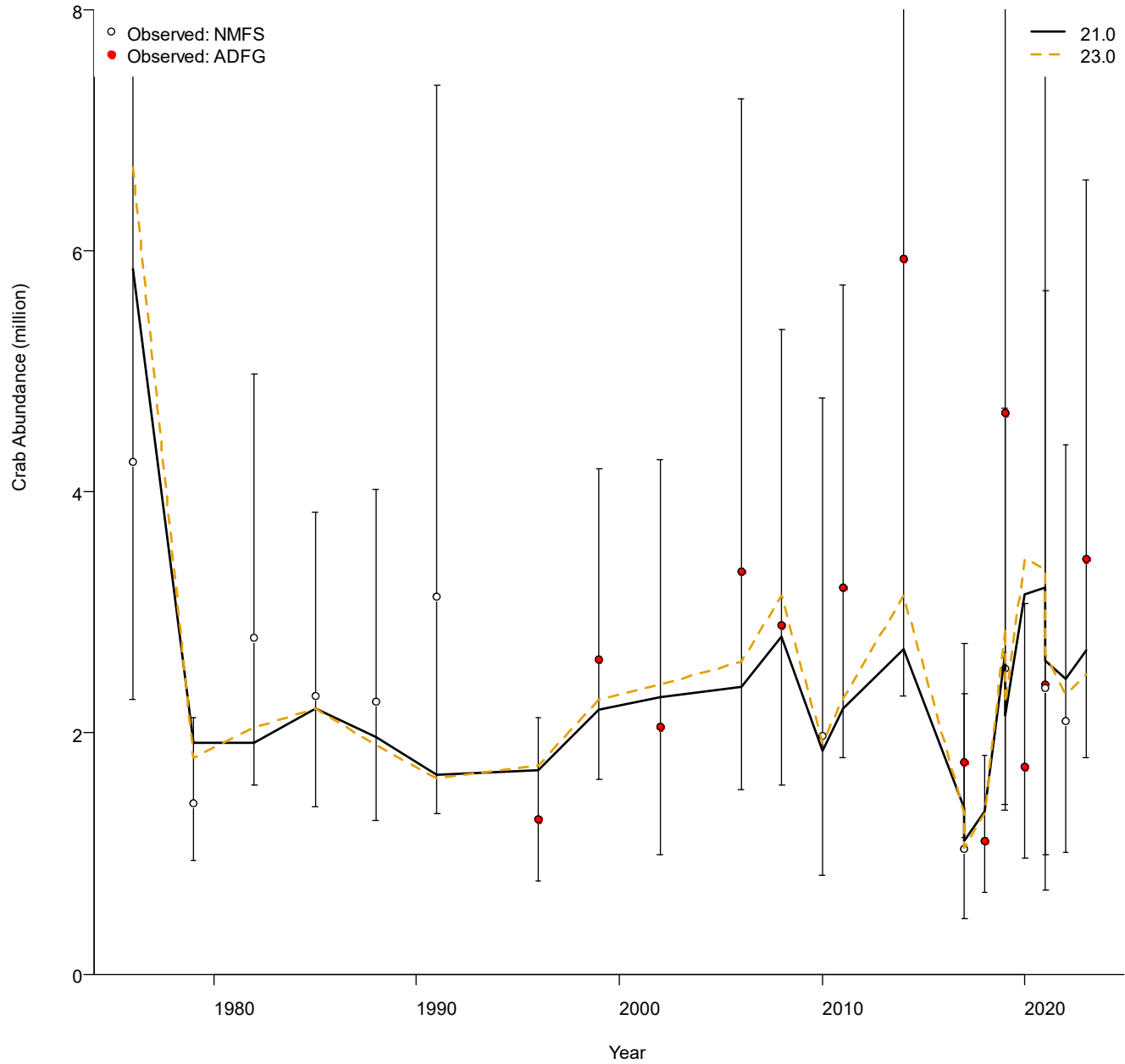
Abundance

Modeled crab abundance Feb 01

Model 23.0: assumes
    higher recruits (not observed in trawl survey),
    higher total abundance, and higher mortality

MMB
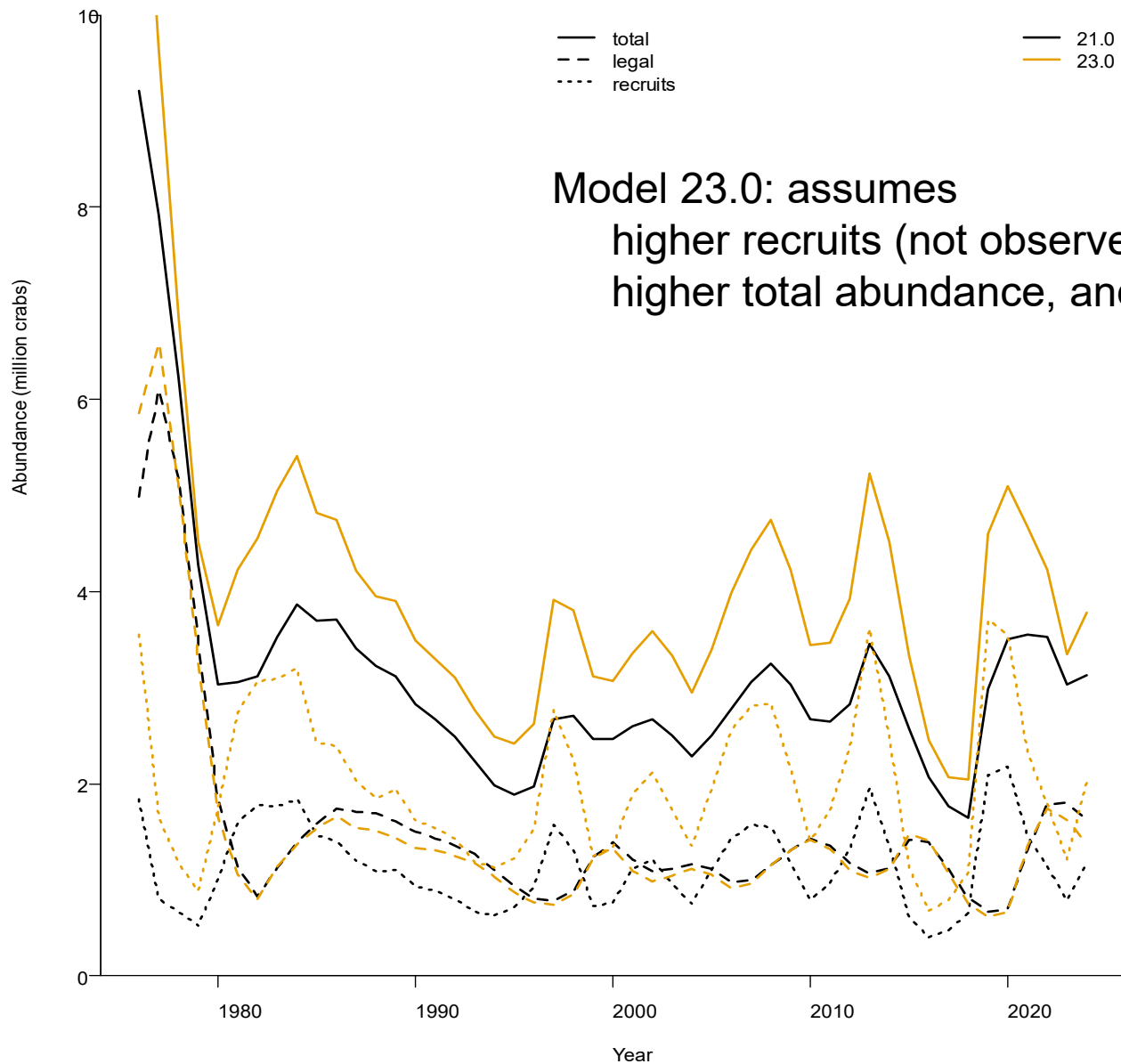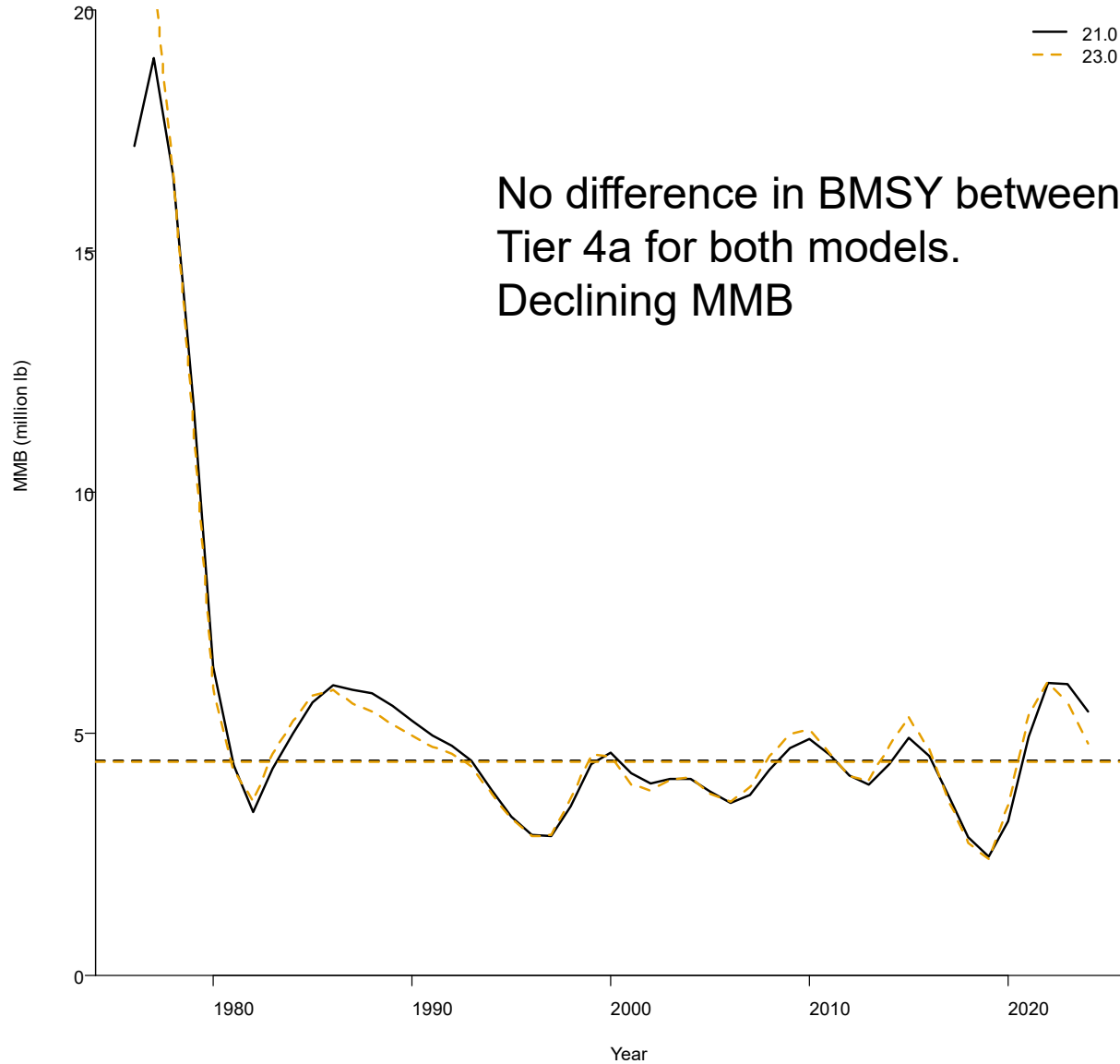
No difference in BMSY between the two models
Tier 4a for both models.
Declining MMB

OFL

- Tier 4a for both 21.0 and 23.0
- FOFL = M = 0.18 (21.0), 0.4116 (23.0)
- OFL: 0.72 (21.0), 1.21 (23.0)

Model Selection:

Better model fit vs Biological correctness?

Discussed: 2013,2016,2017

21.0

- Biologically incorrect
- Trawl survey parameter hits boundaries
- Better overall model fit (but no observable difference)

23.0

- Biologically Correct
- Better trawl survey parameter estimate
- Less overall model fit (but no observable difference)

Evidence of crab M is length-independent?

Other stocks evaluated length-dependent M?

For Jan 2024

- Include NOAA NBS Trawl survey data
- Finalize Winter Subsistence harvest data
- GMACS comparison

Q & A

(Science) is doing the same thing over and over again and expecting (the same) results