BSAI Crab Management

SAFE Report and Crab Plan Team Report

Agenda Item C-3
October 2017

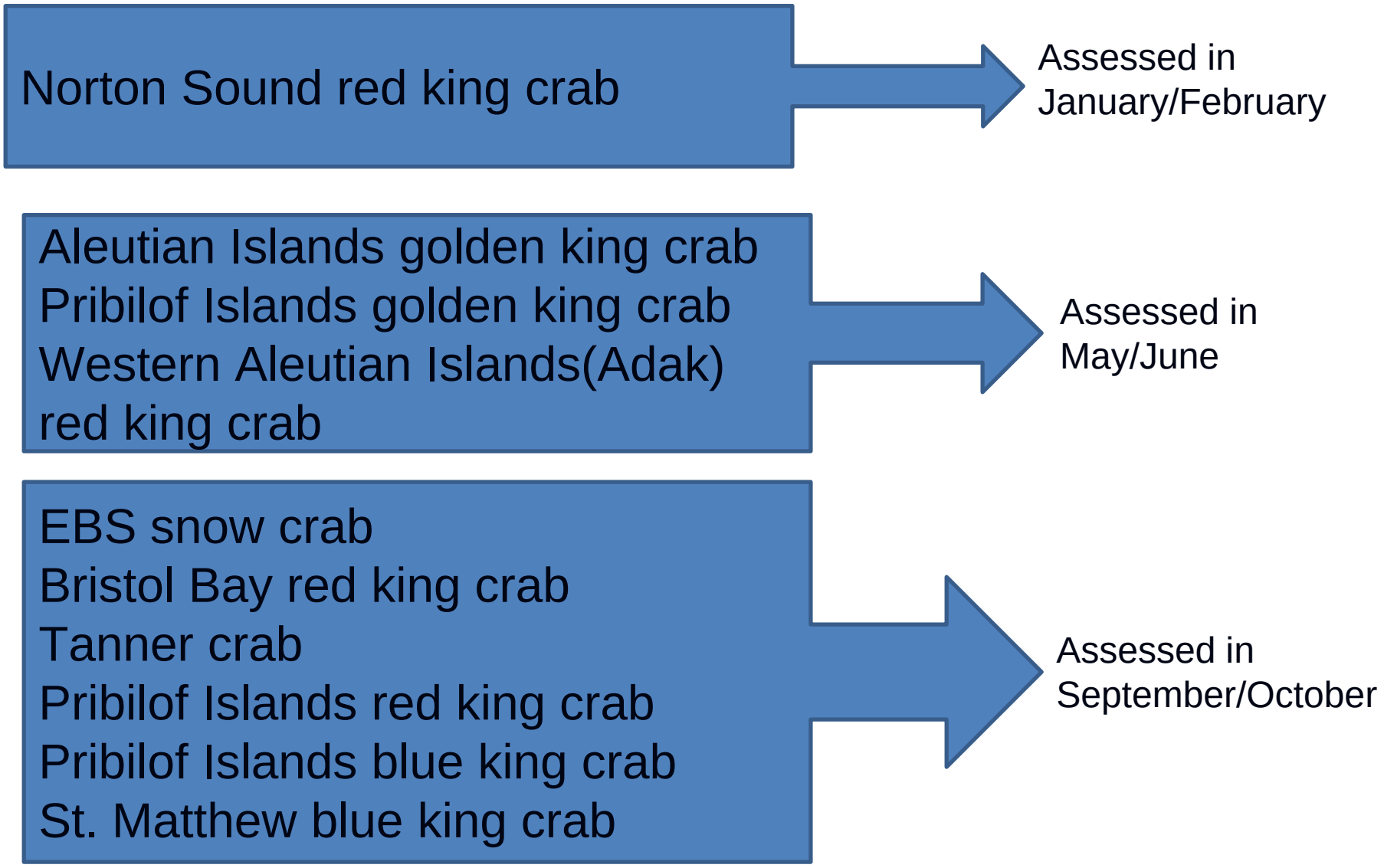
BSAI Crab Plan Team:

Bob Foy (NOAA Fisheries /AFSC-Kodiak), Chair
Karla Bush (ADF&G-Juneau), Vice-Chair
Ginny Eckert (UAF/UAS)
Diana Stram (NPFMC)
(NOAA Fisheries –Juneau)
Miranda Westphal (ADF&G-Dutch Harbor)
Jack Turnock (NOAA Fisheries/AFSC-Seattle)
Shareef Siddeek (ADF&G-Juneau)
Martin Dorn(NOAA Fisheries/AFSC-Seattle)
André Punt (Univ. Of Washington)
Bill Bechtol (UAF)
Brian Garber-Yonts (NOAA Fisheries/AFSC-Seattle)
Buck Stockhausen (NOAA Fisheries/AFSC-Seattle)
Katie Palof (ADF&G-Juneau)
Krista Milani (NOAA Fisheries/AKRO-Juneau)

October 2017 Crab Plan Team Report

- Overview of crab process
- EBS Survey update
- Recommend final OFL/ABC for 6 crab stocks
- Aleutian Islands golden king crab model
- NSRKC model update
- Other business

BSAI Crab Stocks Management Timing



Model timing

Stock	CPT review and recommendations to SSC	SSC review and recommendations to Council	Assessment frequency	Year of next Assessment
Norton Sound red king crab (NSRKC)	January	February	Annual	2018
Aleutian Is. golden king crab (AIGKC)	May	June	Annual	2018
Pribilof Is. golden king crab (PIGKC)	May	June	Triennial	2020
Western Aleutian Is. red king crab (WAIRKC)	May	June	Triennial	2020
EBS snow crab	September	October	Annual	2018
Bristol Bay red king crab(BBRKC)	September	October	Annual	2018
EBS Tanner crab	September	October	Annual	2018
Pribilof Is. red king crab (PIRKC)	September	October	Biennial	2019
Pribilof Is. blue king crab (PIBKC)	September	October	Triennial	2020
Saint Matthew blue king crab (SMBKC)	September	October	Annual	2018

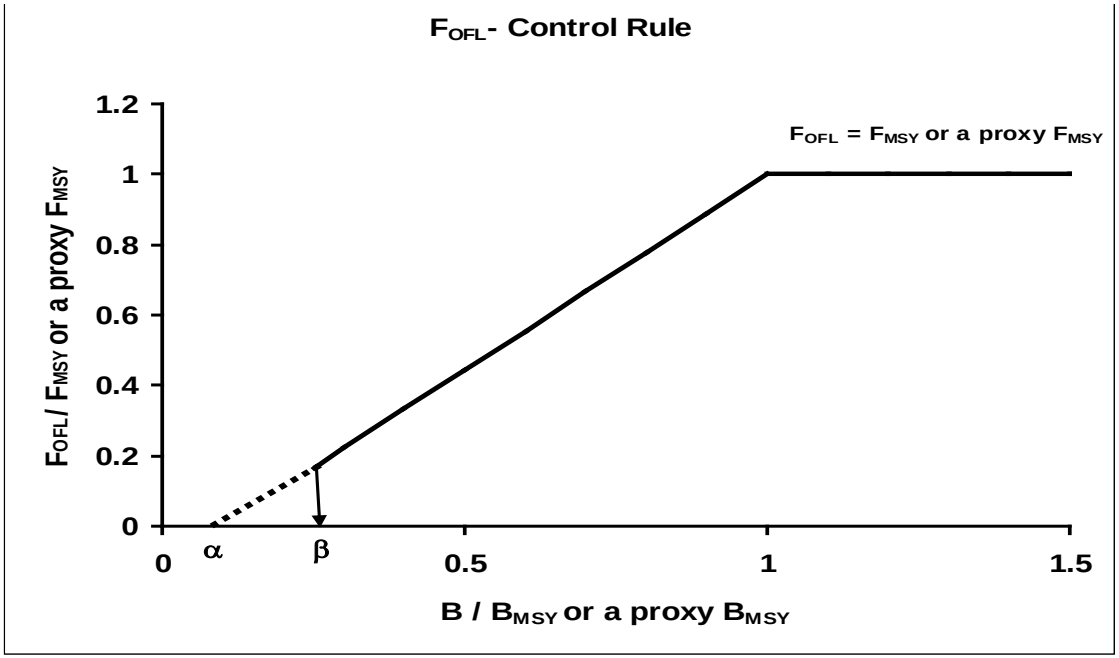
Overfishing limit (OFL)

Overfishing rule limits catch to prevent overfishing and avoid overfished status (0.5 B_{MSY})

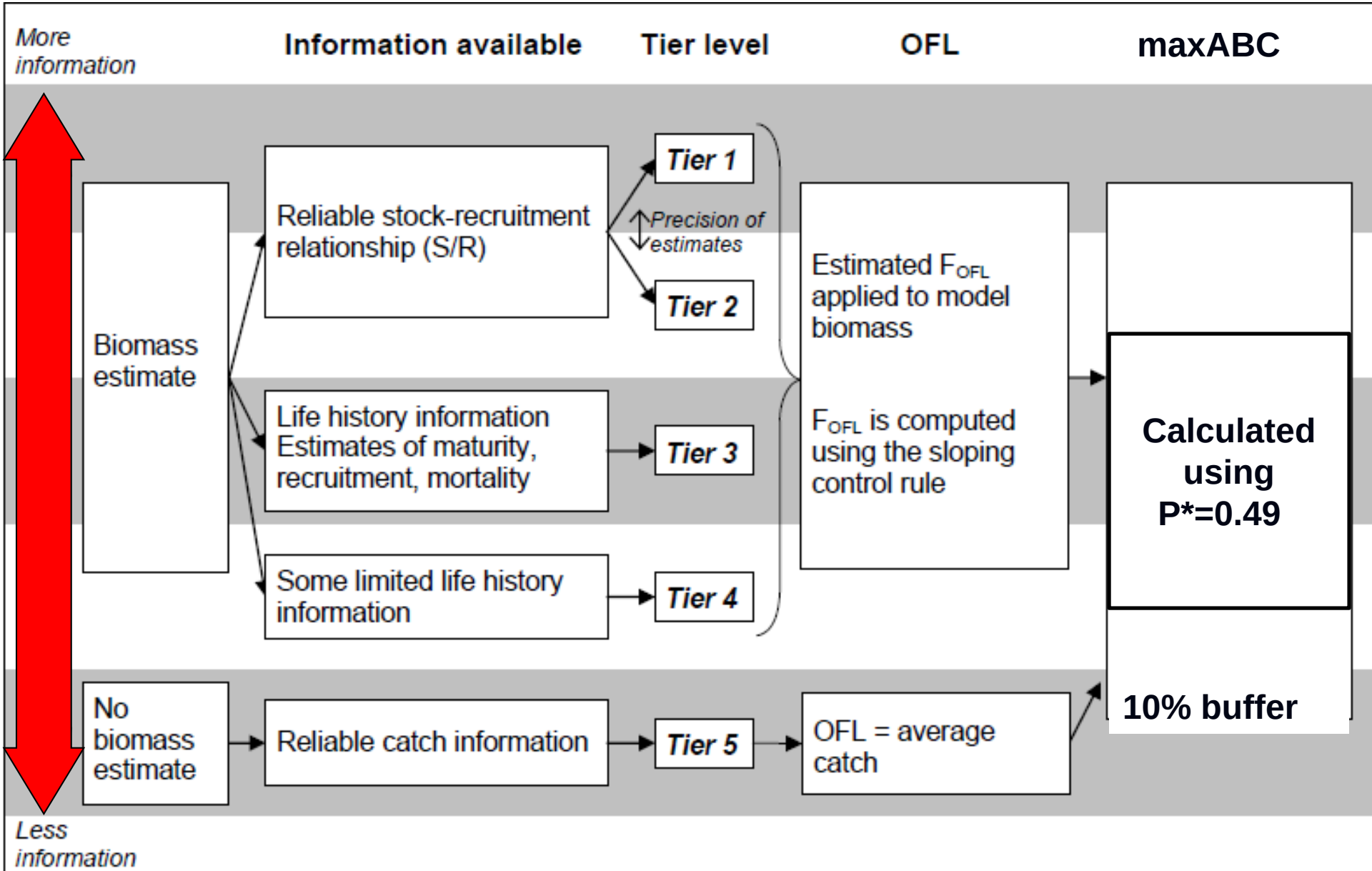
Set by OFL fishing mortality rate (F_{OFL})

F_{OFL} prescribed by Tier system

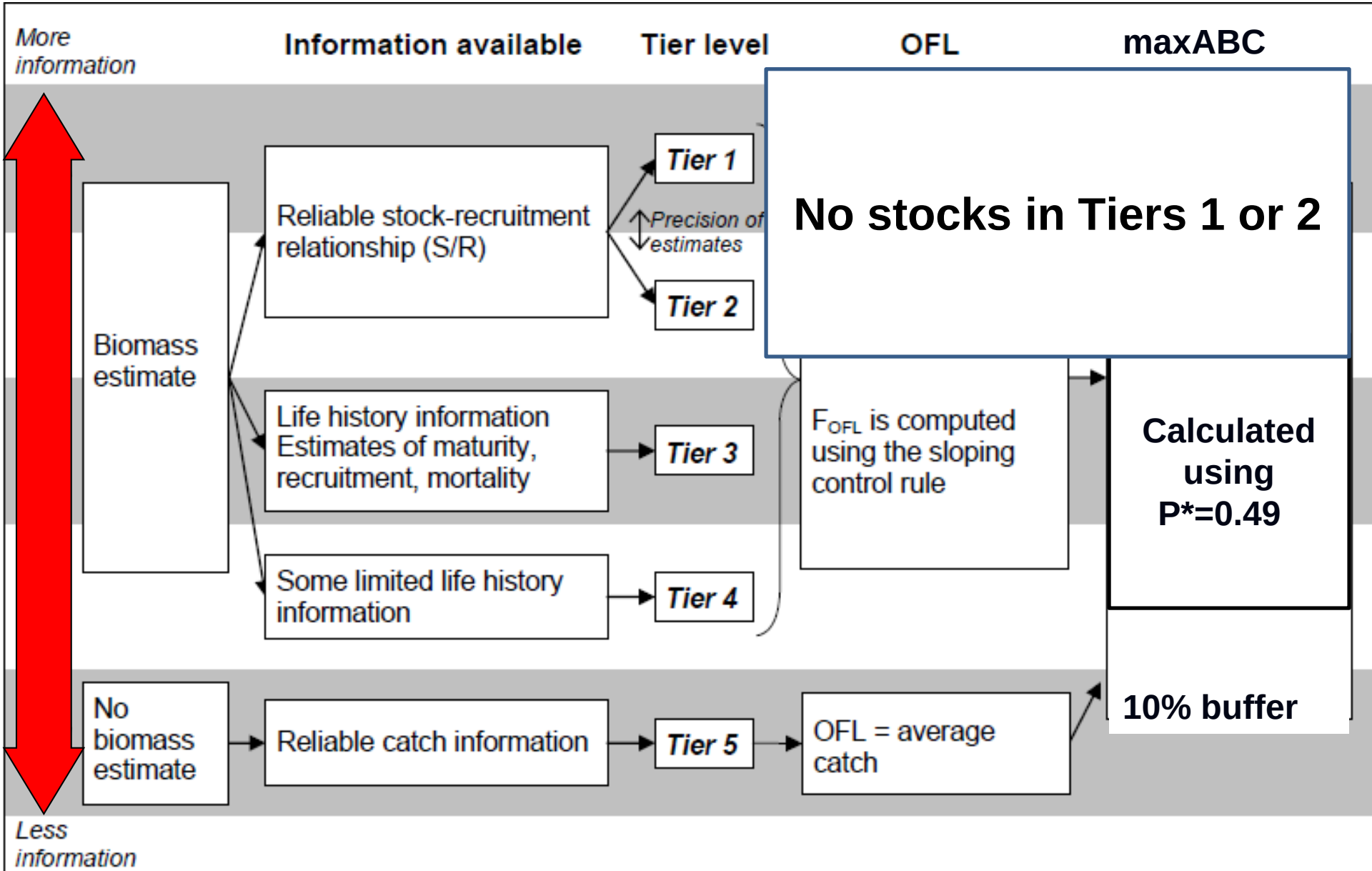
- Stock $\geq B_{MSY}$: $F_{OFL} = F_{MSY}$
- Stock $< B_{MSY}$: $F_{OFL} < F_{MSY}$



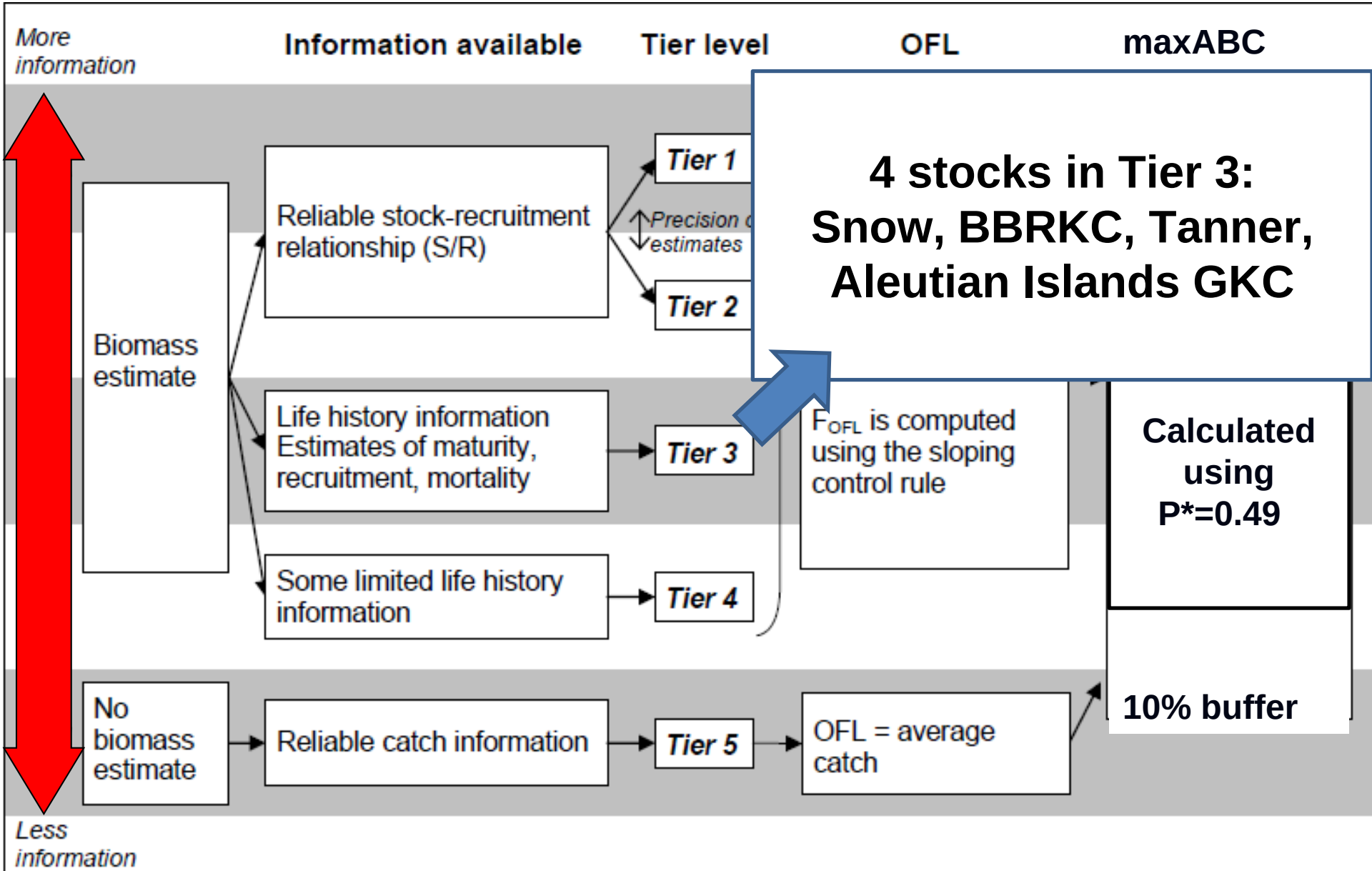
Current Crab Tier system



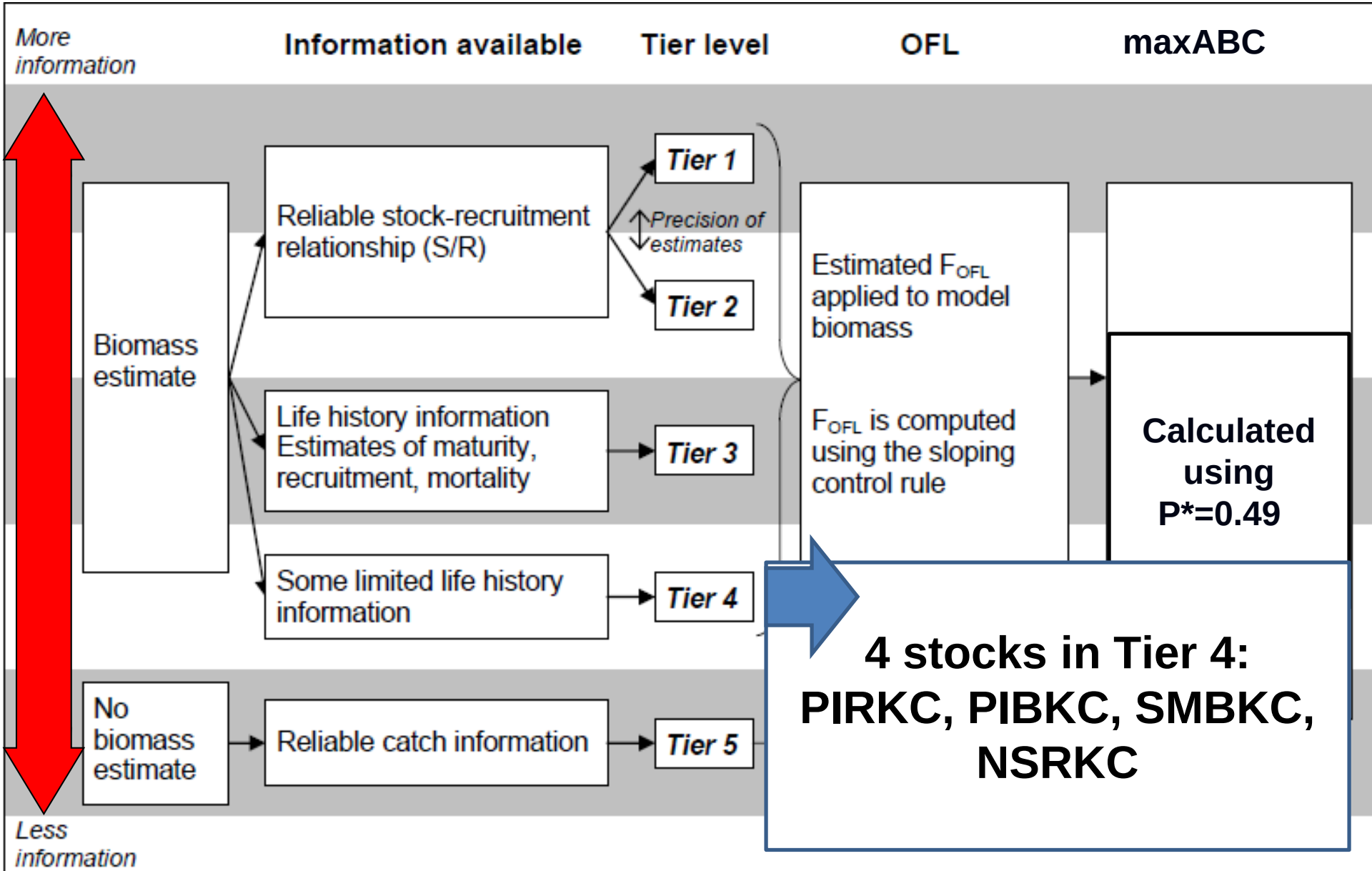
Overview of stocks



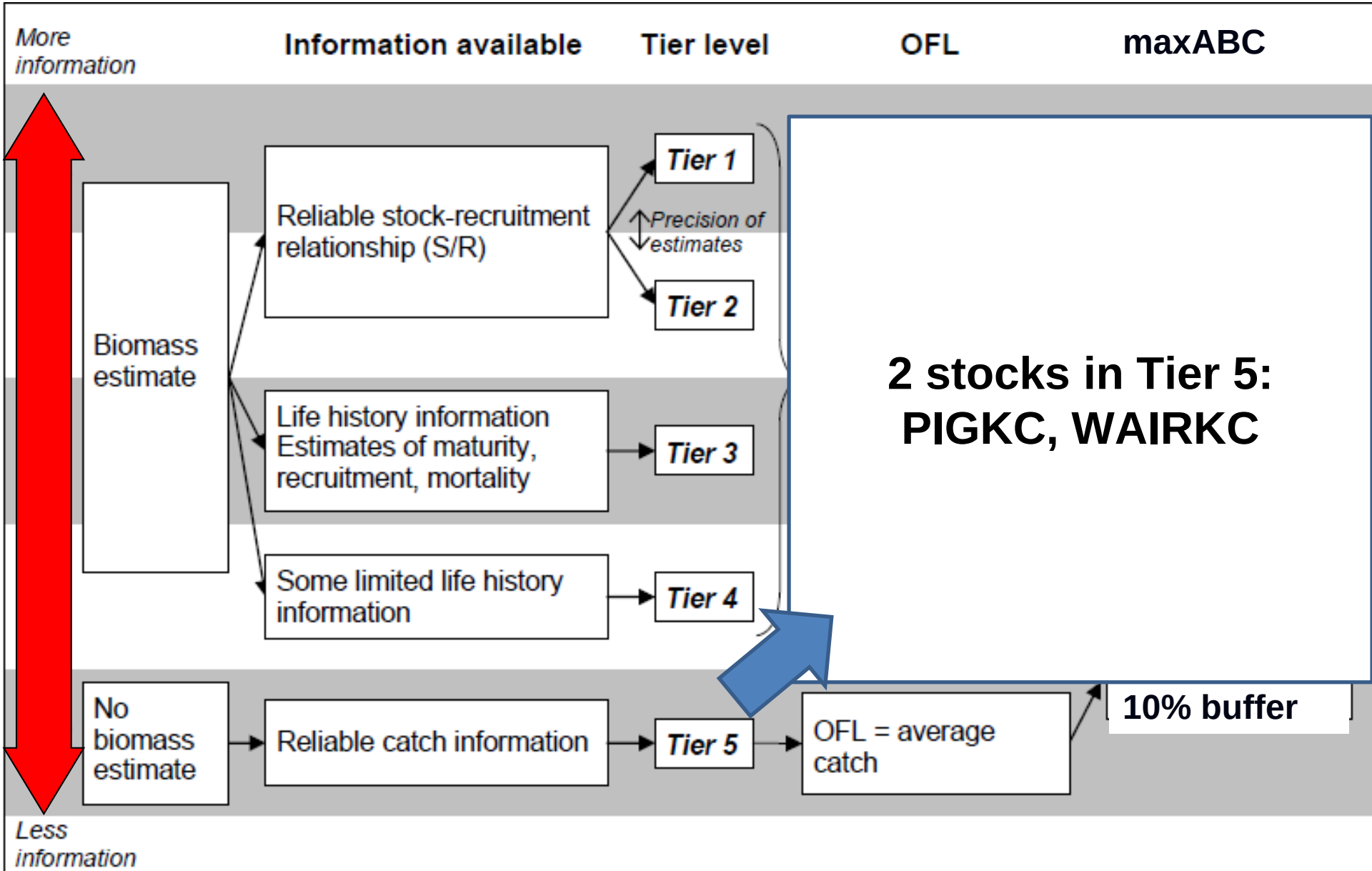
Overview of stocks



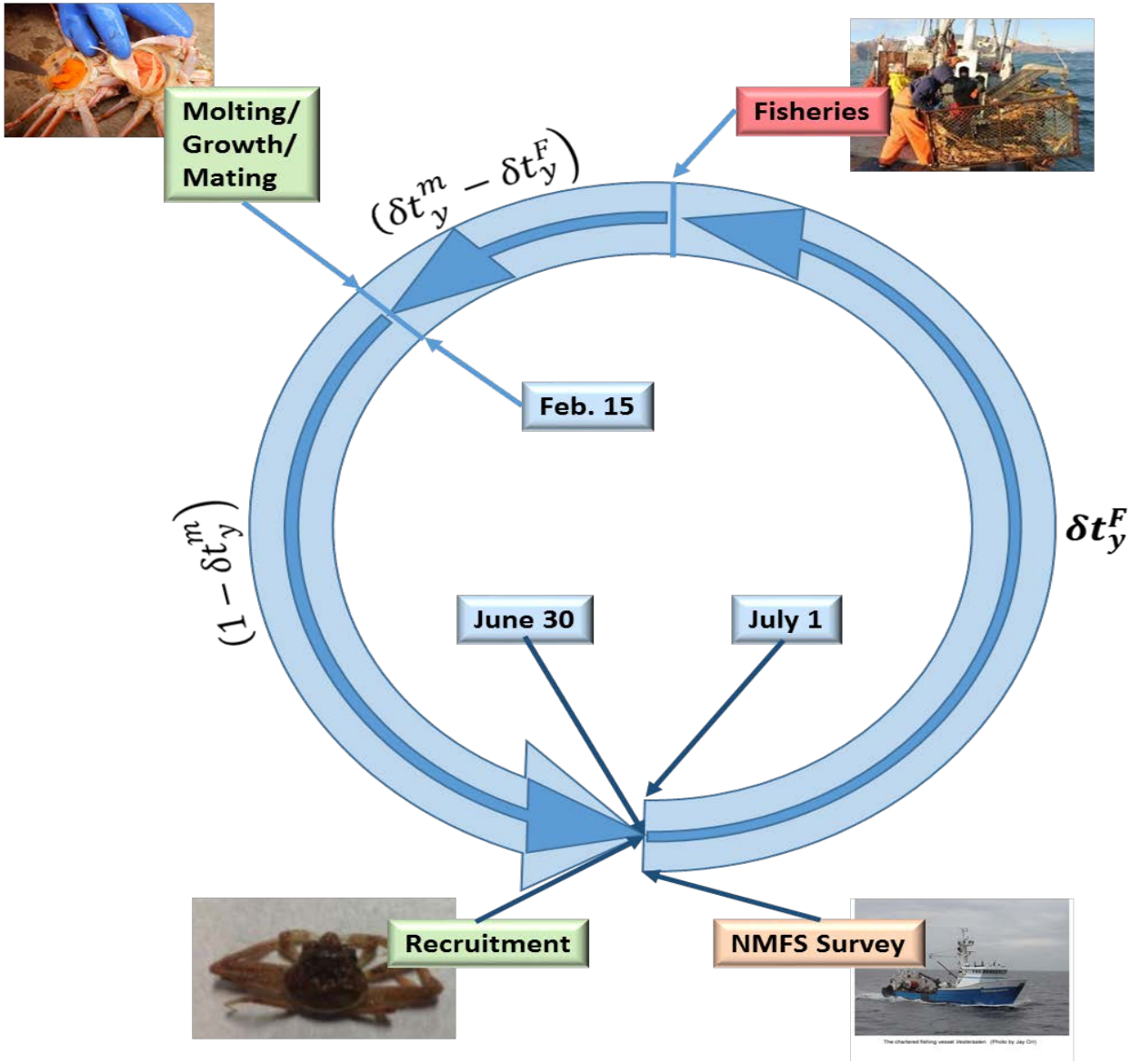
Overview of stocks



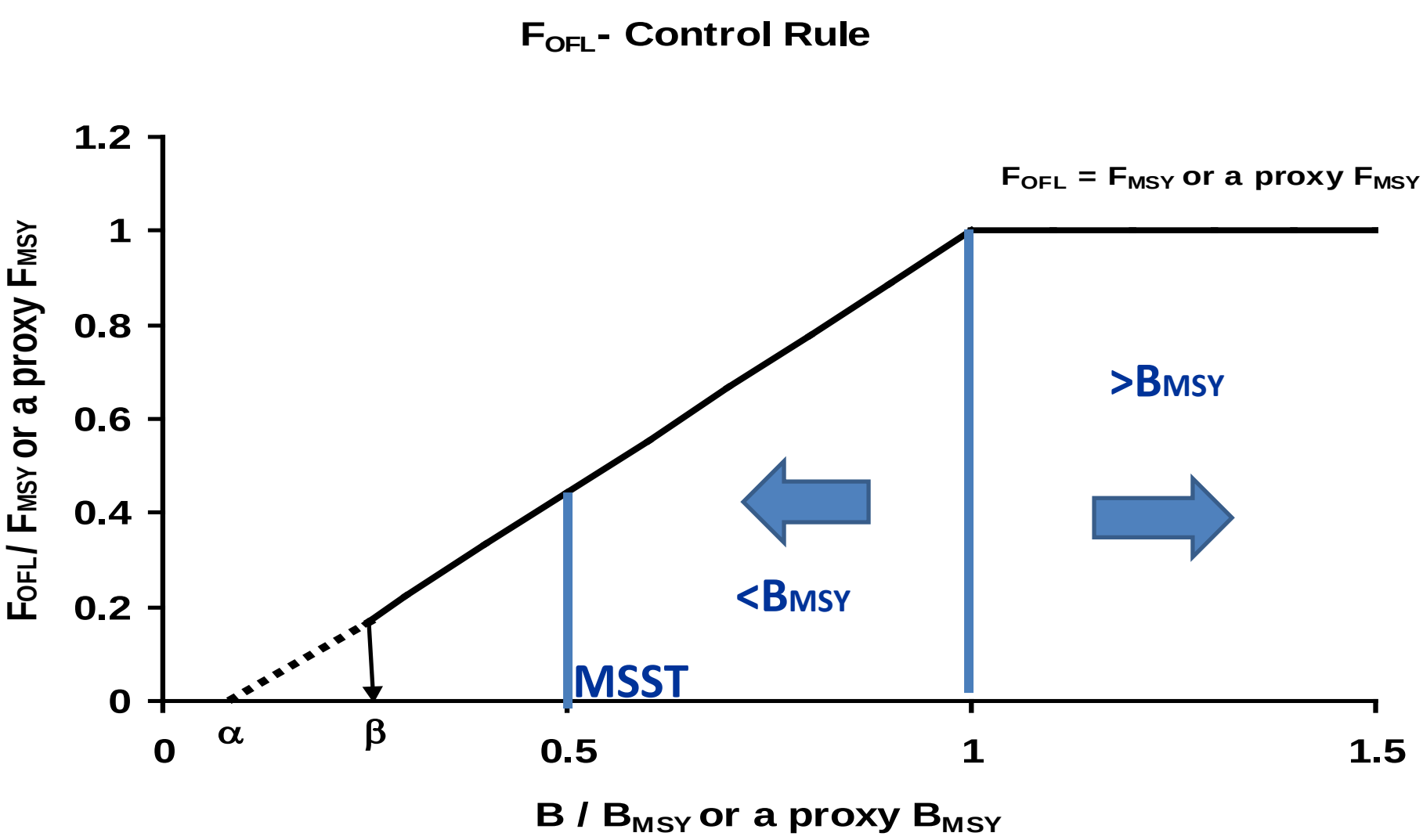
Overview of stocks



Tier 3 stage/size-based population dynamics model



Overfishing limit (OFL)



Projected stock status in relation to biological reference points

Biomass $> B_{MSY}$	**Biomass** $< B_{MSY}$	**Biomass** $< \frac{1}{2} B_{MSY}$ **(MSST)**	**Biomass and status unknown**
• EBS Tanner crab • Norton Sound red king crab • Aleutian Islands golden king crab	• EBS snow crab • Bristol Bay red king crab • St. Matthew blue king crab • Pribilof Islands red king crab	• Pribilof Islands blue king crab	• Pribilof Islands golden king crab • Aleutian Islands (Adak) red king crab

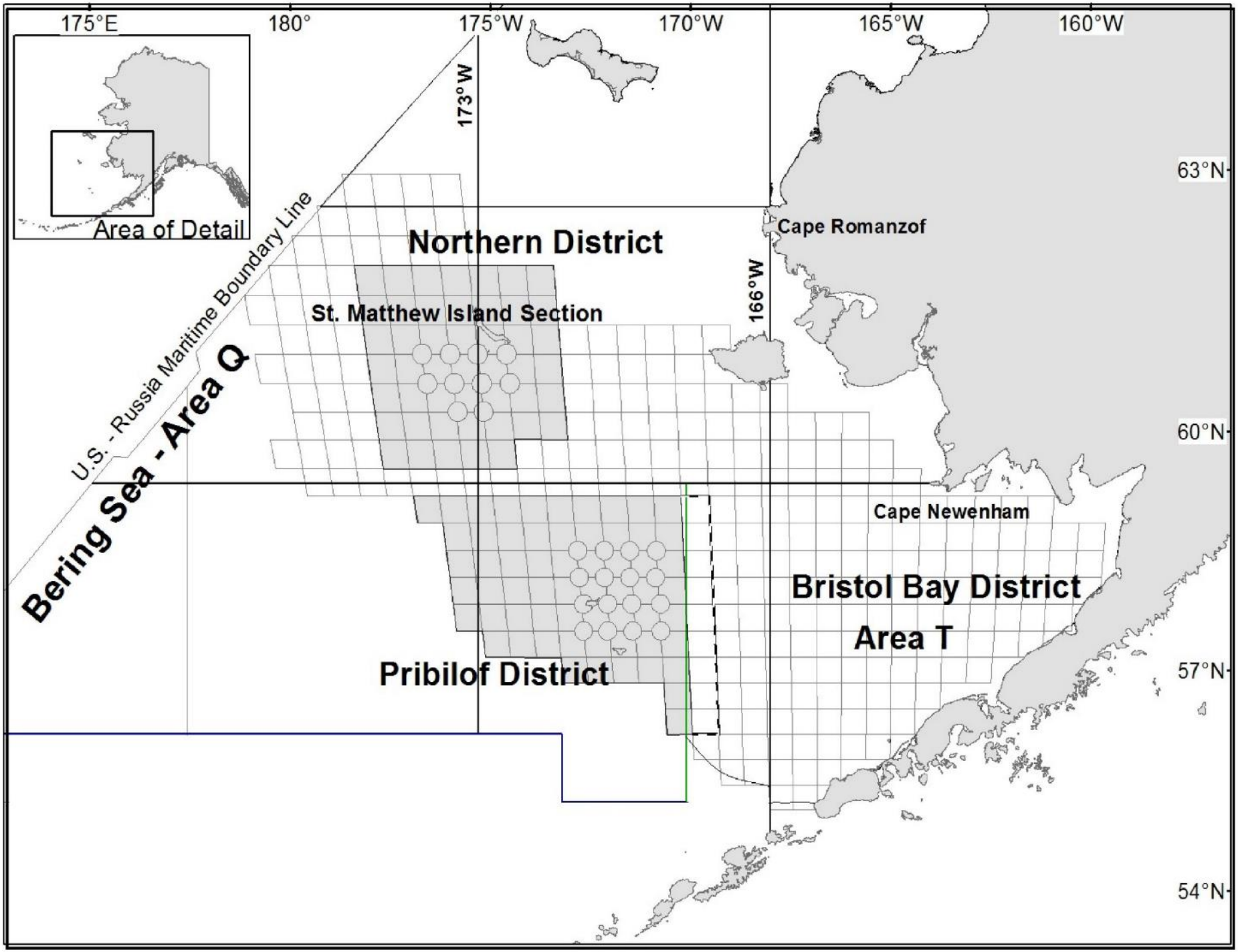
The 2017 Eastern Bering Sea Continental Shelf Bottom Trawl Survey: Results for Commercial Crab Species

NOAA FISHERIES

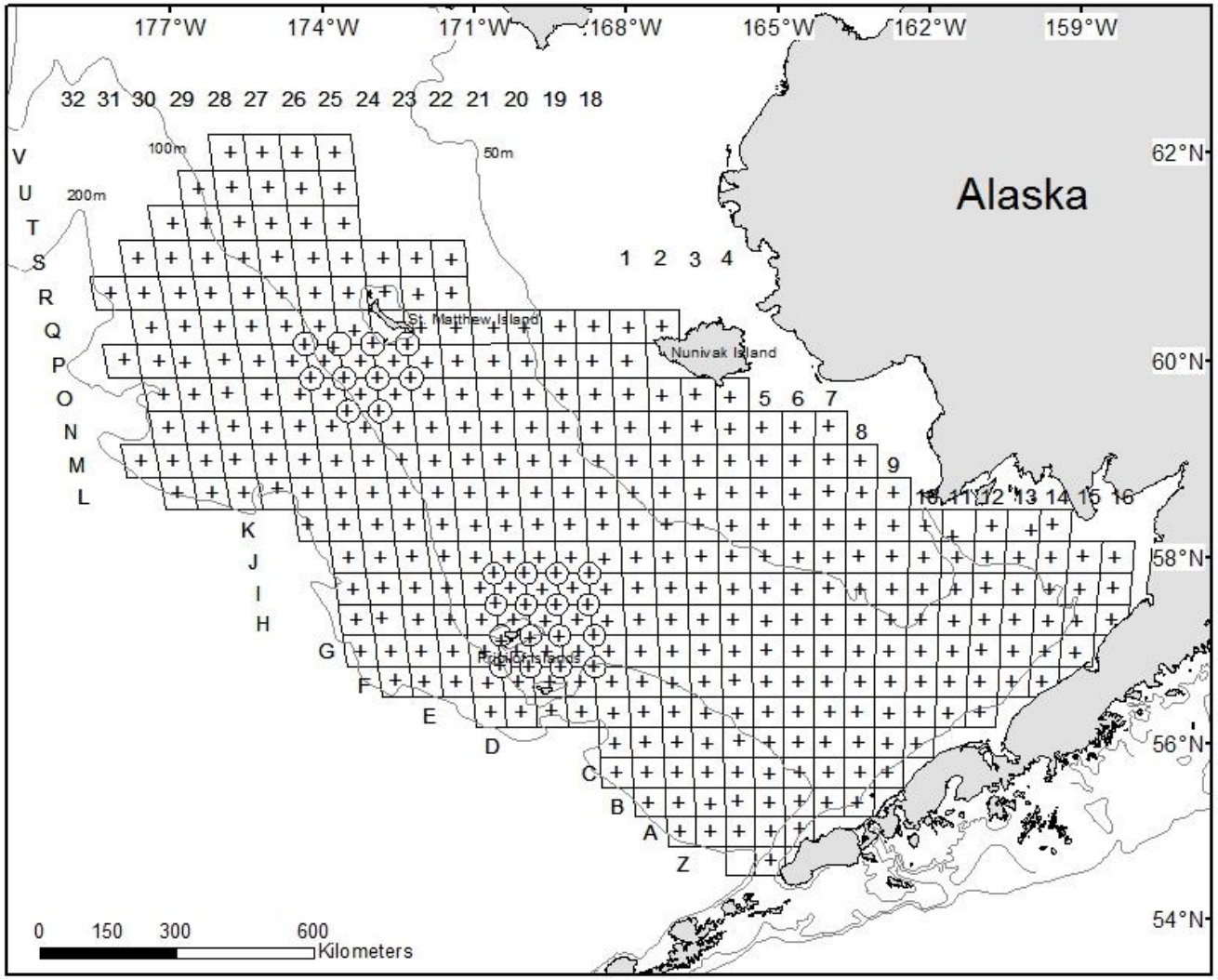
Alaska Fisheries Science Center-Kodiak Lab

- Christie Lang, Jon Richar, Robert Foy,
- AFSC SAP and GAP programs

Crab Plan Team
September 2017


175°E
180°
175°W
170°W
165°W
160°W
173°W
166°W
63°N
60°N
57°N
54°N
Area of Detail
U.S. - Russia Maritime Boundary Line
Bering Sea - Area Q
Northern District
St. Matthew Island Section
Pribilof District
Bristol Bay District
Area T
Cape Romanzof
Cape Newenham

2017 standard Bering Sea survey



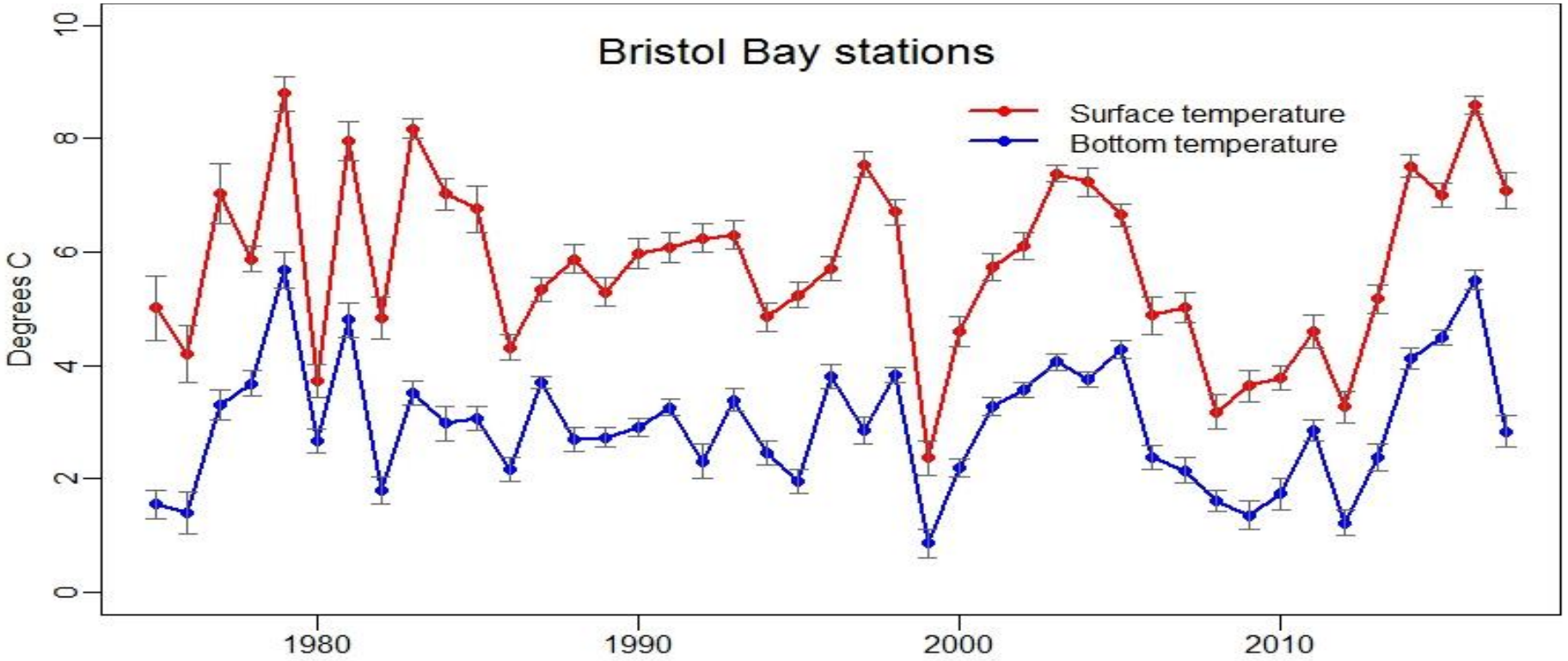
HIGHLIGHTS

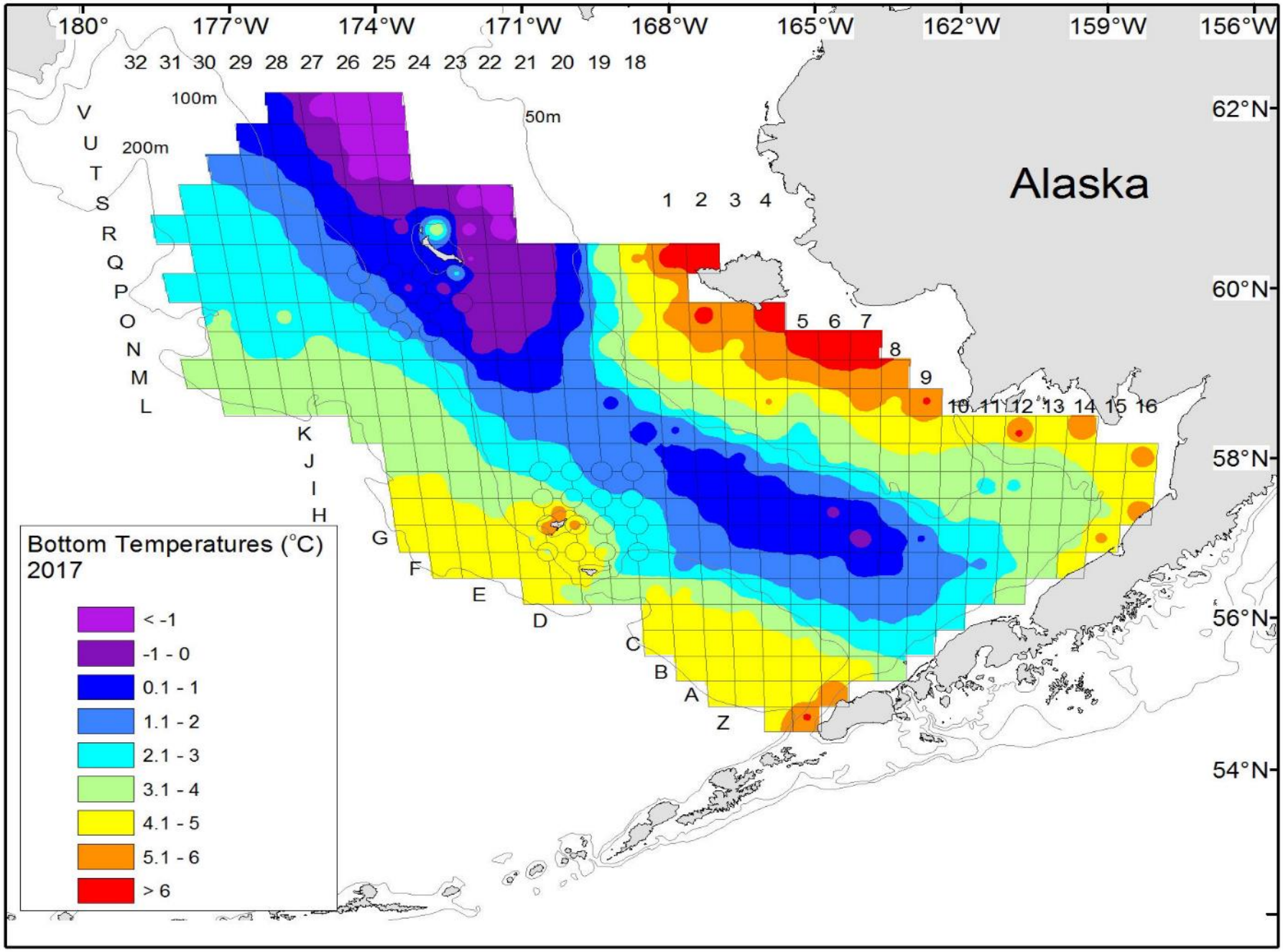
- June 4– July 31
- 375 standard stations
- 139,949 nm^2
- 6 special crab projects
- Colder water!
- RESAMPLE 20 stations in Bristol Bay
- Northern Bering Sea

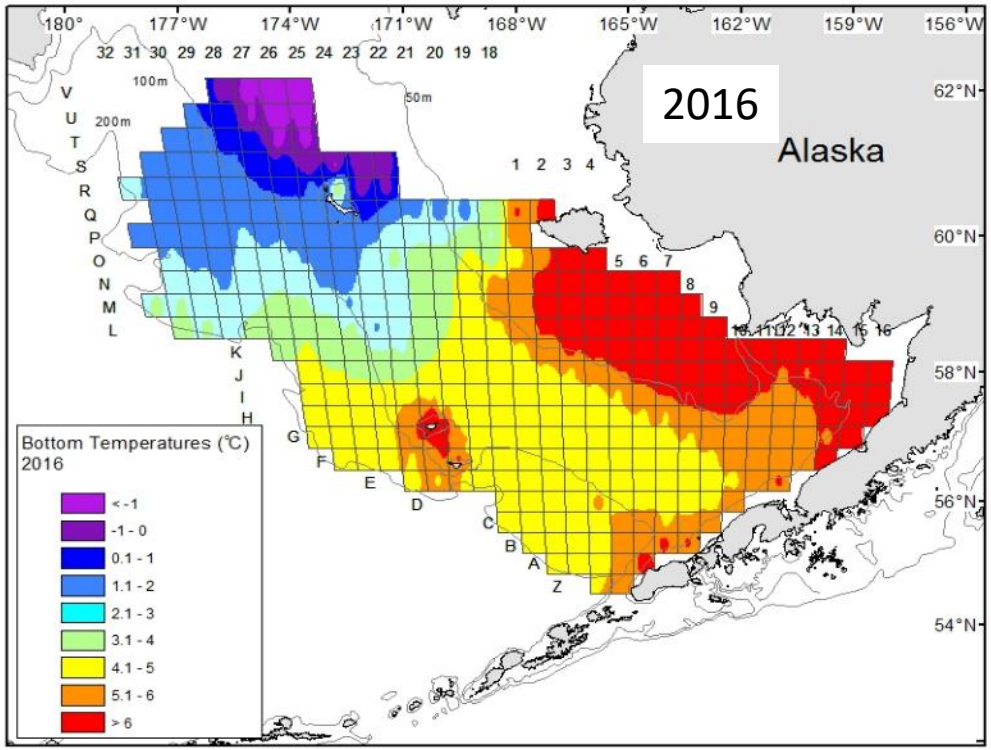
Special projects related to crab species

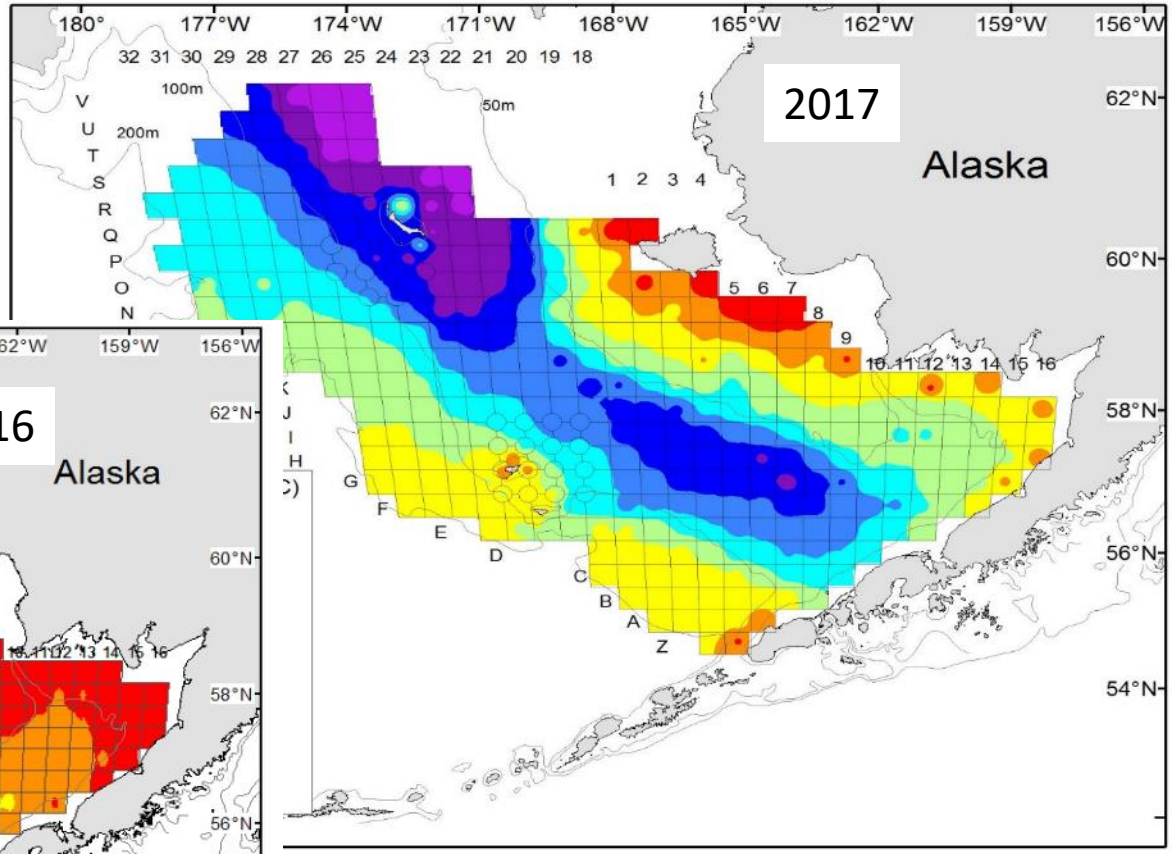
Project title	Principle Investigator	Agency
Bitter crab syndrome	P Jensen	RACE-SAP
Annual vs. biennial snow crab reproductive cycle	J Newby; R Foy	RACE-SAP
Spatial variance in snow crab shell structure	R Foy	RACE-SAP
Snow and Tanner crab growth	Cliff Ryer	RACE-FBE
Tanner crab chela	B. Stockhausen; R. Foy	REFM/RACE
Genetics of mating dynamics in EBS snow crab	Tyler Jackson	ADF&G

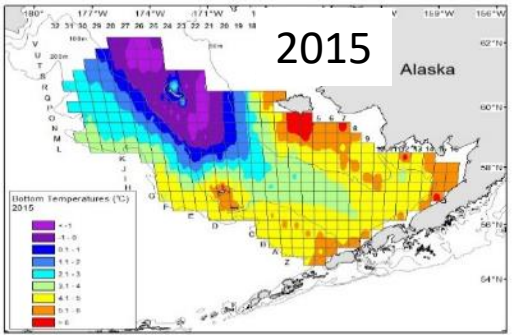
Bristol Bay Surface (red) and Bottom (blue) temperatures

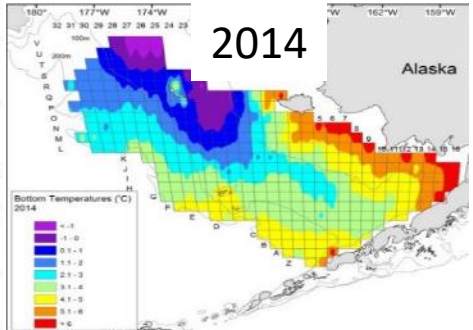


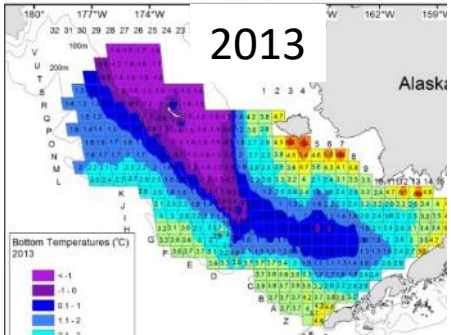

180°
177°W
174°W
171°W
168°W
165°W
162°W
159°W
156°W
62°N
60°N
58°N
56°N
54°N
Alaska
100m
200m
50m
Bottom Temperatures (°C)
2017
< -1
-1 - 0
0.1 - 1
1.1 - 2
2.1 - 3
3.1 - 4
4.1 - 5
5.1 - 6
> 6

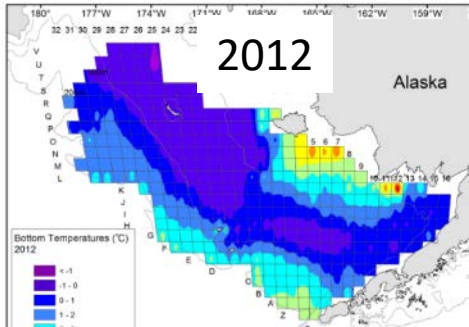

2016
Alaska
Bottom Temperatures (℃)
2016
< -1
-1 - 0
0.1 - 1
1.1 - 2
2.1 - 3
3.1 - 4
4.1 - 5
5.1 - 6
> 6


2017
Alaska

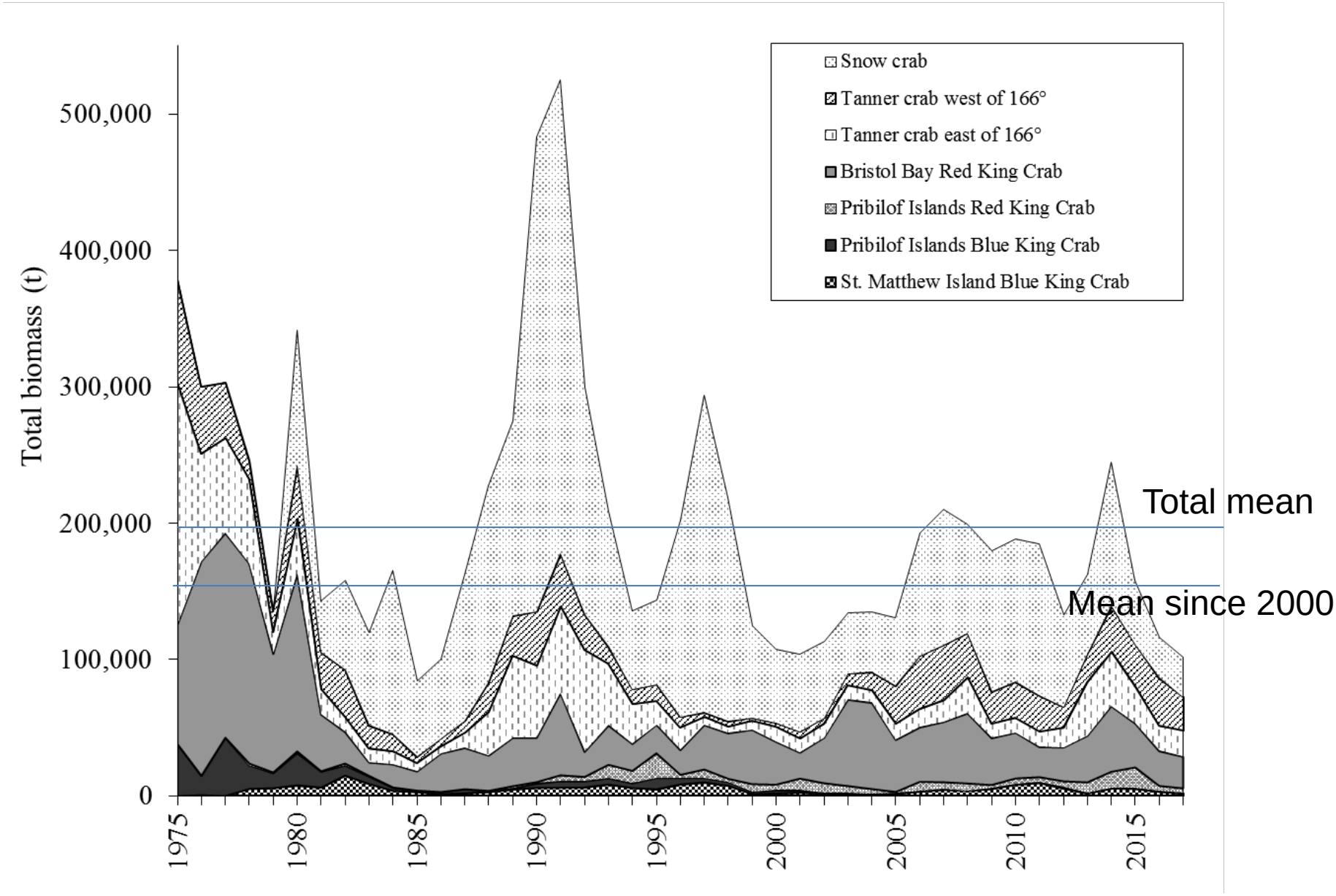

2015
Alaska


2014
Alaska


2013
Alaska


2012
Alaska

Mature male biomass

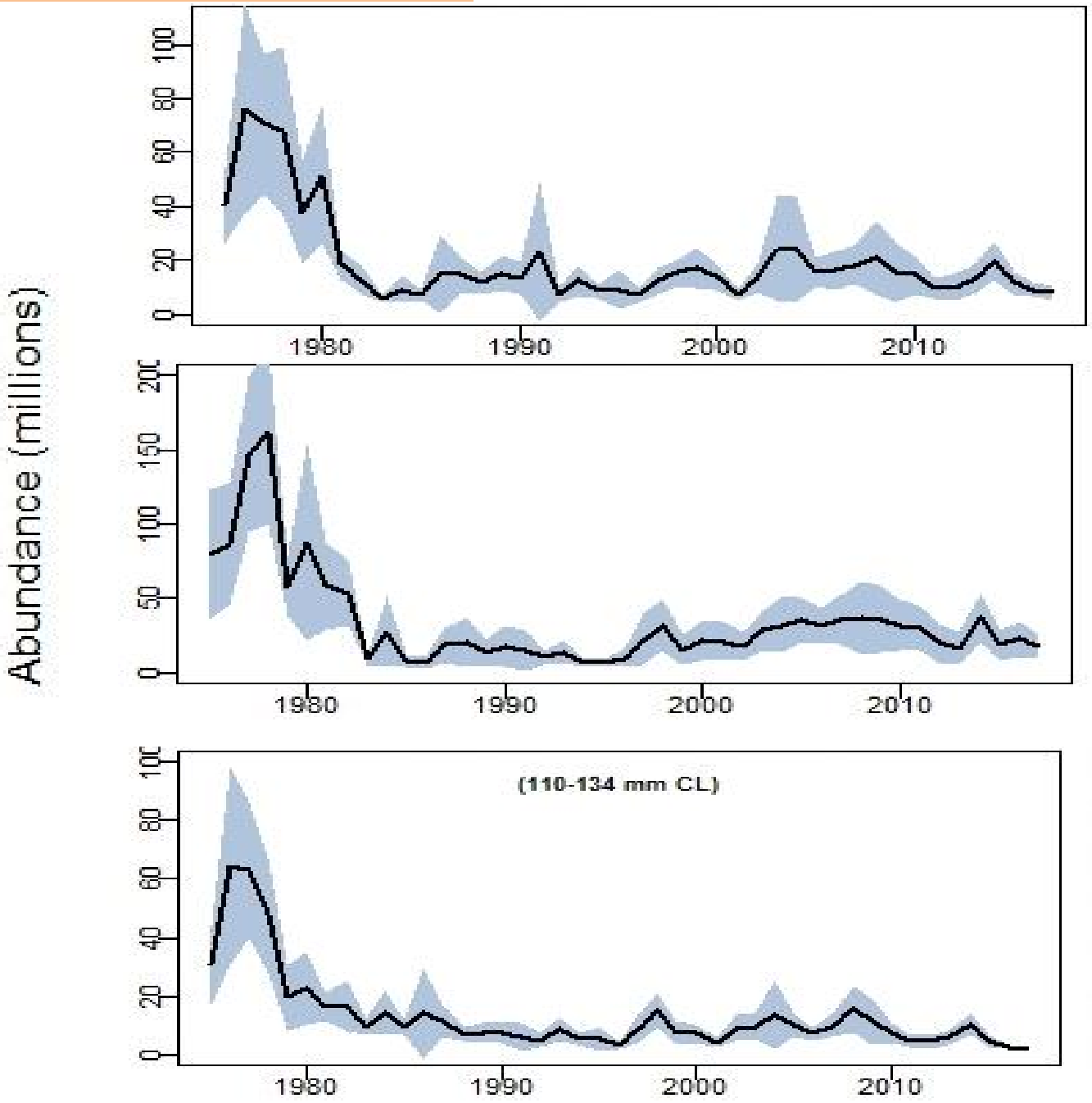


2017 Mature Males (2016 value in parentheses)

	# tows	#tows with crab	# caught	% measured	Biomass (t)
BB RKC	136	64 (59)	266 (302)	100%	23,102 (25,481)
PI RKC	77	8 (5)	57 (69)	100%	3,658 (4,150)
PI BKC	86	4 (3)	4 (3)	100%	253 (129)
SM BKC	56	13 (16)	39 (83)	100%	1,721 (3,072)
TC east	120	80 (99)	1,053 (1,011)	100%	19,313 (18,523)
TC west	255	107 (112)	1,955 (2,797)	99%	24,268 (35,119)
SC	375	167 (190)	2,198 (2,191)	96% (86%)	29,240 (29,961)

Bristol Bay Red King Crab Final Stock Assessment

Bristol Bay Red King Crab



Mature male

-9%

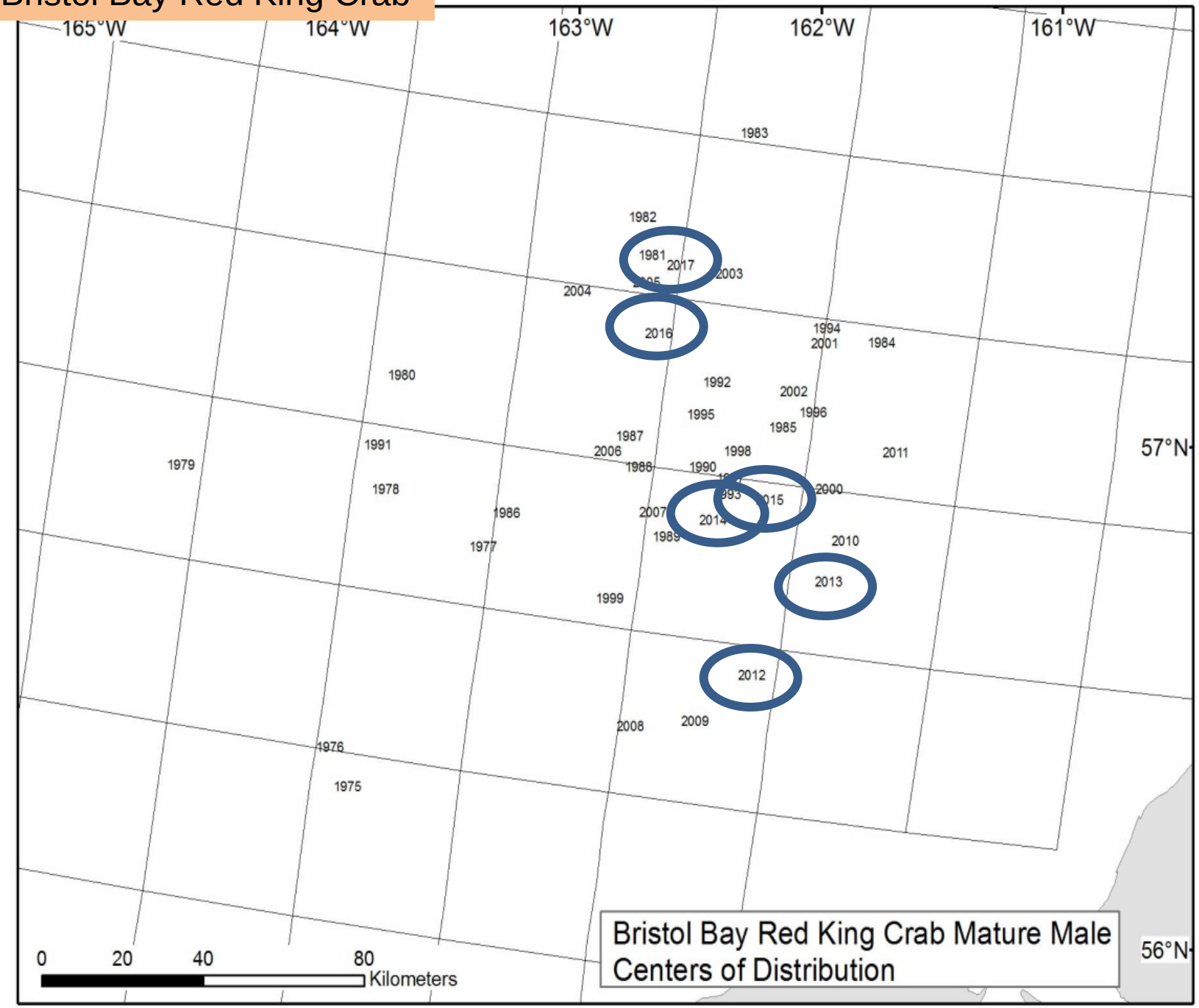
Mature females

-21%

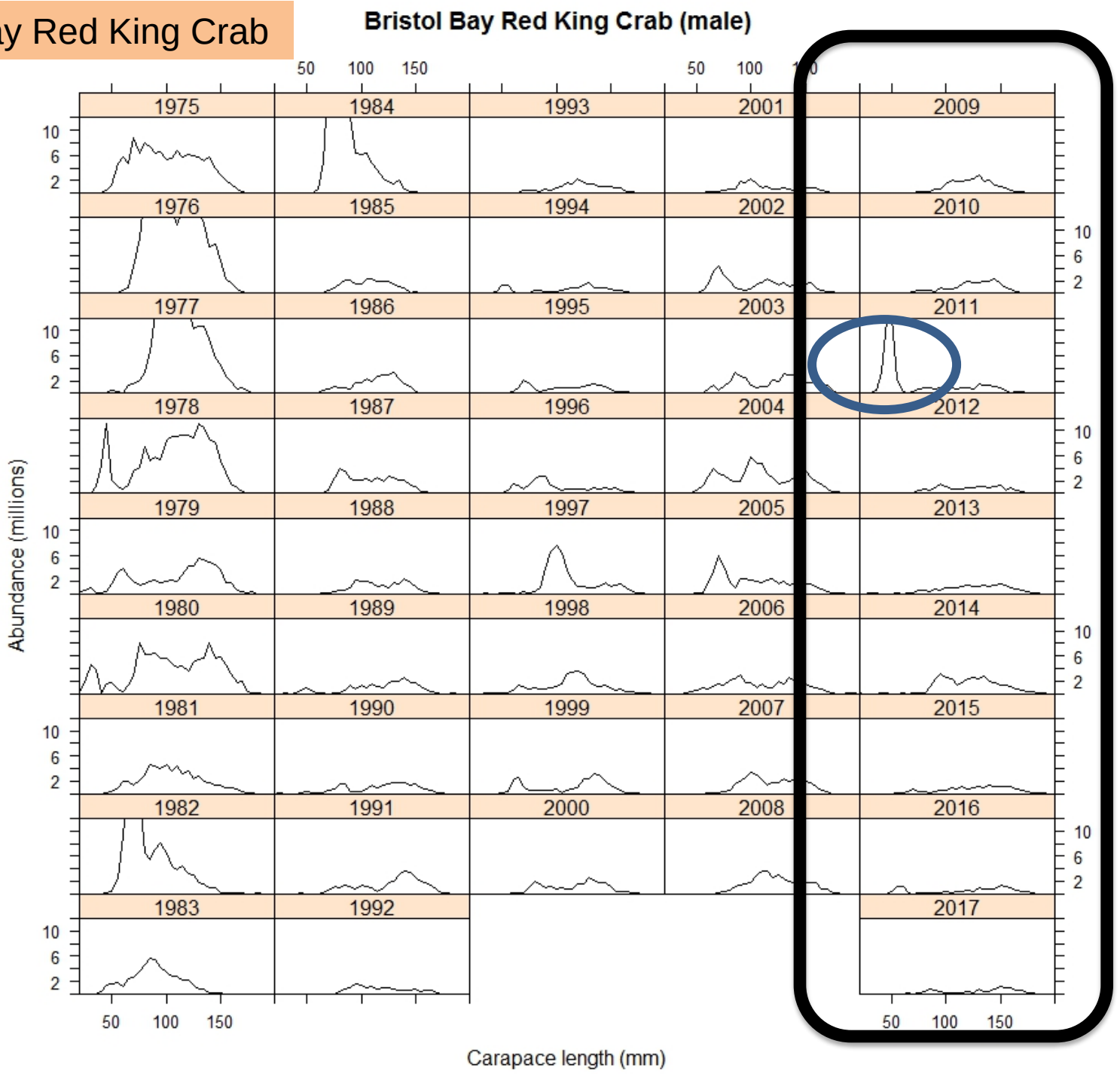
Juveniles

Male +8%
Female +55%

Bristol Bay Red King Crab



Bristol Bay Red King Crab

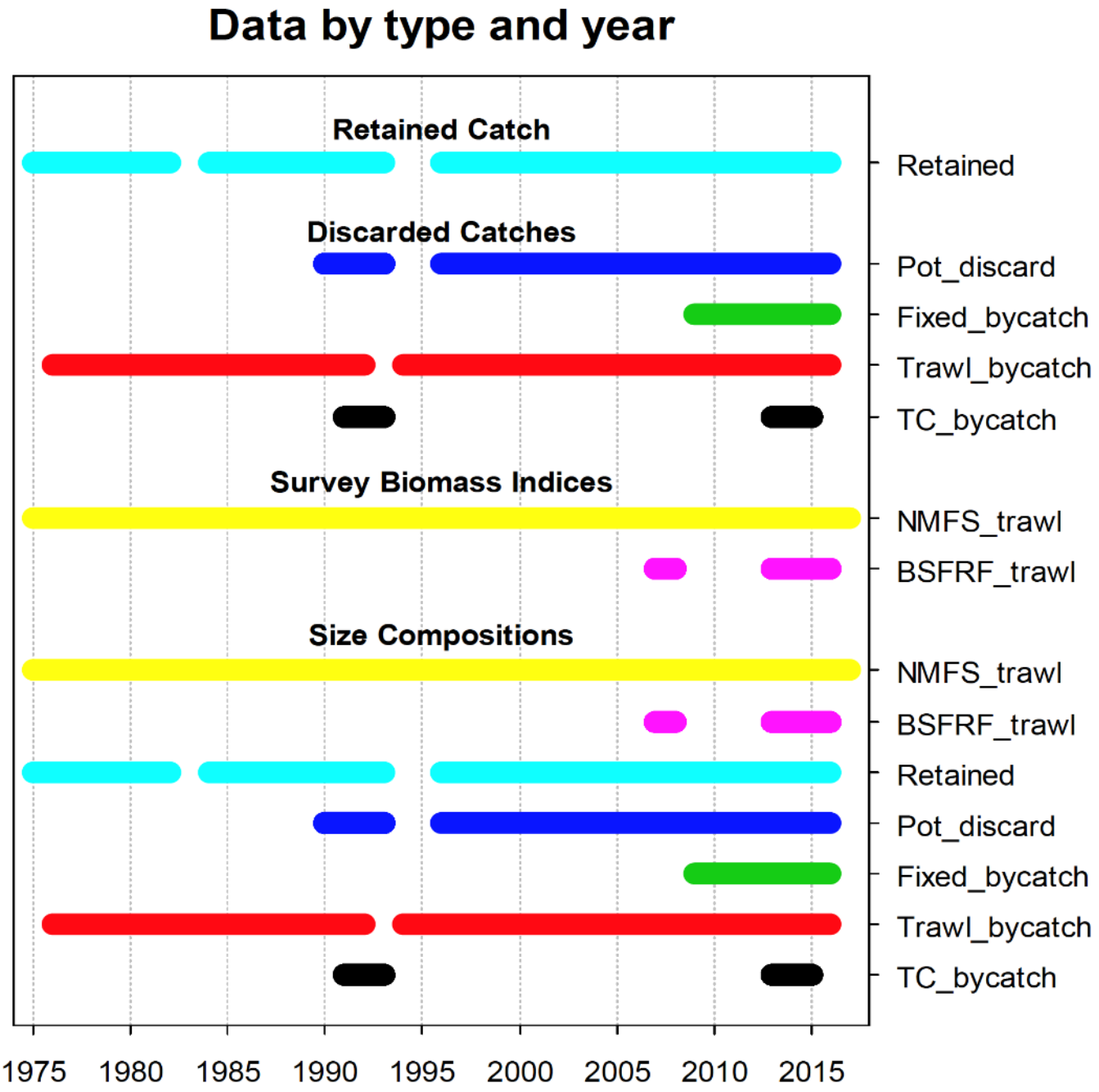


Major changes in 2017

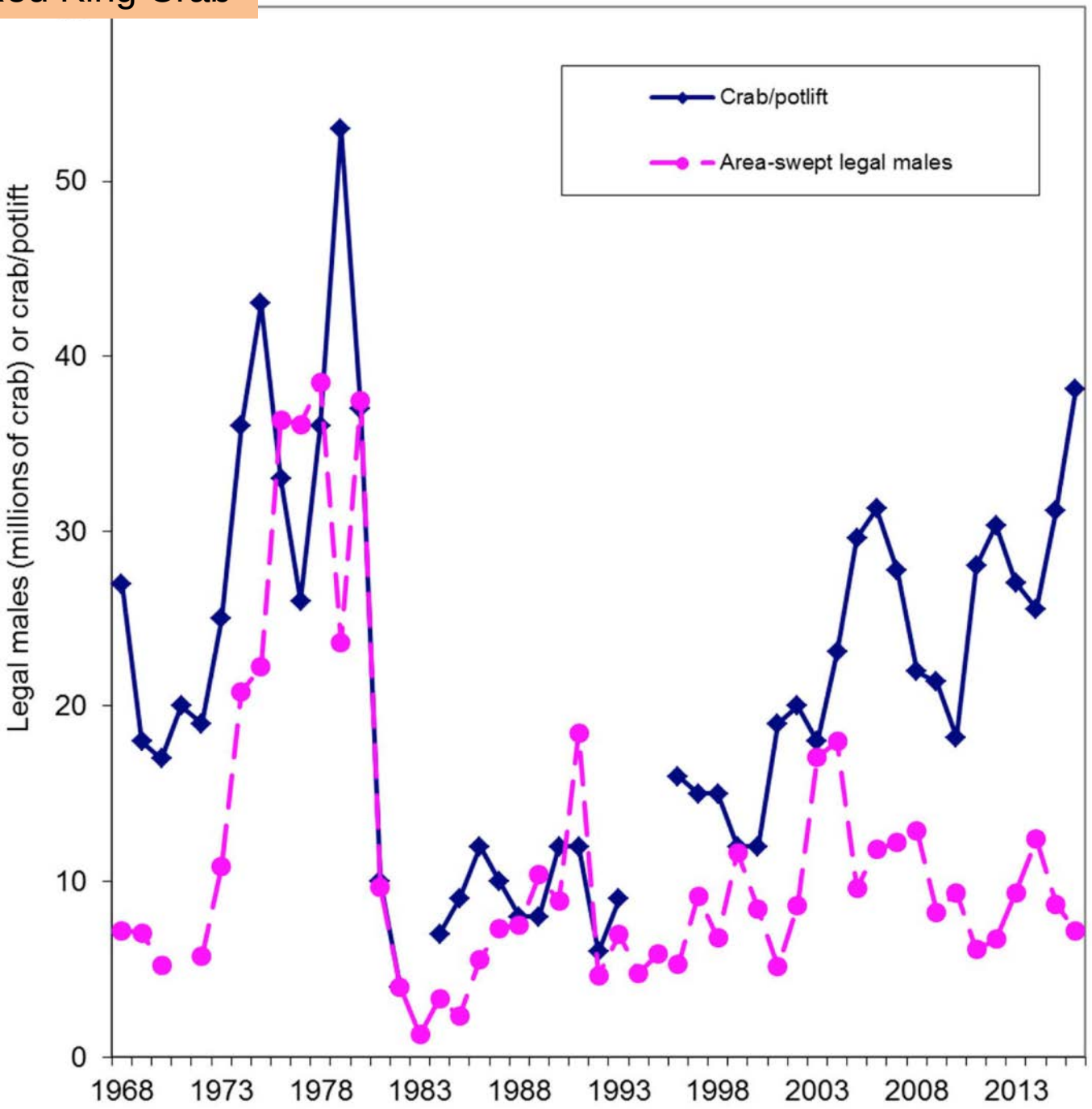
- Data
  - 2017 NMFS EBS trawl survey data
  - 2016 BSFRF survey biomass estimate updated (11% decrease)
  - 2016/17 directed catch and bycatch added
  - bycatch in groundfish fisheries disaggregated by gear type

- Assessment methodology
  - Fits to bycatch in groundfish fisheries disaggregated by gear type
  - Francis iterative re-weighting implemented using two approaches
    - based on sex-specific size compositions
    - based on “extended” size compositions

Bristol Bay Red King Crab

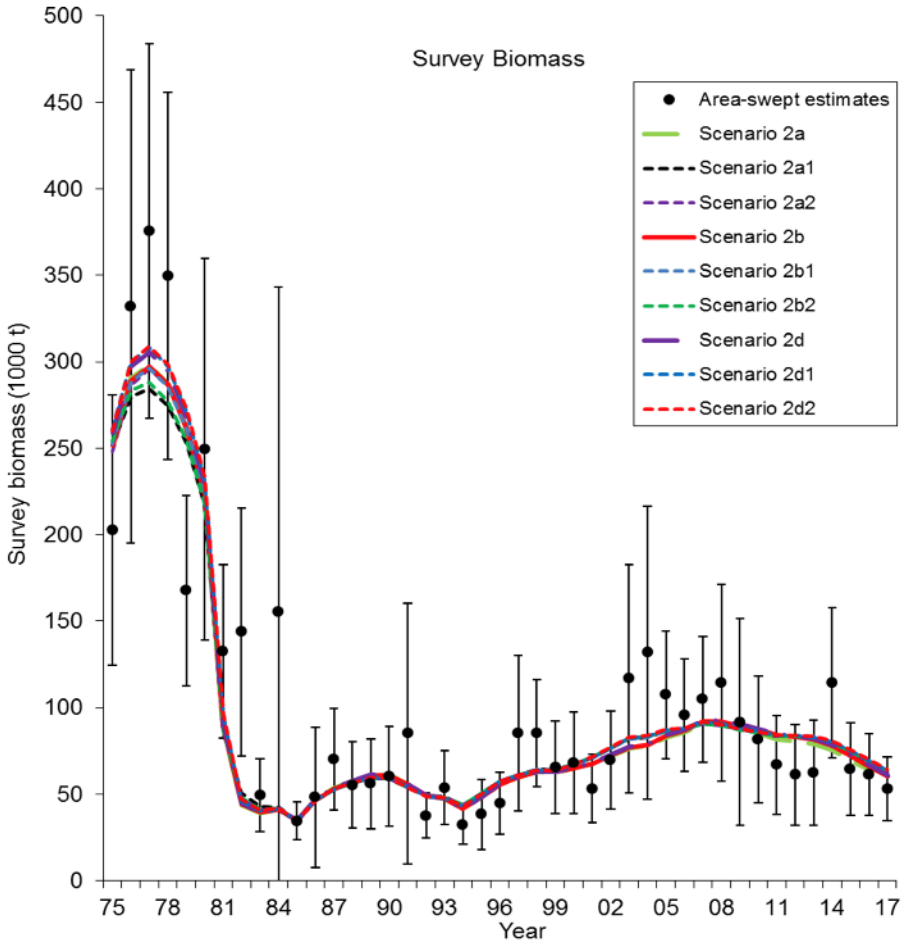


Bristol Bay Red King Crab

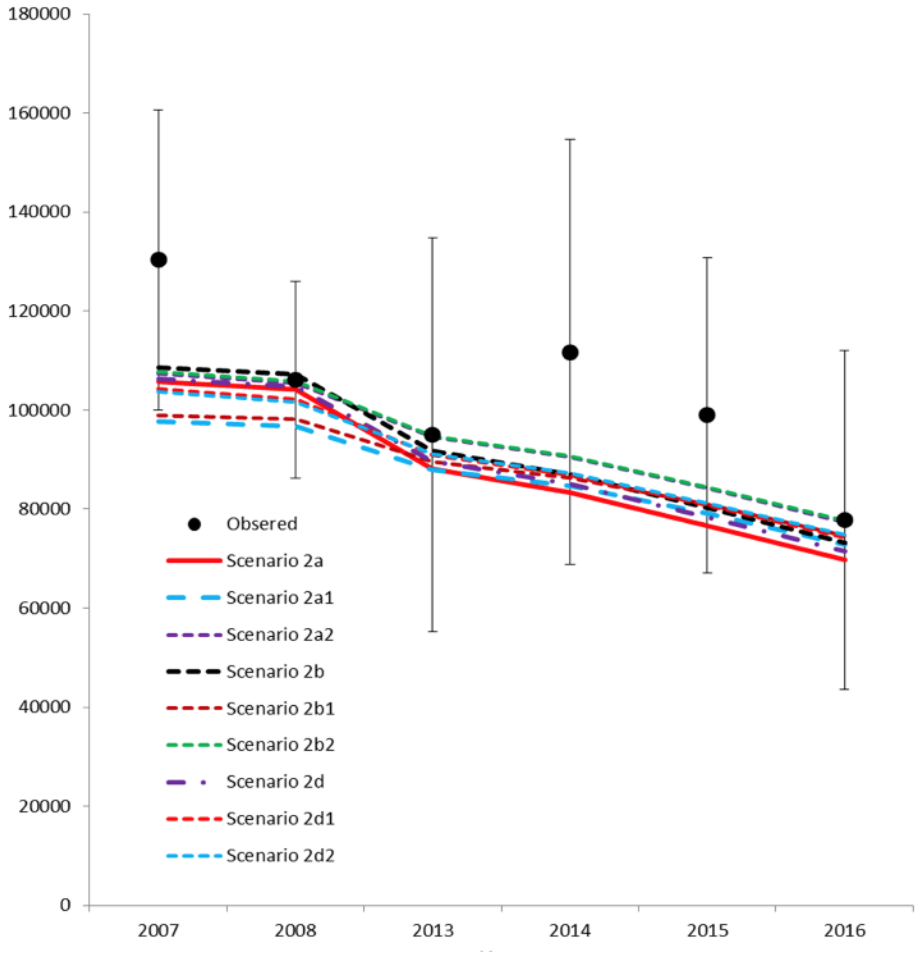


Fits to survey biomass

NMFS



BSFRF



- High NMFS survey Q estimates forced by rapid decline in 1980's abundance, given observed catch levels
- CPT recommended model that addresses the survey selectivity.

CPT Discussion and Recommendations

- Discussion on the model underestimate of BSFRF data and subsequent overestimate of NMFS survey data in past 8 years.
- CPT preferred models that disaggregate the GF discard between pot and trawl.
- Reconsider alternative weighting
- Explore why Q is 1 for AFSC survey

Tier, OFL, and ABC Recommendations

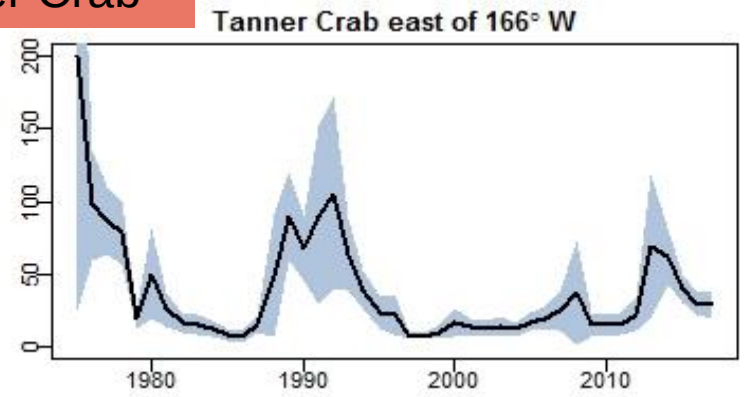
- CPT and author recommended 10% buffer
- CPT concurred with Author recommendation for Tier 3b.

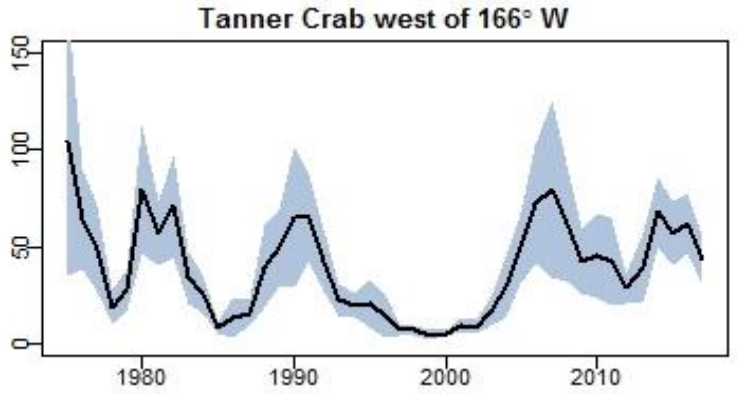
- Biomass (MMB) = 21.31 thousand t
- Total catch OFL = 5.60 thousand t
- ABC (less than max permissible) = 10% buffer = 5.04 thousand t

Tanner Crab
Final Stock Assessment

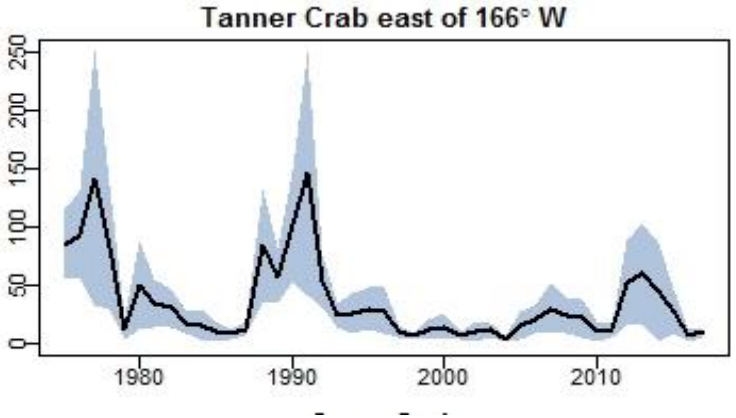
William Stockhausen
Alaska Fisheries Science Center

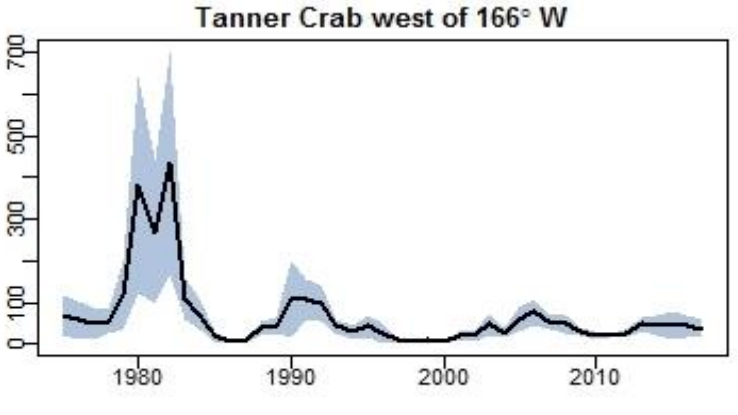
Tanner Crab



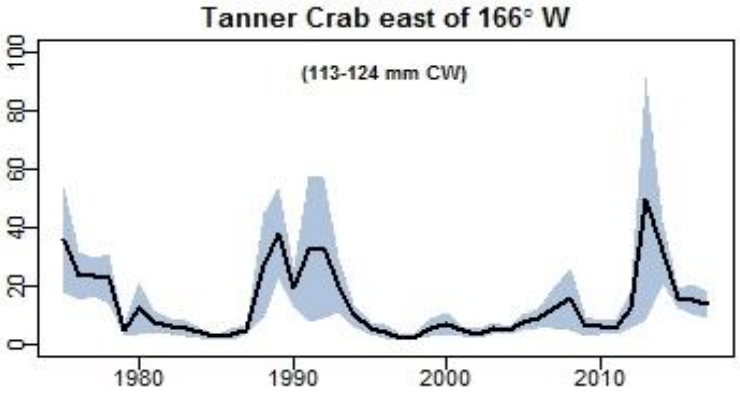


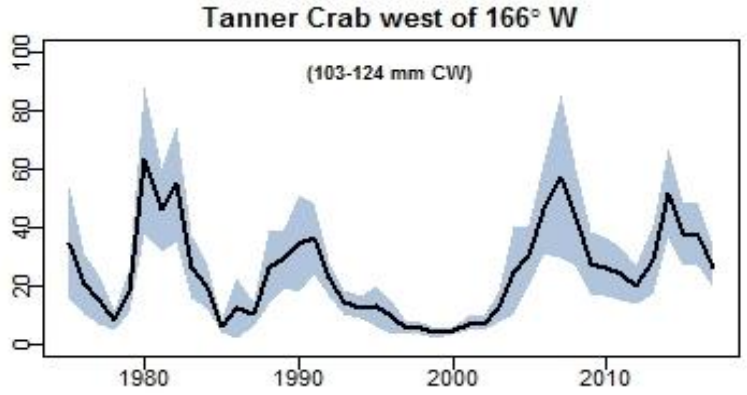
Mature male





Mature females

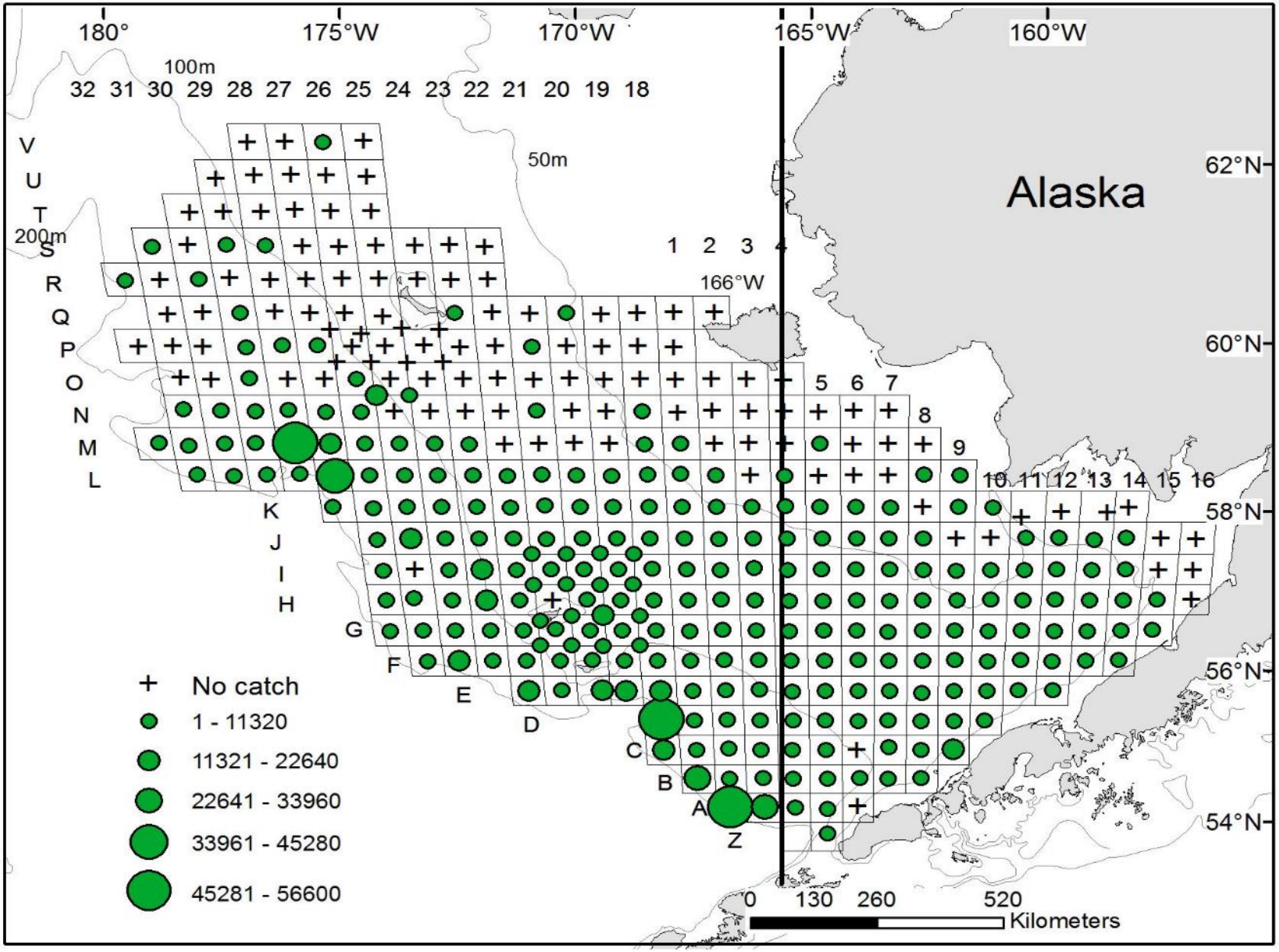


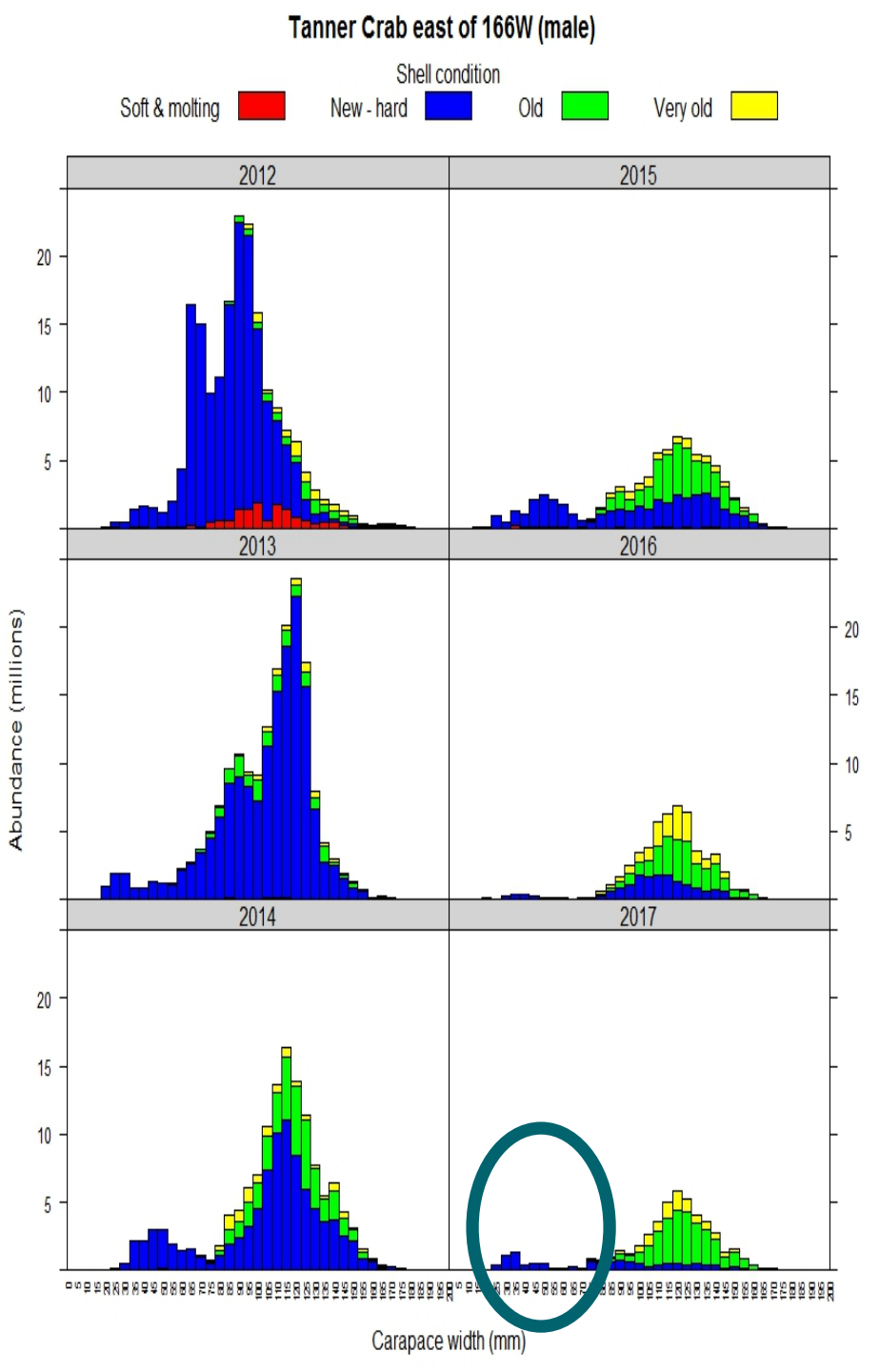


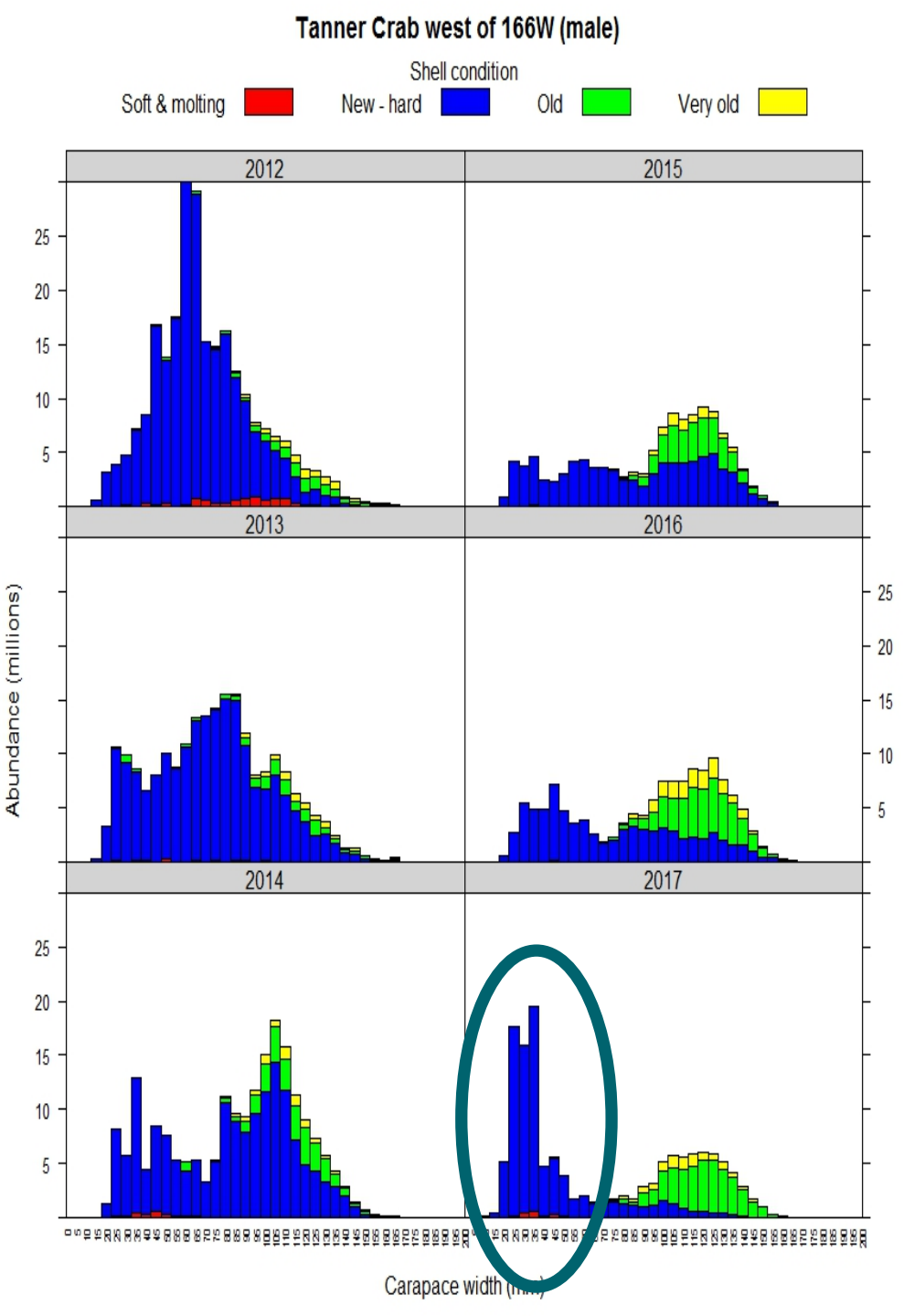
Juvenile

Tanner Crab

Tanner crab (*Chionoecetes bairdi*) total density

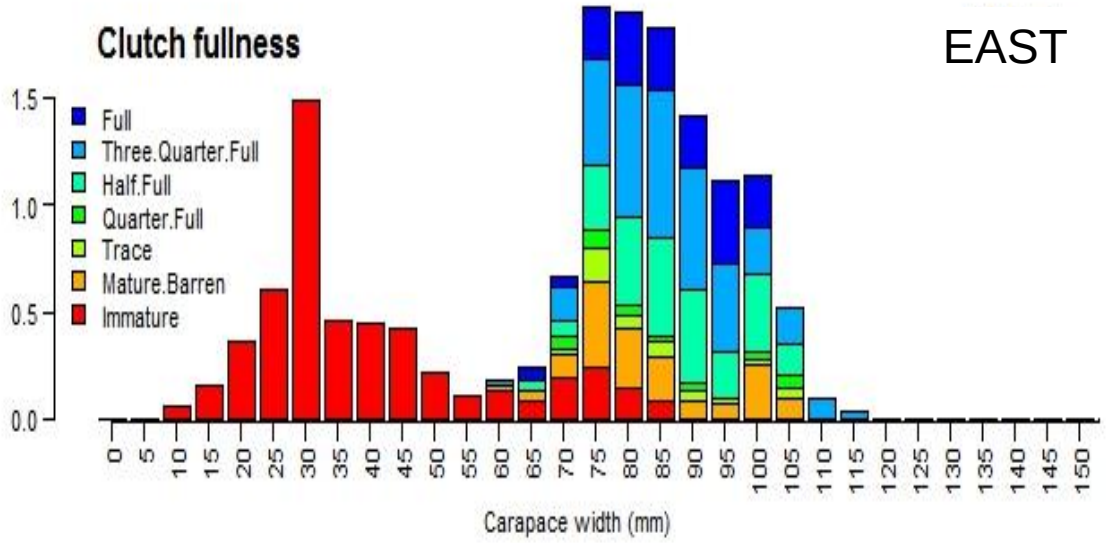



Tanner Crab east of 166W (male)
Shell condition
Soft & molting
New - hard
Old
Very old
2012
2015
2013
2016
2014
2017
Abundance (millions)
Carapace width (mm)

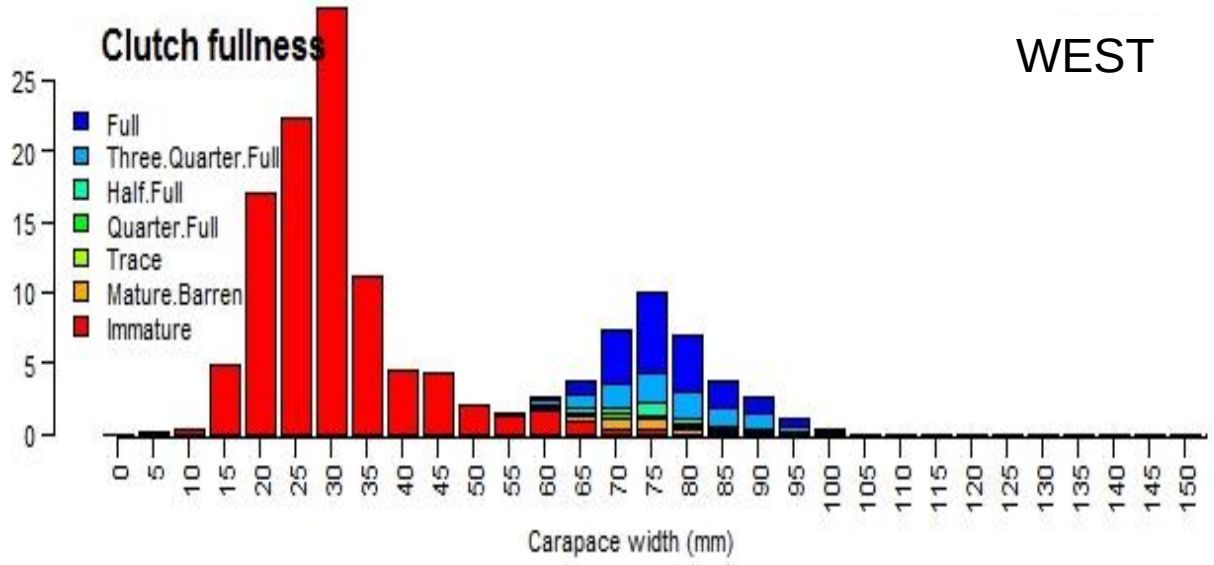

Tanner Crab west of 166W (male)
Shell condition
Soft & molting
New - hard
Old
Very old
2012
2015
2013
2016
2014
2017
Abundance (millions)
Carapace width (mm)

Tanner Crab

Female clutch fullness in 2017

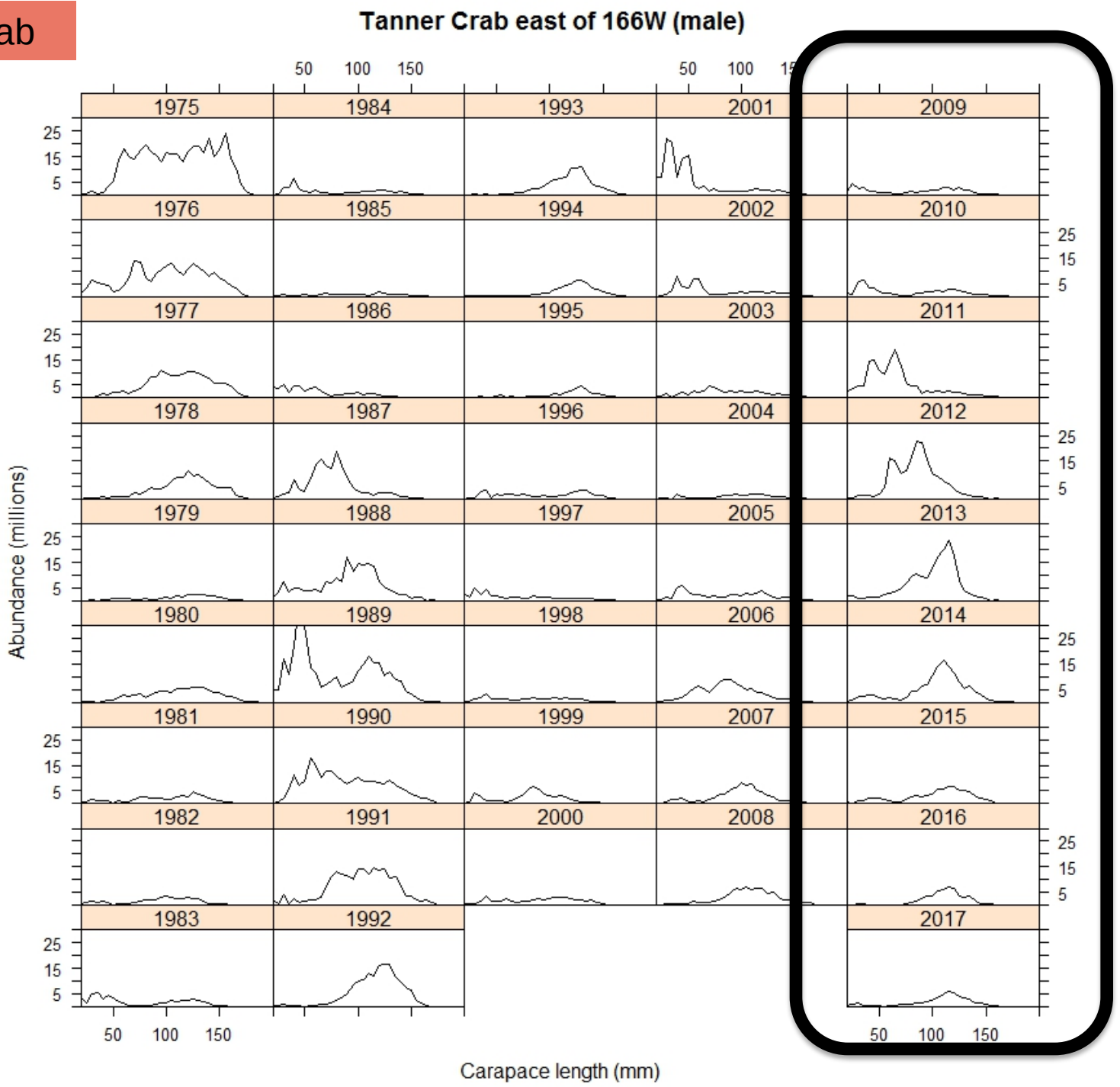


EAST



WEST

Tanner Crab


Tanner Crab east of 166W (male)
1975
1976
1977
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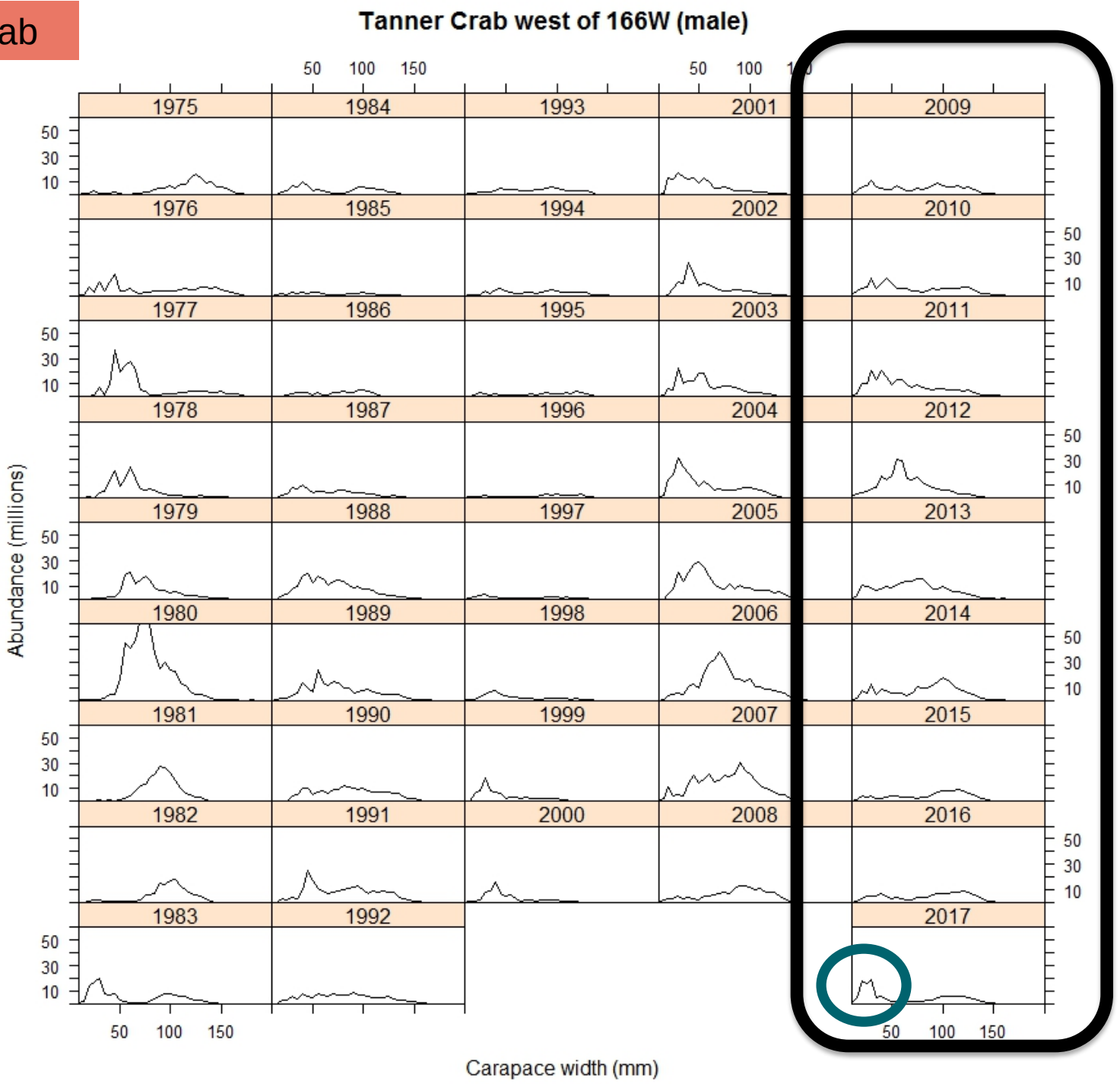
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Abundance (millions)
Carapace length (mm)
5
15
25
50
100
150

Tanner Crab


Tanner Crab west of 166W (male)
1975
1976
1977
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1990
1991
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2005
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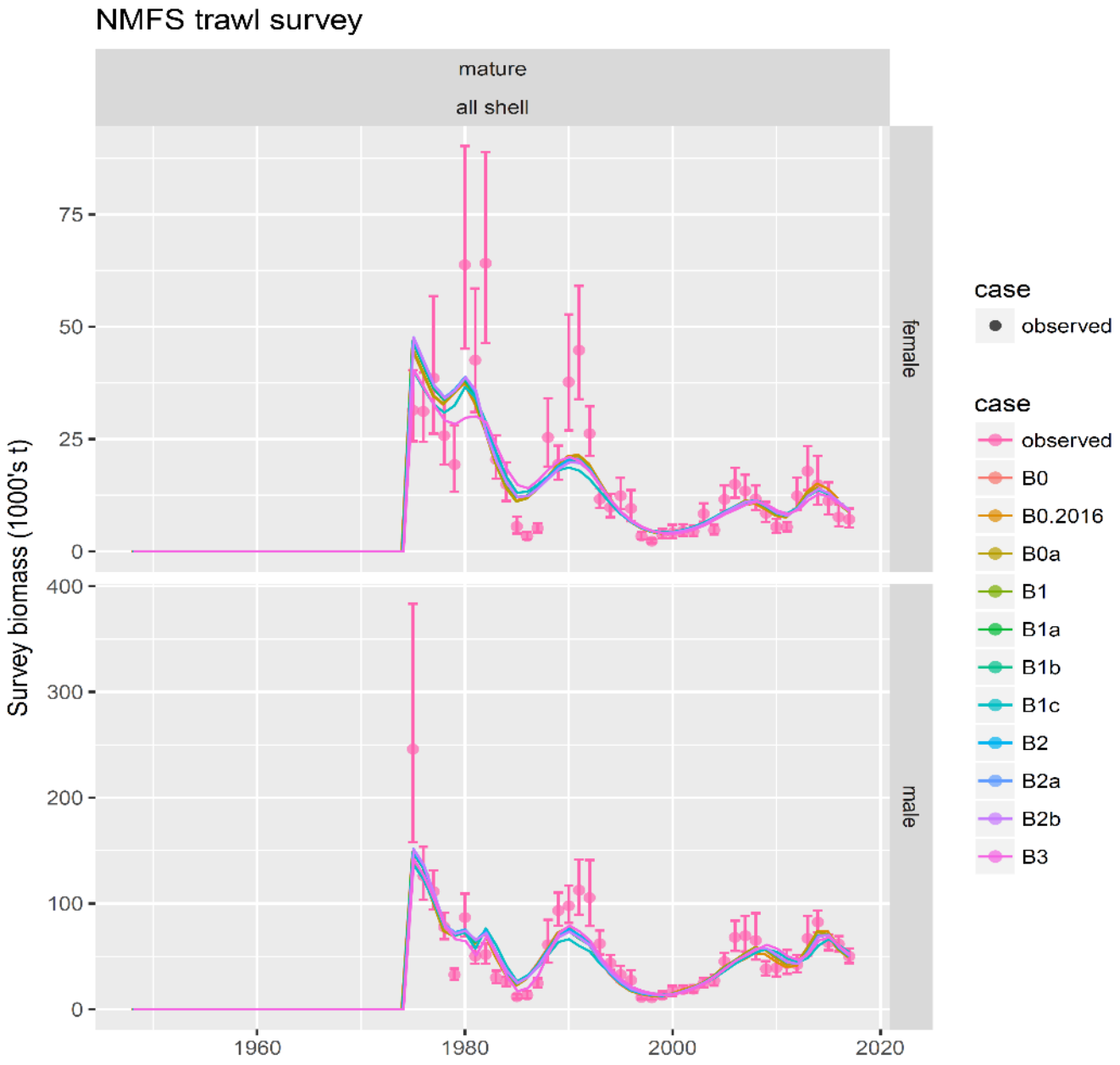
2011
2012
2013
2014
2015
2016
2017
50
30
10
50
100
150
Abundance (millions)
Carapace width (mm)

Tanner Crab

Model fits



Model B2b

- EBS growth data
- New selectivity parameterization for RKC fishery
- Retention curves for 3 time blocks

CPT Discussion and Recommendations

- Evaluate multiple reweighting methods
- Consider new chela data to define mature males
- Address overestimates of large males

Tier, OFL, and ABC Recommendations

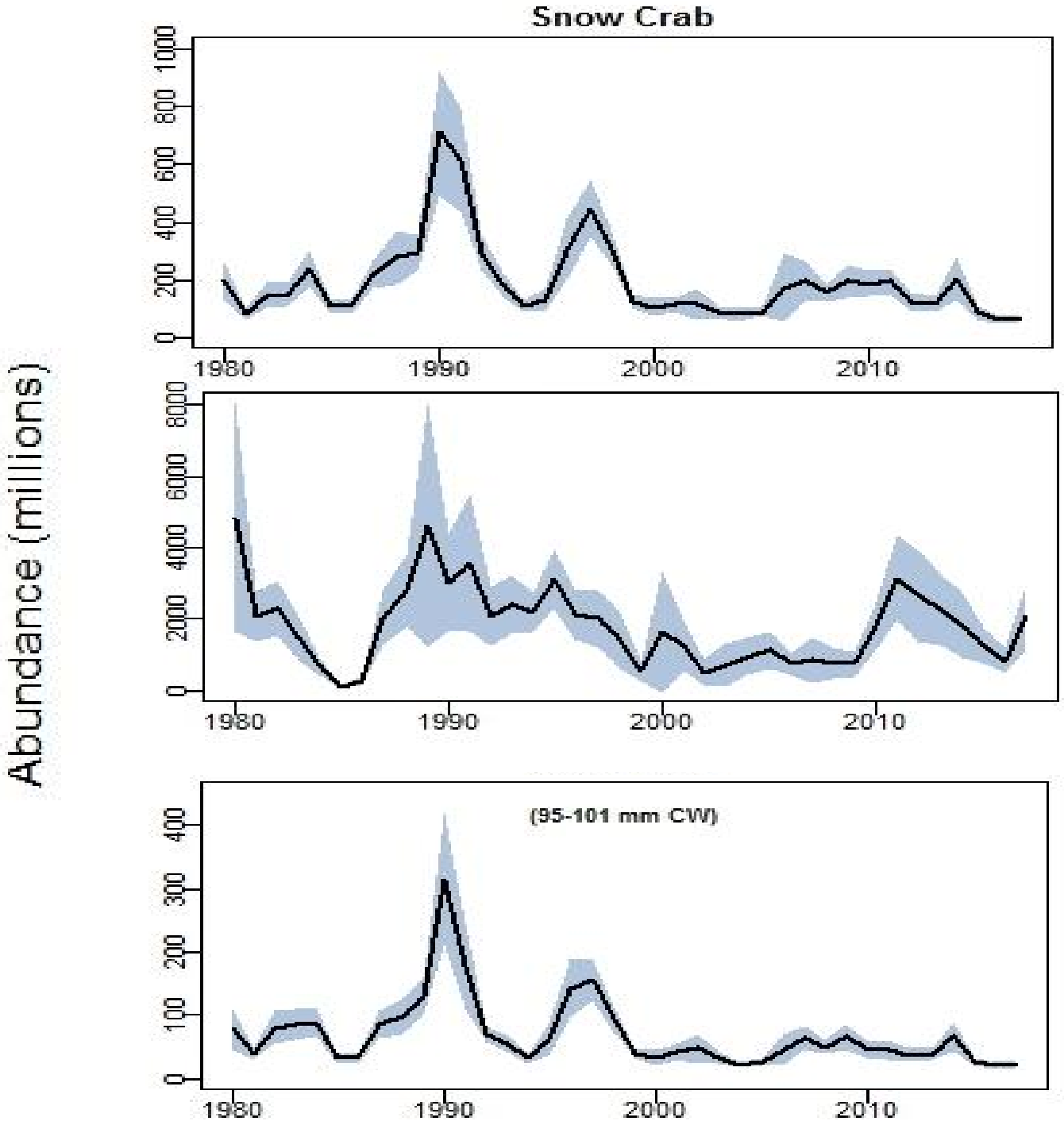
- CPT and author recommended 20% buffer
  - New model but some parameters hit bounds, and large males still overestimated.
- CPT concurred with Author recommendation for Tier 3a.

- Biomass (MMB) = 43.31 thousand t
- Total catch OFL = 25.42 thousand t
- ABC (less than max permissible) = 20% buffer = 20.33 thousand t

Snow Crab
Final Stock Assessment

Cody Szuwalski

Alaska Fisheries Science Center



Mature male

-2%

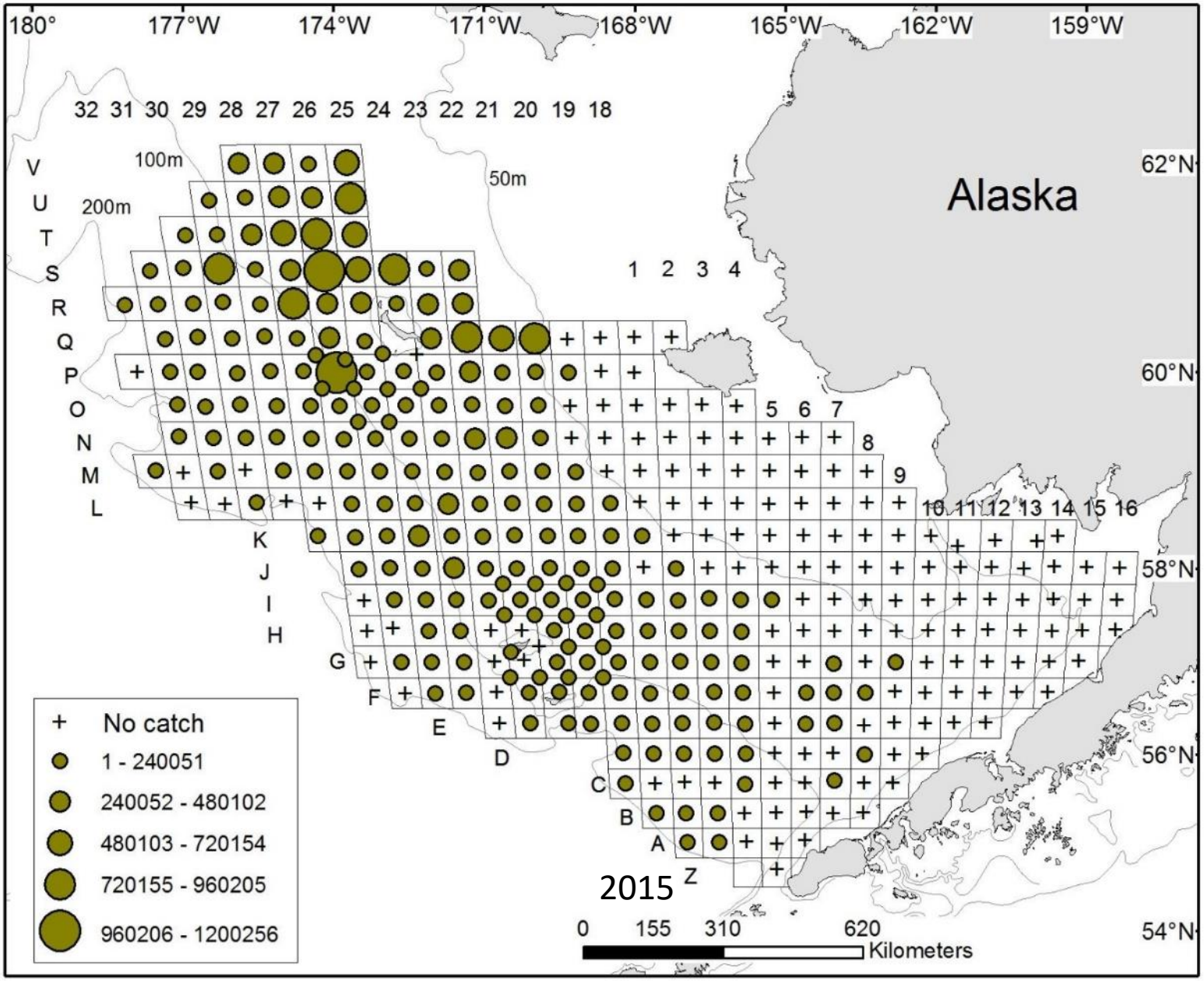
Mature female

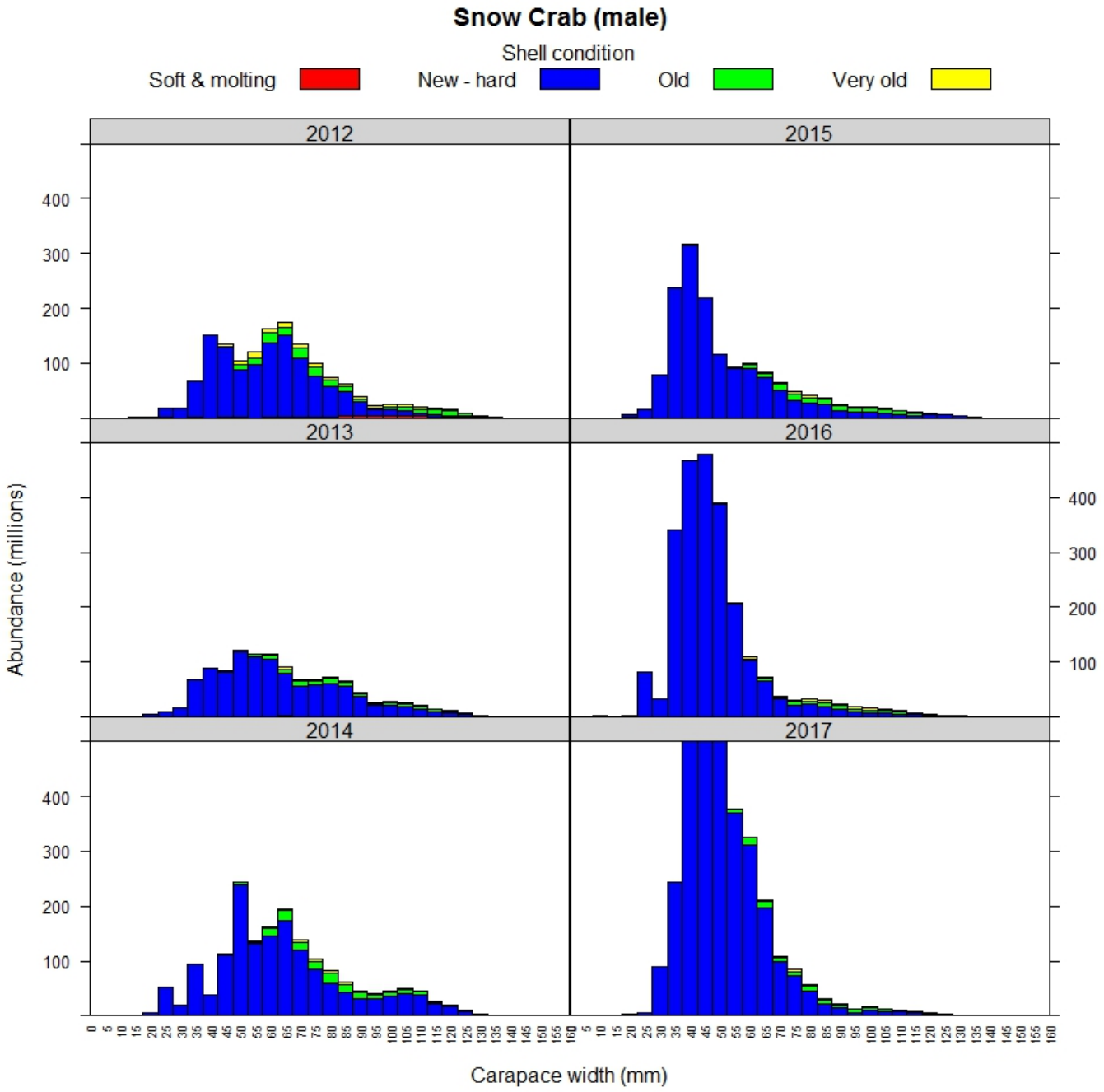
+99%

Juvenile

Male +82%
Female +99%

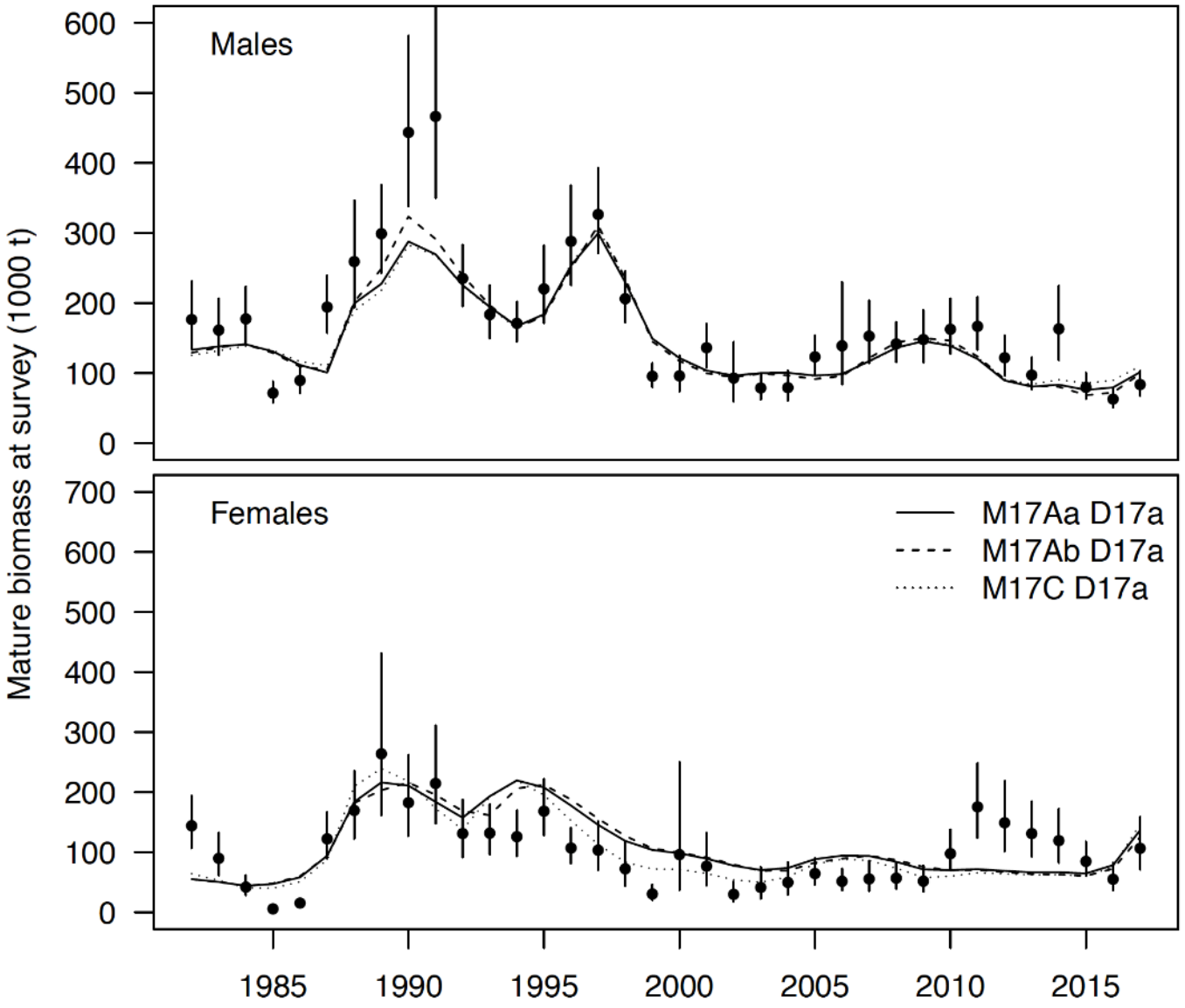
snow crab total density



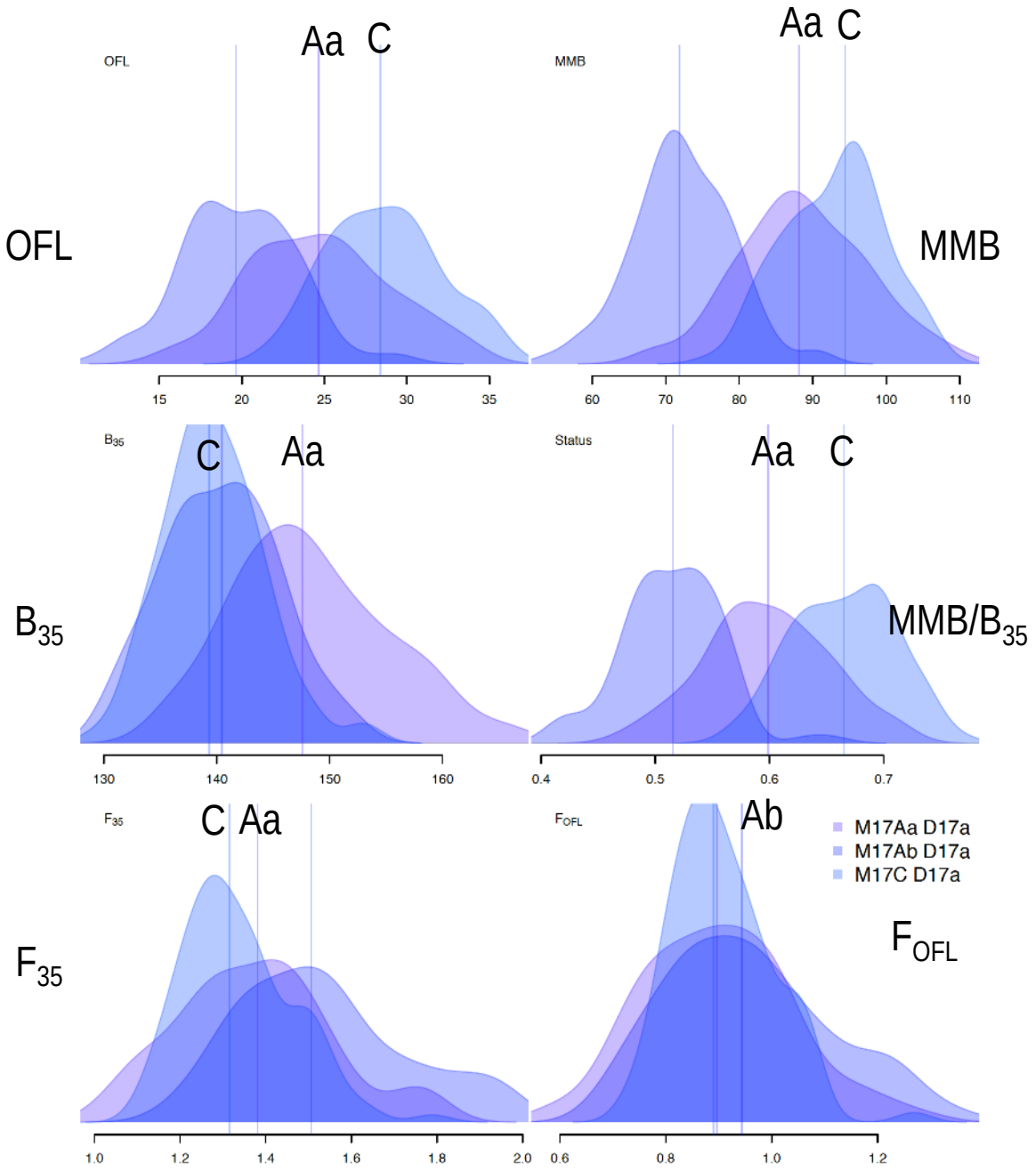

Snow Crab (male)
Shell condition
Soft & molting
New - hard
Old
Very old
2012
2015
2013
2016
2014
2017
Abundance (millions)
Carapace width (mm)

Fits to NMFS mature survey biomass

- Recommended model M17C.D17a
  - fits NMFS female survey biomass best
  - displays better MCMC characteristics and jittering results
  - estimates M for females better



OFL-related Quantities



CPT Discussion and Recommendations

- Incorporate new growth data in 2018 stock assessment
- Reconsider weighting framework

Tier, OFL, and ABC Recommendations

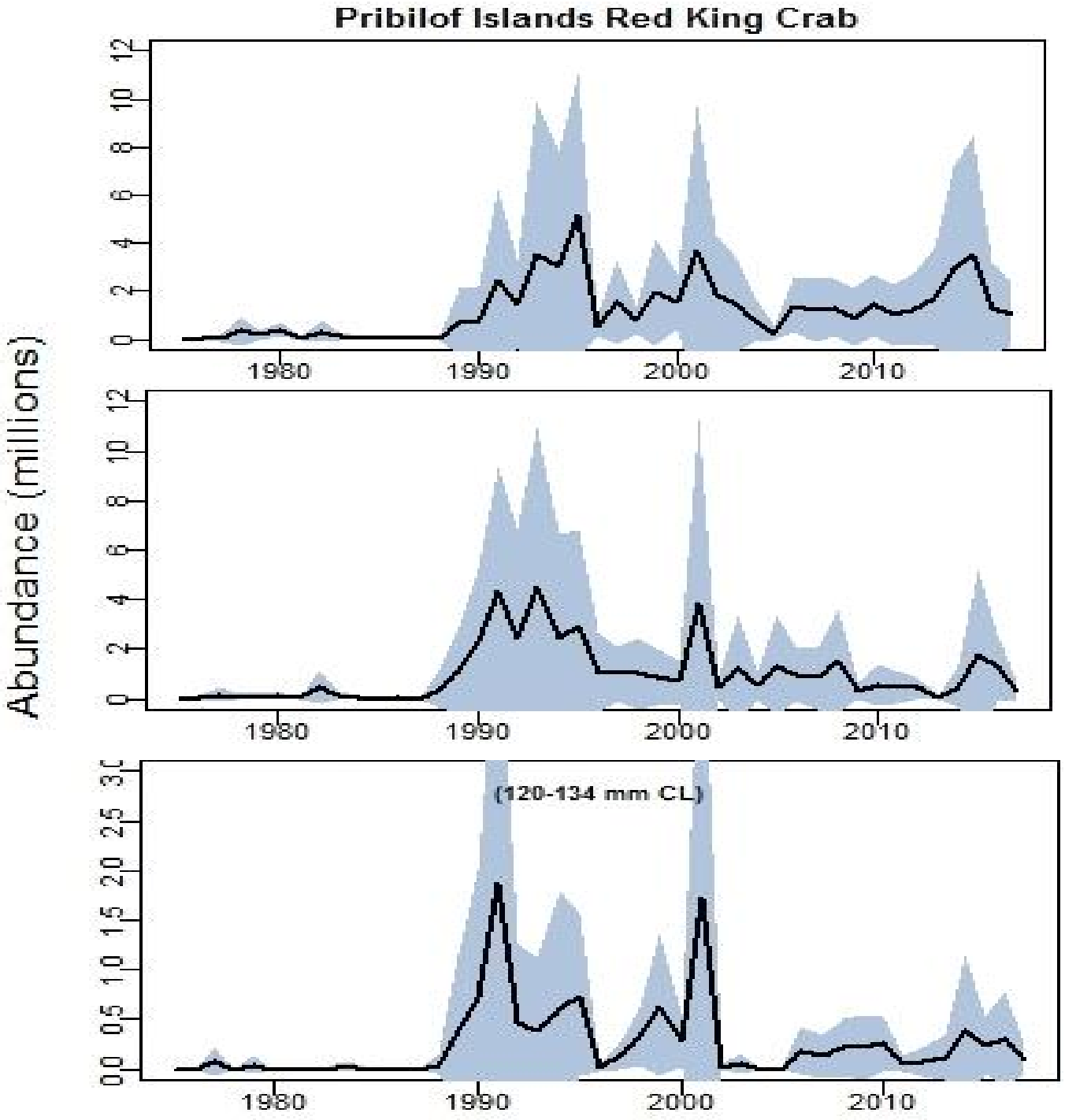
- CPT concurred with author recommended model and Tier status 3b.

- Biomass (MMB) = 99.6 thousand t
- Total catch OFL = 28.41 thousand t
- ABC (less than max permissible) = 20% buffer = 25.6 thousand t
  - **CPT recommended 10% last year; Increased uncertainty in appropriate model and large difference in parameter estimates.**

Pribilof Islands Red King Crab Final Stock Assessment

Jack Turnock

AFSC



Mature male

-12%

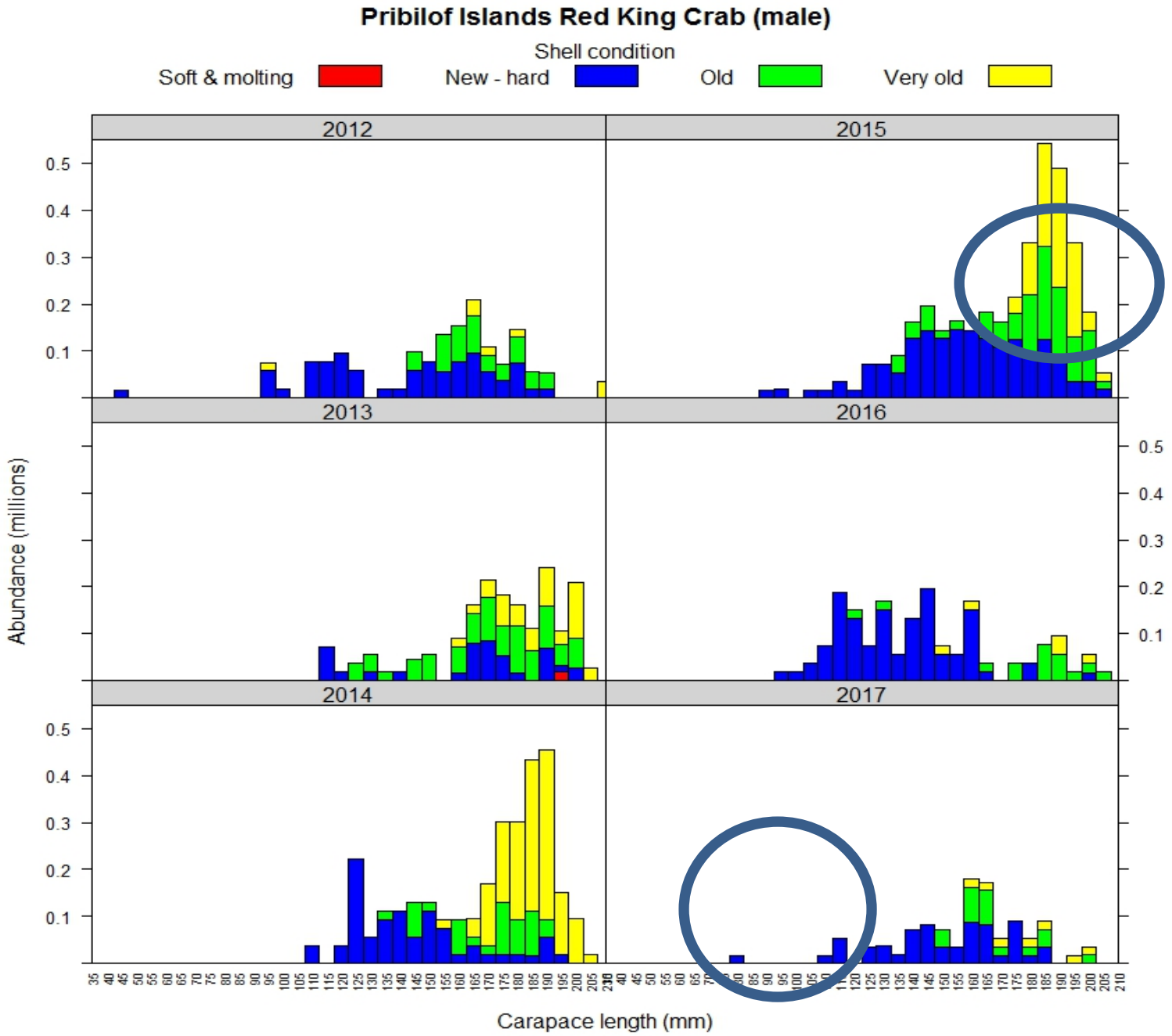
Mature females

-73%

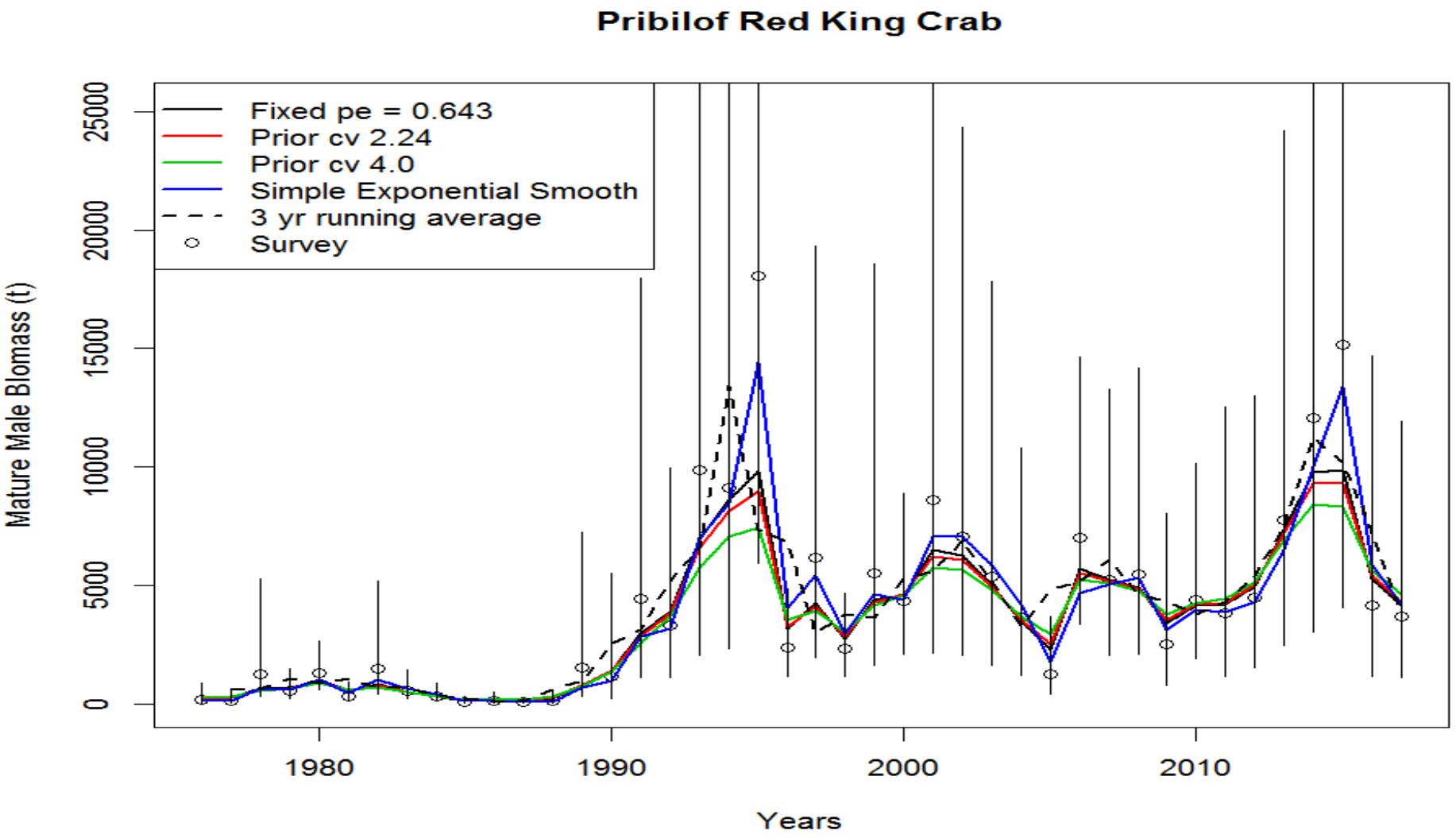
Juvenile

Male -83%

Female zero caught


Pribilof Islands Red King Crab (male)
Shell condition
Soft & molting
New - hard
Old
Very old
2012
2015
2013
2016
2014
2017
Abundance (millions)
Carapace length (mm)

Pribilof Islands Red King Crab



- Random effects model recommended to smooth the survey data

Tier, OFL, and ABC Recommendations

- CPT and author recommended 25% buffer
- CPT concurred with Author recommendation for Tier 4b.

- Biomass (MMB) = 3,364 t
- Total catch OFL = 480 t
- ABC (less than max permissible) =

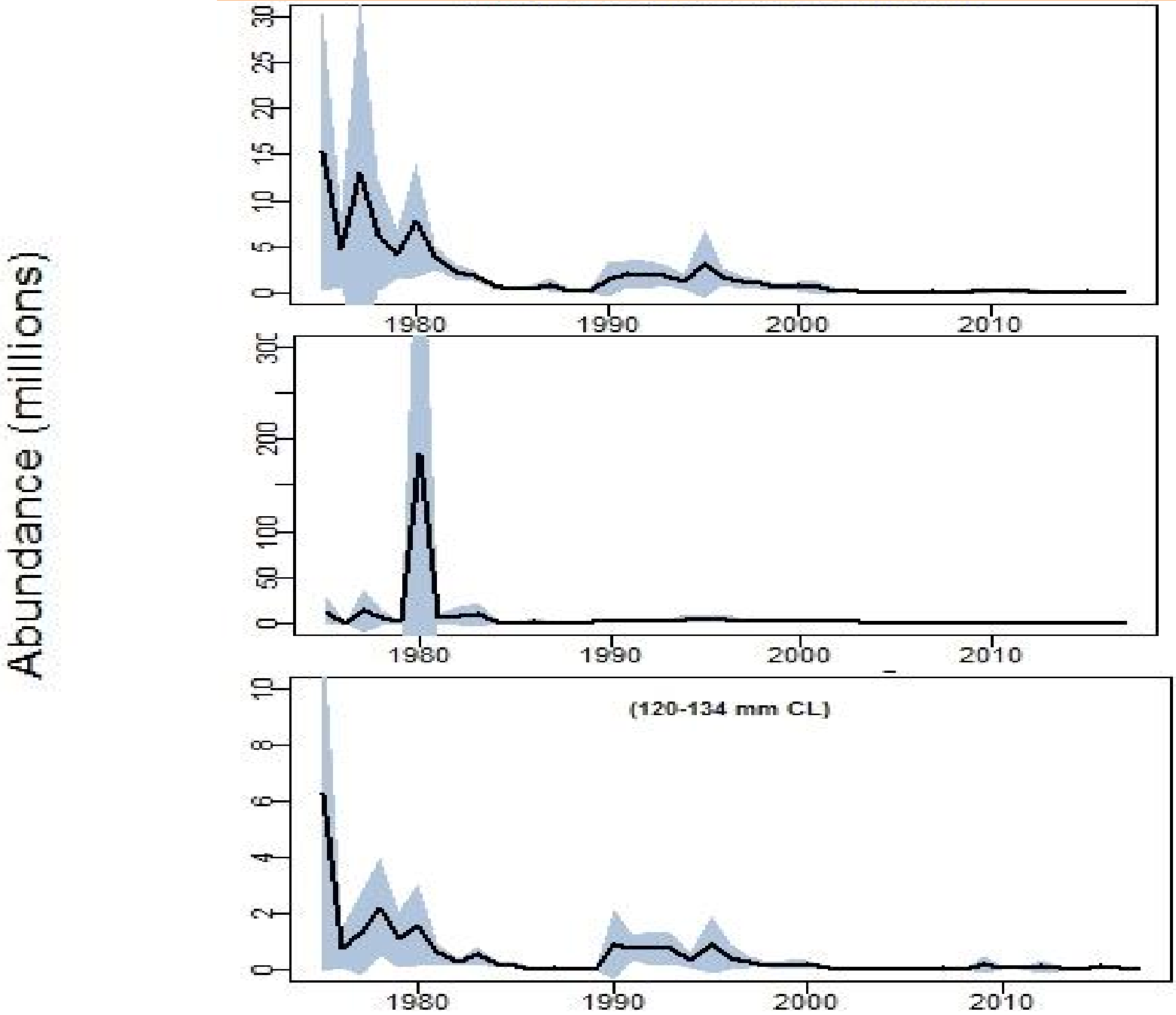
  25% buffer = 360t

Pribilof Islands Blue King Crab Final Stock Assessment

Buck Stockhausen

Alaska Fisheries Science Center

Pribilof Islands blue king crab



Mature male

+96%

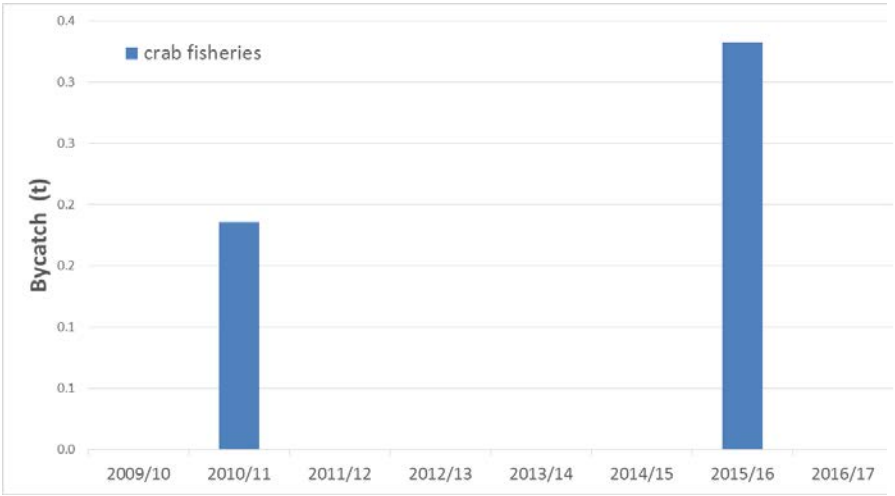
Mature female

-42%

Juvenile

Male -36%
Female +12%

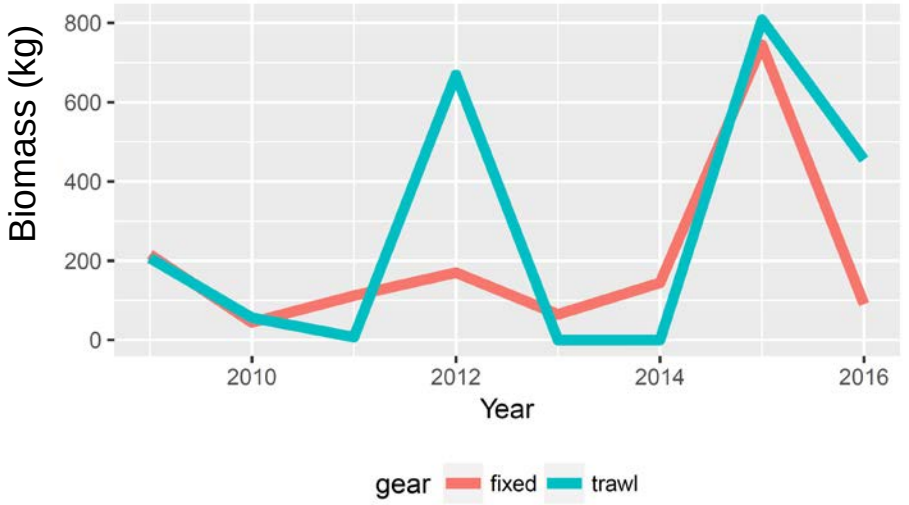
Bycatch in Non-target Fisheries

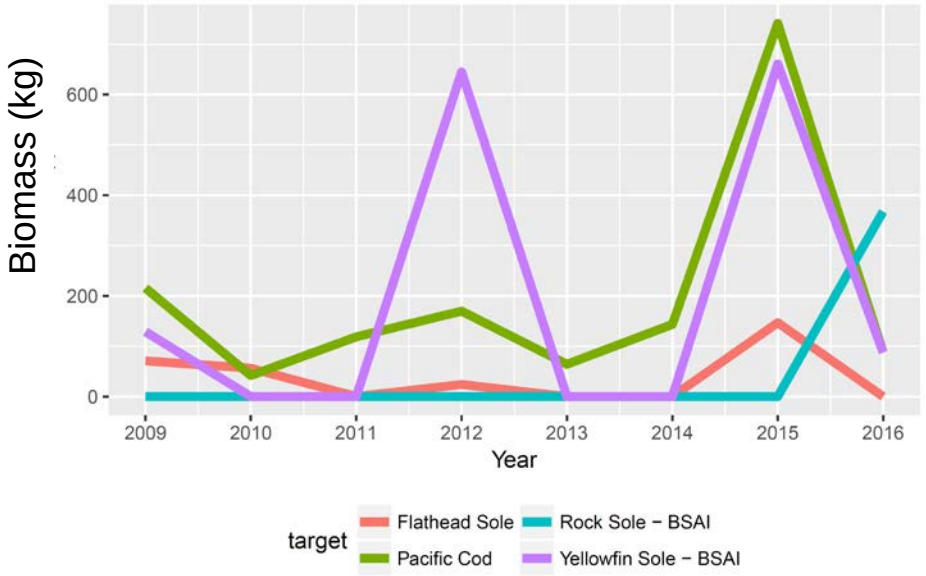


HM_{fixed} = 0.2 (was 0.5)

HM_{trawl} = 0.8

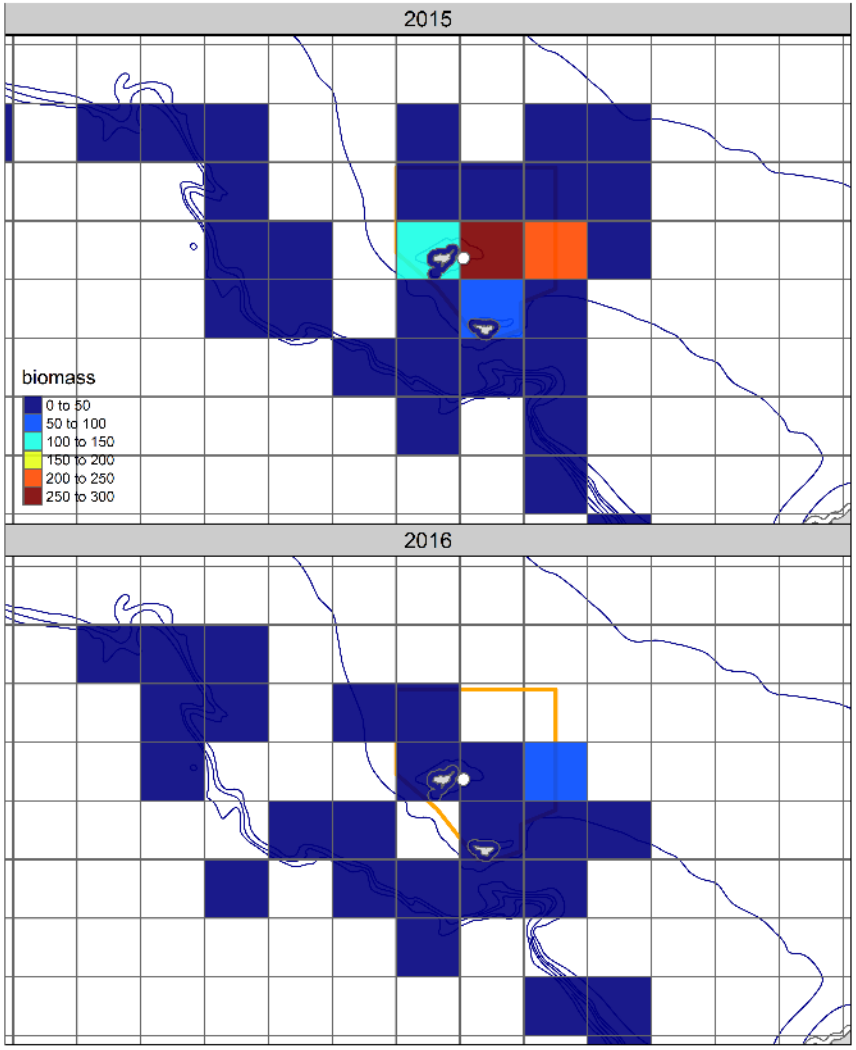
Groundfish Fisheries



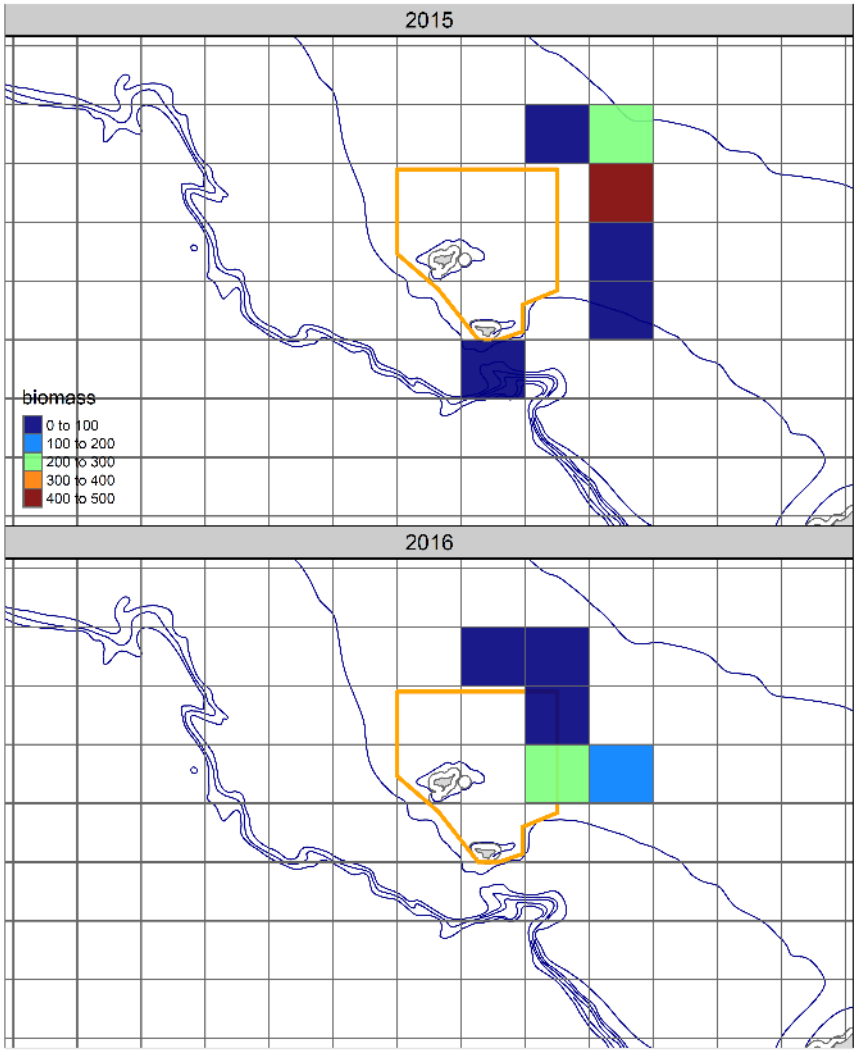


Bycatch in Groundfish Fisheries

fixed gear



trawl gear



Tier, OFL, and ABC Recommendations

- CPT concurred with authors random effects model
- CPT and author recommended 25% buffer
- CPT concurred with Author recommendation for Tier 4c.

- Biomass (MMB) = 233 t
- Total catch OFL = 1.16 t
- ABC (less than max permissible) =

  25% buffer = 0.87 t

St. Matthew Island Blue King Crab Final Stock Assessment

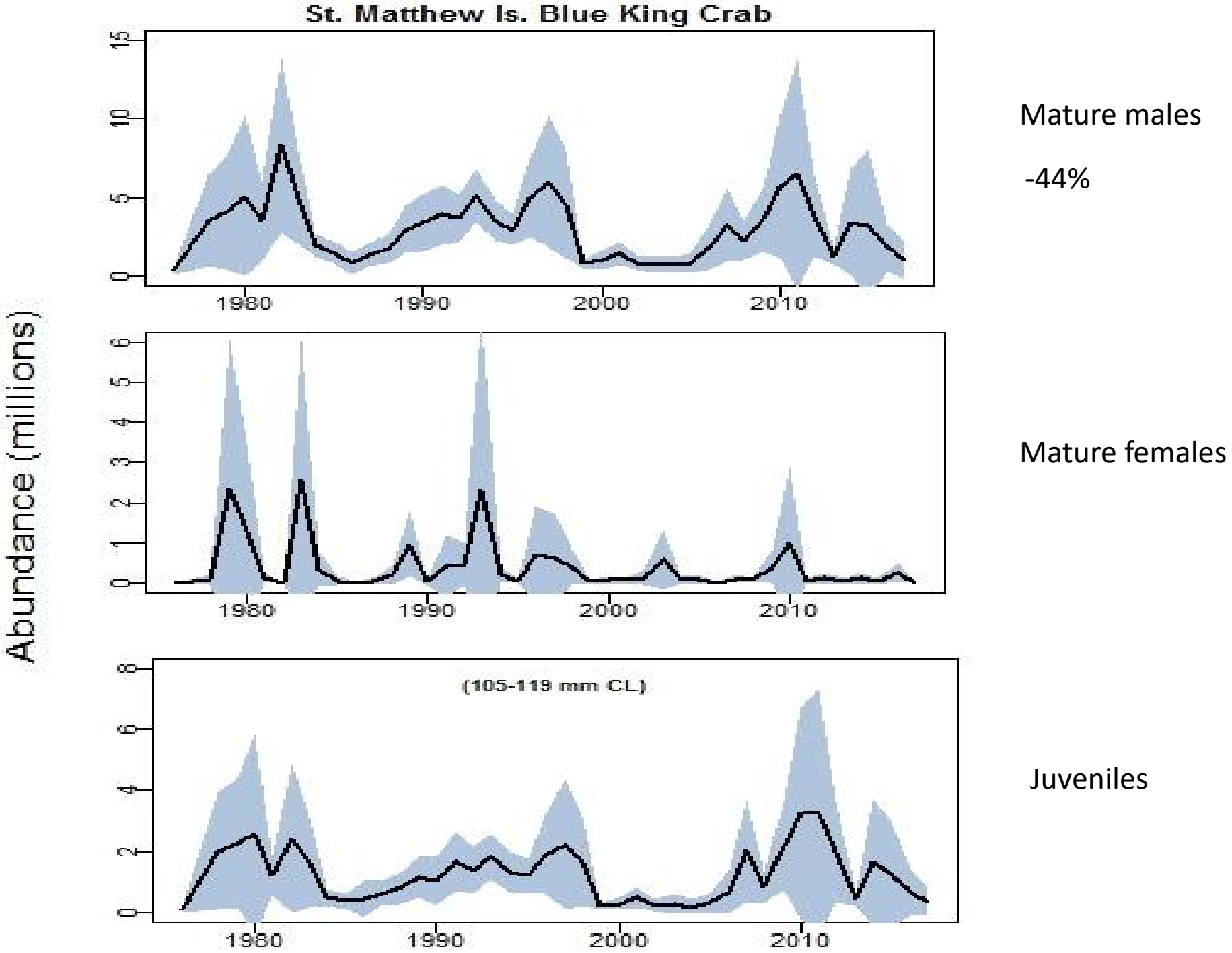
Saint Matthew Island Blue King Crab Stock Assessment 2017

James Ianelli[1], D'Arcy Webber[2], Jie Zheng[3], and Alathea Letaw[4]
[1]NOAA, jim.ianelli@noaa.gov
[2]Quantifish, darcy@quantifish.co.nz
[3]Alaska Department of Fish and Game, jie.zheng@alaska.gov
[4]NOAA, alathea.letaw@noaa.gov

September 2017

Executive Summary

1. **Stock**: Blue king crab, *Paralithodes platypus*, Saint Matthew Island (SMBKC), Alaska.
2. **Catches**: Peak historical harvest was 4288 t (9.454 million pounds) in 1983/84[1]. The fishery was

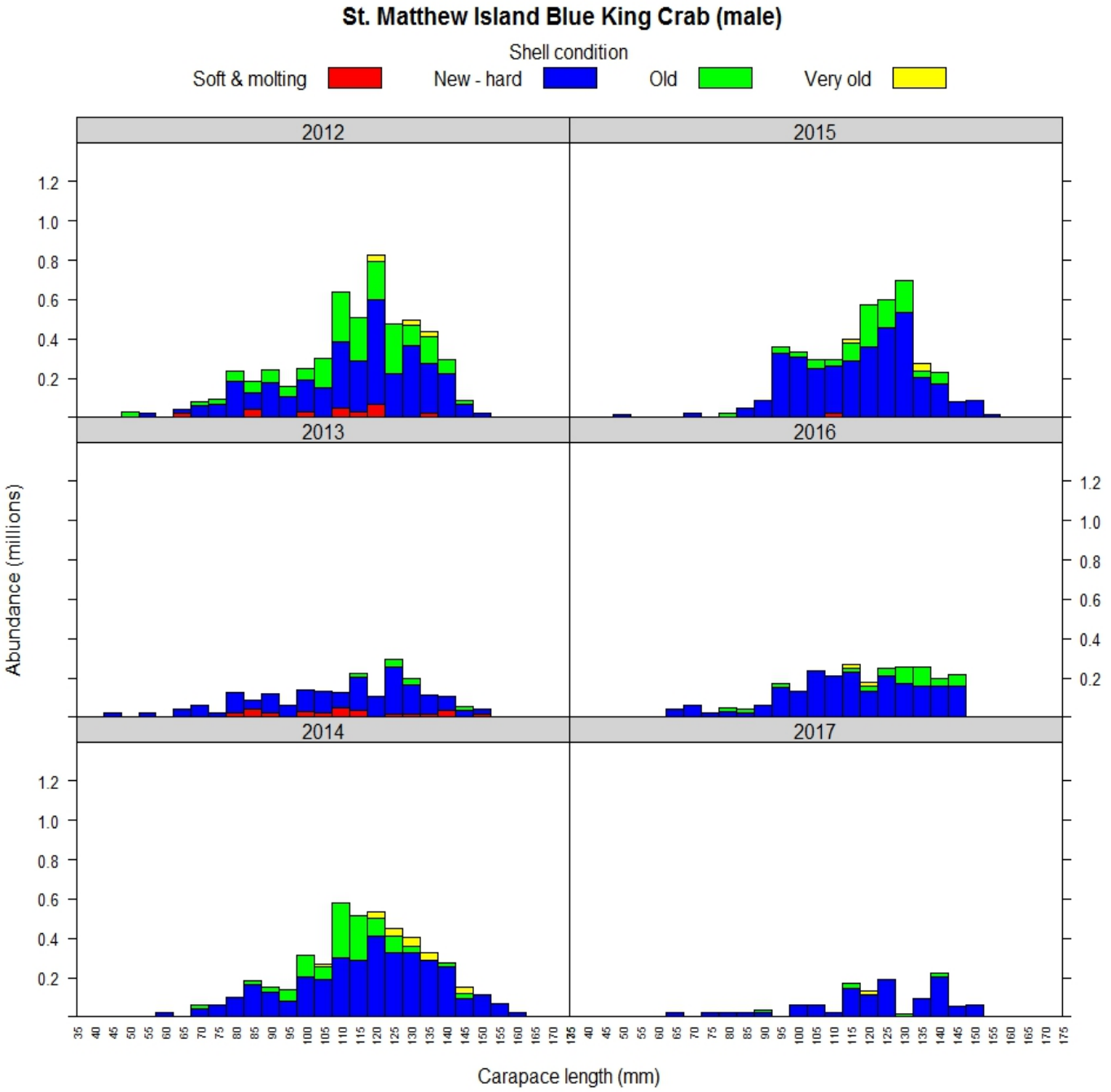


Mature males

-44%

Mature females

Juveniles


St. Matthew Island Blue King Crab (male)
Shell condition
Soft & molting
New - hard
Old
Very old
2012
2015
2013
2016
2014
2017
Abundance (millions)
Carapace length (mm)

SMBKC: Data extent

SMBKC crab

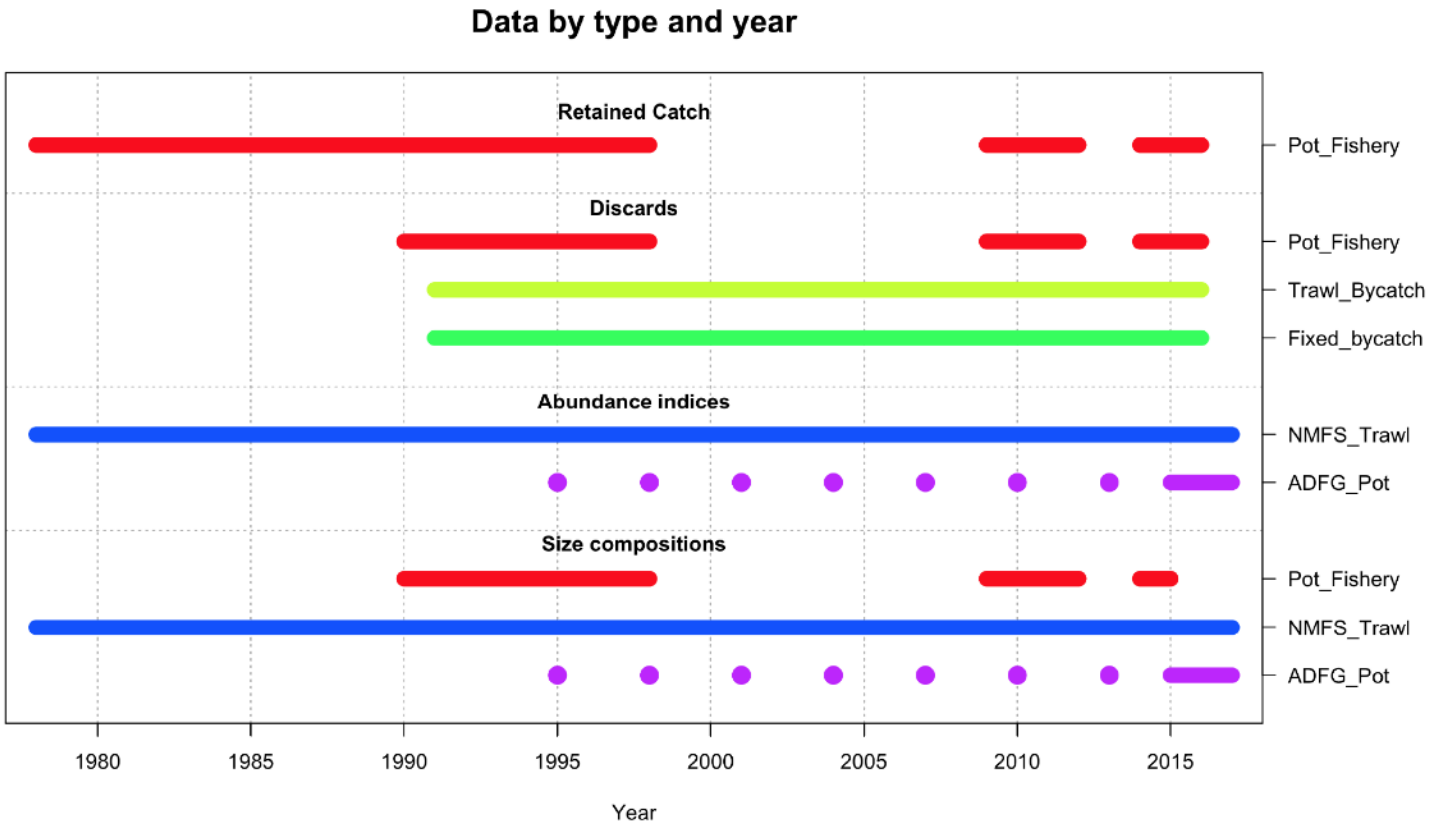
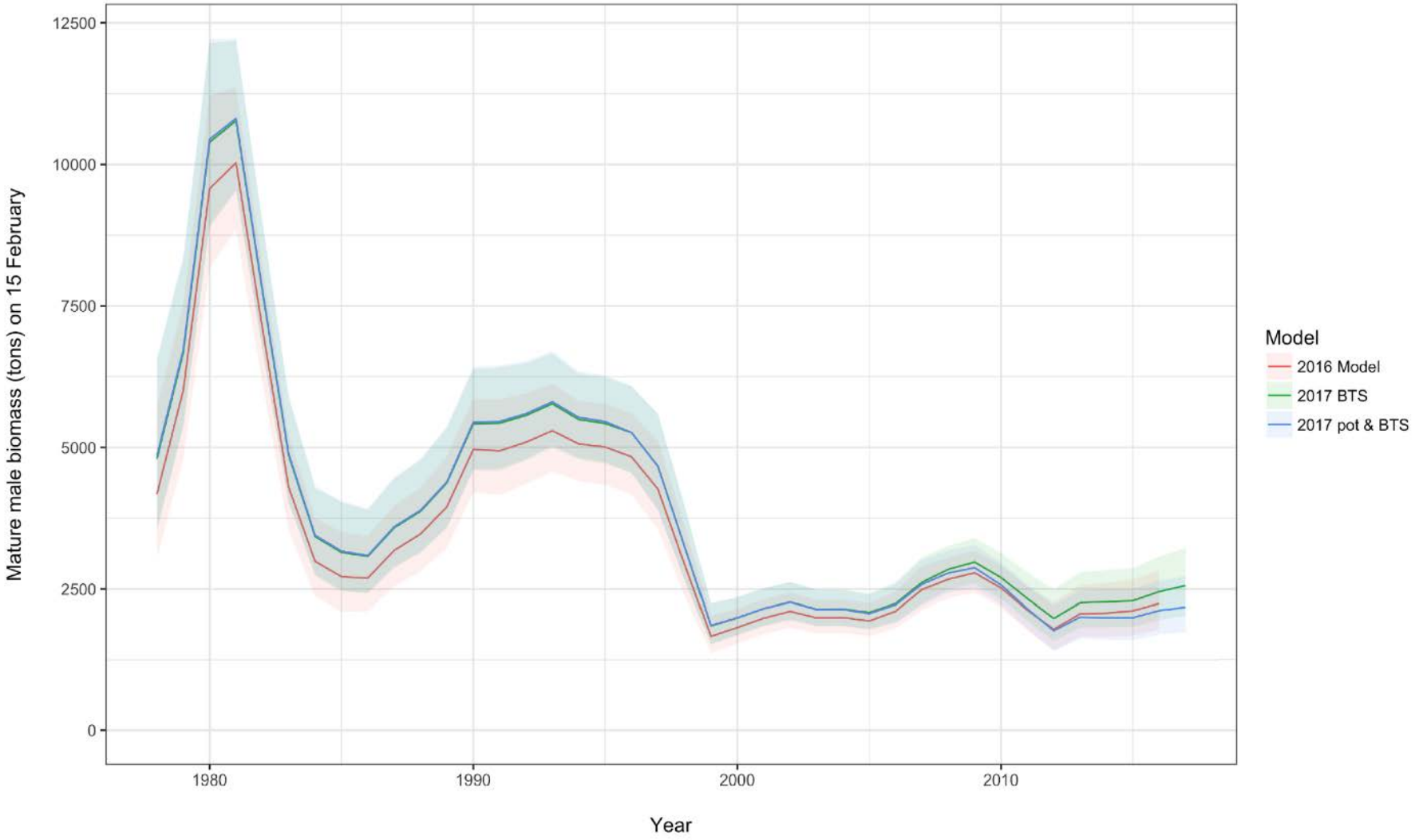


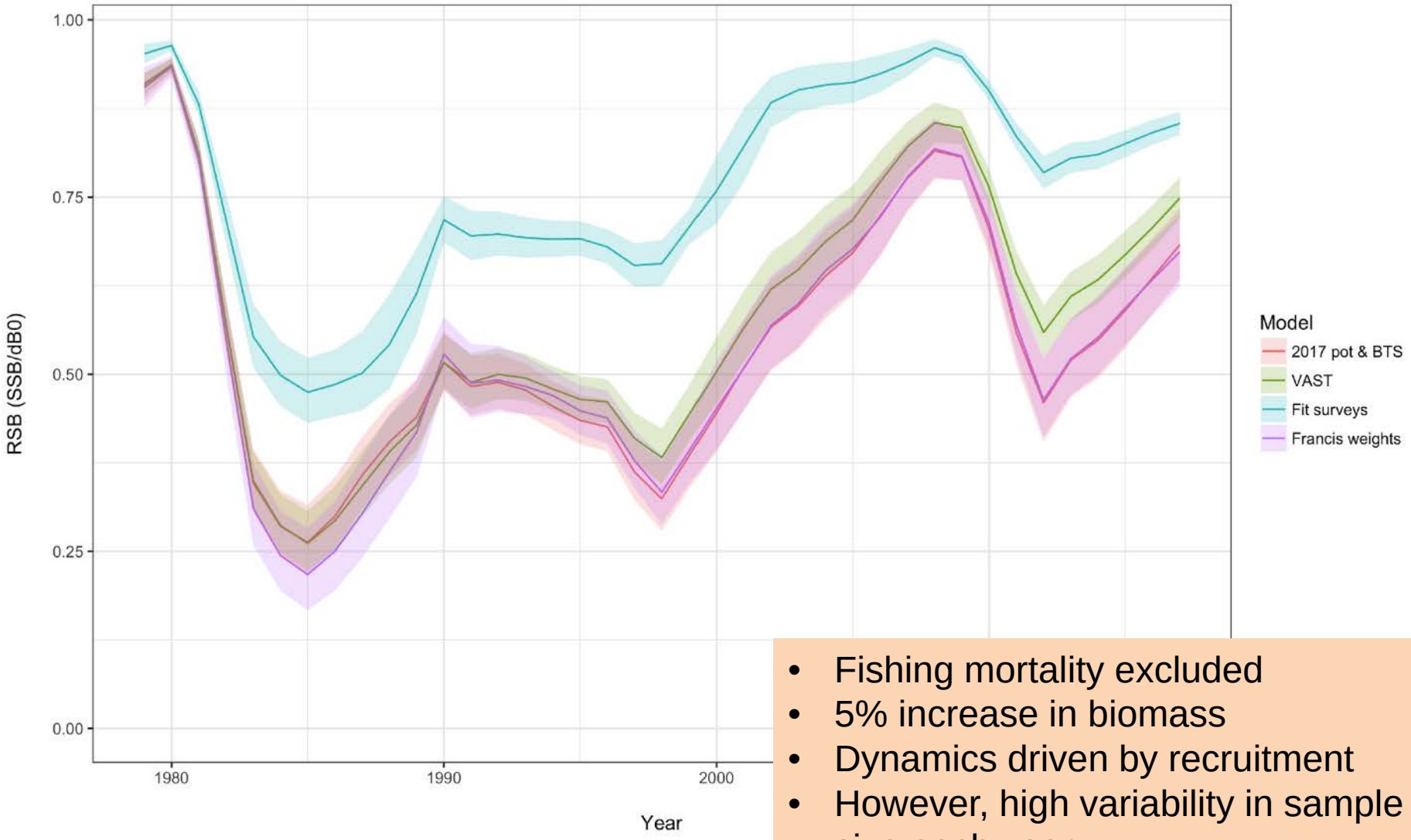
Figure 3: Data extent for the SMBKC assessment (with the 2017 Pot survey included).

Sensitivity to new data



St Matthew Island blue king crab

Dynamic B-zero...alternative to evaluate fishing effects



- Fishing mortality excluded
- 5% increase in biomass
- Dynamics driven by recruitment
- However, high variability in sample size each year.

Tier, OFL, and ABC Recommendations

- CPT and author recommended 20% buffer
- CPT concurred with Author recommendation for Tier 4b.

- Biomass (MMB) = 2.18 thousand t
- Total catch OFL = 0.12 thousand t
- ABC (less than max permissible) = 20% buffer = 0.10 thousand t

- SSC increased buffer to 25%=0.09 thousand t

Western Aleutian Islands red king crab

Stock Status

- 2016/2017 total catch = <1 t
- 2016/2017 OFL = 56 t

Overfishing DID NOT occur

- Stock now on triennial assessment cycle (2020)
- Updated catch and survey data annually

Can not assess overfished status

Pribilof Islands golden king crab

Stock Status

- 2016/2017 total catch = 0.24 t
- 2016/2017 OFL = 91 t

Overfishing DID NOT occur

- Stock now on triennial assessment cycle (2020)
- Updated catch and survey data annually

Can not assess overfished status

September 2017 Crab Plan Team Report

- AIGKC model (M.S.M. Siddeek, J. Zheng, C. Siddon, and B. Daly)
- NSRKC model (Toshihide “Hamachan” Hamazaki, Jie Zheng)
- Ecosystem Report (Stephanie Zador)
- Groundfish bycatch ov**e**rview (Krista Milani AKRO)
- Crab bycatch overview (Ben Daly)
- BSFRF research update (Scott Goodman)
- January 9-11 CPT meeting planning