

Review of TACs

Bering Sea Crab: 2019/20 Season

ADF&G presentation to BSAI crab industry, 9 Oct 2019

Join by teleconference:

Call in #: 1-800-315-6338

Access code: 4861842

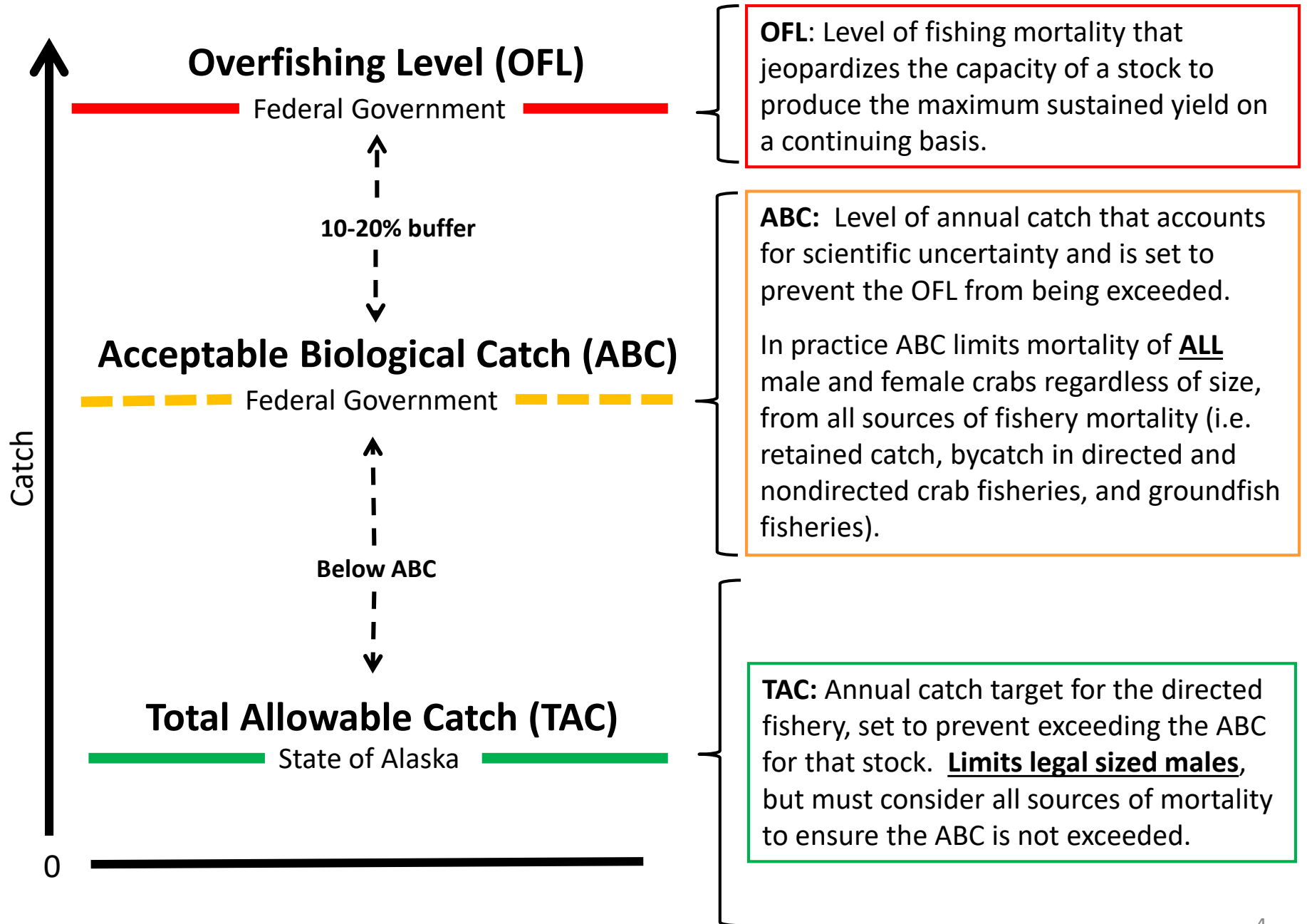
Outline

- Introduction
- PIBKC
- PIRKC
- SMBKC
- BBRKC
- Tanner
- Intermission
- snow

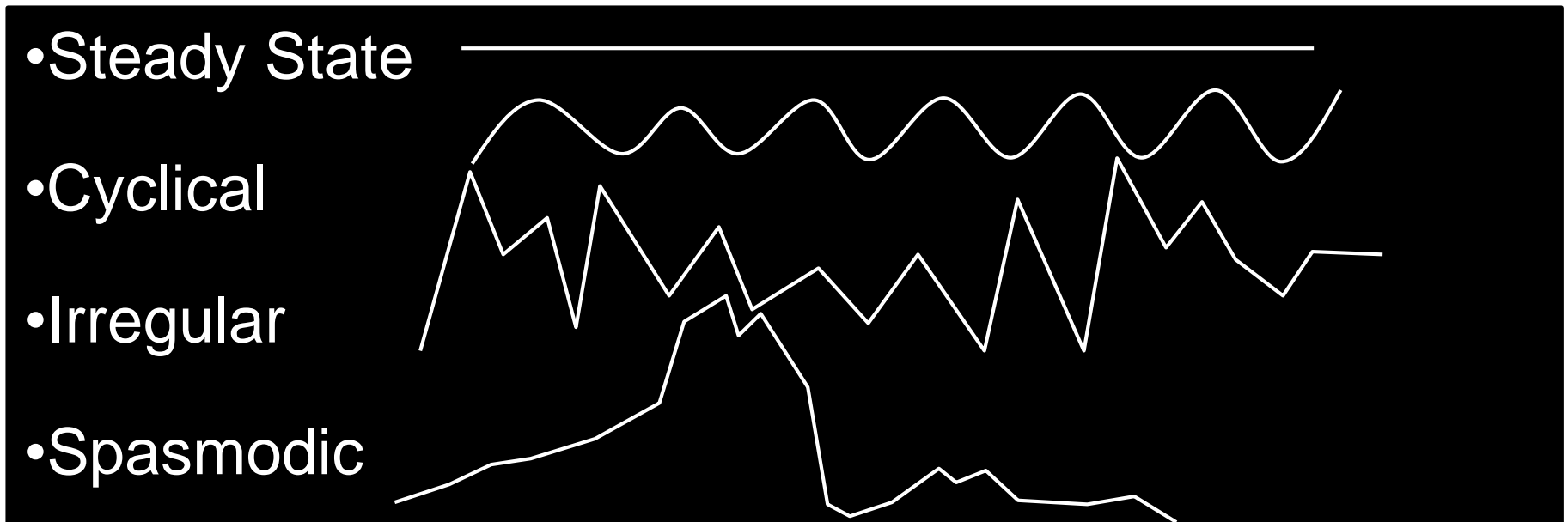
2019/20 TAC Summary

Fishery	OFL (mill lb)	ABC (mill lb)	TAC (mill lb)
Pribilof blue king crab	0.0026 (total catch)	0.0020 (total catch)	0 (directed fishery closed)
Pribilof red king crab	1.90 (total catch)	1.43 (total catch)	0 (directed fishery closed)
St. Matthew blue king	0.10 (total male catch)	0.08 (total male catch)	0 (directed fishery closed)
Bristol Bay red king crab	7.50 (total catch)	6.00 (total catch)	3.80 (retained catch)
Bering Sea Tanner crab	63.62 (total catch)	50.89 (total catch)	0 (EBT), 0 (WBT) (directed fishery closed)
Bering Sea snow crab	121.00 (total catch)	96.80 (total catch)	34.02 (retained catch)

Details follow...



Population Trends



- How can we account for all this change over time??
- Potential different realities create challenges in estimating population abundance

Population Abundance

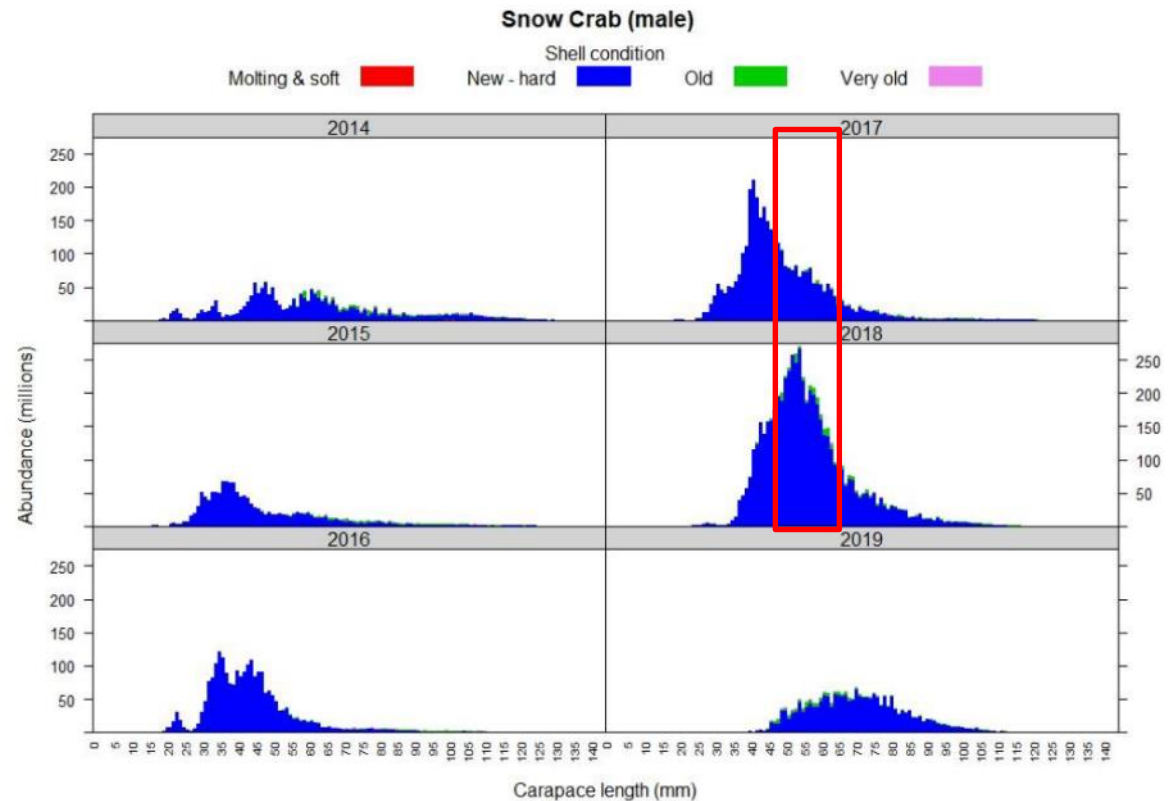
Surveys: bottom trawl yields **area-swept estimates**

- Net mensuration: net width x tow length = area-swept
- Crab catch / area-swept → density → expand to total area
- Survey-based abundance *indices* (i.e., area-swept estimates)
 - Sampling error, survey selectivity, summer snap-shot

Stock Assessment Models: **quantitative predictions** about crab populations

- Length-based analysis: reduces uncertainty in annual abundance estimates
- Can account for gear selectivity, natural mortality, growth, etc
- Lots assumptions that goes into them:
 - Growth
 - Male maturity
 - Natural mortality
 - Etc

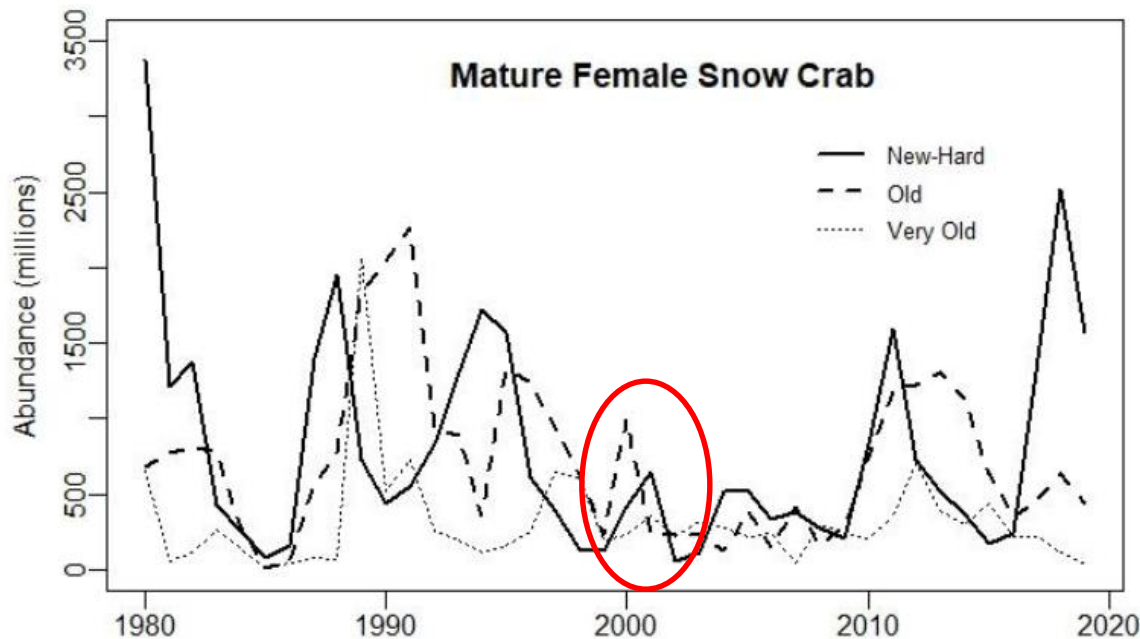
Example of Sampling Error



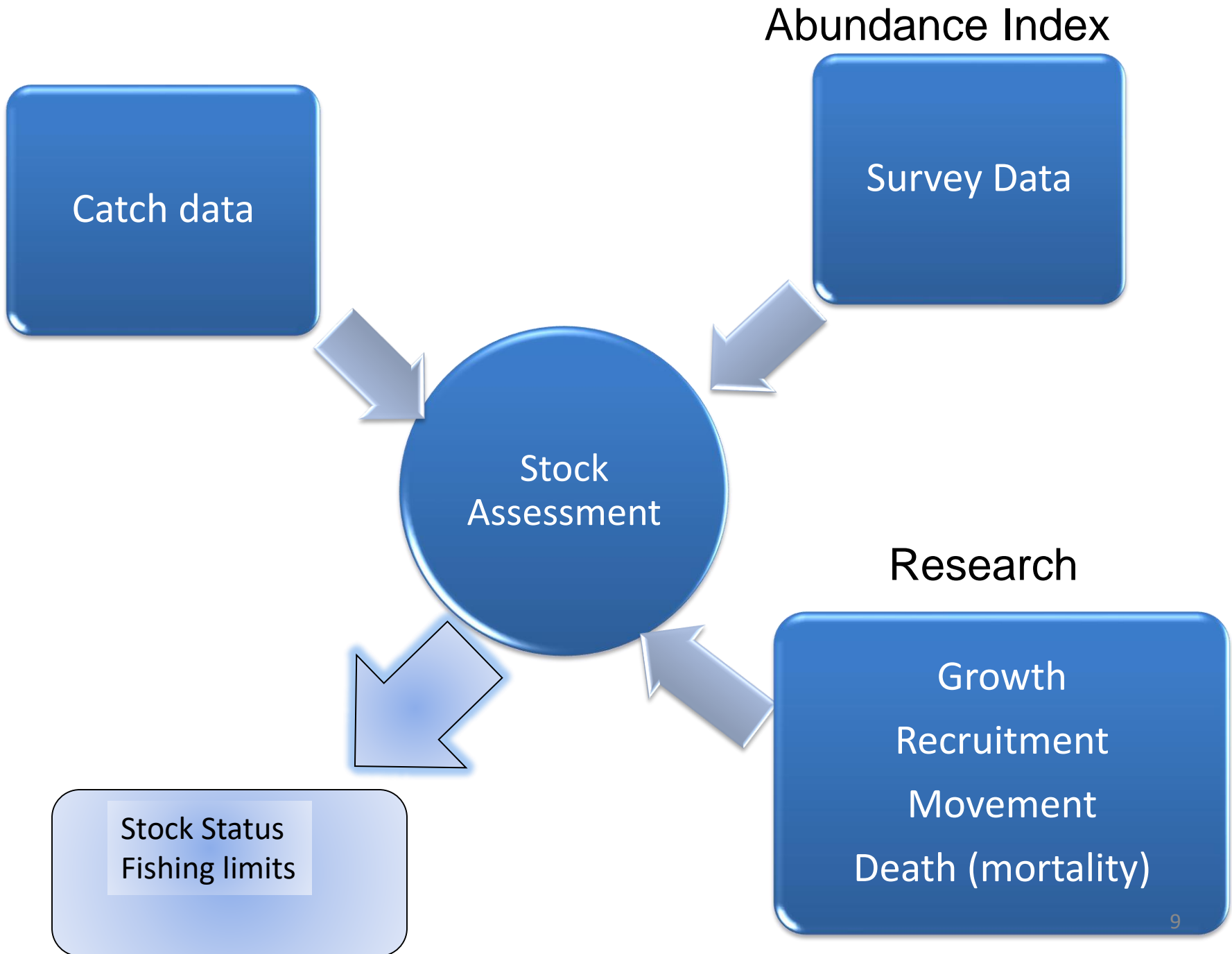
A size class that gets larger from one year to the next suggest sampling error, not that more crab were born and immediately were in that size class.

Example of Sampling Error

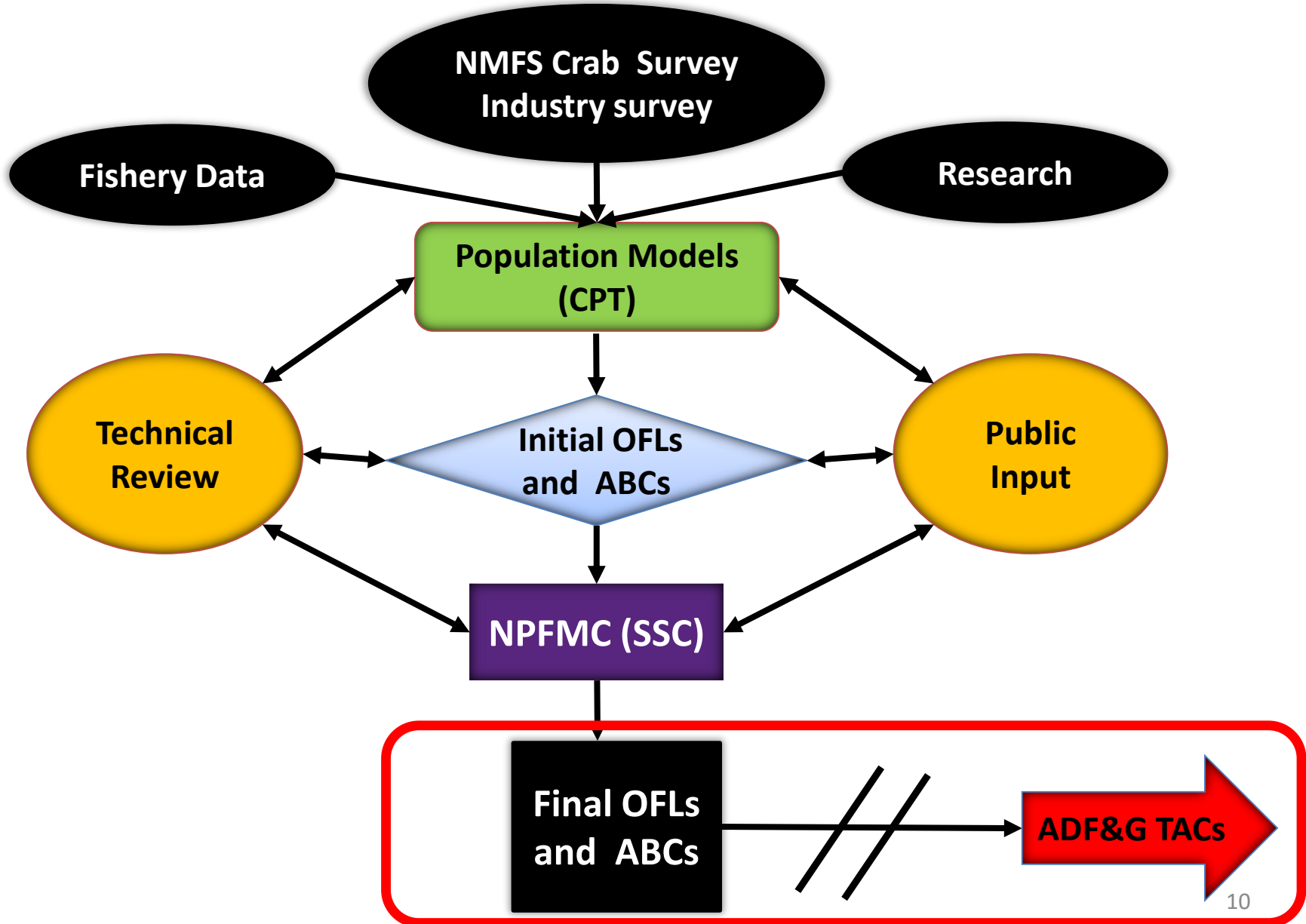
From 2019 NOAA Tech Memo



- The survey fails to detect portions of the population.
- Survey estimates of newshell female snow crab were 125 million in 1999, yet estimates of oldshell mature females was nearly 1,000 million in 2000.
- Estimates of oldshell females should be at or below levels of newshell females the year prior.



Federal Crab Stock Assessment Process



FMP 8.2.2. Total Allowable Catch and Guideline Harvest Level

The FMP authorizes the State to set preseason TACs and GHs under State regulations.....

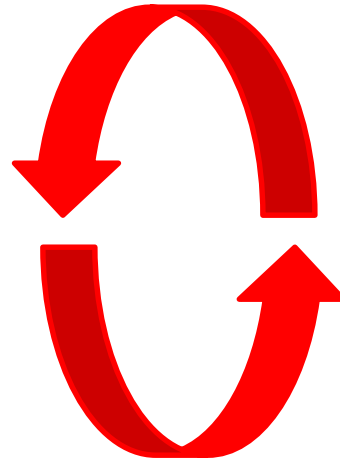
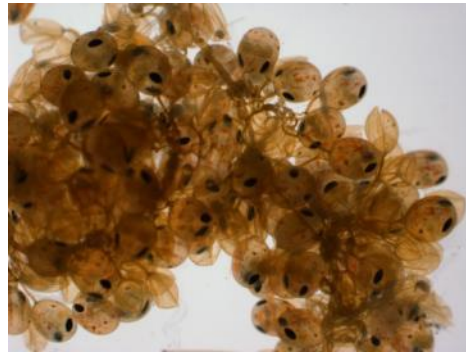
The State will take into account the following factors, to the extent information is available, in developing harvest strategies or setting TACs and GHs:

- (1) whether the (Annual Catch Limit) ACL for that stock was exceeded in the previous year;
- (2) stock status relative to the OFL and ACL;
- (3) estimates of exploitable biomass;
- (4) estimates of recruitment;
- (5) estimates of thresholds;
- (6) market and other economic considerations;
- (7) additional uncertainty; and
- (8) any additional factors pertaining to the health and status of the stock or the marine ecosystem.

Additional uncertainty includes:

- (1) management uncertainty (i.e., uncertainty in the ability of managers to constrain catch so the ACL is not exceeded, and uncertainty in quantifying the true catch amount) and
- (2) scientific uncertainty identified and not already accounted for in the ABC (i.e., uncertainty in bycatch mortality, estimates of trends and absolute estimates of size composition, shell condition, molt status, reproductive condition, spatial distribution, bycatch of non-target crab stocks, environmental conditions, fishery performance, fleet behavior, and the quality and amount of data available for these variables).

Life Cycle



Crabs

Kingdom: **Animalia**

Phylum: **Arthropoda** (“Arthro”=jointed, “pod” =foot or leg)

Subphylum: **Crustacea**

Class: **Malacostraca**

Order: **Decapoda** (“Deca”=10, “pod”=foot or leg)

Infraorder

Anomura

Brachyura



Biology: Anomurans vs. Brachyurans

Anomurans (king crabs)

- No terminal molt
 - Females molt yearly
 - Males may molt
- No sperm retention
 - Males must be present at fertilization
- Podding behavior
 - Patchy distribution
 - Could impact survey precision

Brachyurans (snow, Tanner)

- Terminal molt (oldshell)
 - Females
 - Males
- Sperm retention
 - Males not present at fertilization
 - Complicates our understanding of mating dynamics and reproductive potential

Groups considered in TAC setting

Mature males: generally thought of as “currency” of the population. Exploitation rates scaled to MMB or TMB

Mature females: represent an important component of the reproductive potential of the population

Legal males: a size intended to allow at least one opportunity for mating before potential removal by fishery

Industry preferred males: often larger than the legal size. Group of individuals targeted by the fishery.

Abundance estimates in TAC setting

1. **“Area Swept” estimates**.....raw area-swept; male maturity defined by size cut-off, female maturity defined by abdomen shape
2. **“Model observed” estimates**..... model estimates of area-swept, defining male and female maturity within the model using maturity curves informed by morphometric data using historic chela height data and female abdomen shape
3. **“Model survey” estimates**..... interprets what the area-swept estimates “should have been”, attempting to correct for survey sampling error
4. **“Model population” estimates**.....the fitted line that applies a survey selectivity curve by sex and size, attempting to correct for trawl efficiency (Q)
.....estimates of the underlying population..... “the population estimate if all crabs in the line of the survey trawl net were caught”
 - Q = proportion of animals in trawl path captured

- These estimates can differ greatly
- In any given year we don't know what estimate is closer to the true population size
- Resulting TAC can vary depending on what set of estimates is used

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Geophysical Research Letters

Research Letter |  Full Access

Extreme Conditions in the Bering Sea (2017–2018): Record-Breaking Low Sea-Ice Extent

Phyllis J. Stabeno , Shaun W. Bell

First published: 14 August 2019 | <https://doi.org/10.1029/2019GL083816> | Cited by: 1



National Oceanic and
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Unprecedented 2018 Bering Sea ice loss repeated in 2019

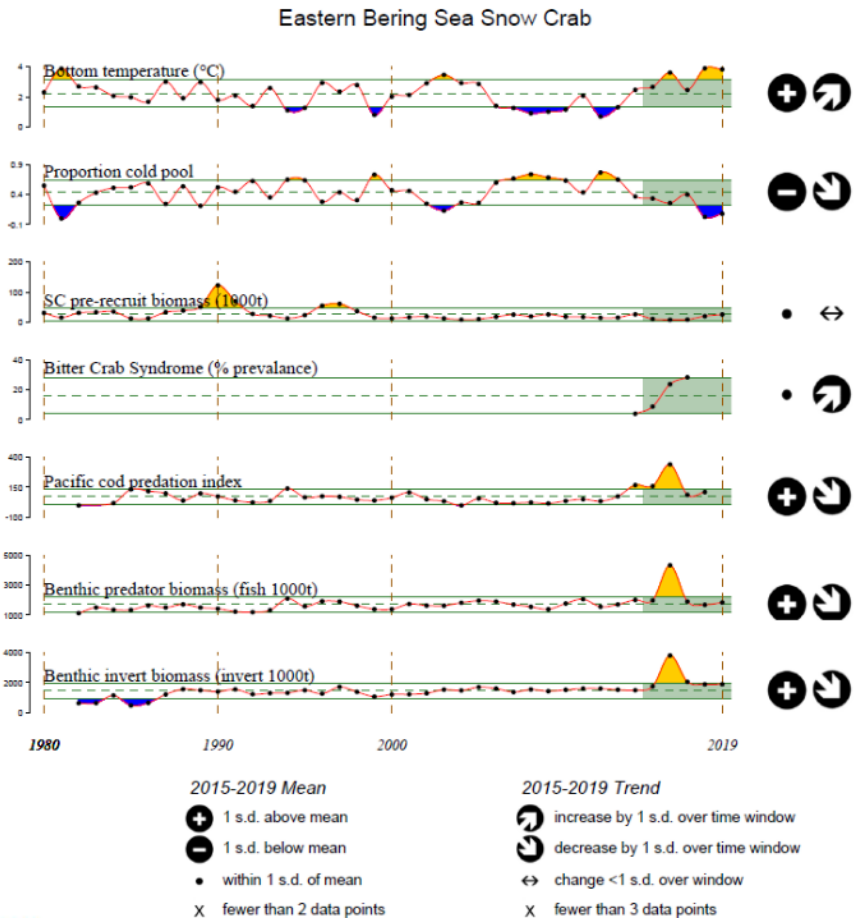
Sea ice extent on April 29 of each year using data from the National Snow and Ice Data Center (NASA Earth Observatory, Joshua Stevens)



Sea ice extent was at record low in 2018

Ecosystem status report card

Erin Fedewa, NOAA scientist



EBS Snow Crab Ecosystem Considerations

- **Summer bottom temperatures** in the snow crab management area were **well above average in 2019**, and the **cold pool extent** was the **lowest on record in 2018**, followed by **2019 with the second lowest** value in the time series.
- **Snow crab pre-recruit** (males 95-101 mm CW) biomass has continued to increase to a **near-average level in 2019**, following a decline in 2015.
- **Prevalence of bitter crab syndrome** in juvenile snow crab has **increased by nearly 25%** since monitoring efforts began in 2014, with **infection rates as high as 49%** northeast of St Matthew Island.
- **Pacific cod predation** on snow crab has remained **above the long-term average since 2012**. Relatively high predation rates in the past five years reflect **high catches of Pacific cod in the snow crab management area**.
- **Benthic invert biomass** has remained **above average** in recent years, attributed to **high catches of sea stars** in the snow crab management area.

- Environment and ecosystem is changing rapidly
- Must be considered in management decisions

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Pribilof Blue King Crab

Federal 2019/20 Status

Stock estimated at 6% of B_{MSY} in 2018/19

Stock projected at 4% of B_{MSY} in 2019/20

- **biomass must be above 25% of B_{MSY} for directed fishery opening**

ABC = 2,000 lb total catch

OFL = 2,600 lb total catch

State harvest strategy (5 AAC 34.918)

•**Stock threshold for opening fishery:**

- 13.2-million pounds total (male and female) mature biomass @ survey for 2 consecutive years

- 10% exploitation then applied to mature male abundance

2018 estimate for total mature biomass @ survey:

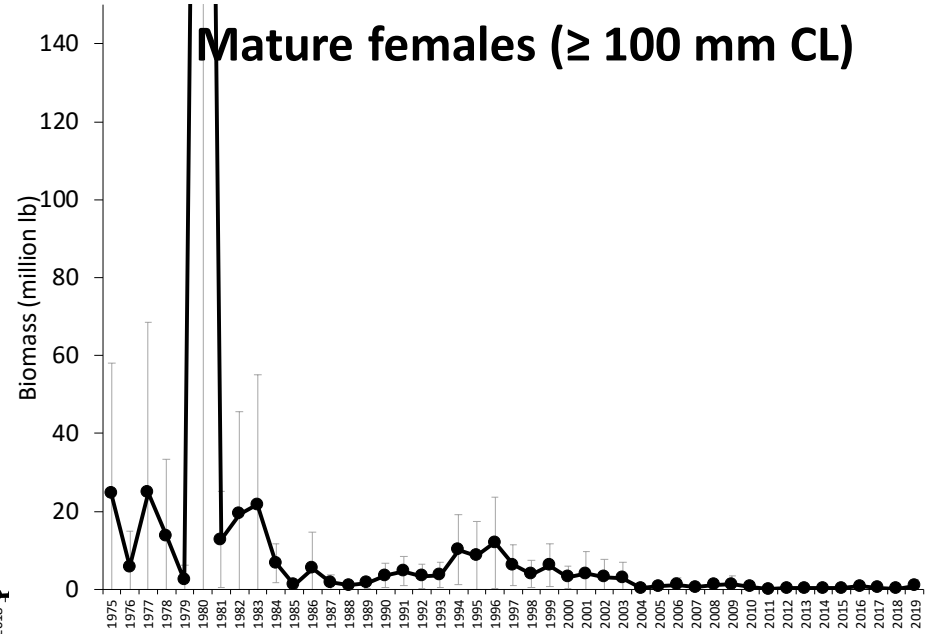
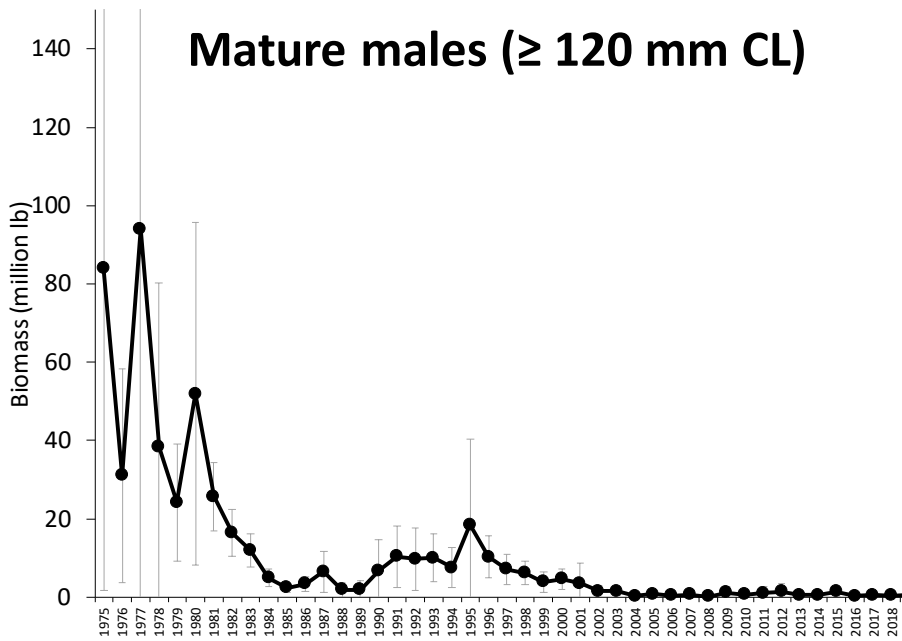
- 0.50-million pounds (NMFS area-swept estimate)

2019 estimate for total mature biomass @ survey:

- 1.35-million pounds (NMFS area-swept estimate)

→ **Stock is below state threshold for a fishery opening**

Pribilof Blue King Crab



Pribilof Blue King Crab

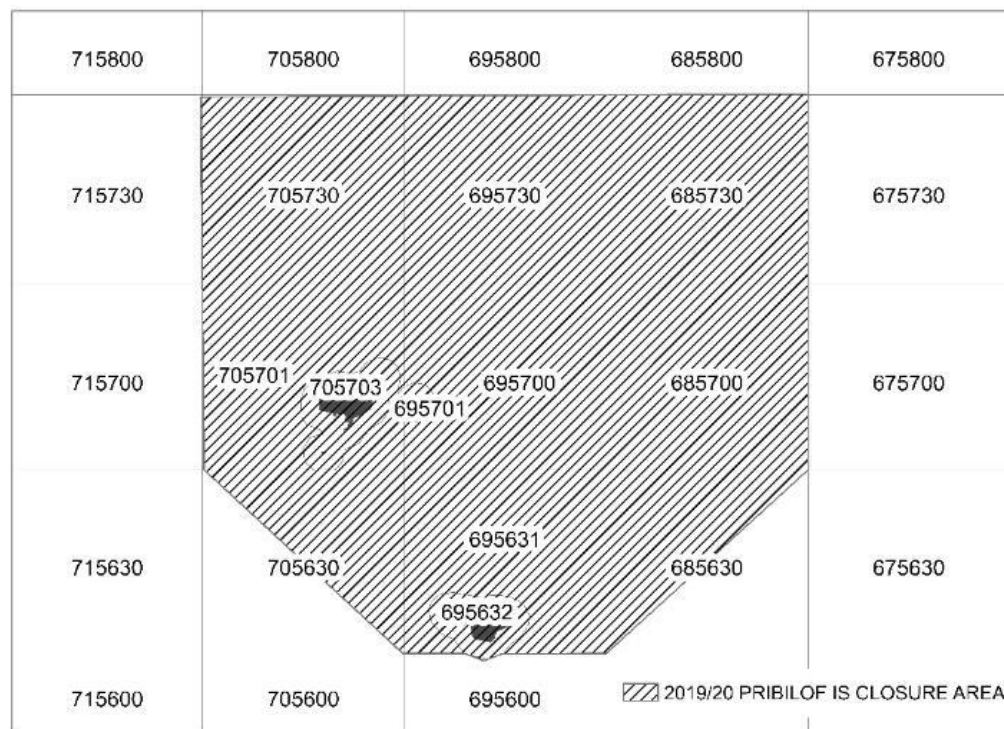
Closed areas to protect stock from overfishing in 2019/20

Closed to commercial crab fisheries to protect BKC

Metrics for opening portions of the closure area:

- BKC spatial distribution in past 2-years
- Bycatch rates in recent fisheries

High risk of exceeding OFL (2,600 lbs): Observer numbers are expanded to entire fishery

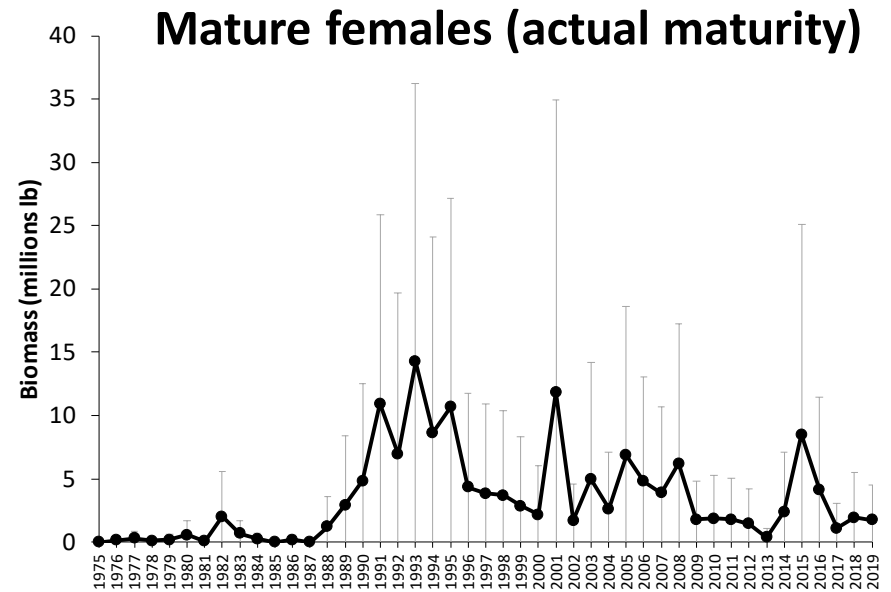
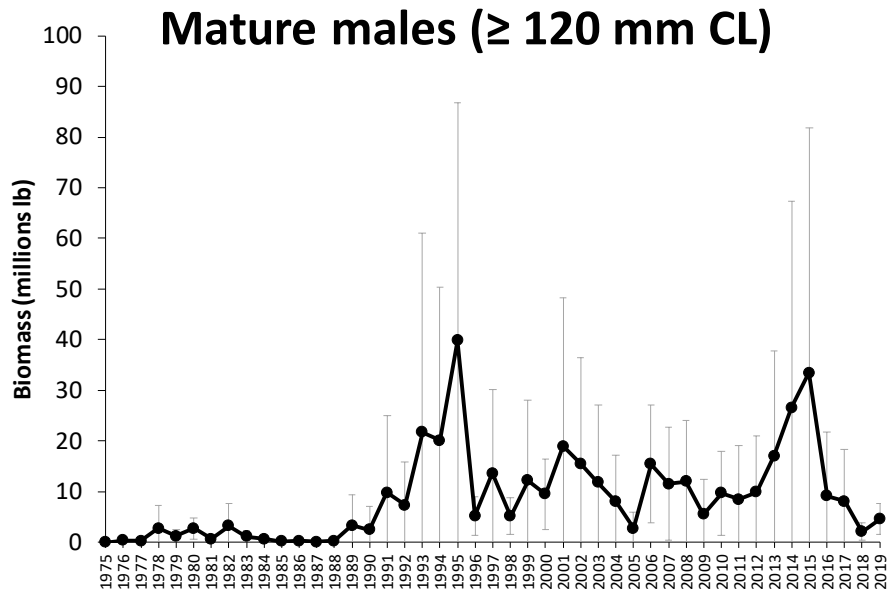


Pribilof Red King Crab

Federal 2019/20 Status

ABC = 1.43 mill lb, including bycatch mortality of males and females in all fisheries
OFL = 1.90 mill lb

State harvest strategy: no harvest strategy in regulation, some harvest in the 1990s with BKC



Pribilof Red King Crab

TAC = 0

- Poor precision of abundance estimates
- Little sign of recruitment to stock
- Concerns for bycatch of blue king crabs remains very high
 - Pribilof blue king crab OFL= 2,600 lb (bycatch mortality only)

The same concerns since 1999

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St. Matthew Blue King Crab

Federal 2019/20 Status

Stock estimated at 33% of B_{MSY} in 2018/19

- **Below MSST (50% B_{MSY}), hence SMBKC is “overfished”**
- **Federal control rule: biomass must be 25% of B_{MSY} for directed fishery opening**

Stock projected to be at 31% of B_{MSY} in 2019/20

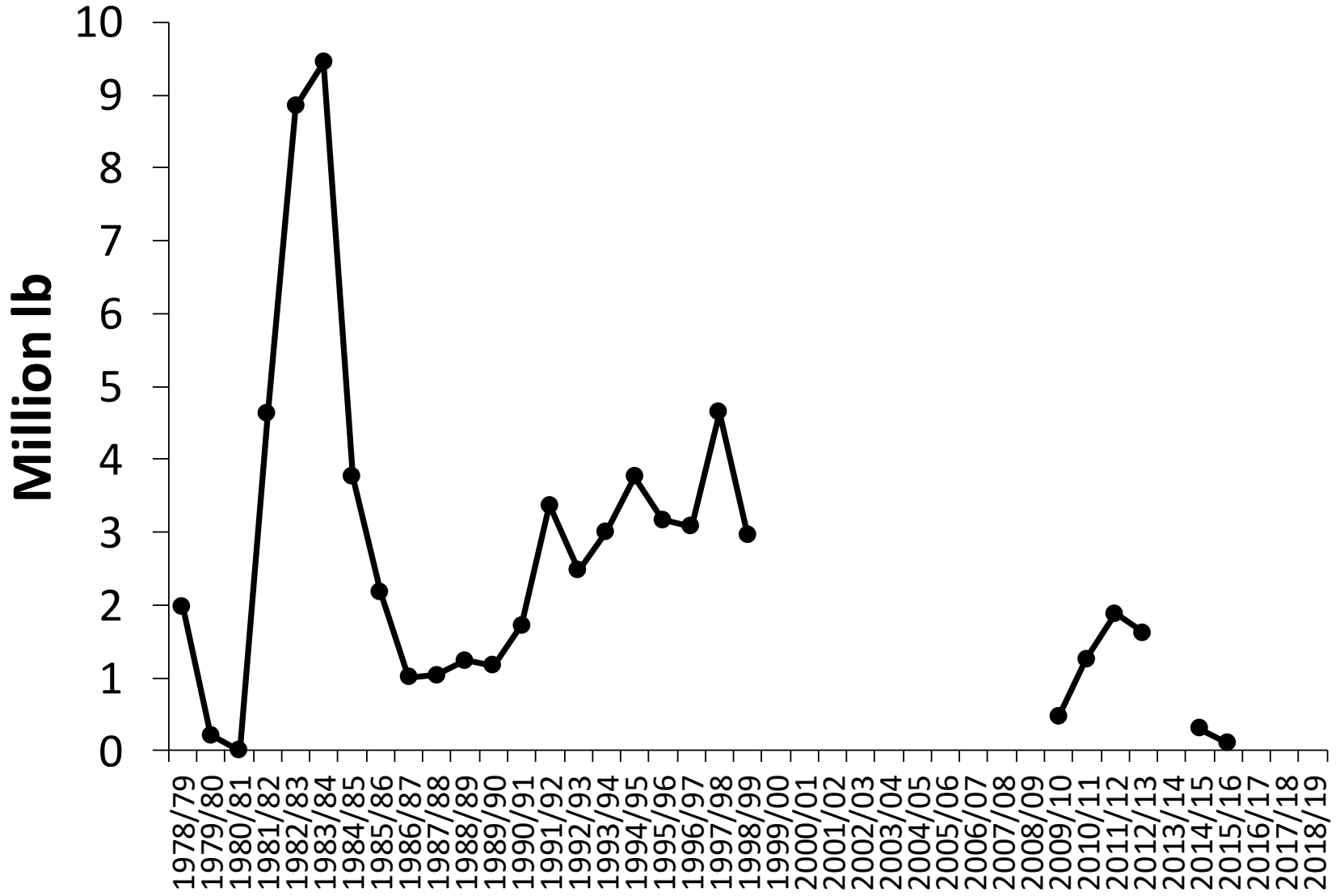
- Federal rebuilding plan will be developed in coming year(s)

ABC = 0.08-mill lb (80,000 lb) total male catch (male only assessment model)

- including bycatch mortality of males in all fisheries

OFL = 0.10-mill lb total male catch

St Matthew BKC Harvest



St. Matthew Blue King Crab: State harvest strategy (5 AAC 34.917)

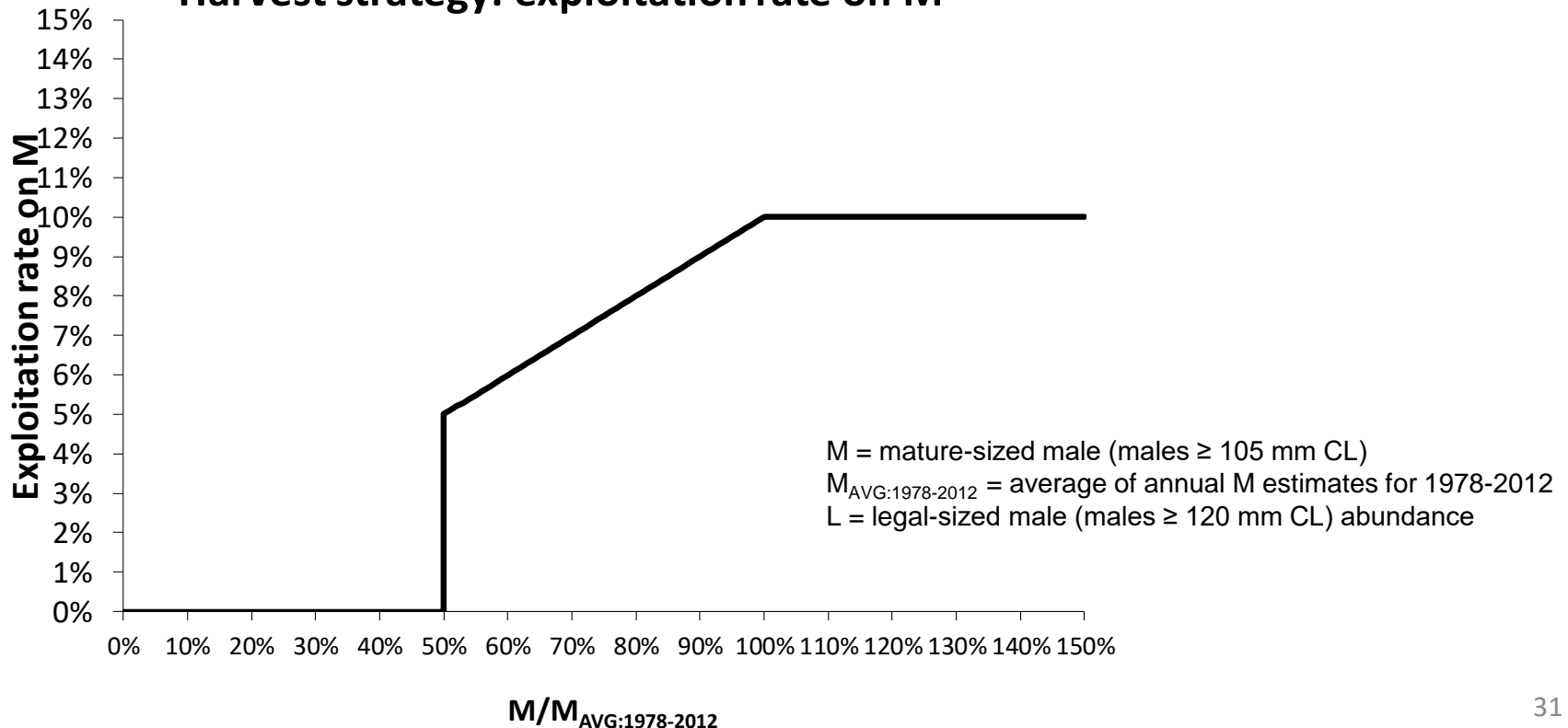
Stock threshold for opening fishery:

- Survey abundance of mature-sized males (M) = 50% of 1978-2012 average

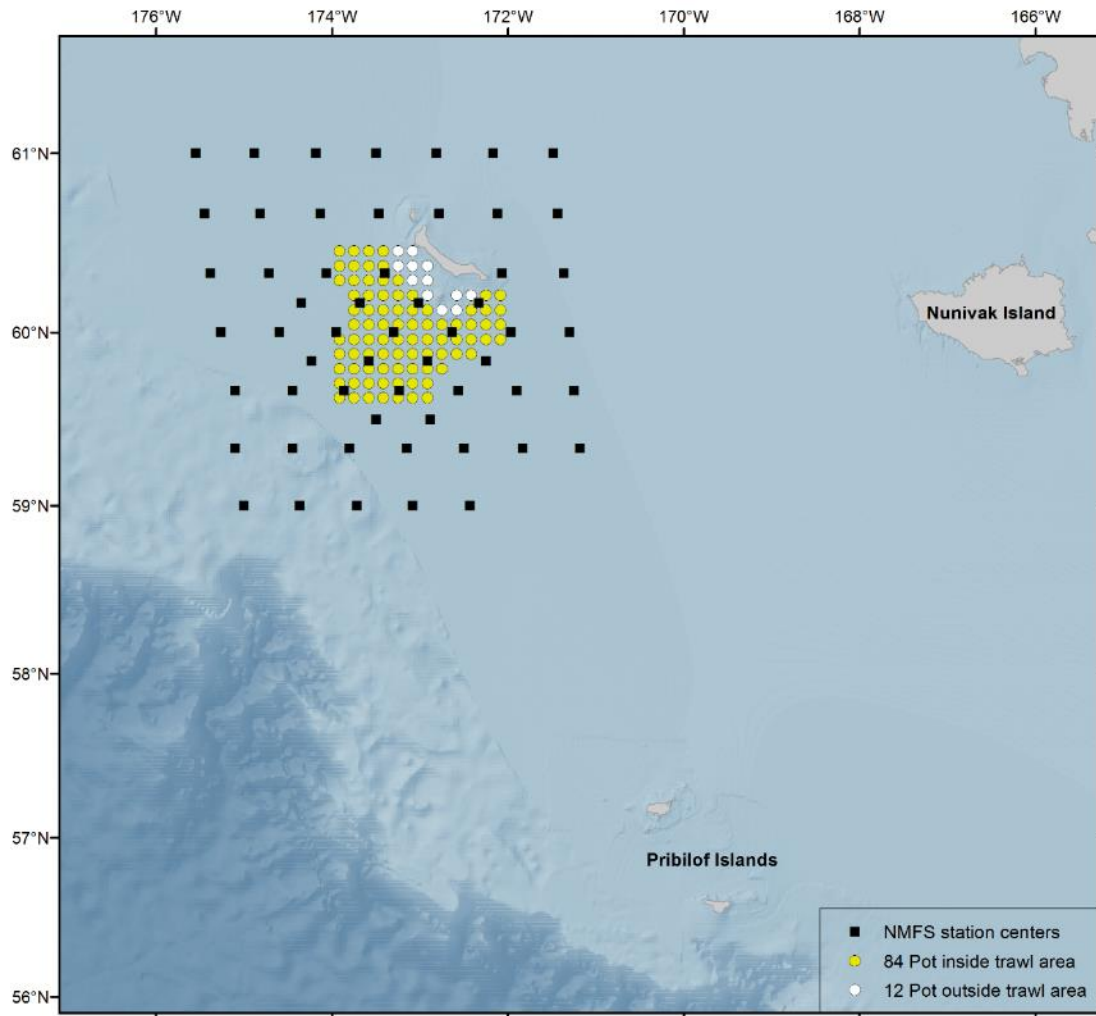
Exploitation rate on mature-sized males (M):

- 5%, when M = 50% of 1978-2012 average
- Increases linearly up to 10% with increasing M , up to the 1978-2012 average
- 10%, when $M \geq$ 1978-2012 average
- Harvest capped at 25% of legal male abundance (L) at time of survey

Harvest strategy: exploitation rate on M



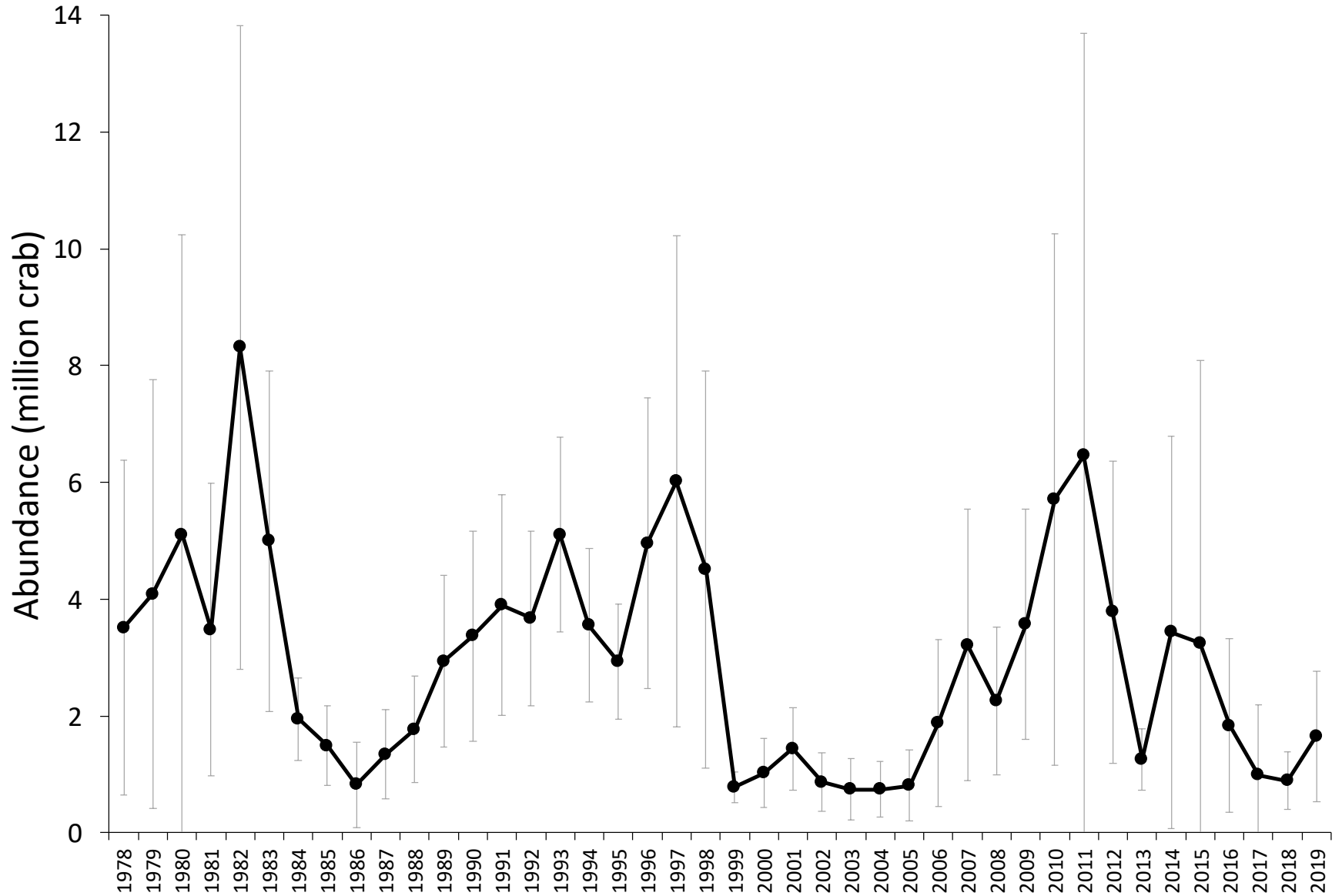
Two surveys: NOAA bottom trawl survey and ADF&G pot survey



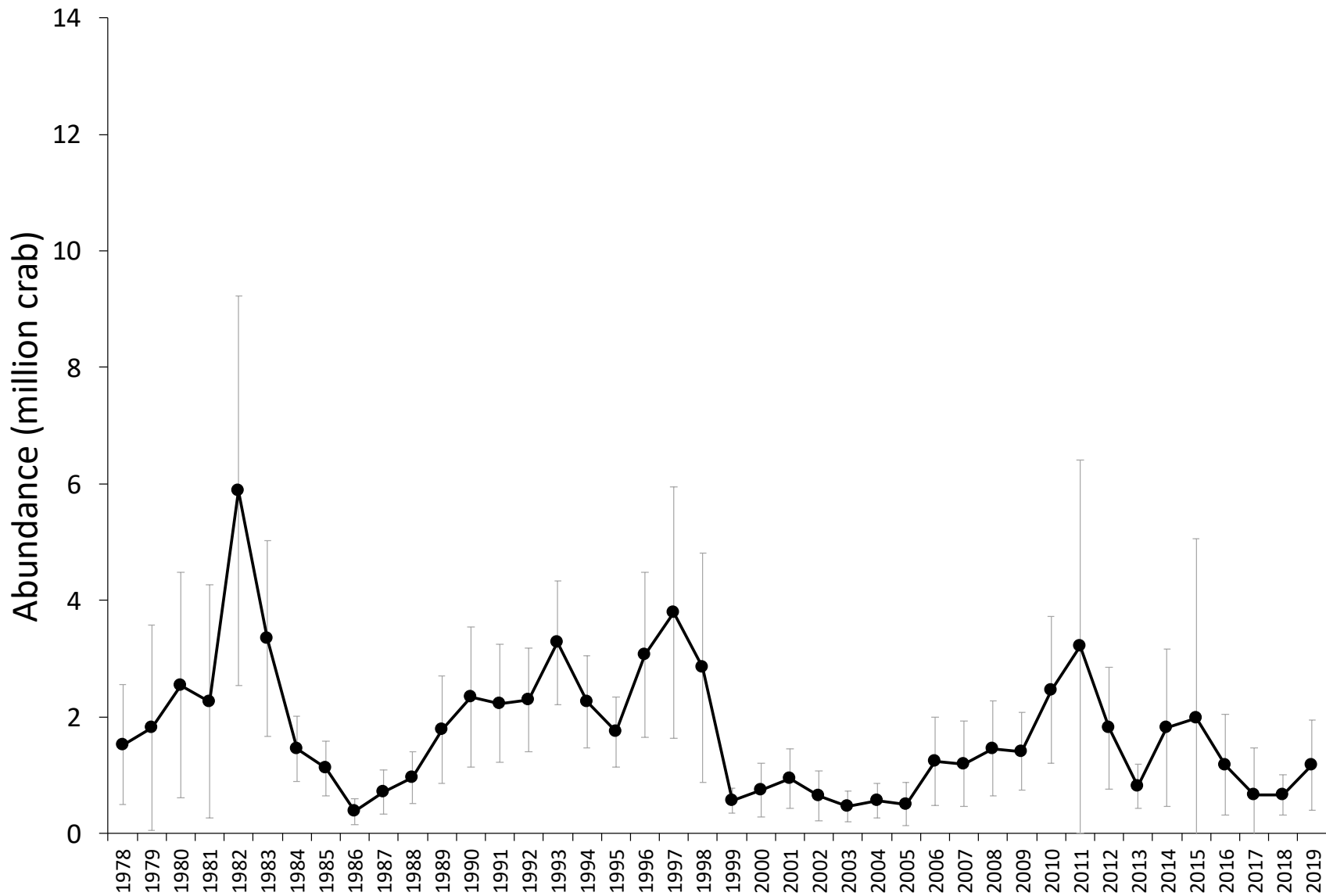
For population abundance estimates, models use:

- NMFS area swept bottom trawl abundance data
- ADF&G pot survey CPUE

Mature males (≥ 105 mm CL)

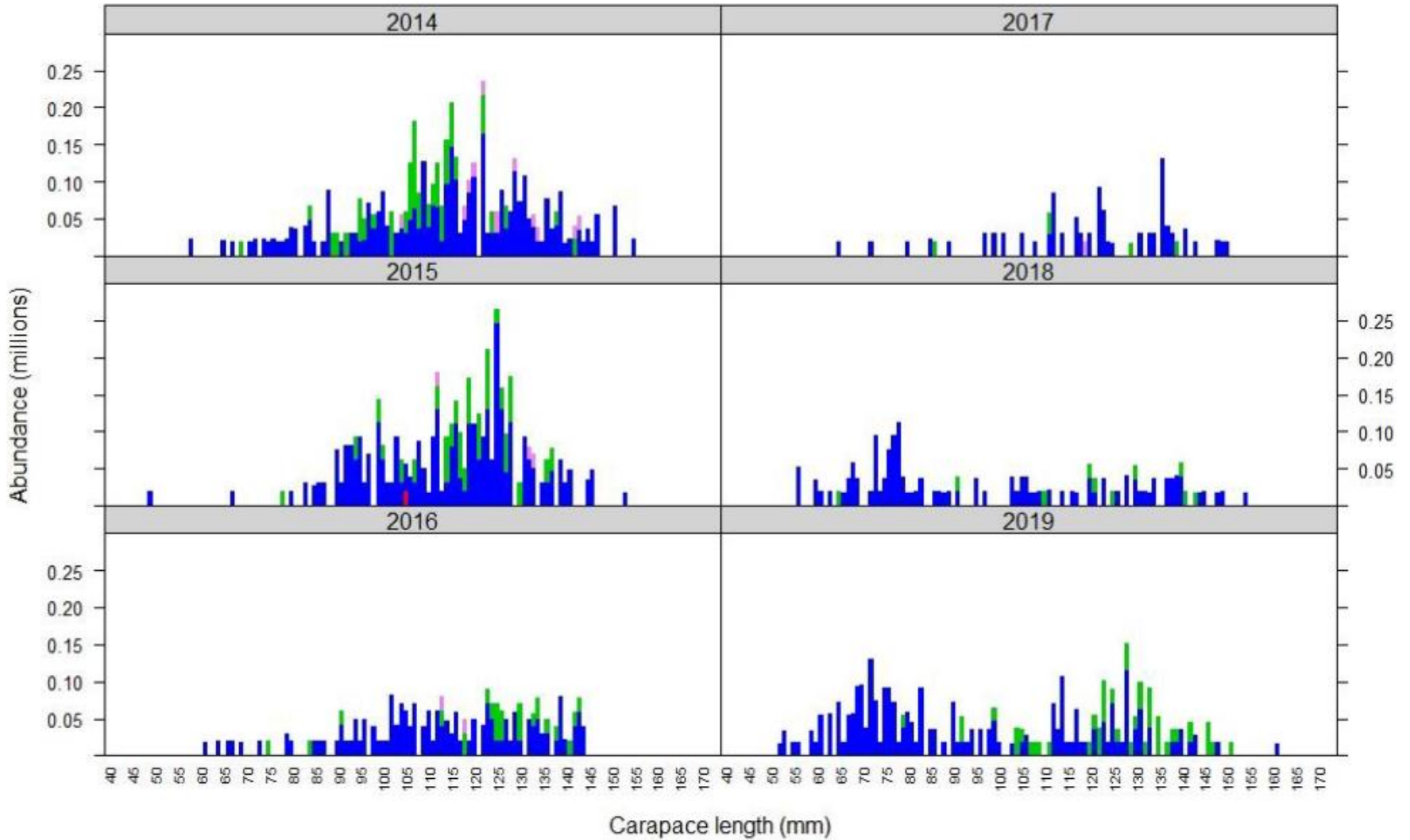


Legal males (≥ 120 mm CL)

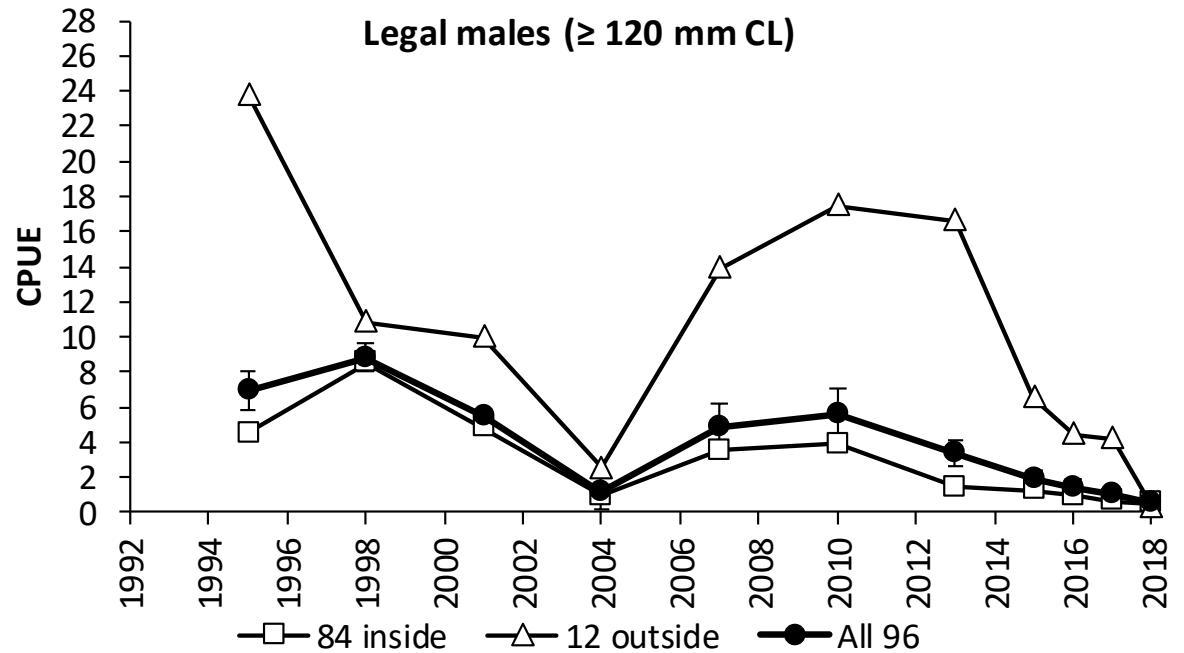
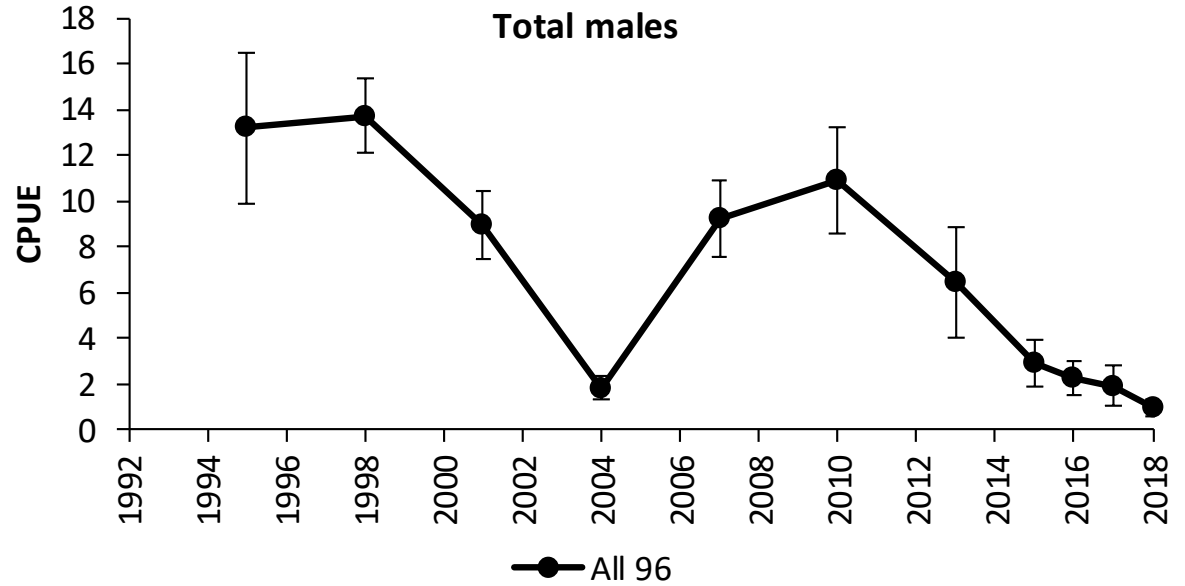


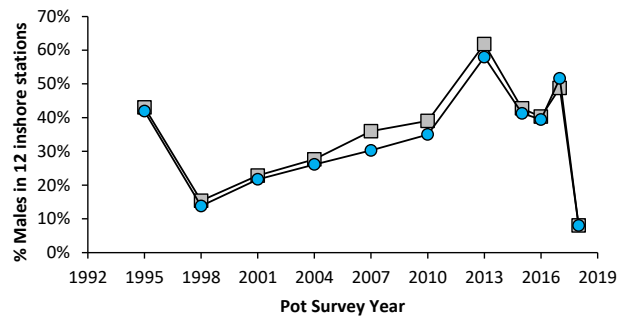
St. Matthew Island Blue King Crab (male)

Shell condition
 Molting & soft █ New - hard █ Old █ Very old █



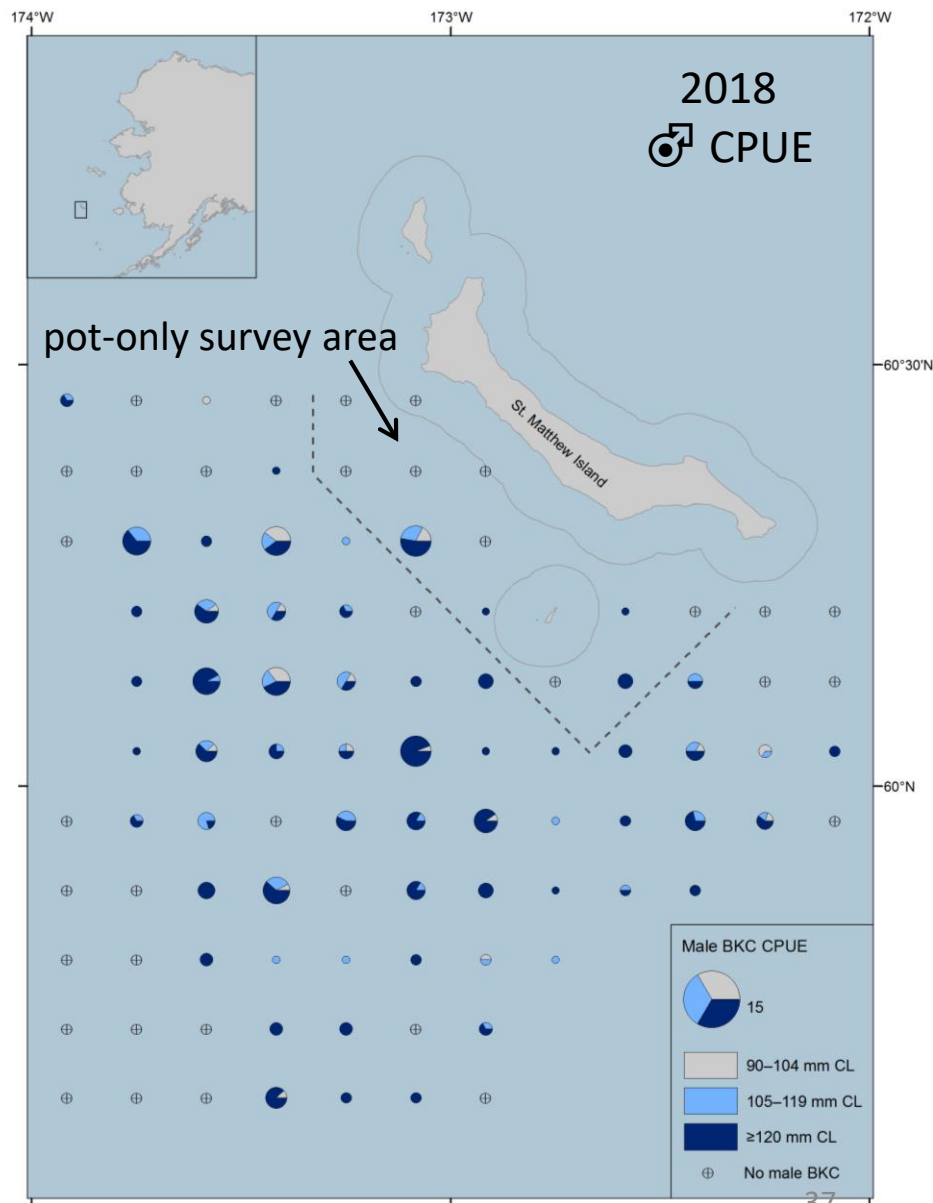
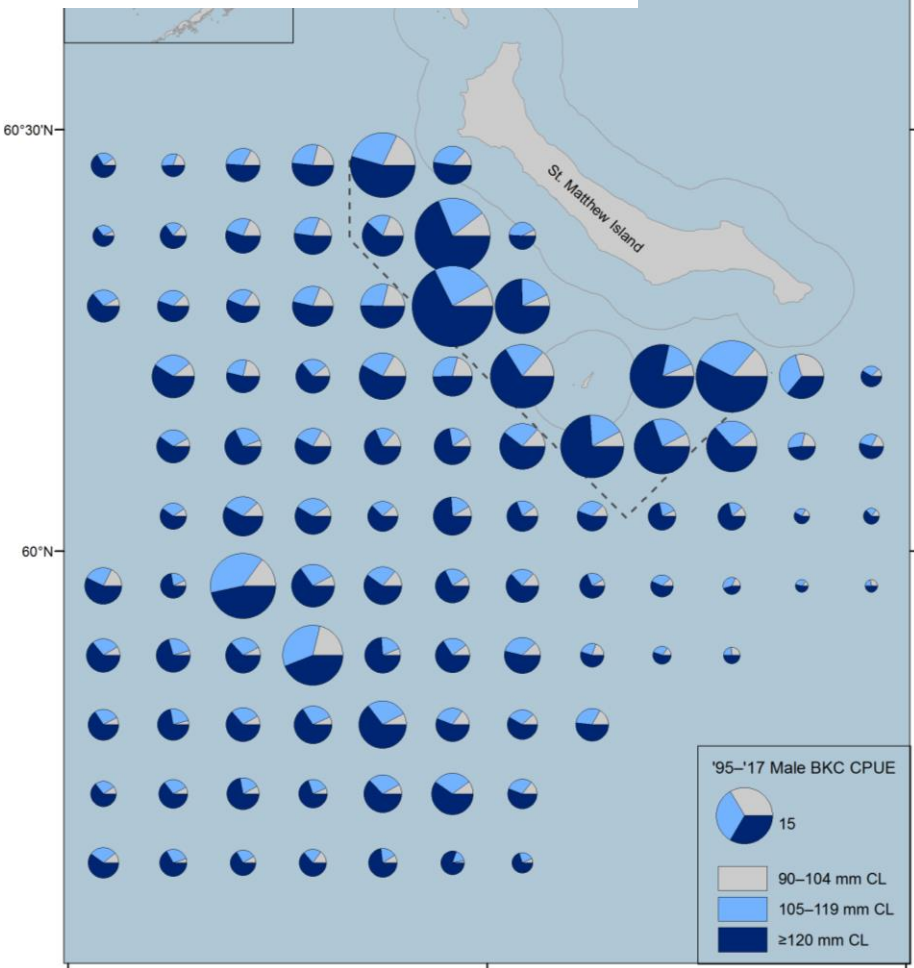
ADF&G pot survey results

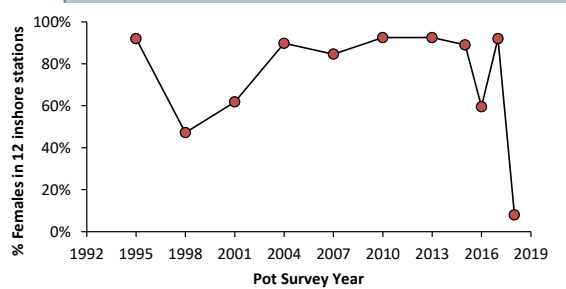
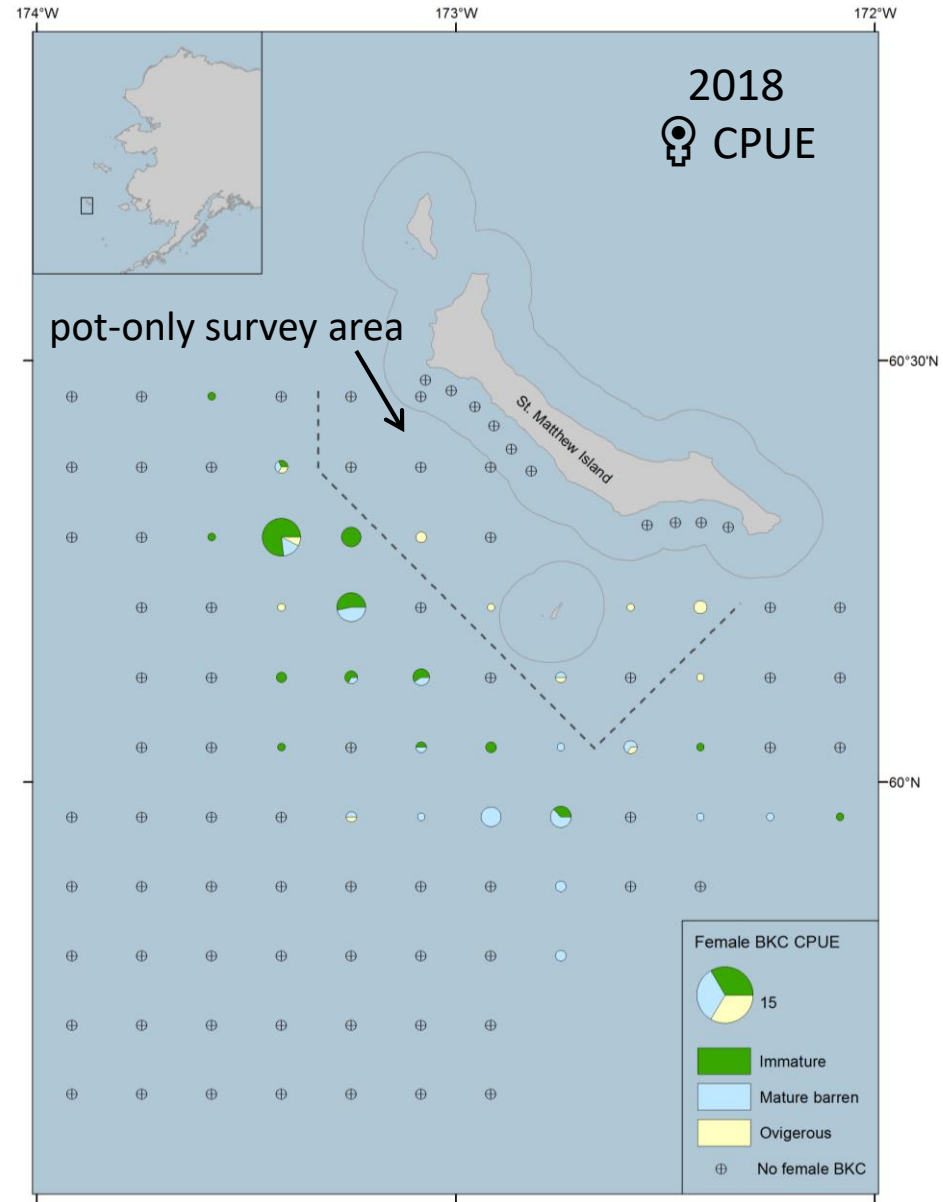
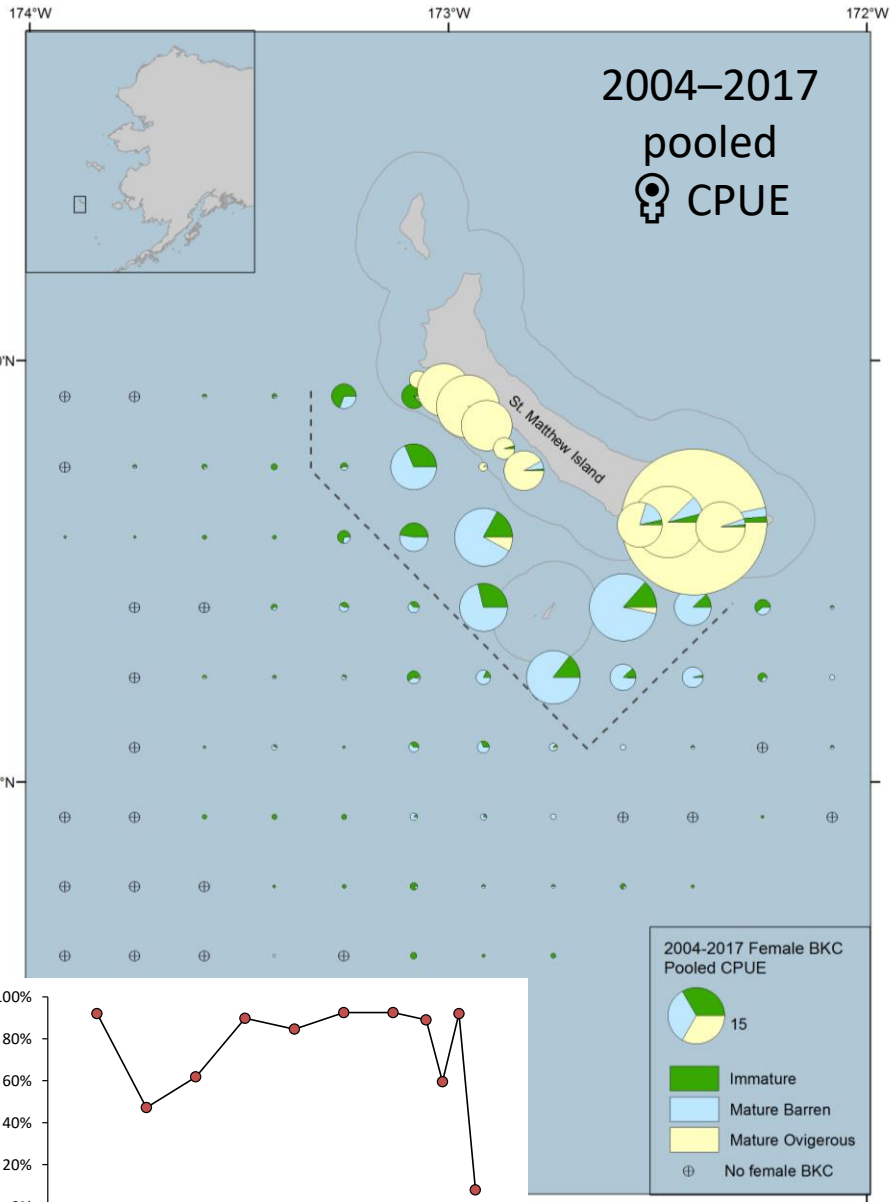




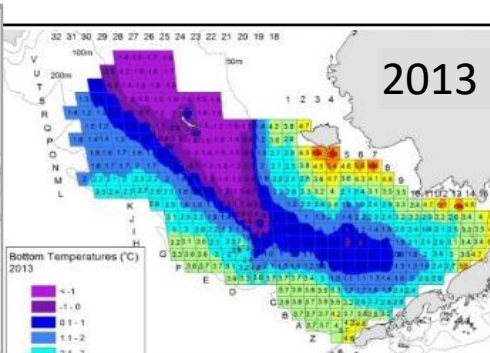
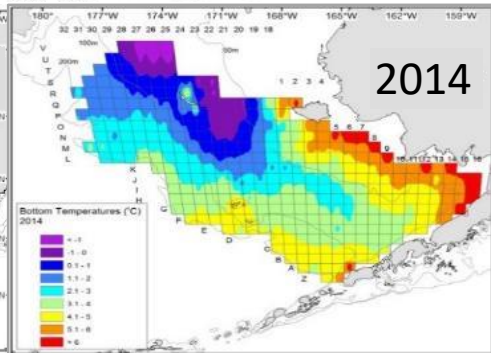
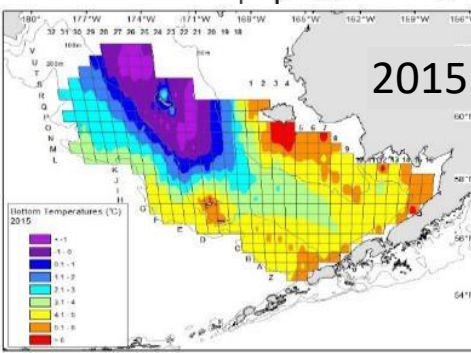
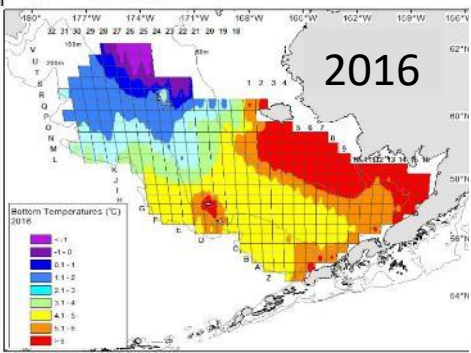
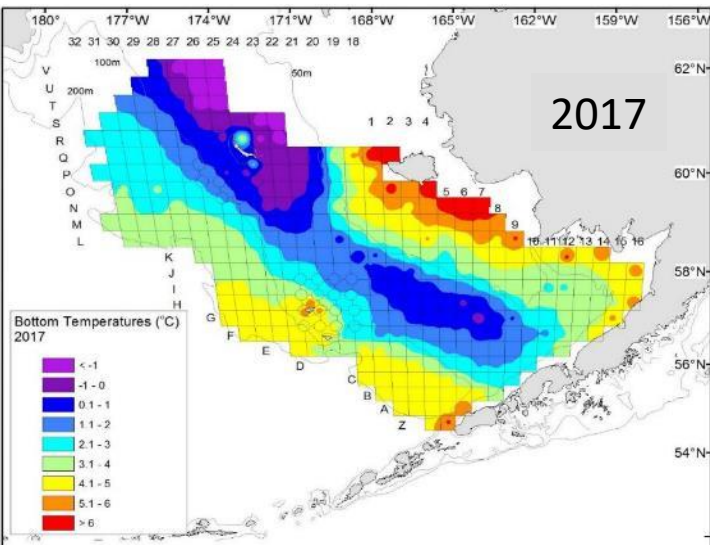
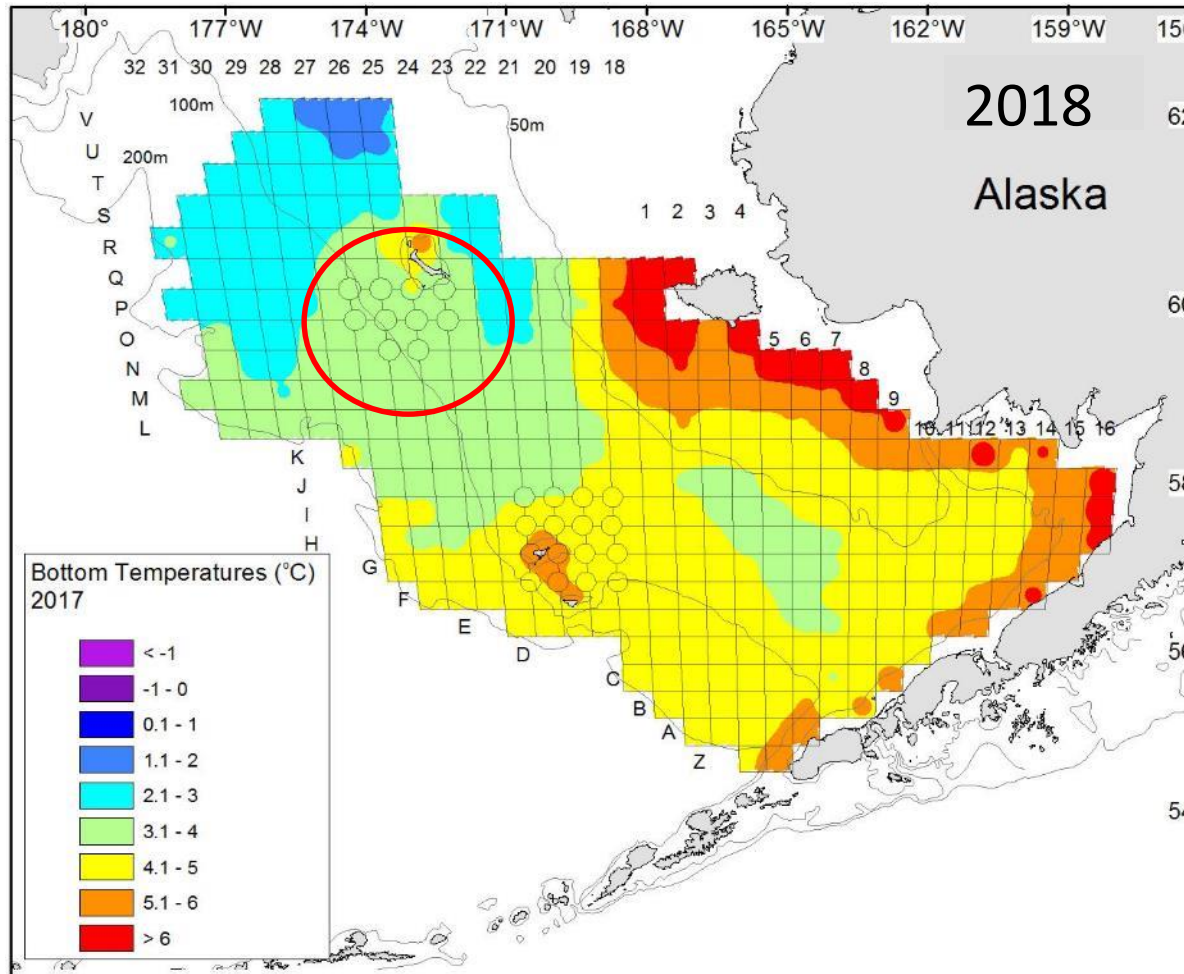
Legal males (≥120 mm CL)
 Mature males (≥105 mm CL)

1995–2017
 pooled
 ♂ CPUE





Cold pool in 2018 did not cover historical SMBKC distribution



2019/20 St Matthew BKC fishery closed

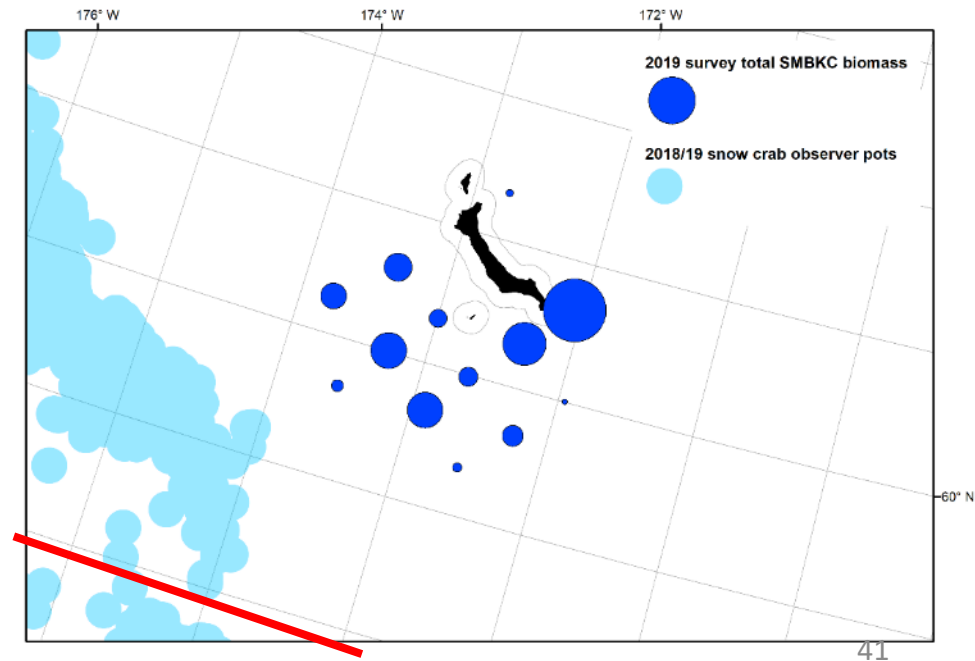
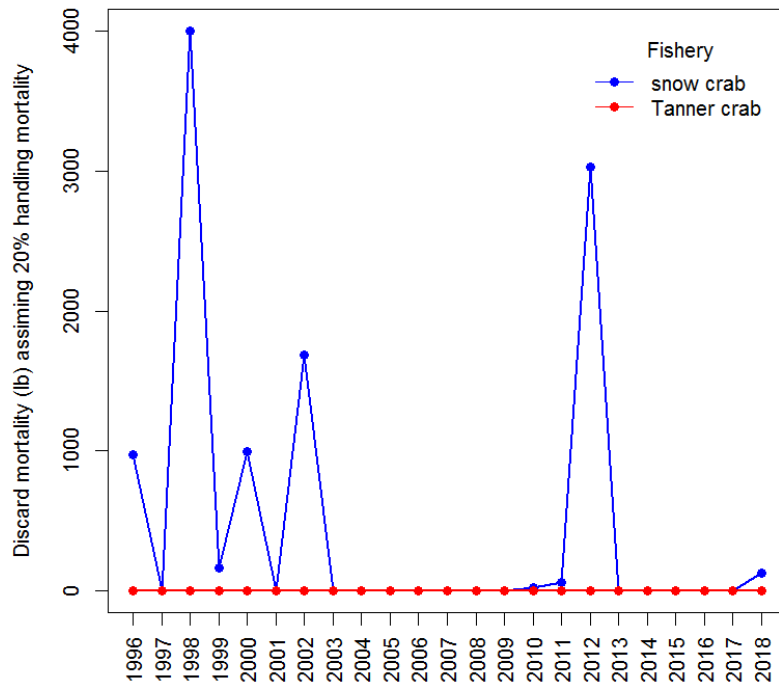
TAC = 0

- Declared “overfished” in 2018 + 2019 assessment
 - Federal rebuilding plan in development: will likely include directive to close directed fishery until it is declared rebuilt
 - Ultimately limited by ABC: 80,000 lb
 - Need to closely monitor bycatch in snow crab and groundfish fisheries
- Below model-based threshold for opening fishery
- Trawl survey data shows some weak signs of recruitment

St. Matthew BKC Bycatch

- ABC = 80,000 lb
- Possible bycatch in snow crab fishery
 - Observer data expanded to entire fishery
 - Potential impact to snow crab fishery (potential area closure)

SMBKC discard mortality in non-directed crab fisheries



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Bristol Bay Red King Crab

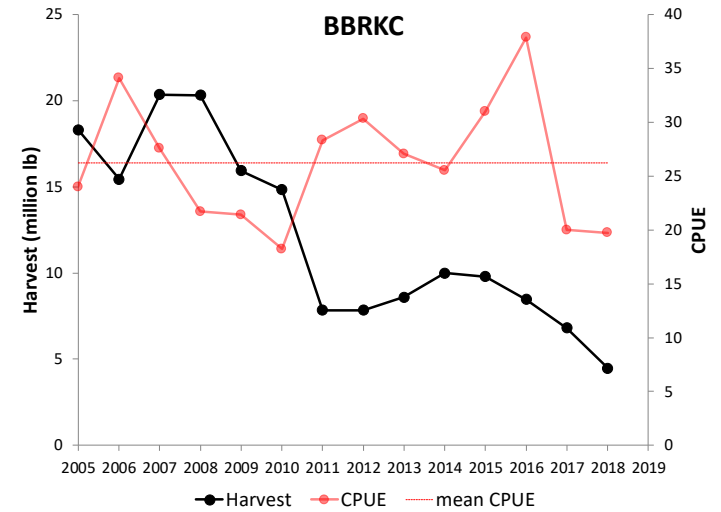
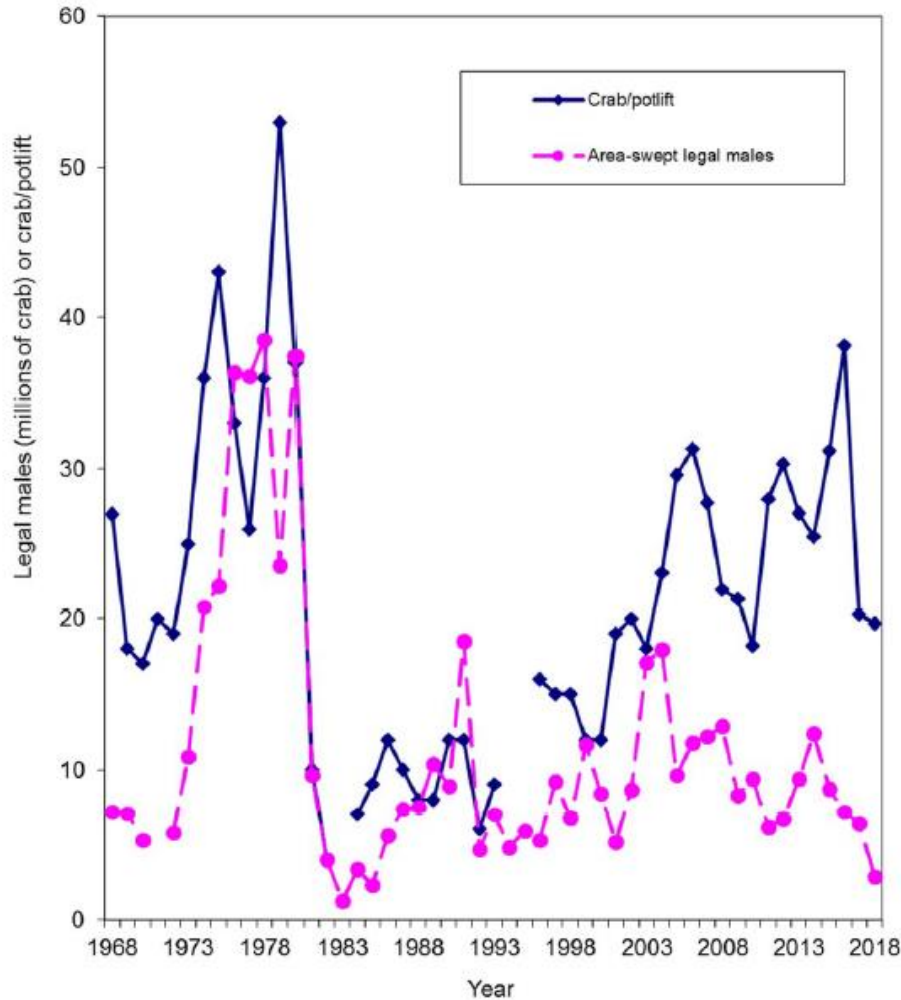
Federal 2019/20 Status

- ABC= 6.00-mill lb total catch
 - including bycatch mortality of males and females in all fisheries
 - based on a 20% buffer on OFL
- OFL = 7.50-mill lb total catch

Historical status and catch specifications for Bristol Bay red king crab (million lb). Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2015/16	28.4	61.0	9.97	10.17	11.69	14.84	13.36
2016/17	27.6	56.9	8.47	8.65	9.63	14.63	13.17
2017/18	28.1	54.8	6.60	6.82	7.93	12.35	11.11
2018/19	23.4	37.3	4.31	4.31	5.85	11.76	9.41
2019/20		35.2				7.5	6.00

2019 SAFE



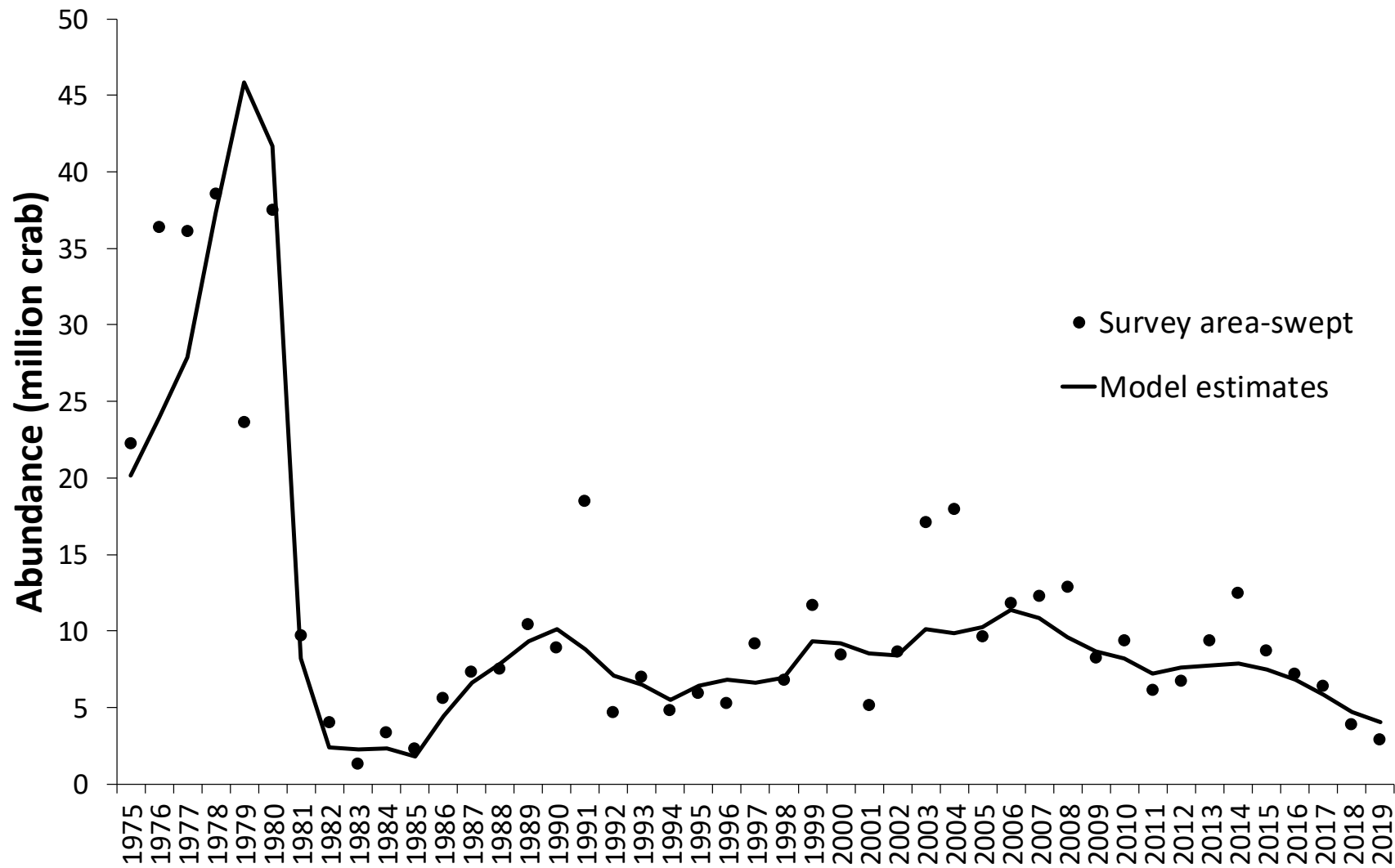
- CPUE variable
- CPUE in past 2 seasons below average for rationalized years

Figure 4 from 2019 SAFE. Comparison of survey legal male abundances and catches per unit effort for Bristol Bay red king crab from 1968 to 2019.

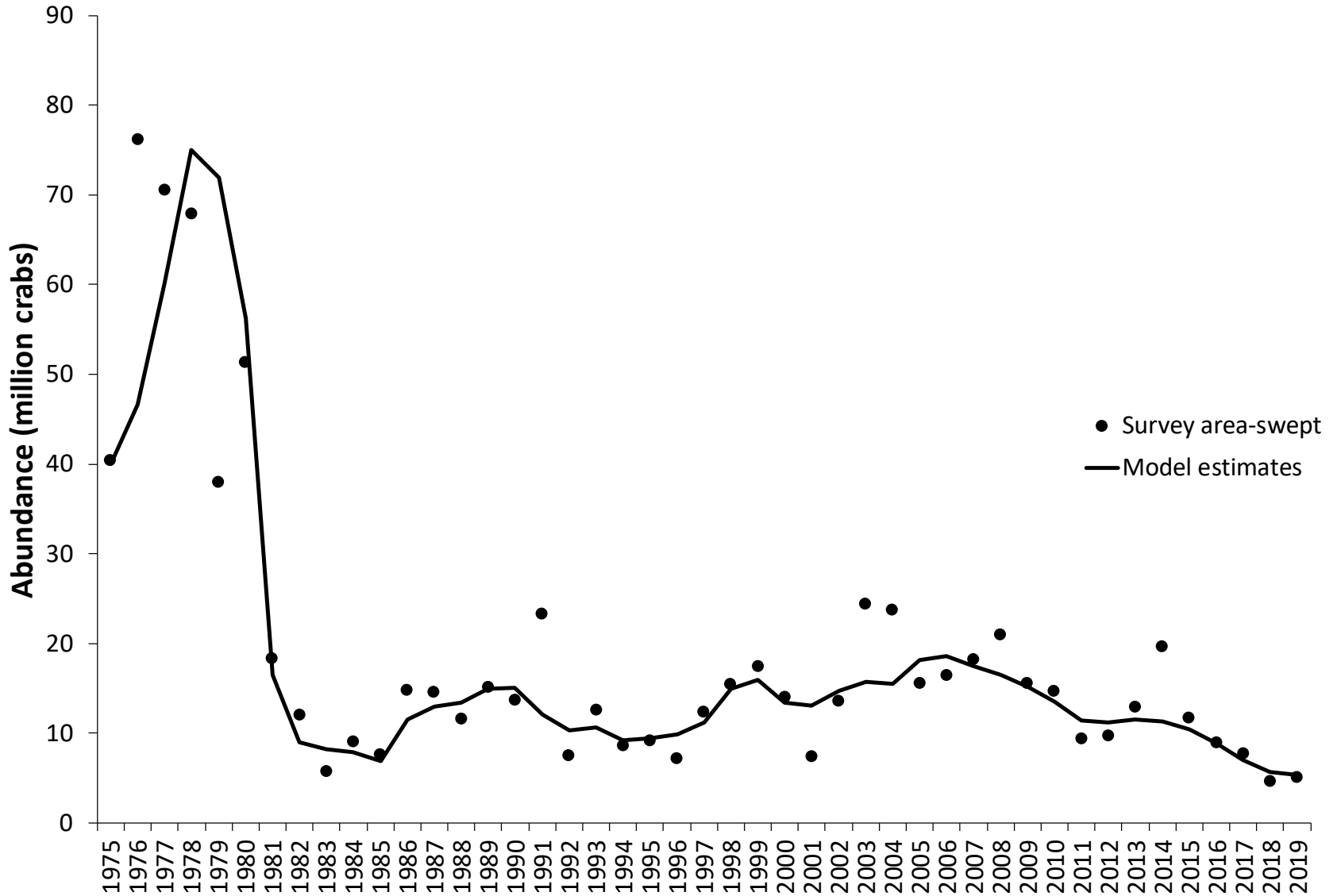
2018/19 observations from BBRKC fleet

- Continued increase in average weight since 2016/17 season.
 - 7.10 lbs in 2018/19, 6.84 lbs in 2017/18, 6.7 lbs in 2016/17.
 - Captains commenting that they are fishing the same group of crab as last year, which are a year older and year heavier.
 - General concern from captains about the increase in average weight.
- Several vessels reported having to move gear off large masses of female crab where pots were catching as many as 200 females.

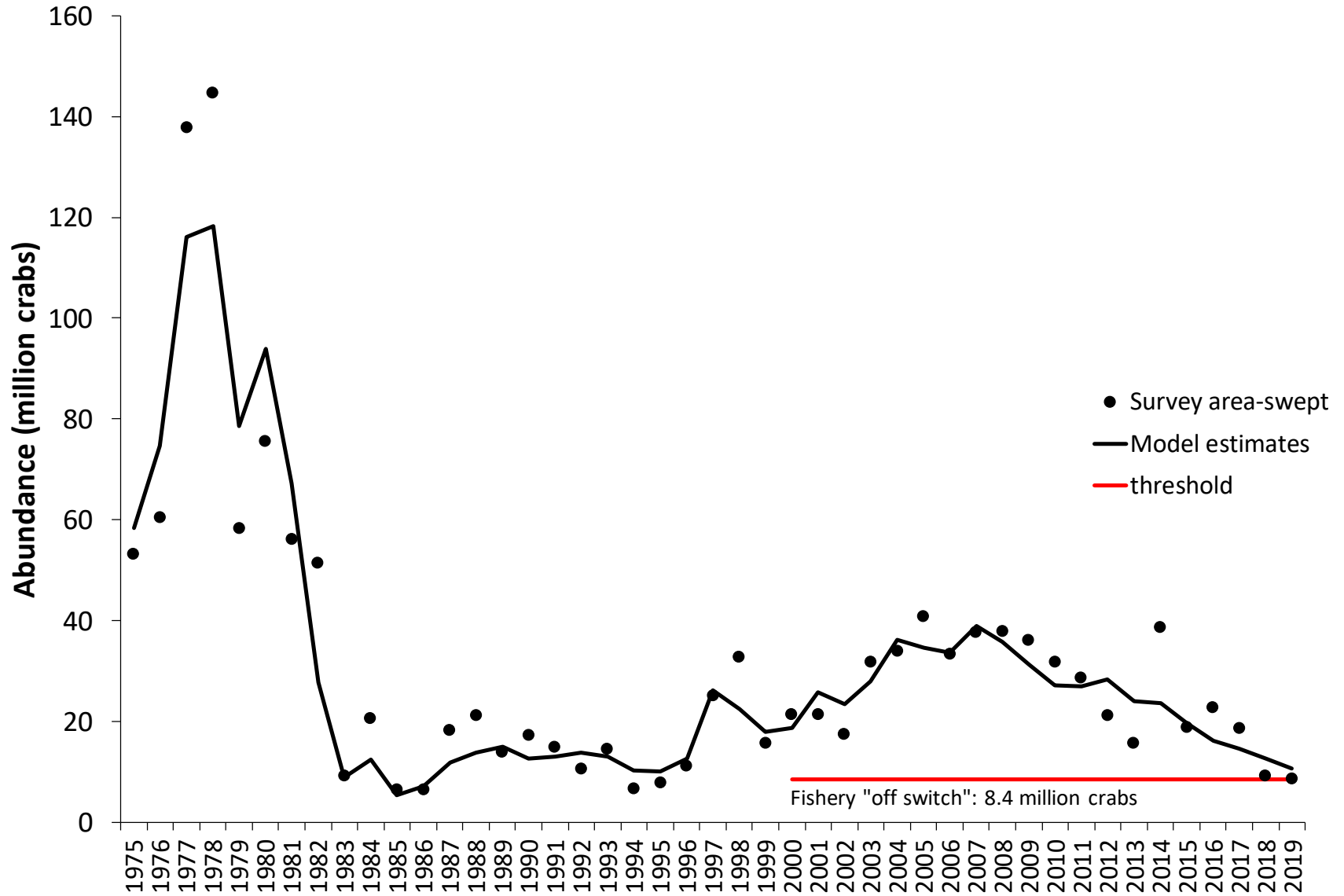
Legal males (≥ 135 mm CL)



Mature male abundance

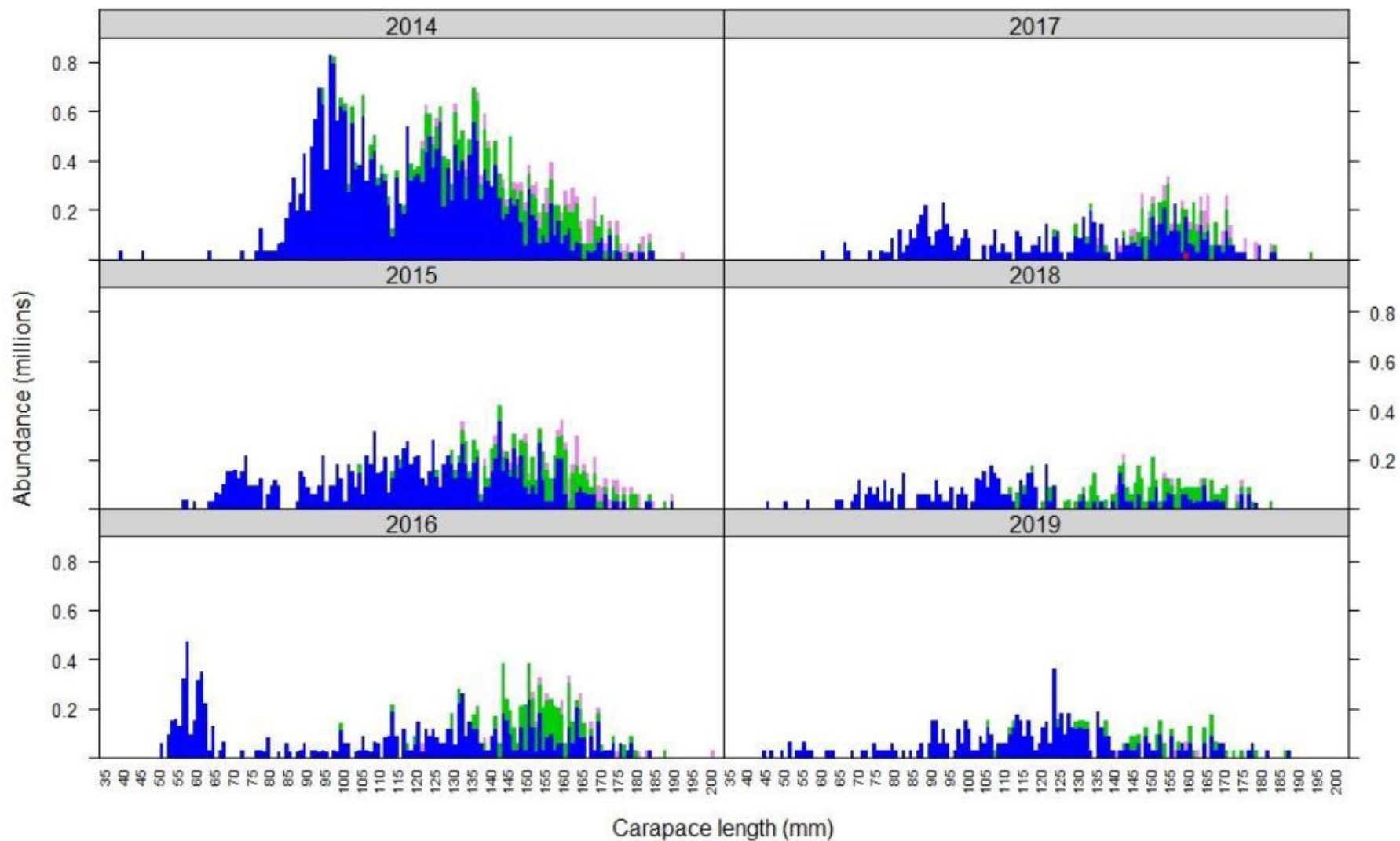


Mature female abundance

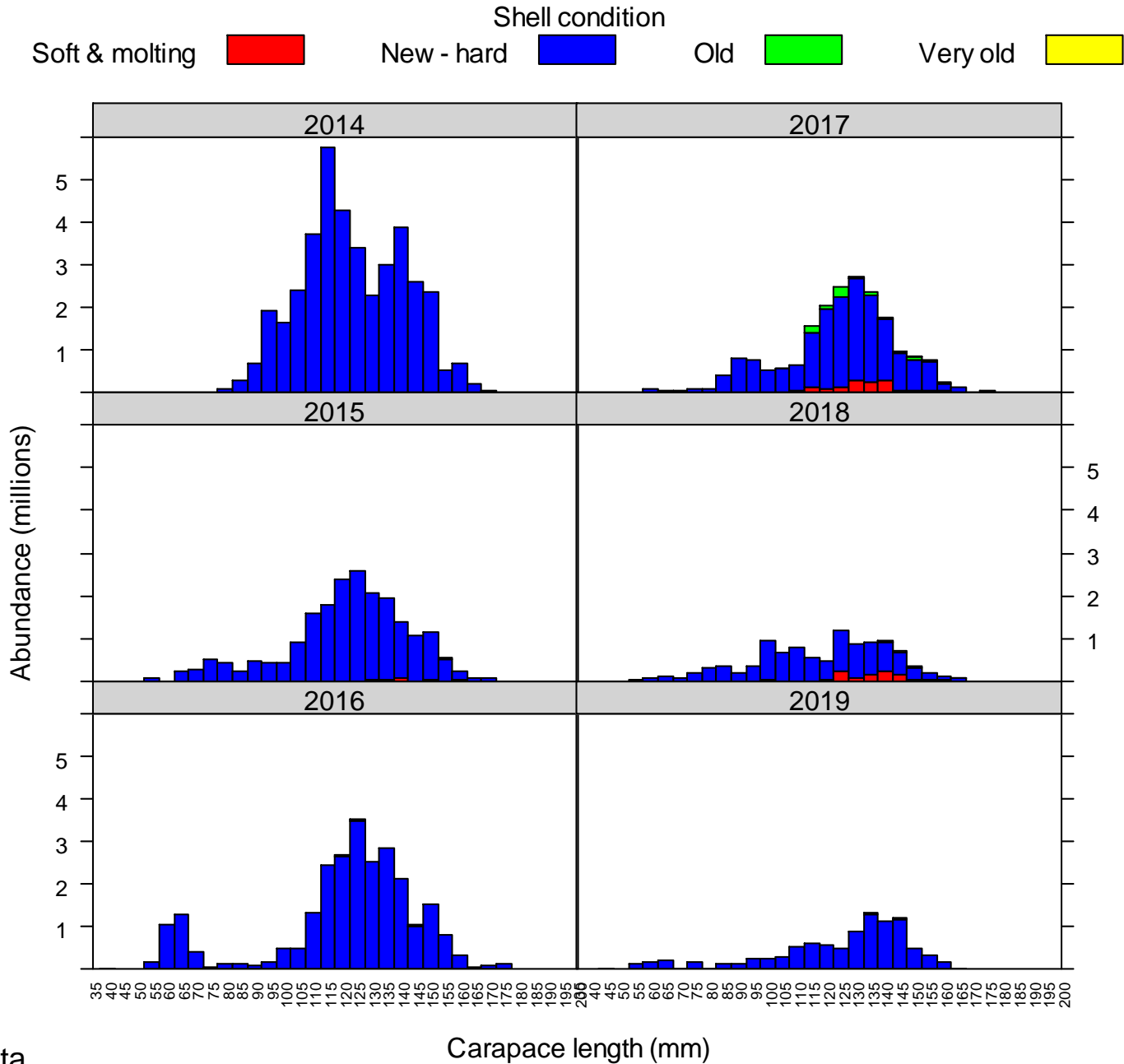


Bristol Bay Red King Crab (male)

Shell condition
Molting & soft █ New - hard █ Old █ Very old █



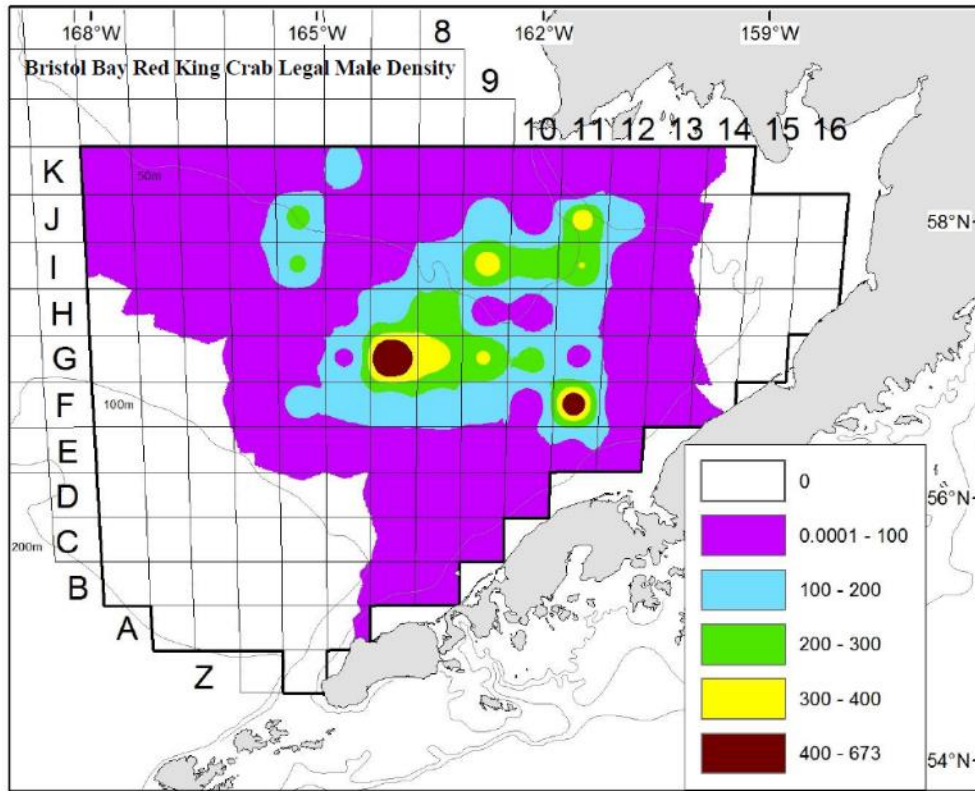
Bristol Bay red king crab (female)



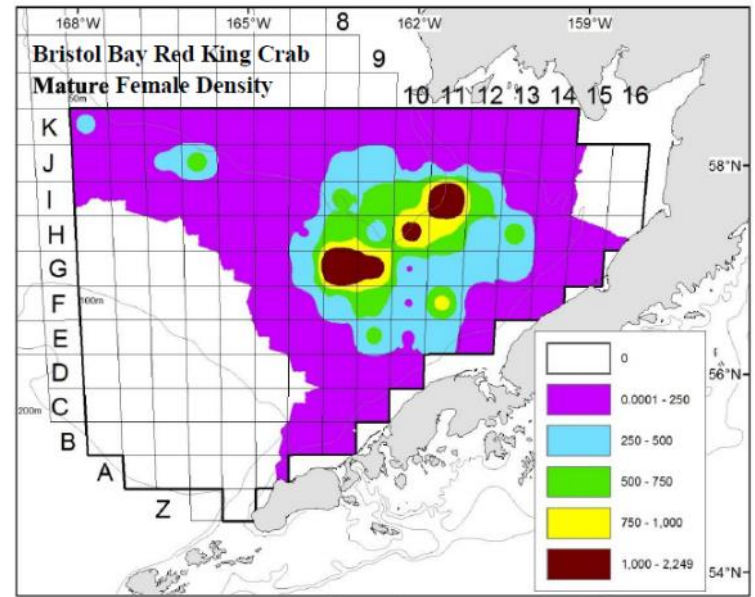
Bristol Bay Red King Crab

2019 survey results: Survey distribution, crab nm⁻² station

Legal males



Mature females



Bristol Bay Red King Crab

State harvest strategy (5 AAC 34.816)

1. Stock threshold for opening fishery:

- 8.4-million mature-sized females (females \geq 90 mm CL), and
- 14.5-mill lb of effective spawning biomass (ESB)

2. Exploitation rate on mature-sized (\geq 120-mm CL) male abundance:

- 10%, when ESB <34.75-mill lb
- 12.5%, when ESB is between 34.75-mill lb and 55.0-mill lb
- 15%, when ESB \geq 55.0-mill lb

3. Harvest capped at 50% of legal male abundance

2019 length-based analysis (LBA) estimates for determining fishery opening, computing TAC (area-swept estimates for comparison):

Parameter	LBA		Area-swept Estimate (NMFS-AFSC)	
	Estimate	95% CI		
ESB (millions of lb)	28.009	(-)	(-)	(-)
F (millions of crab)	10.613	(8.81 - 12.418)	8.587	(+/- 3.156)
M (millions of crab)	5.345	(4.39 - 6.232)	5.008	(+/- 1.633)
L (millions of crab)	4.006	(3.2 - 4.757)	2.887	(+/- 2.887)
W (lb)	(-)	(-)	6.846	(-)

- ESB = effective spawning biomass
- F = mature-sized female (females \geq 90 mm CL) abundance
- M = mature-sized male (males \geq 120 mm CL) abundance
- L = legal male (males \geq 135 mm CL) abundance
- W = expected average weight of landed legal males

Avg wt 2018/19 Fishery = 7.104

State harvest strategy (5 AAC 34.816) - Results for 2019/20

1. Stock above threshold for opening fishery

- $F = 10.613\text{-million} > \text{threshold} = 8.4\text{-million}$ (ADF&G LBA estimate)
- $ESB = 28.009\text{-mill lb} > \text{threshold} = 14.5\text{-mill lb}$ (ADF&G LBA estimate)

2. Exploitation rate on mature-sized male abundance (M)

- ESB is between 14.50 mill lb and 34.75-mill lb
→ 10% exploitation rate on estimated mature male abundance

3. TAC computation according to state harvest strategy:

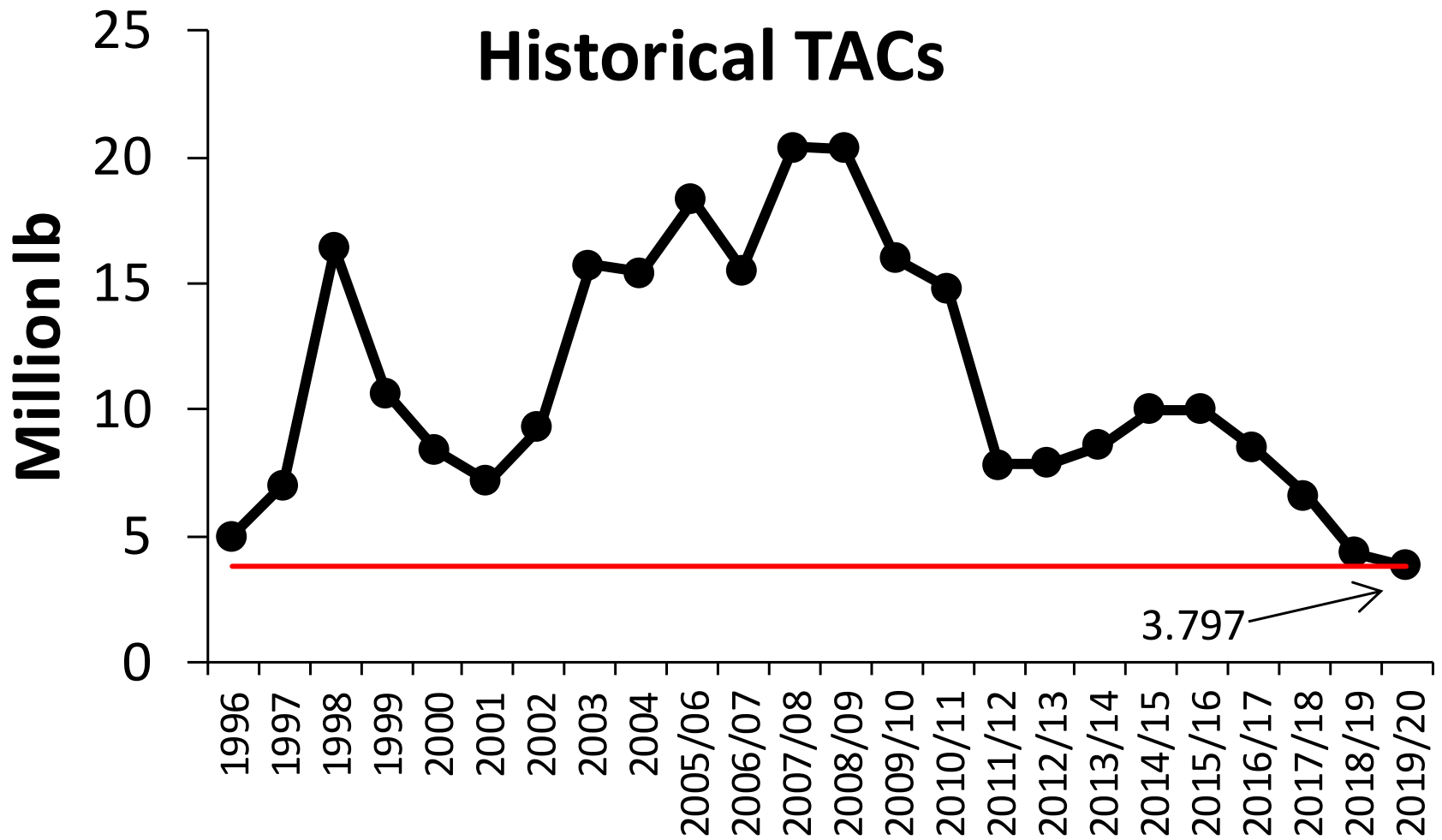
- 10% exploitation rate applied to estimated mature-sized male abundance
 - 5.345-million mature-sized males (ADF&G LBA estimate)
 - $(0.10) \times (5.345\text{-million}) = 0.535\text{-million crabs}$

• Check: 50% cap on harvest of legal males

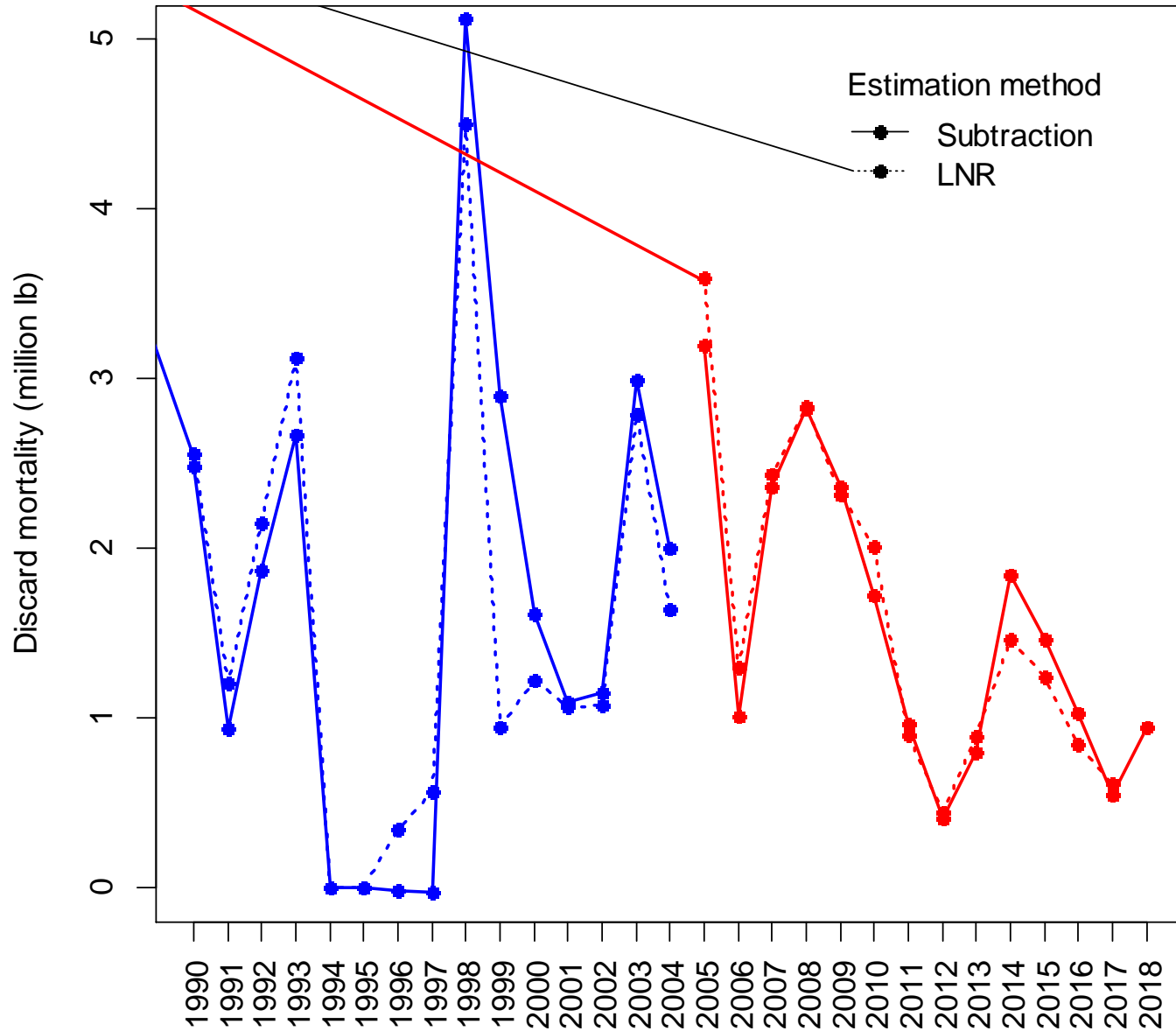
- 4.006-million legal males (ADF&G LBA estimate)
- $(0.5) \times (4.006\text{million}) = 2.003\text{-million crabs} > 0.535\text{-million crabs}$

→ Compute TAC on harvest of 0.535-million legal males, assuming 2018/19 fishery avg wt (7.104 lb) = 0.535×7.104

TAC = 3.797 million lb

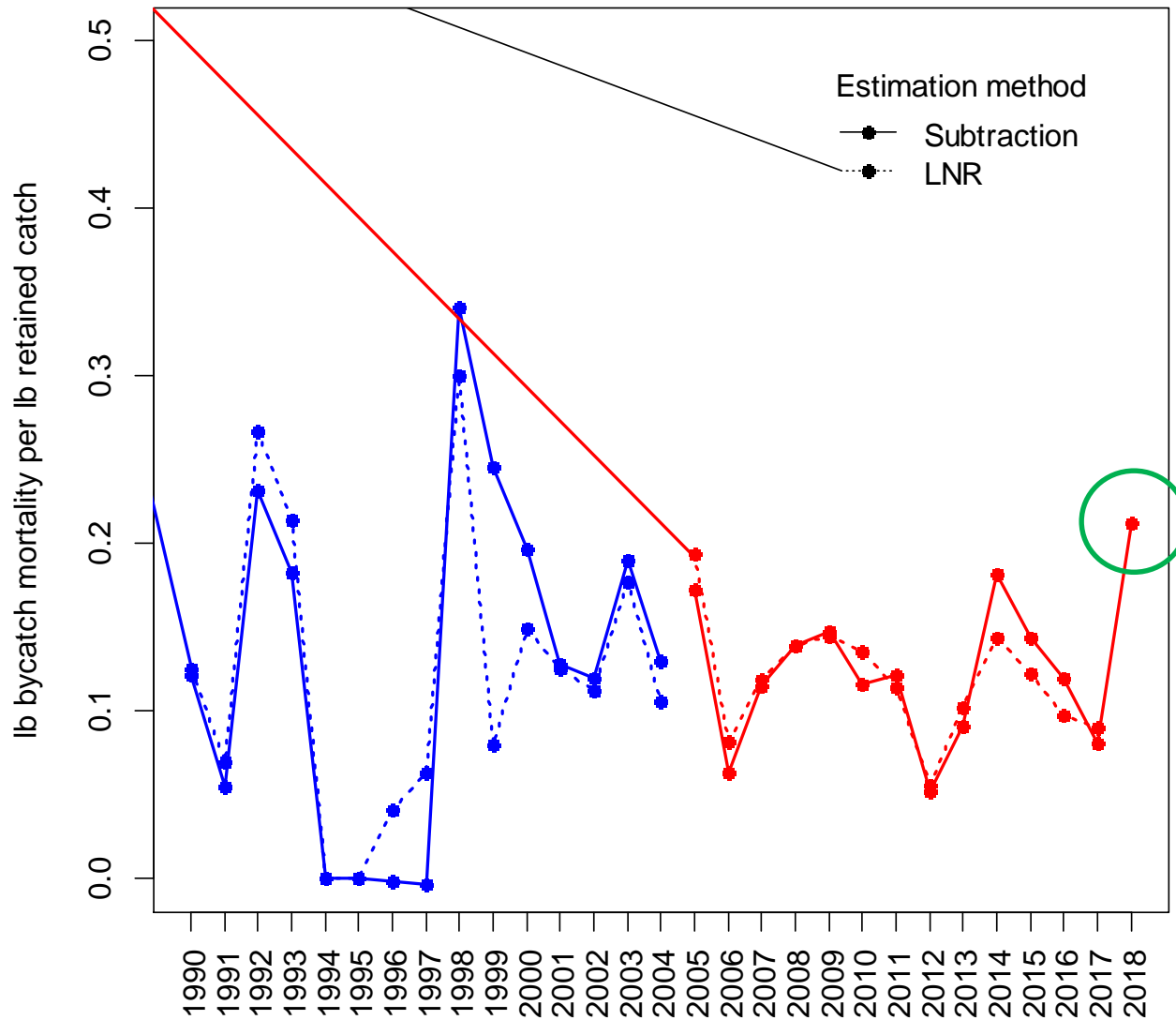


BBRKC discard mortality



2018 absolute value of discard mortality was relatively low, but the TAC was also low (~4 mill lb)

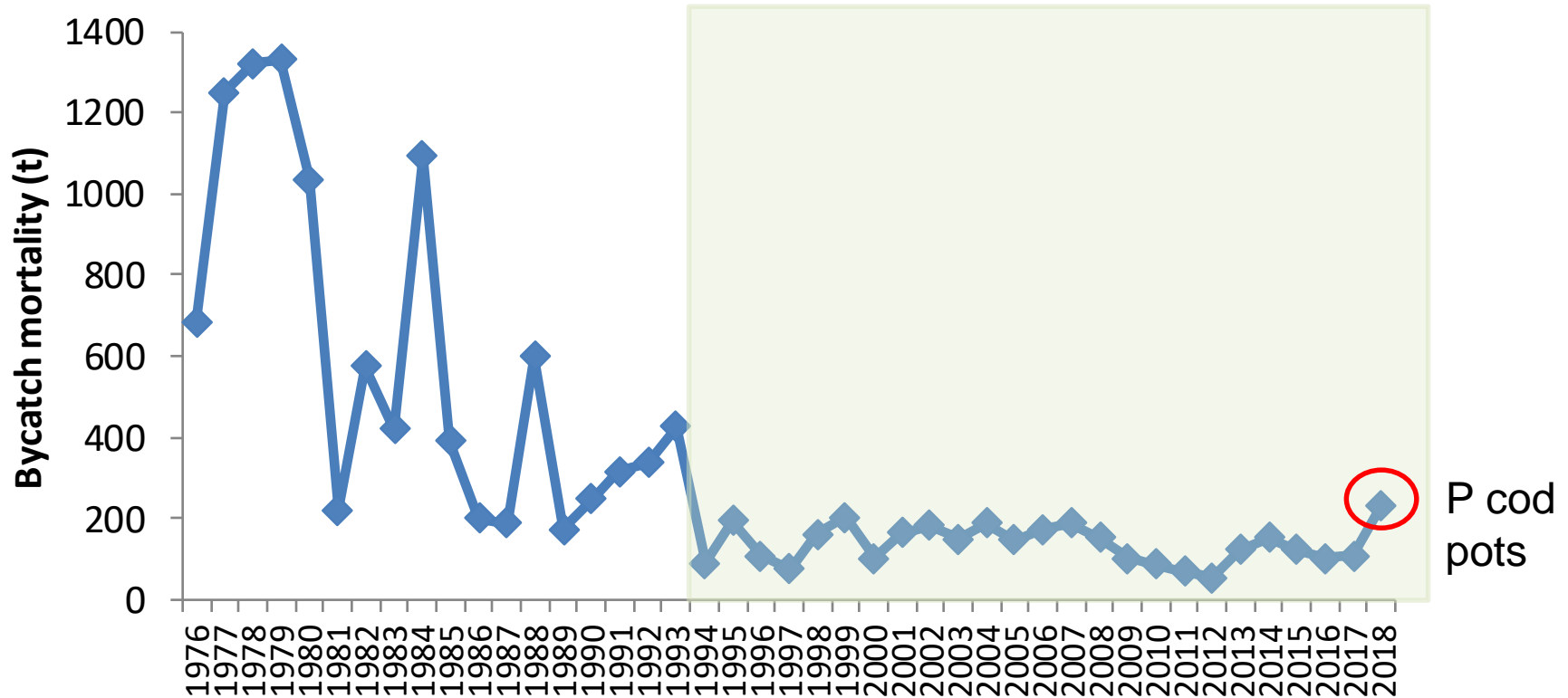
BBRKC discard mortality rate



High discard
rate in 2018

Bycatch in groundfish fisheries

Groundfish

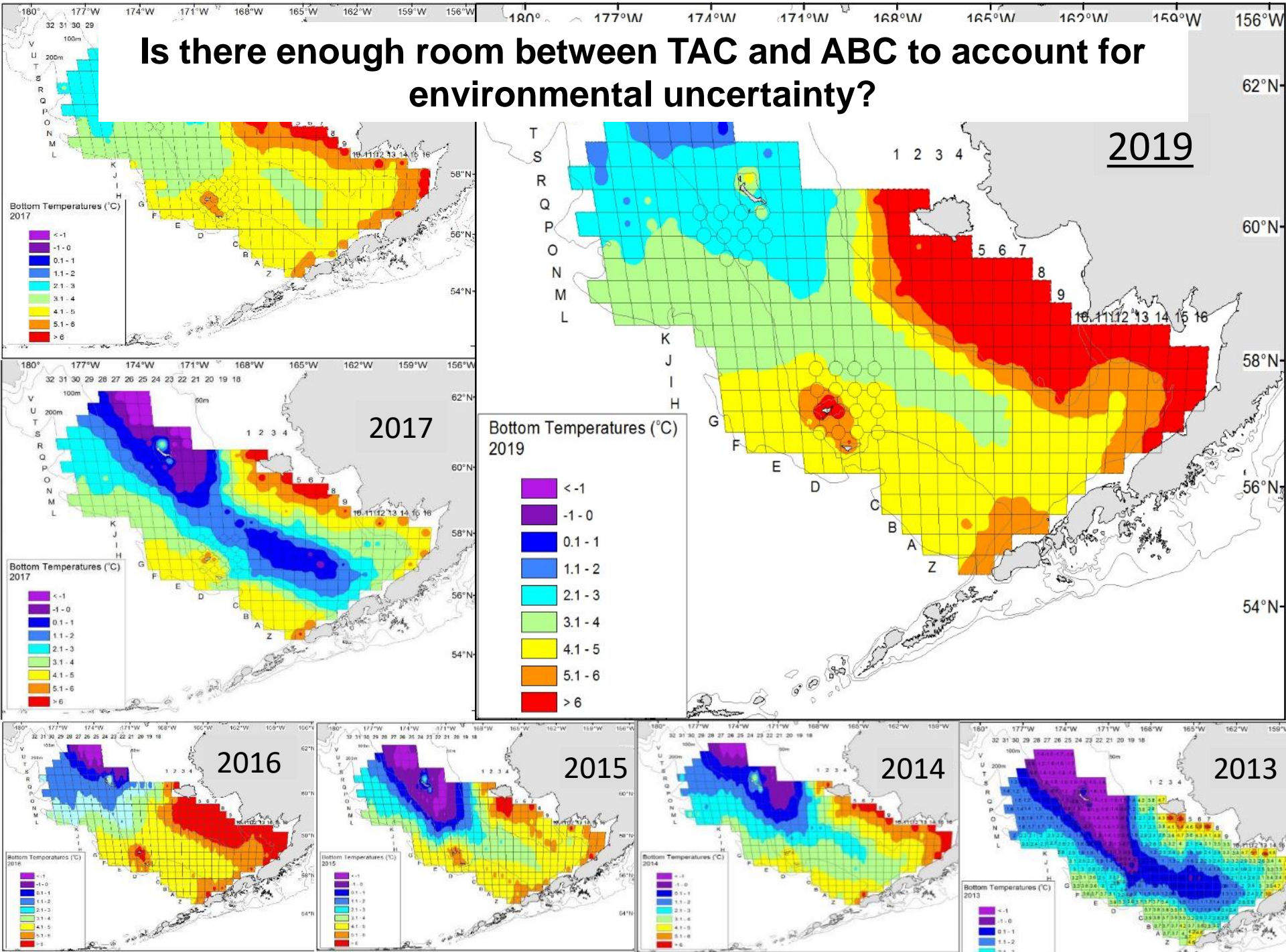


Bristol Bay Red King Crab: Total mortality @ TAC and ABC

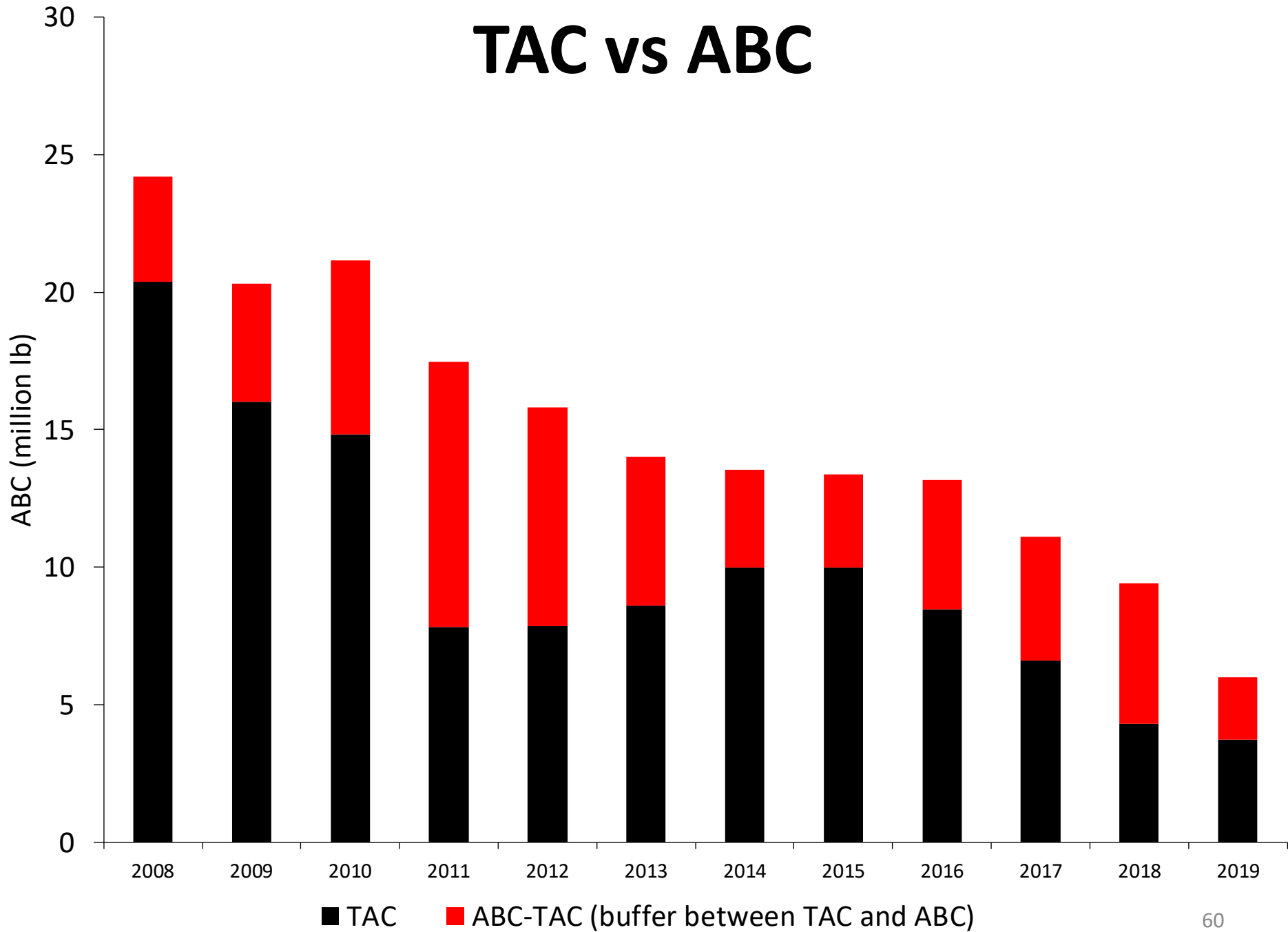
Assumptions	Mortality (million lb)
Assume max mortality in groundfish fisheries, 94/95-18/19 =	0.51
Expected mortality in Tanner crab fishery	0.00
	<u>Subtotal</u> 0.51
Remaining for directed (incl. bycatch mort), mill lb (ABC-Subtotal) =	5.49
Assume maximum (lb discard mort)/(lb retained) in directed fishery, 05/06-18/19 =	0.212
Maximum total mortality = (remaining for directed)/(1+0.212) =	<u>4.53</u>

- Max mortality in GF fisheries since 1994/95 occurred in 2018/19
- Max discard mortality rate in directed fishery in rationalized years occurred in 2018/19
- Given these assumptions, our proposed TACs should be low enough to allow sufficient discard and bycatch mortality (i.e., $3.797 < 4.53$)

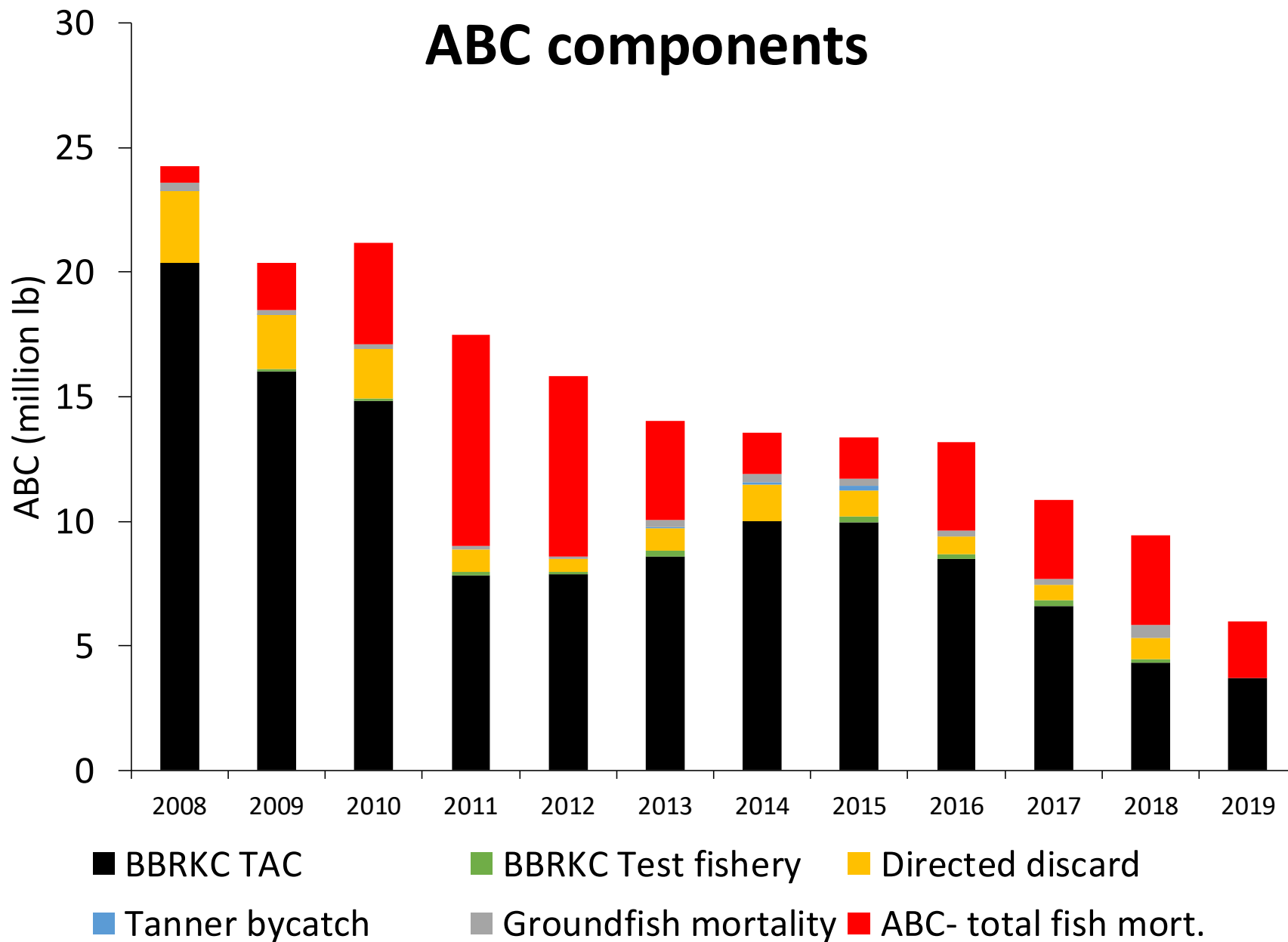
Is there enough room between TAC and ABC to account for environmental uncertainty?



TAC vs ABC



ABC components



Trends – Outlook: 2019 stock assessment recruitment trend

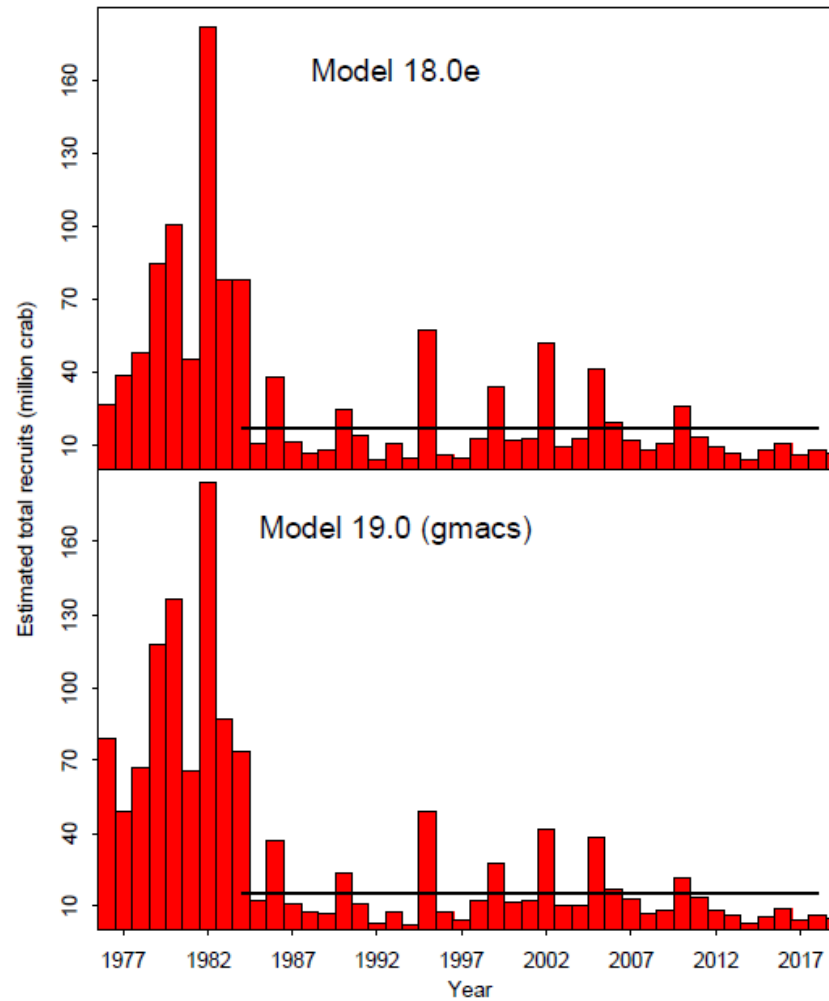
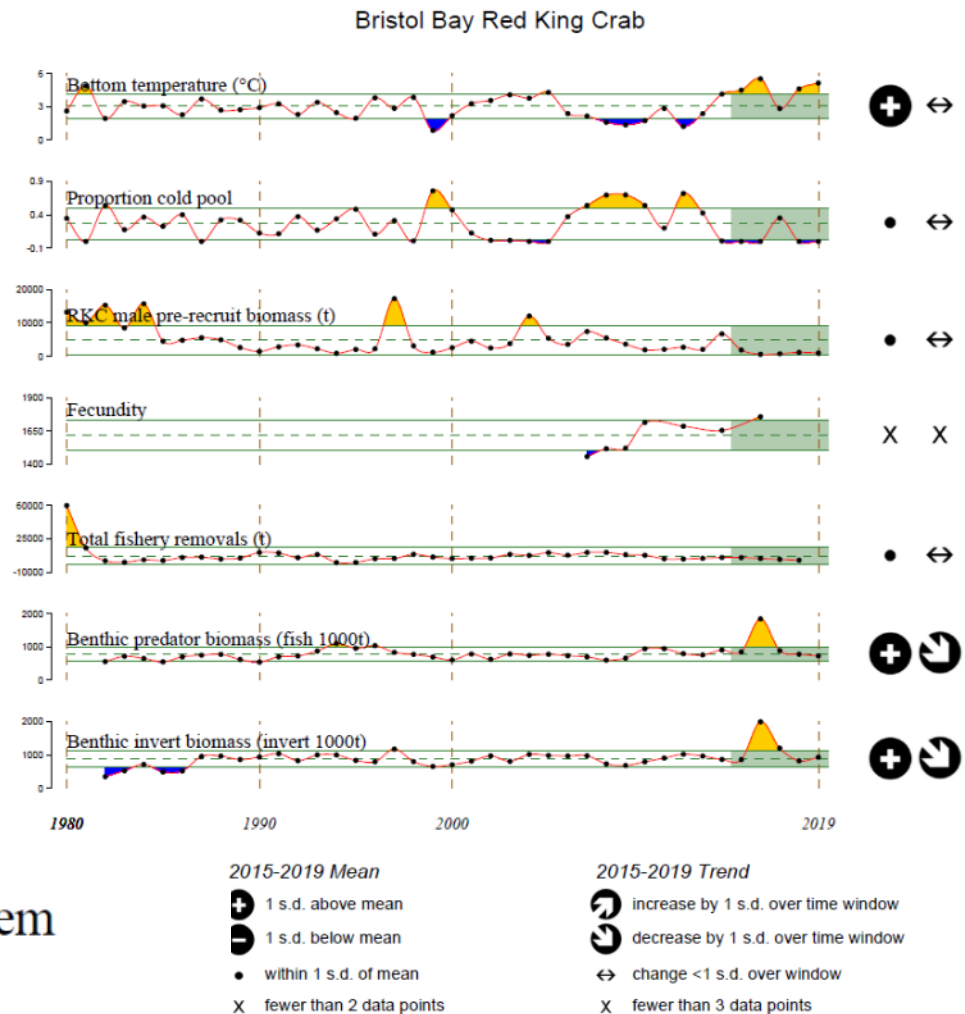


Figure 12(18.0e & 19.0). Estimated recruitment time series during 1976-2019 with models 18.0e and 19.0 (gmacs). Mean male recruits during 1984-2018 was used to estimate B35%.

Ecosystem status report card

Erin Fedewa, NOAA scientist



Bristol Bay Red King Crab Ecosystem Considerations

- **Summer bottom temperatures** in Bristol Bay were **well above average** during four of the past five years, and **the cold pool did not extend into the Bristol Bay** management area during these four warm years.
- **Red king crab pre-recruit** (males 110-134 mm CL) biomass has remained **below the 40-year average** since 2014 despite **total fishery removals** remaining at a **near-average level**.
- **Survey biomass of benthic predators** and **benthic inverts** **increased in 2016** due to high catches of flathead sole, Pacific halibut, Alaska skate and sea stars. **Since 2016, the overall trend** in biomass of benthic predators and inverts **has decreased to a near-average level**.

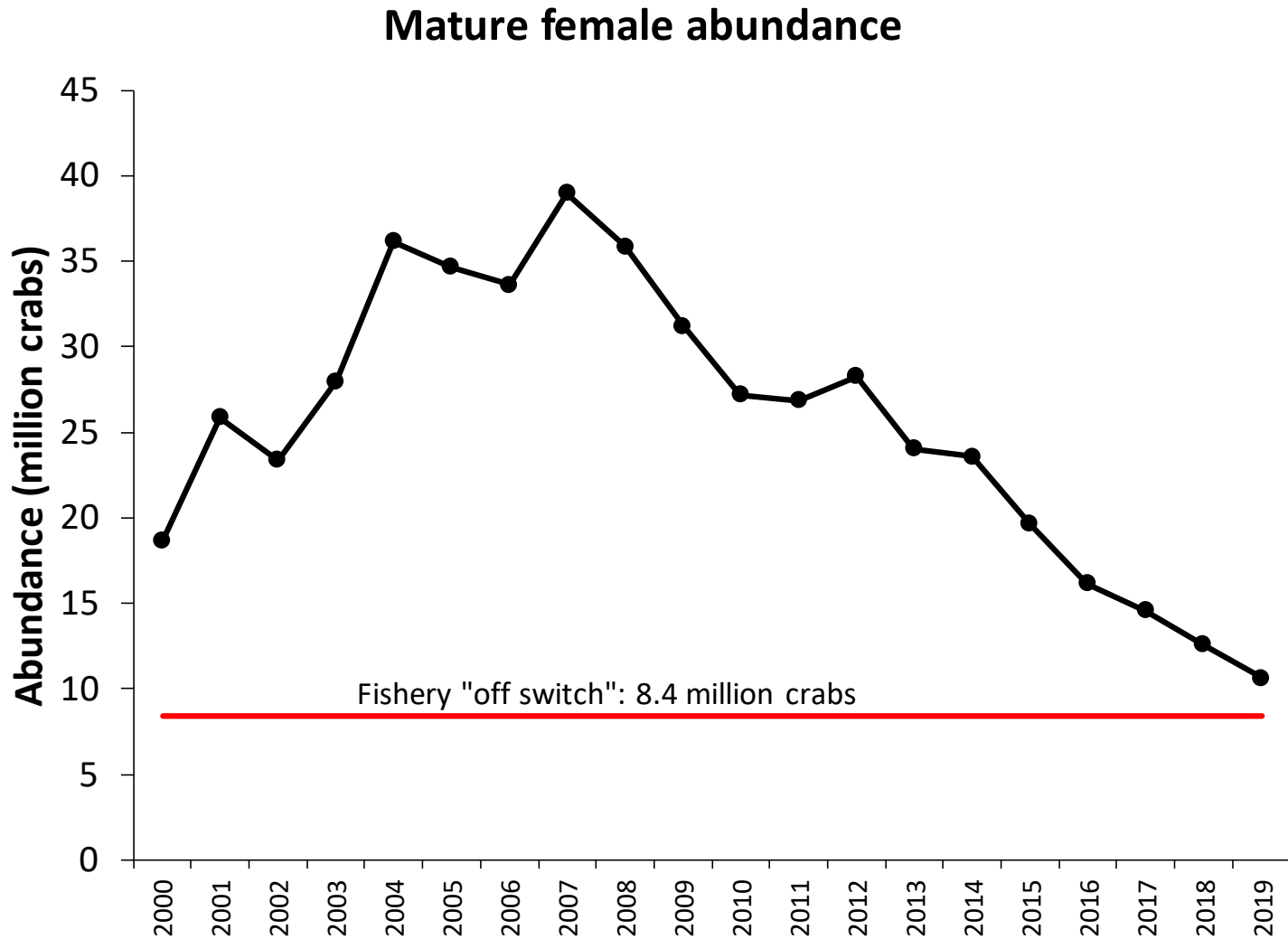
Environmental uncertainty

- Increasing temps
- Changing ecosystem: shifts in predators, competitors

Overall Outlook

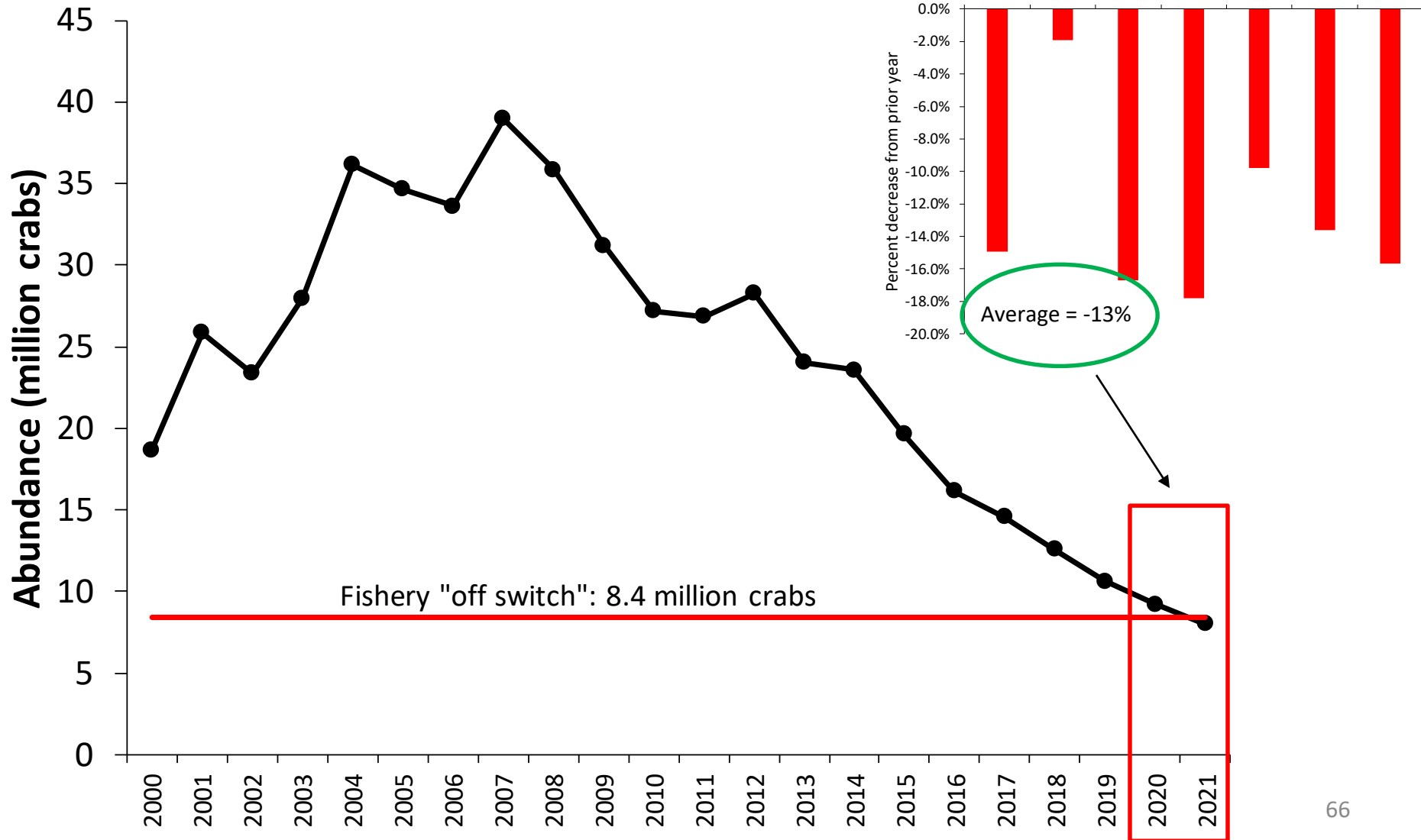
- Continued downward trajectory for ESB, M, F, L
- Low estimated recruitment
- Length frequencies discouraging, no strong pulses of small crabs in system

Trending towards thresholds



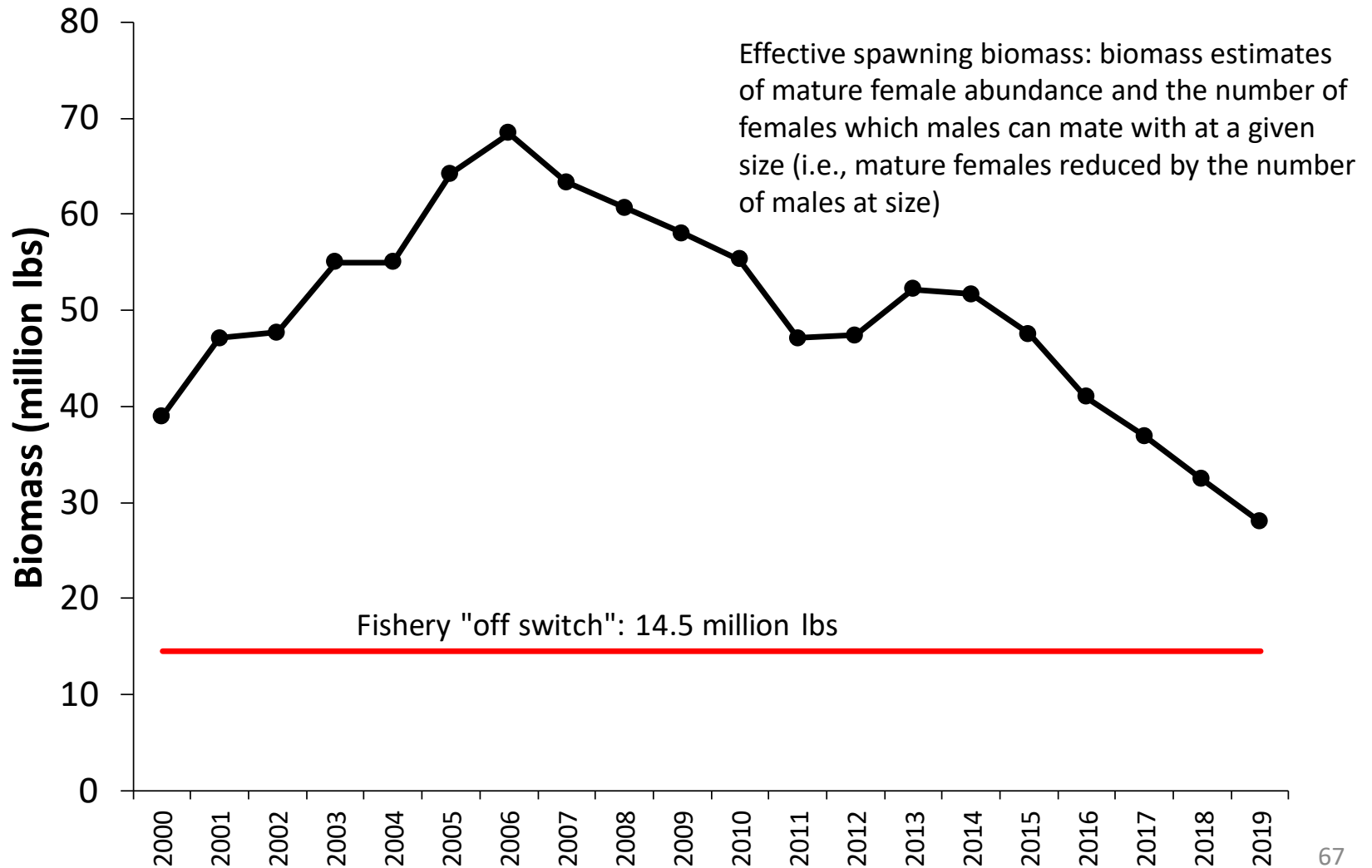
Trending towards thresholds

Mature female abundance



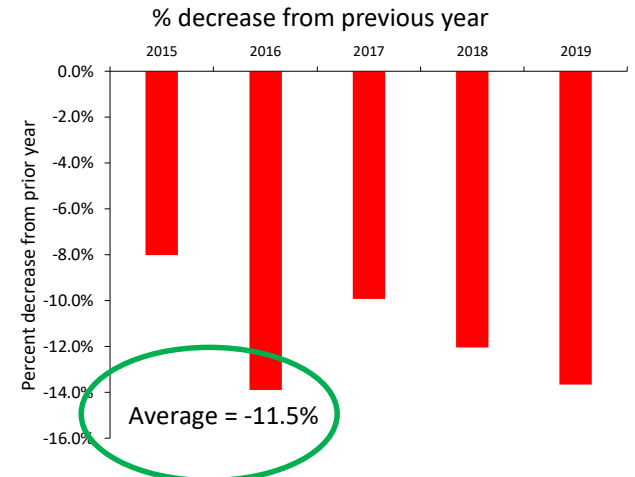
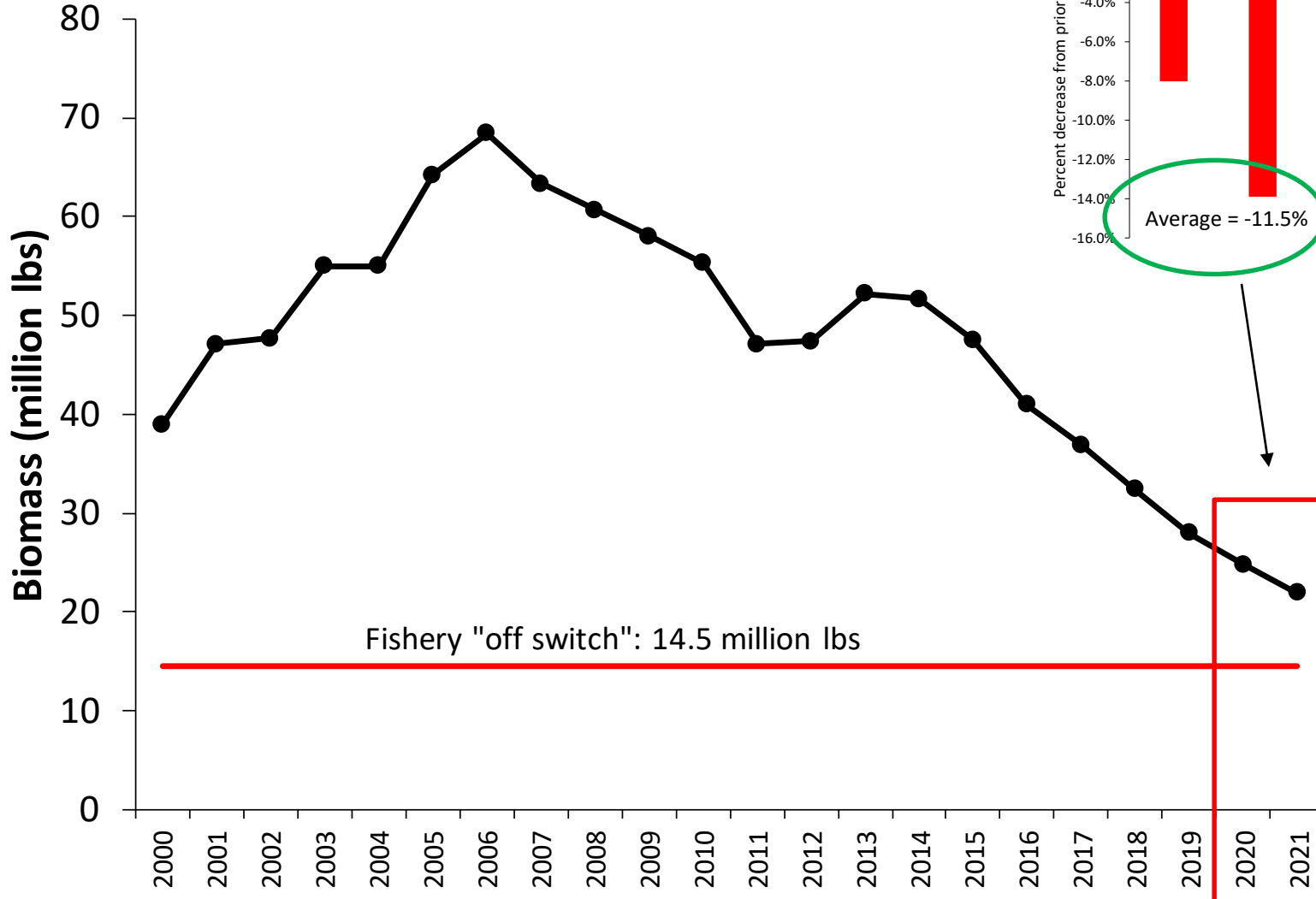
Trending towards thresholds

Effective spawning biomass (ESB)



Trending towards thresholds

Effective spawning biomass (ESB)



State harvest strategy thresholds

- Based on mature females:
 - S-R relationship: expected number of recruits as a function spawner abundance
 - Poorly fitting for most BSAI crab stocks, but decent for BBRKC using historical data
 - Thresholds: minimum abundance “that allows sufficient recruitment so that the stock can eventually reach a level that produces MSY”
- Current S-R plot:
 - Current thresholds are low bars, if anything they could be more conservative
 - Falling below state thresholds will likely be accompanied by falling below federal threshold for being declared “overfished” (i.e., less than MSST)

Outline

- Introduction
- PIBKC
- PIRKC
- SMBKC
- BBRKC
- **Tanner**
- Intermission
- snow

Bering Sea Tanner Crab

Federal 2019/20 Status

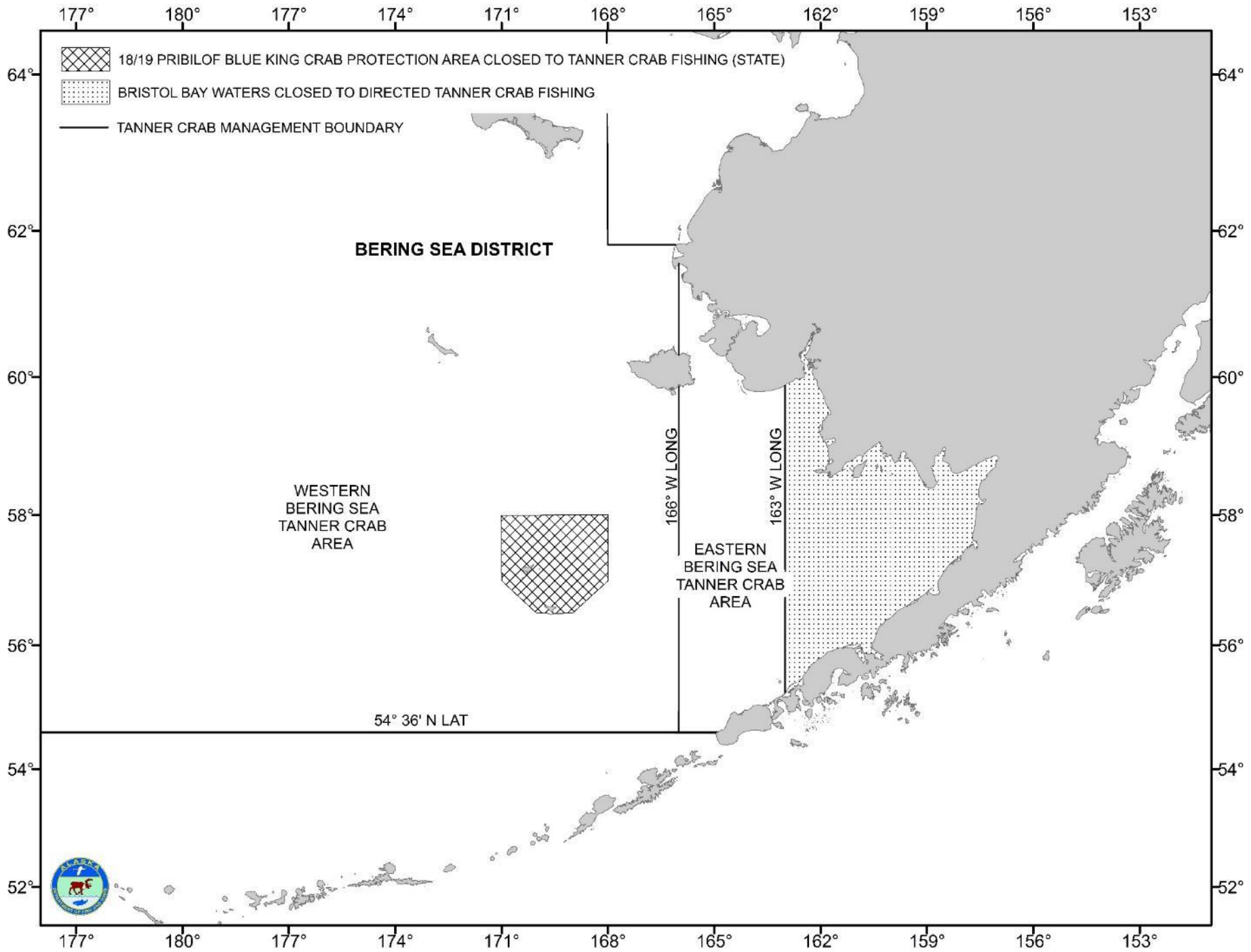
ABC = 50.89-mill lb total catch

- Including bycatch mortality of males and females in all fisheries
- Set with 20% “buffer” on OFL (i.e., $ABC = 0.8 \cdot OFL$)

OFL = 63.62-mill lb total catch

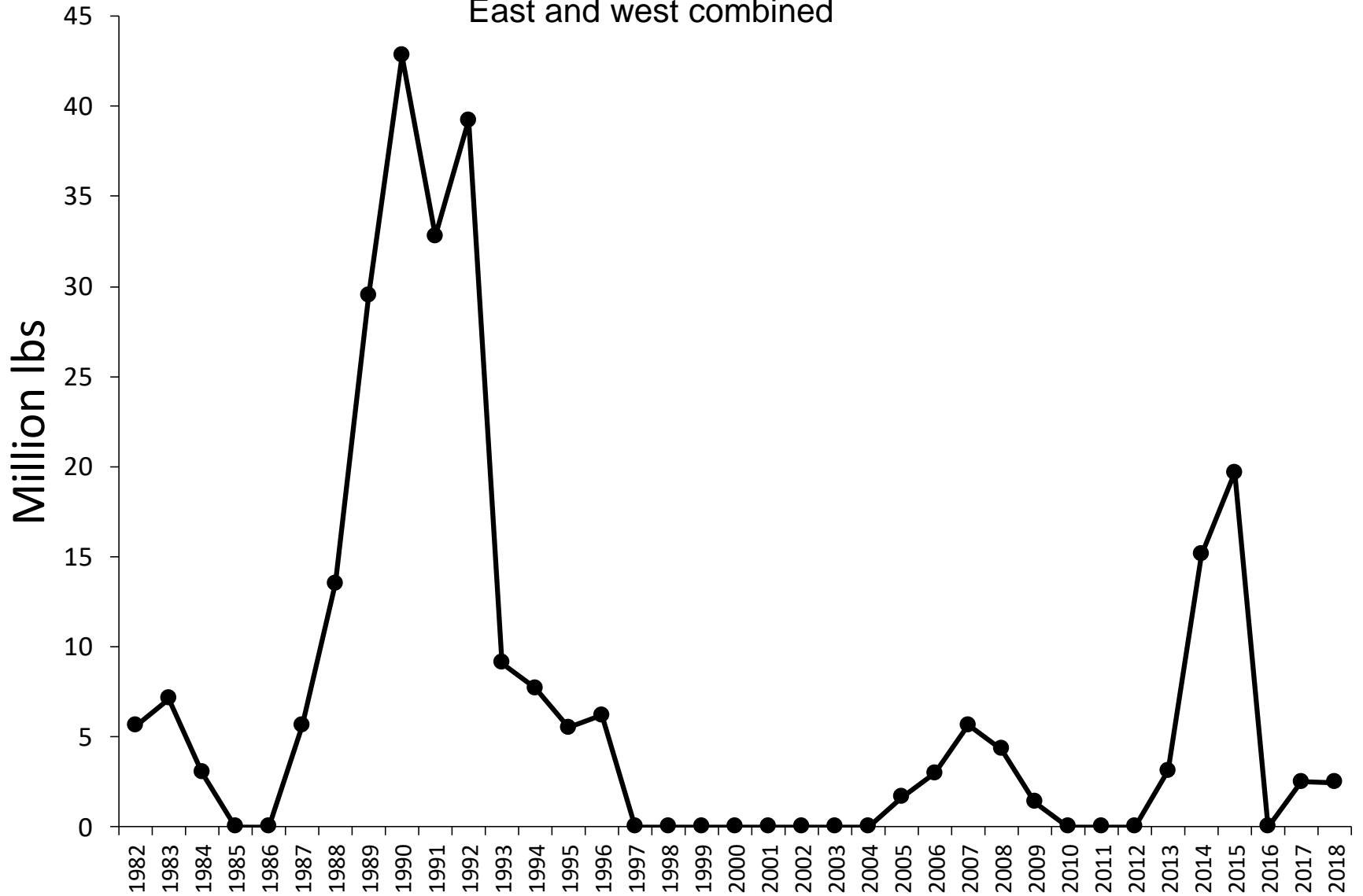
Historical status and catch specifications for Eastern Bering Sea Tanner crab (million lb). Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

Year	MSST	Biomass (MMB)	TAC (East + West)	Retained Catch	Total Catch Mortality	OFL	ABC
2015/16	28.27	162.99	19.67	19.64	25.09	59.94	47.95
2016/17	32.15	171.87	0.00	0.00	2.52	56.46	45.17
2017/18	33.40	95.49	2.50	2.50	5.22	56.03	44.83
2018/19	45.27	182.09	2.44	2.44	4.18	46.01	36.82
2019/20		87.18				63.62	50.89



Historical TACs

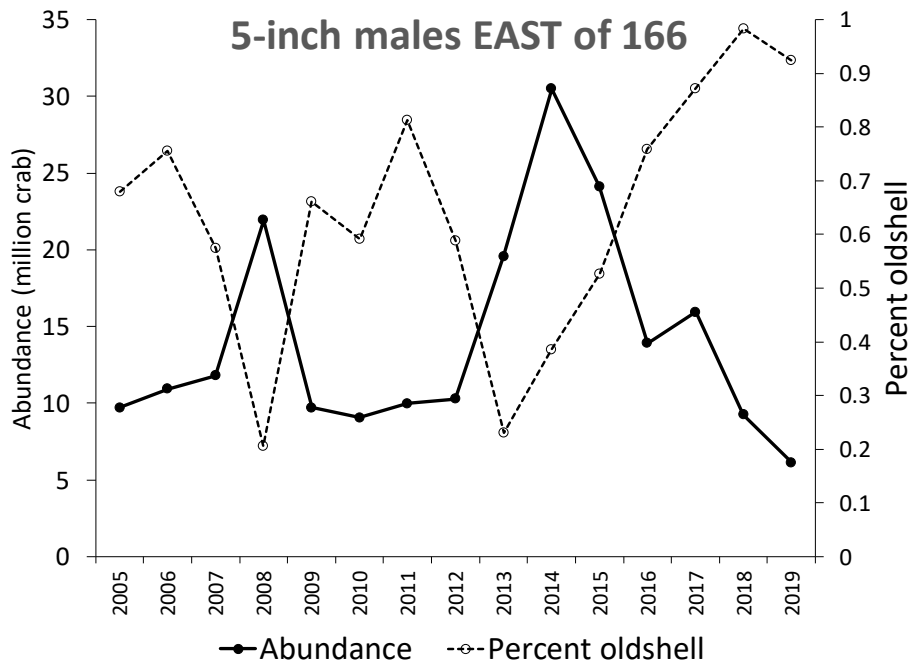
East and west combined



2018/19 WBT observations from the fleet

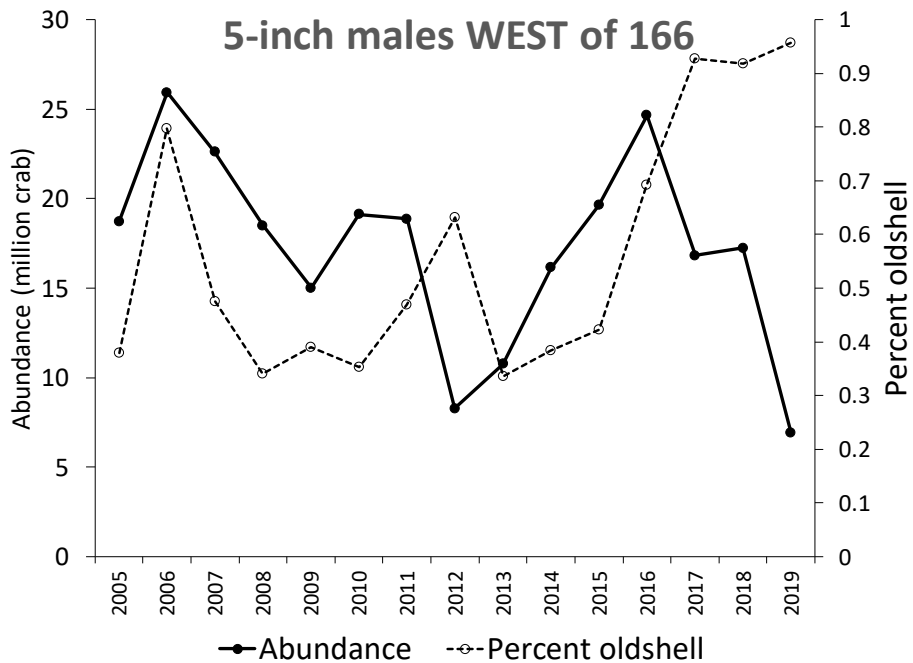
- Observed vessel CPUE ranged from 9 to 91.5.
- Captains reported slow fishing in November (after finishing RKC), but fishing improved for vessels that waited to fish until February/March (after finishing BSS).
- Fishing was spotty in general compared to 2017/18 season.

EAST



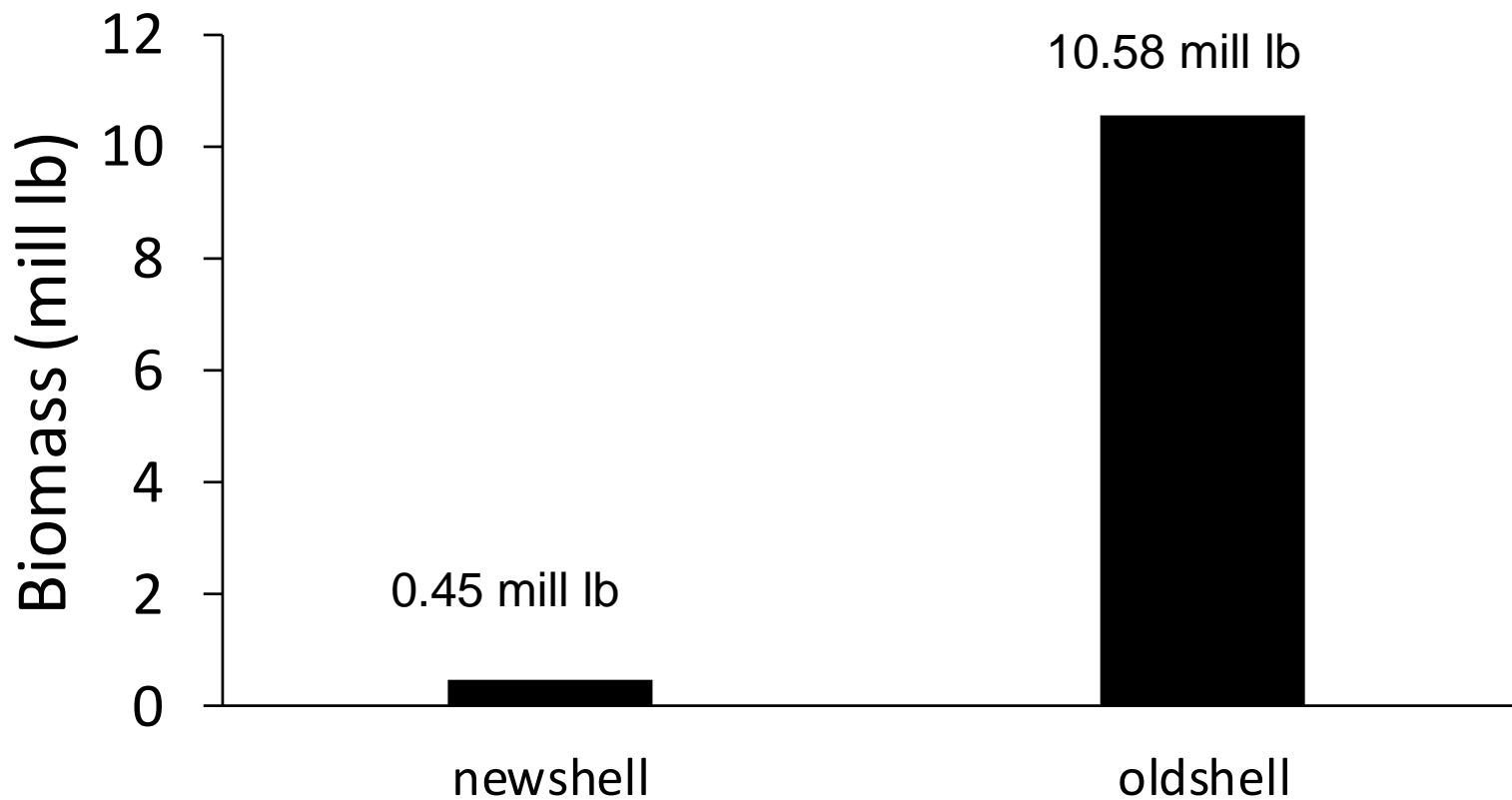
2019: 93% oldshell

WEST



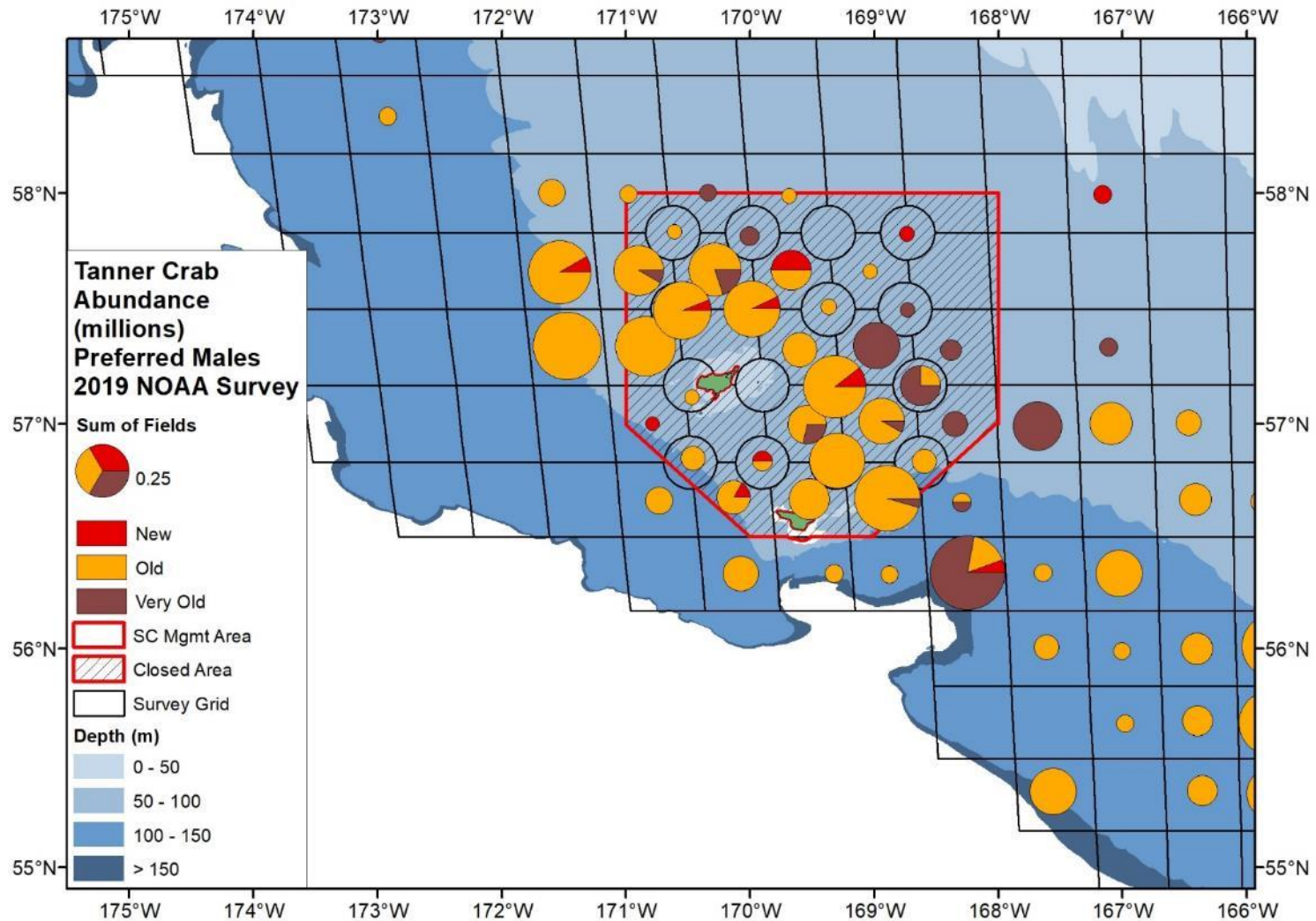
2019: 96% oldshell

5 inch males WEST of 166

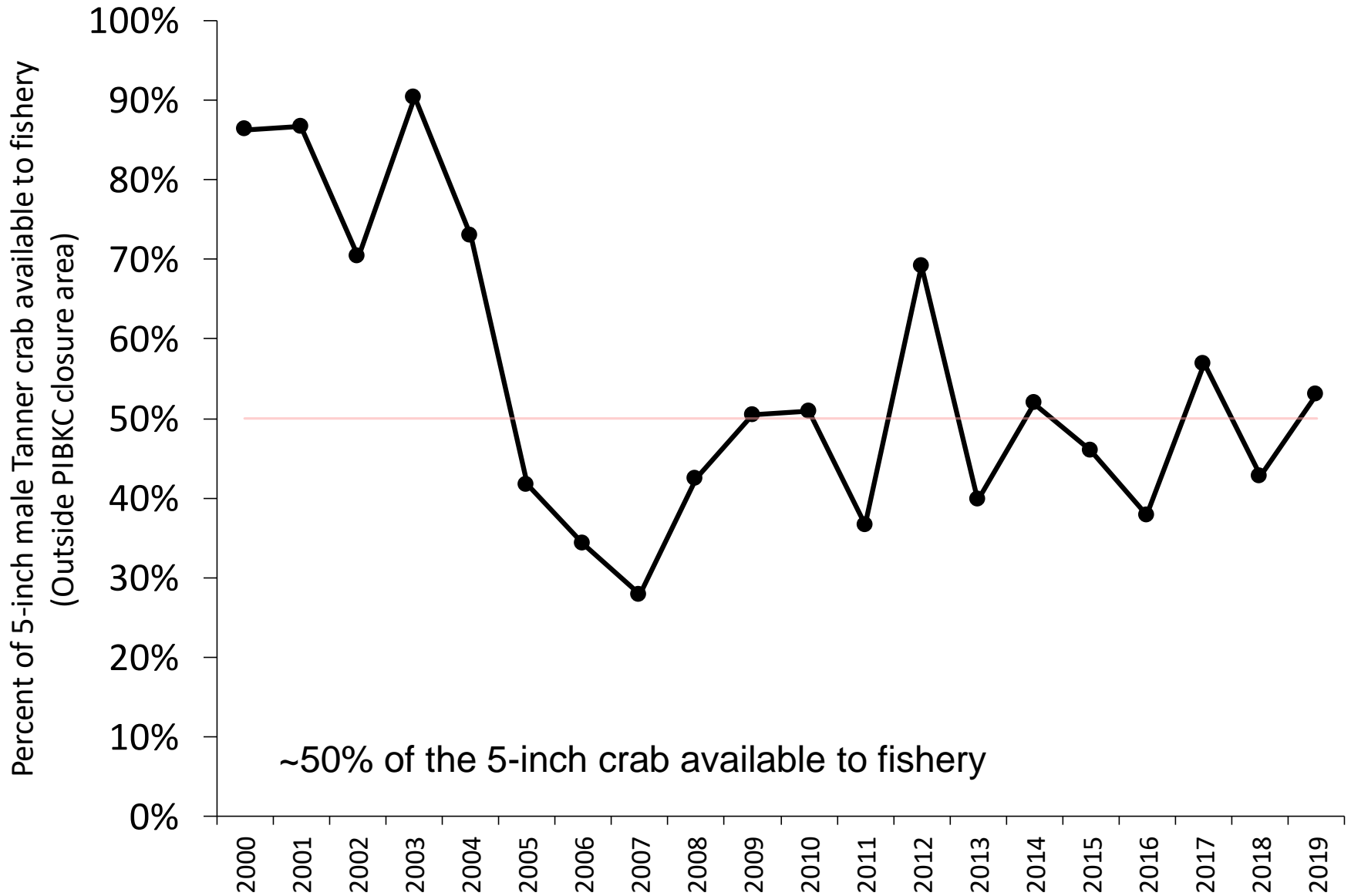


Pribilof Islands Closure Area

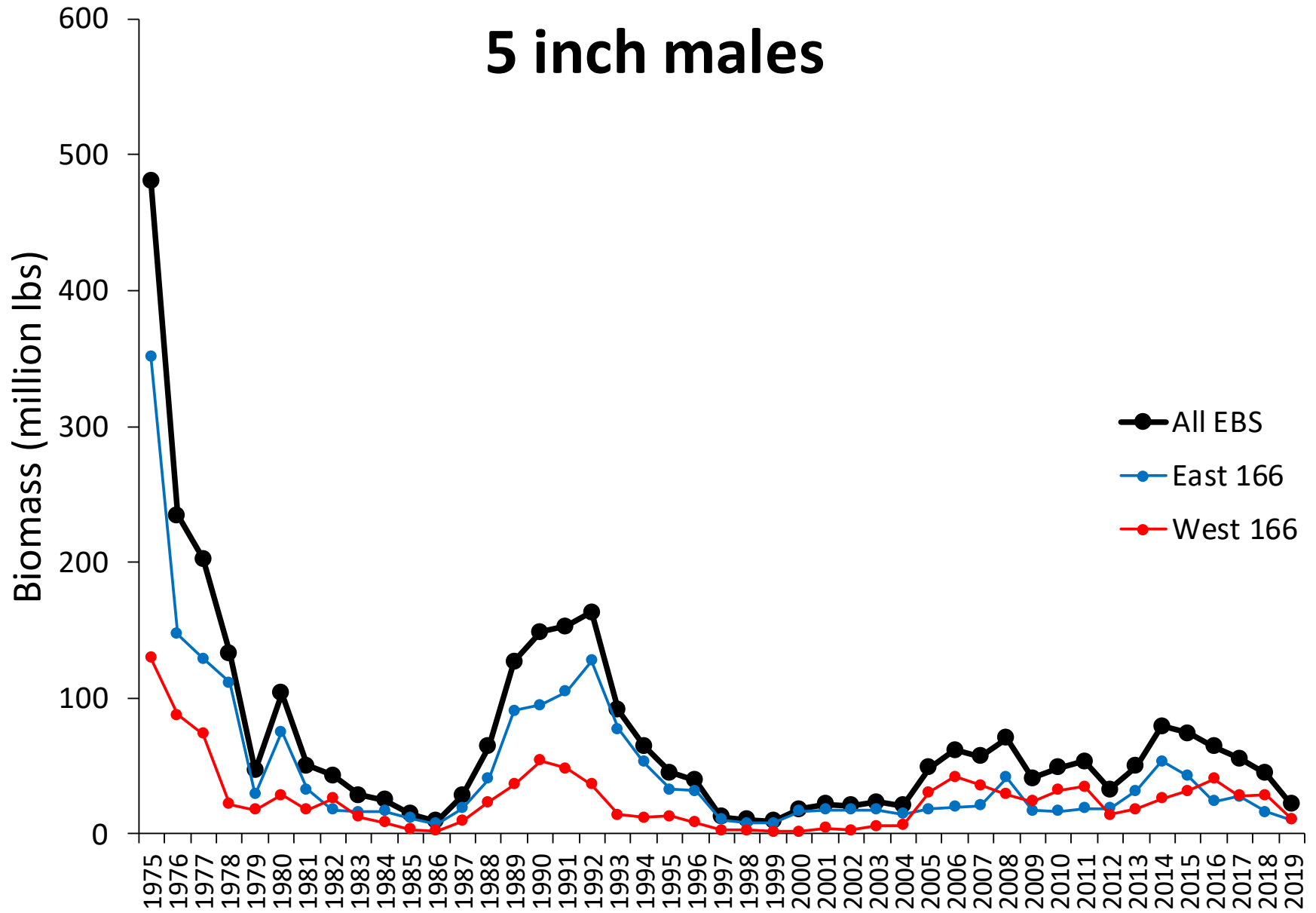
2019 NOAA RACE EBS Trawl Survey - *C. bairdi* Preferred Male Abundance



5-inch males west of 166 W

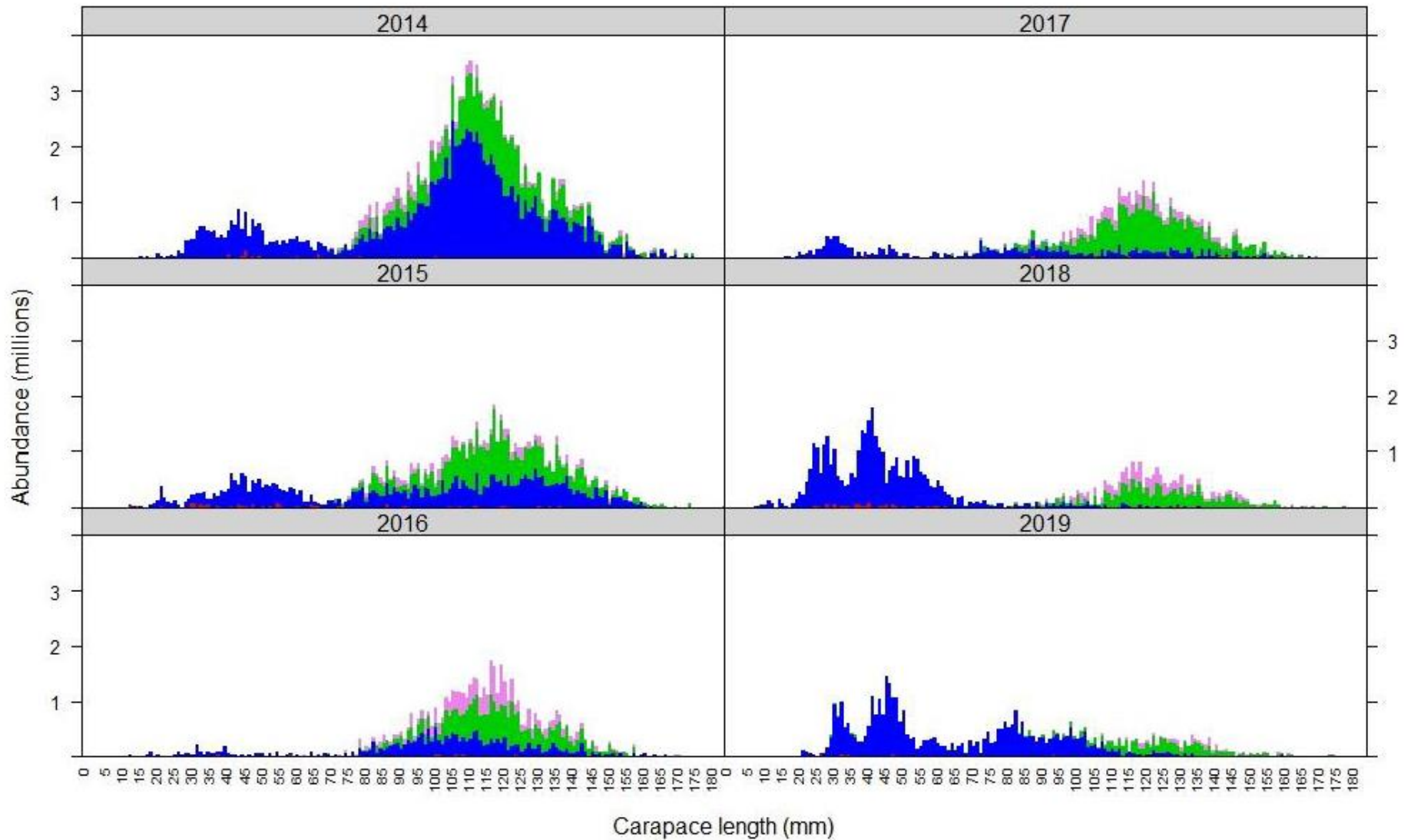


5 inch males



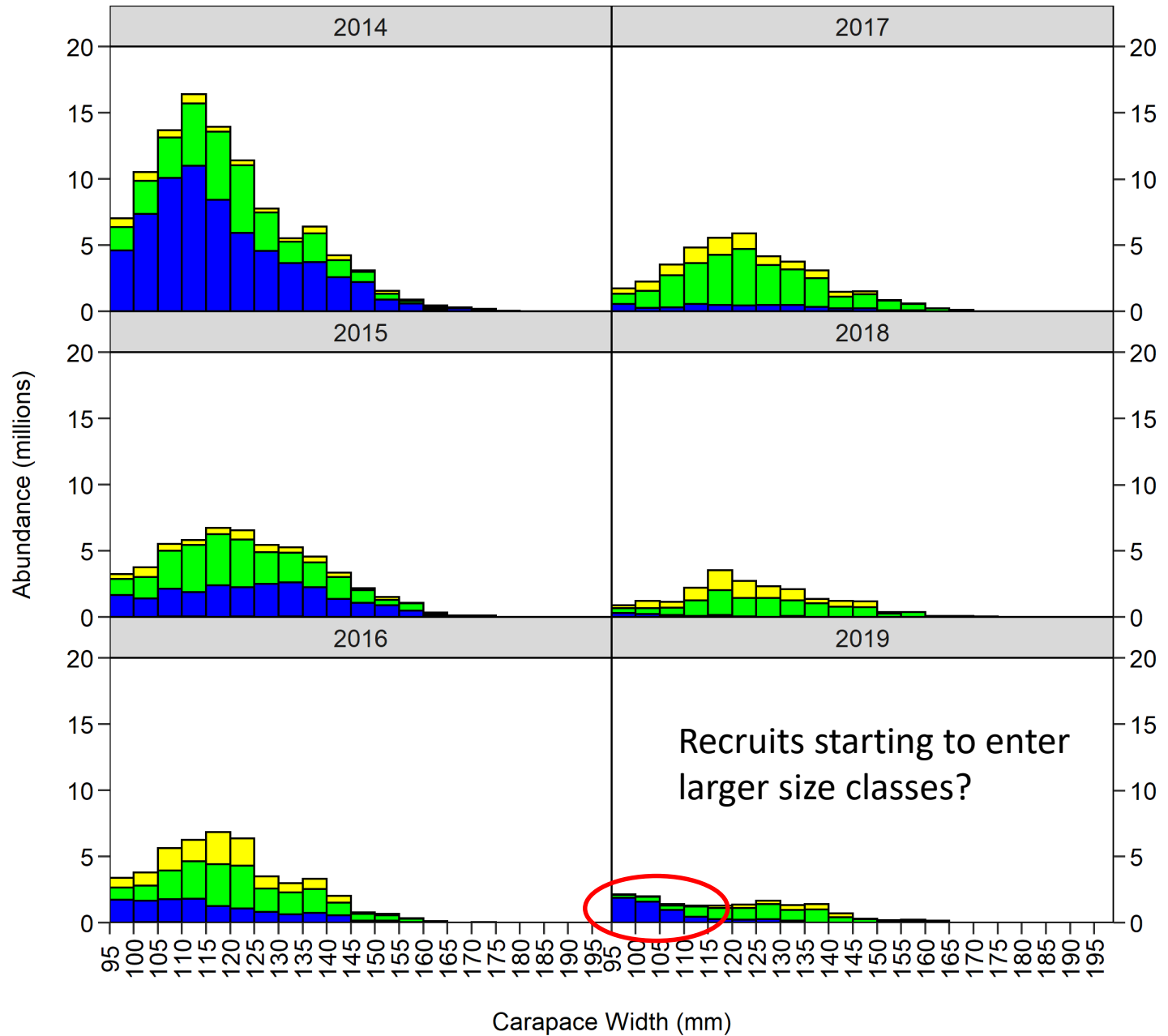
Tanner Crab east of 166°W

Shell condition
Molting & soft ■ New - hard ■ Old ■ Very old ■



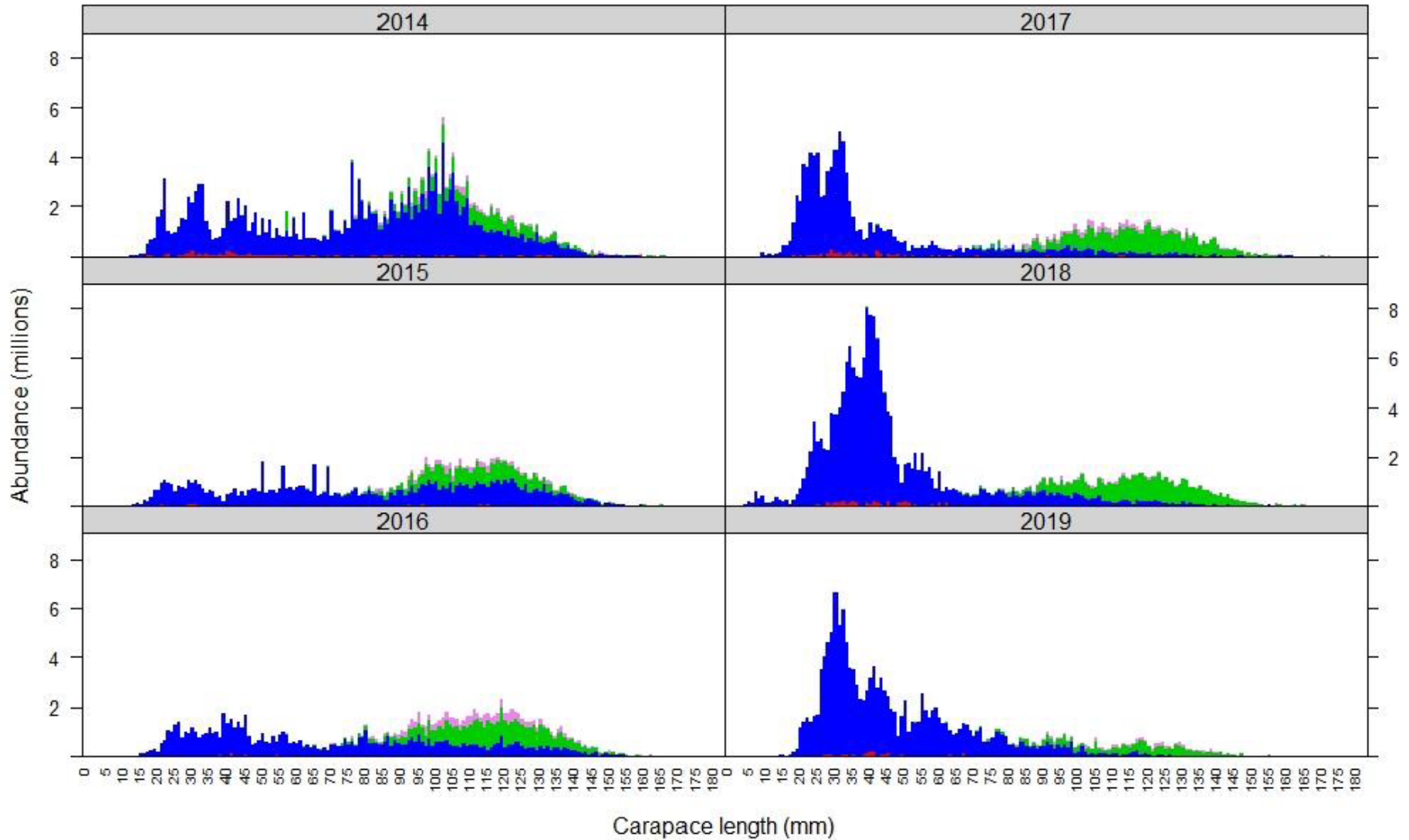
Male

Shell Condition ■ Soft & molting ■ New - hard ■ Old ■ Very old



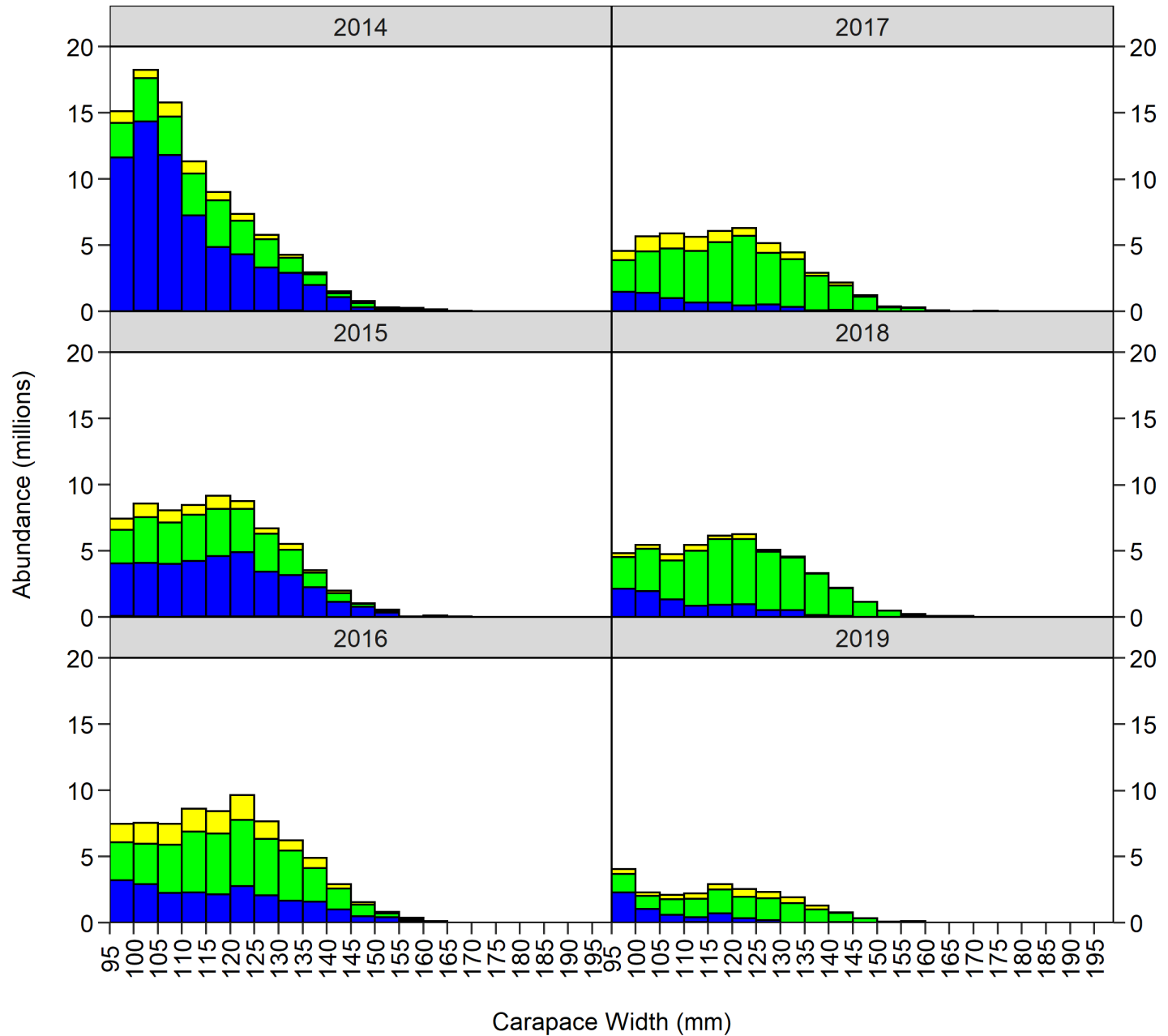
Tanner Crab west of 166°W

Shell condition
Molting & soft ■ New - hard ■ Old ■ Very old ■

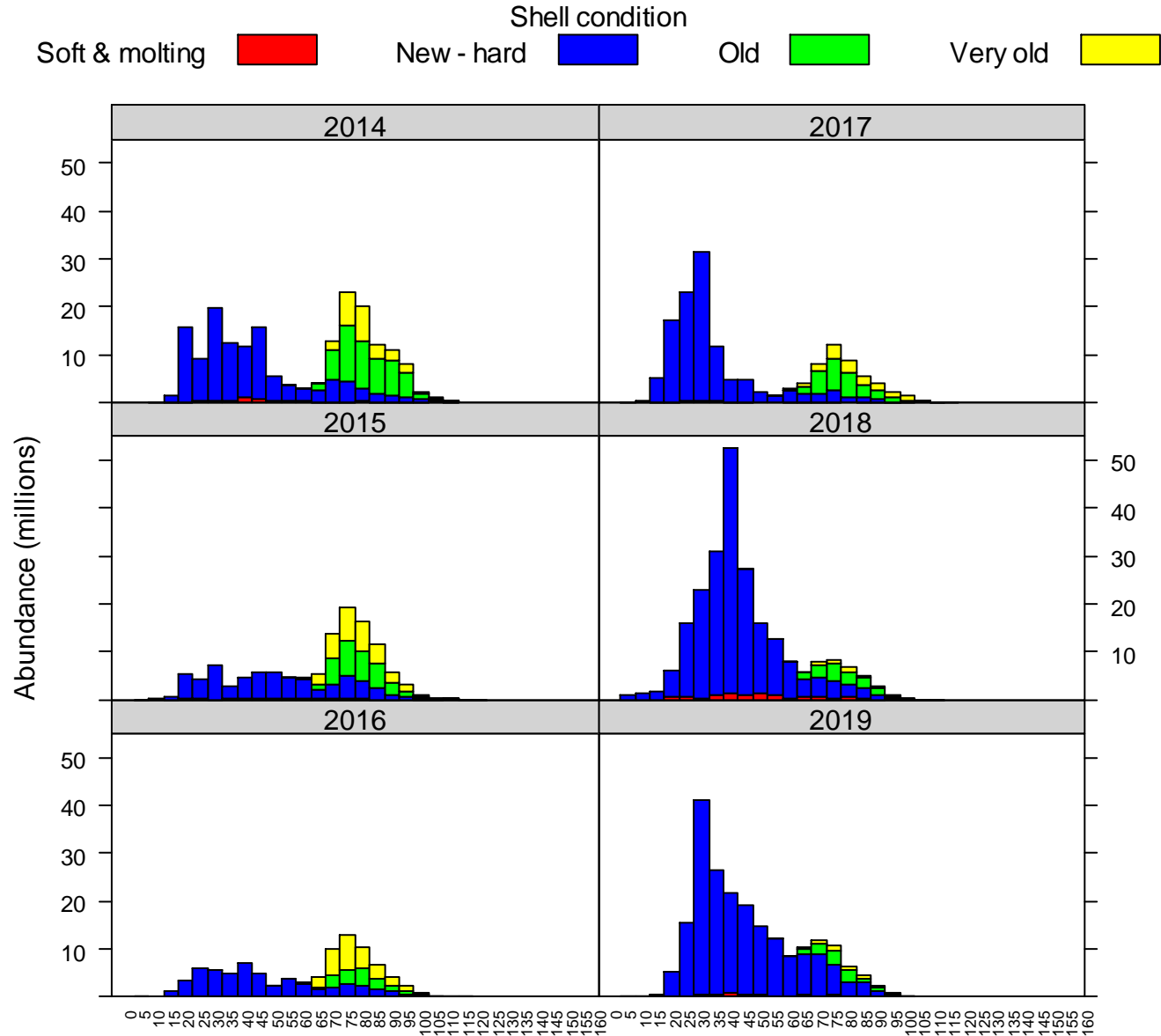


Male

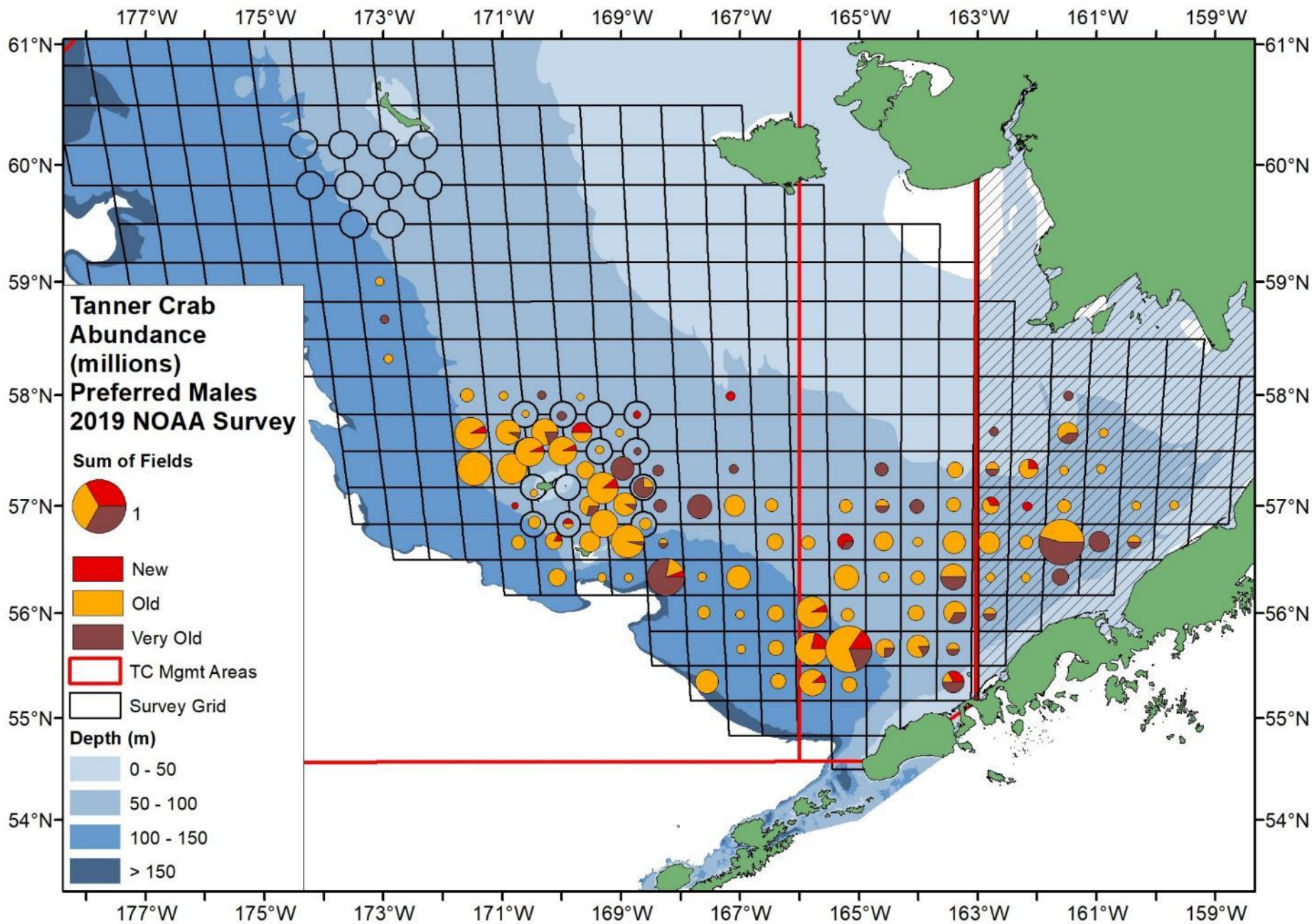
Shell Condition ■ Soft & molting ■ New - hard ■ Old ■ Very old



Tanner crab all EBS (female)



2019 NOAA RACE EBS Trawl Survey - *C. bairdi* Preferred Male Abundance



females

Mature female biomass

Below threshold

Within threshold range

Above threshold

males

Fishery Closed

Fishery Closed

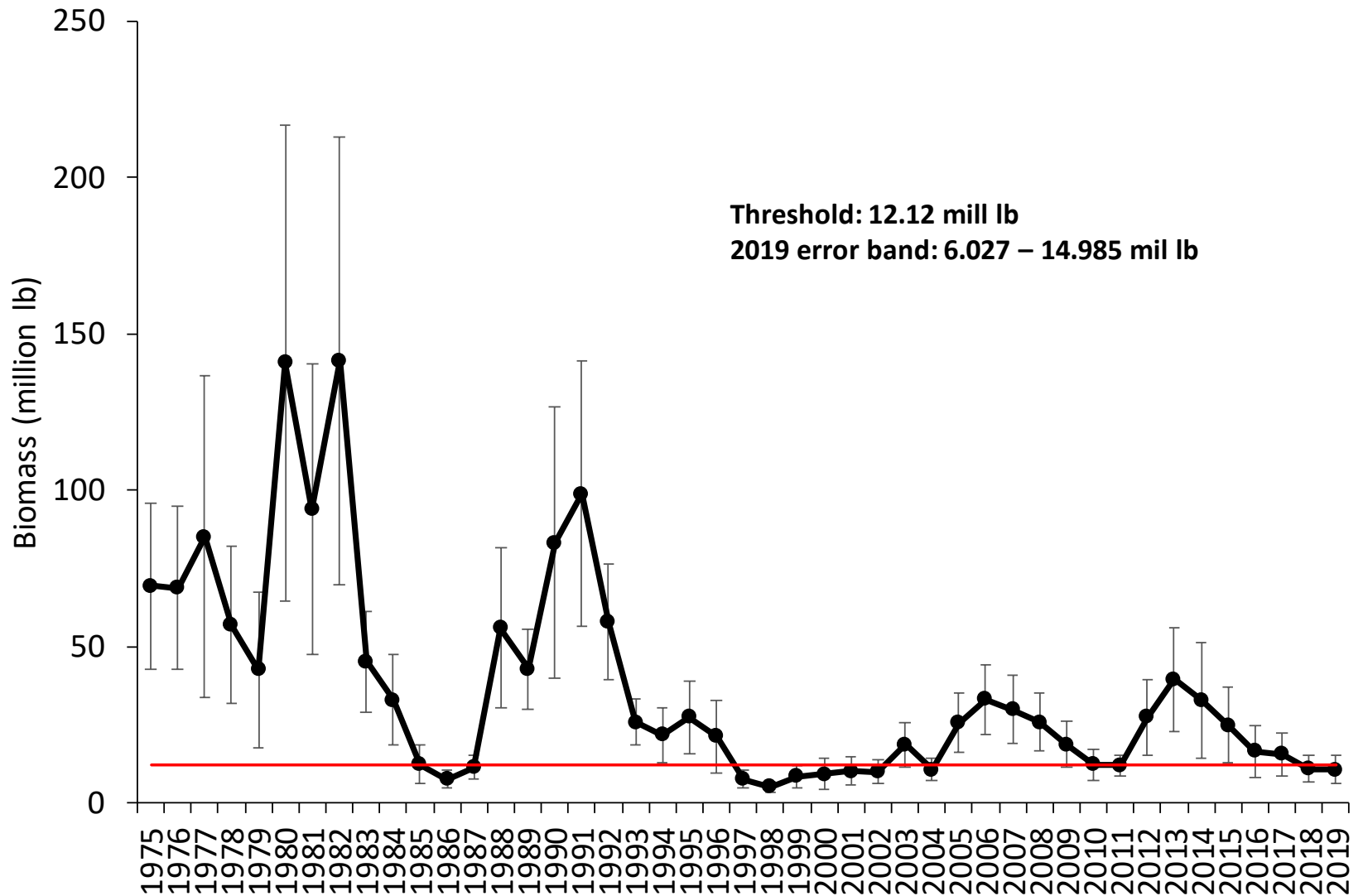
$$TAC = (B/B_{AVG} - 1) \times (0.9) \times C_{MSY}$$

Fishery Closed

$$TAC = (B/B_{AVG}) \times (0.9) \times C_{MSY}$$

$$TAC = (0.9) \times C_{MSY}$$

Mature female biomass



females

males

Mature female biomass

Below threshold

Within threshold range

Above threshold

Males below 100% ave

Males above 100% ave

Males below 25% ave

Males 25%-100% ave

Males above 100% ave

Fishery Closed

Fishery Closed

$TAC = (B/B_{AVG} - 1) \times (0.9) \times C_{MSY}$

Fishery Closed

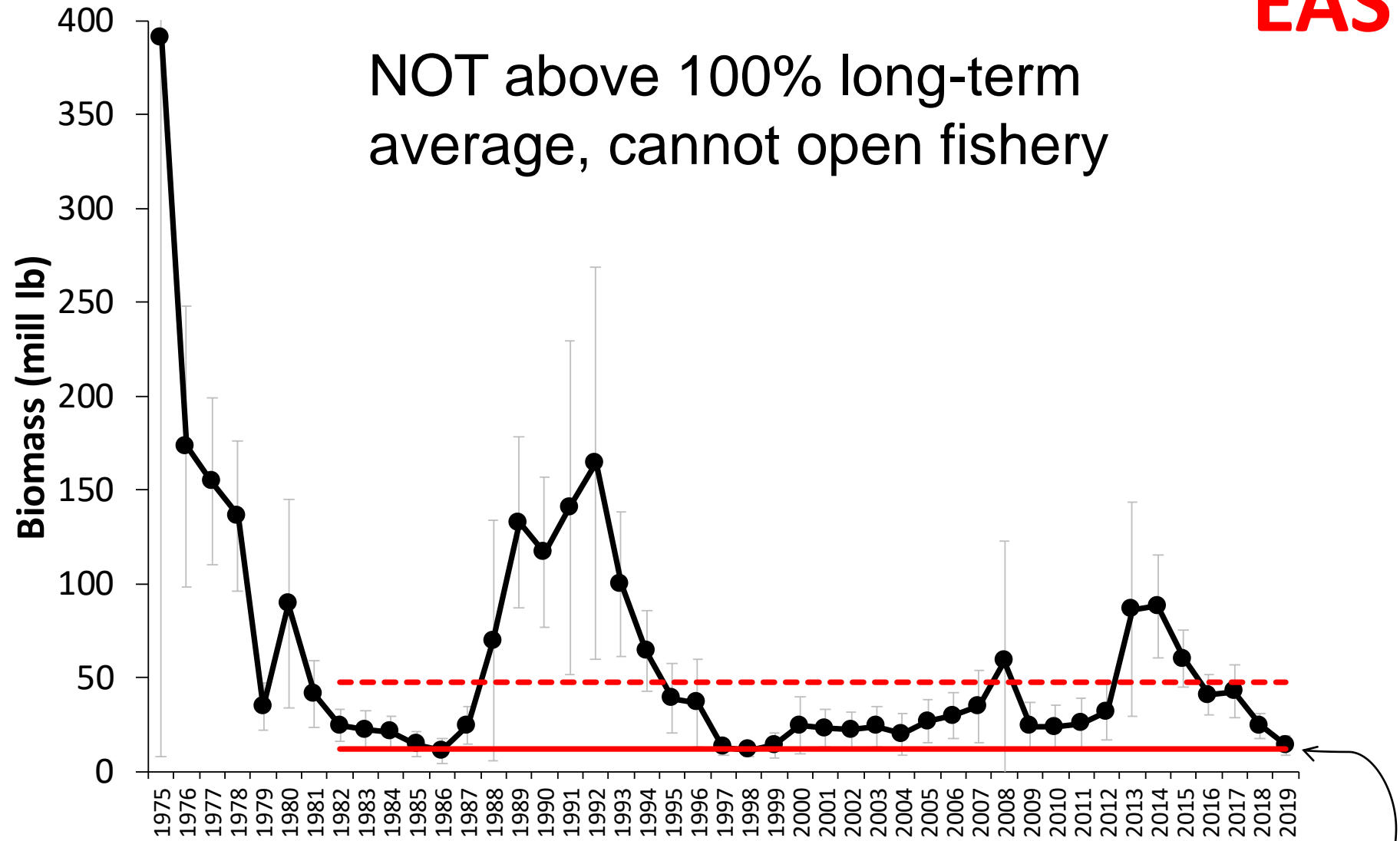
$TAC = (B/B_{AVG}) \times (0.9) \times C_{MSY}$

$TAC = (0.9) \times C_{MSY}$

Mature males EAST of 166 W

EAST

NOT above 100% long-term average, cannot open fishery



1982-2016 avg: 47.54 mill lb

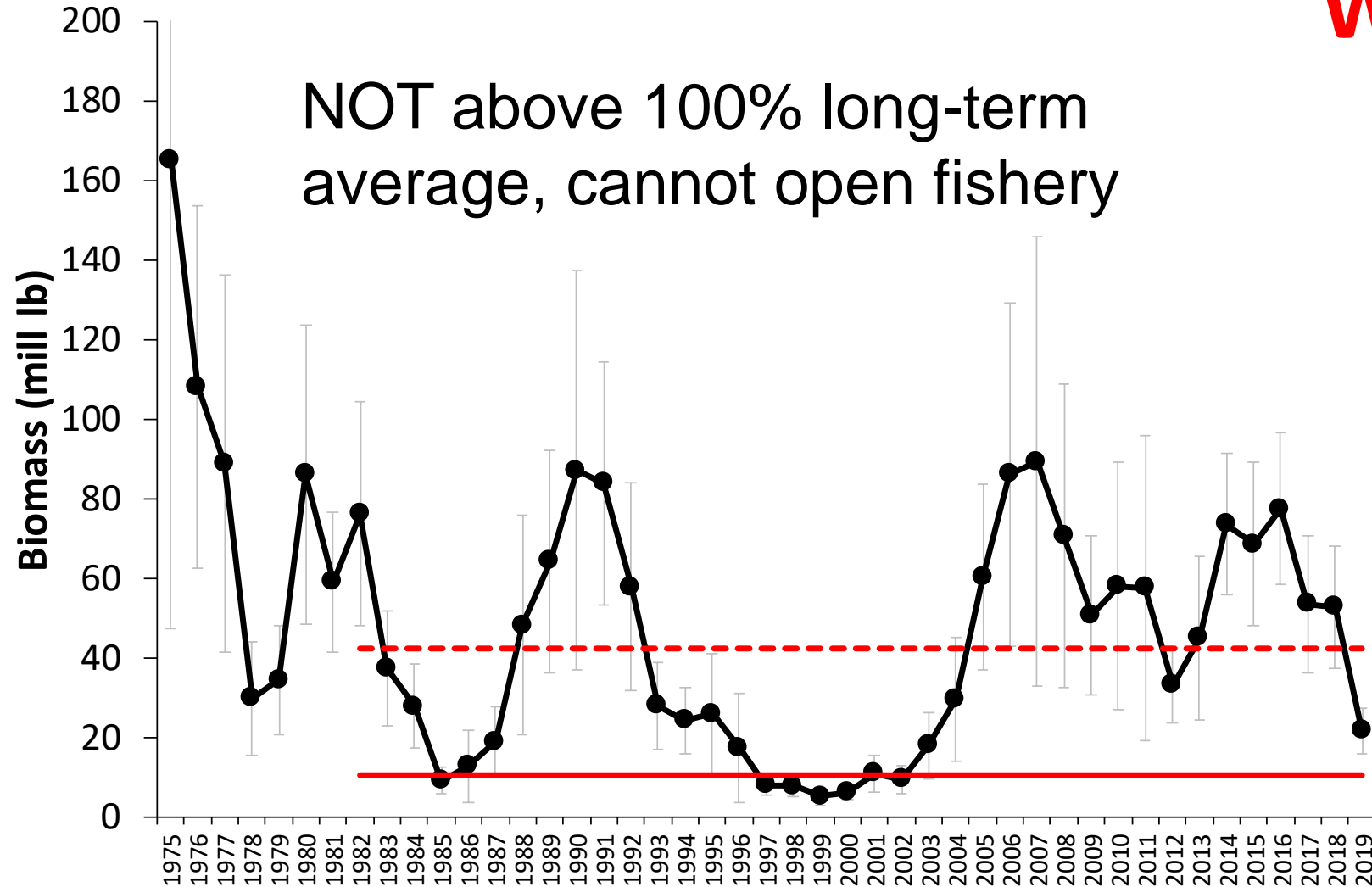
2019 estimate: 14.06 mill lb

30% of long-term average

Mature males WEST of 166 W

WEST

NOT above 100% long-term average, cannot open fishery



1982-2016 avg: 42.39 mill lb

2019 estimate: 21.63 mill lb

51% of long-term average

TAC = 0 for east and west

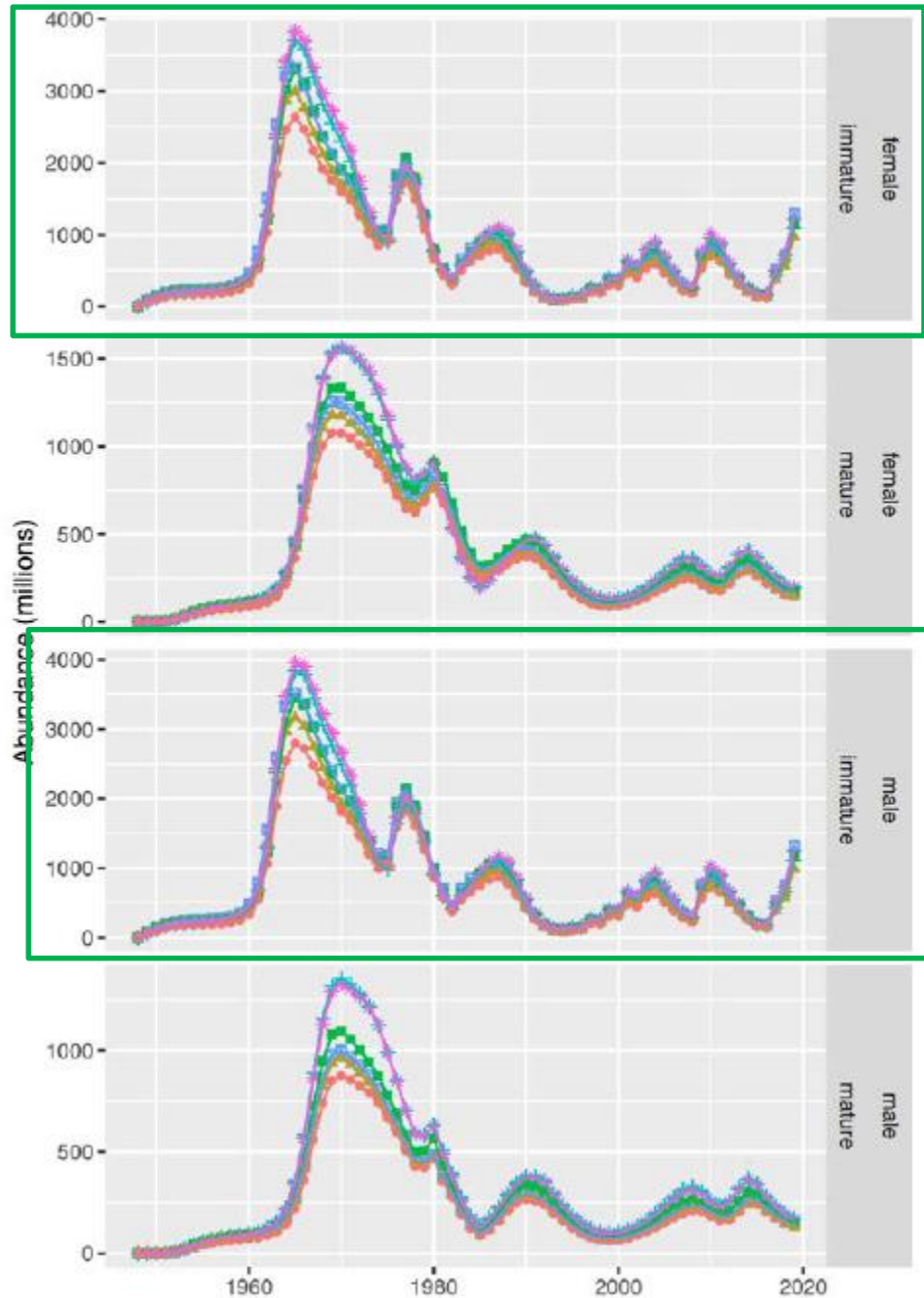
- Mature and legal portions of the population are down relative to last year
- State harvest strategy: MMB is below threshold for opening fishery in both areas
 - MMB 30% and 51% of long-term average for east and west
- 5 inch males are 93% and 96% oldshell
 - Only 0.45 mill lb newshell in the west, of which approximately 50% is in the PI closure area

...Looking ahead

- State Tanner crab harvest strategy revision currently in progress
- Simplify and evaluate the utility of including female control rule
 - Consider variety of scenarios ranging from no female consideration to full female consideration
 - Address “on/off” switches
- Management strategy evaluation (MSE)
 - ADF&G, BSFRF, UW, NOAA scientists, and super-computers
 - Considering 13 harvest strategy scenarios
 - Project the population forward 100 years under different harvest strategy scenarios
 - Evaluate results via conservation and economic performance metrics
- ADF&G/industry recommended harvest strategy to BOF in March 2020

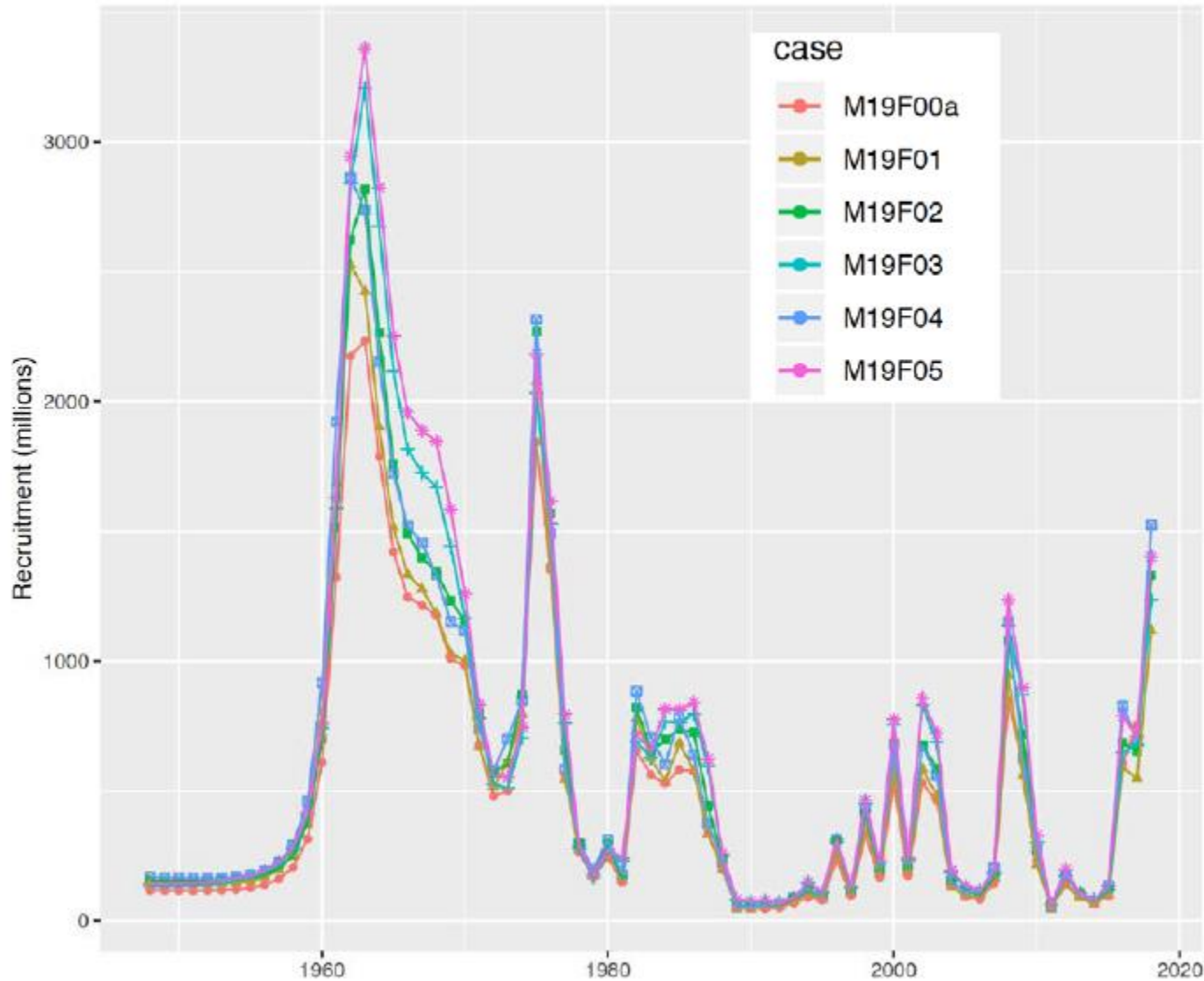
Model estimates

- Immature crab on increasing trend



Estimated recruitment

Highest estimated recruitment since the 70s!



Ecosystem status report card

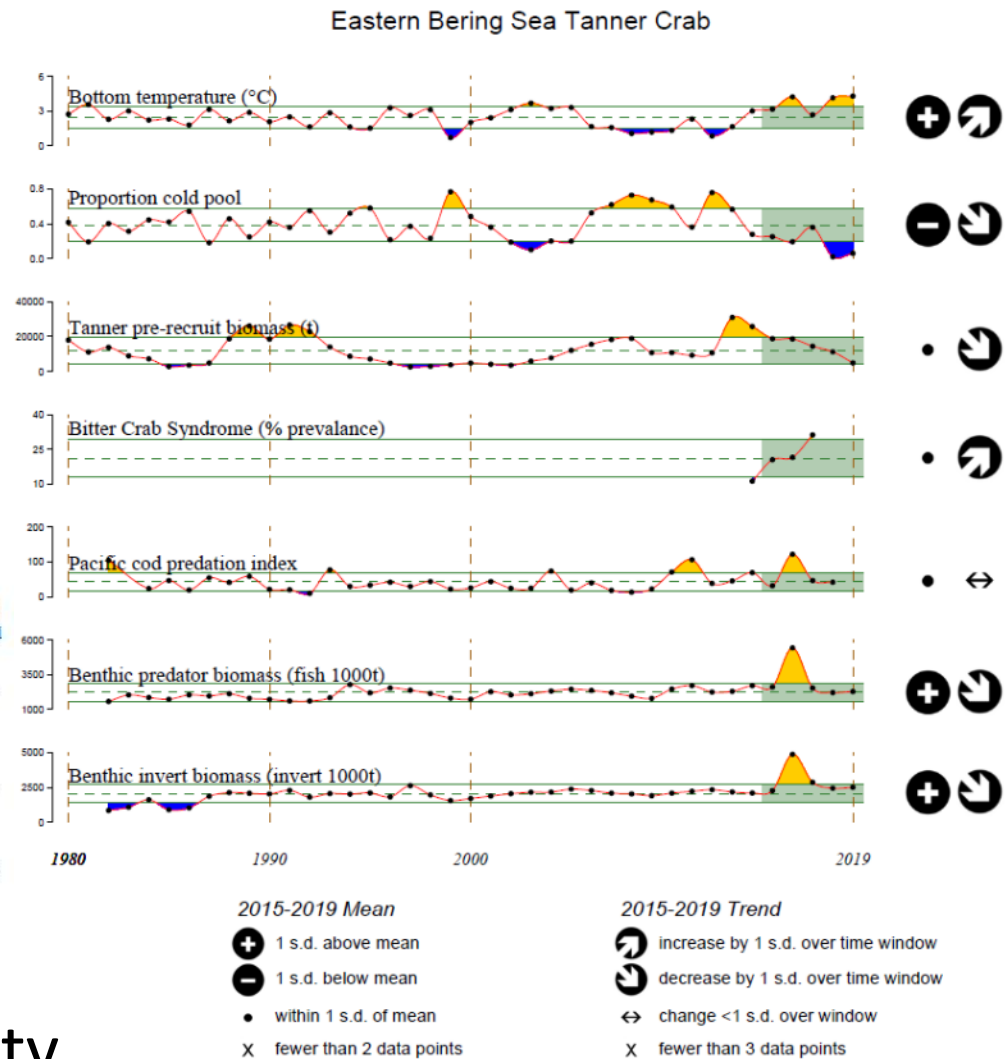
Erin Fedewa, NOAA

EBS Tanner Crab Ecosystem Considerations

- **Summer bottom temperatures** in the eastern Bering Sea were **well above average in 2019**, and the **warmest in the 40-year time series**. The cold pool extent was the **lowest on record in 2018**, followed by **2019 with the second lowest** value in the time series.
- **Tanner crab pre-recruit** (males 103-124 mm CW) biomass has **continued to decline** since 2014. Pre-recruit biomass estimates in 2019 are the **lowest since 2002**, during which the directed tanner crab fishery was closed.
- **Prevalence of bitter crab syndrome** in juvenile tanner crab has **increased by nearly 20%** since monitoring efforts began in 2014, with up to **53% of juvenile tanner crab infected** in index stations **northwest of the Pribilof Islands in 2017**.
- **Pacific cod predation** on tanner crab in 2016 was the **highest in the time series**, corresponding with **above-average benthic predator biomass** due to high catches of Pacific cod, flatfish and skate. Since 2016, the overall trend in Pacific cod predation and benthic predator and invert biomass **has decreased to a near-average level**.

Environmental uncertainty

- Increasing temps
- Changing ecosystem: shifts in predators, competitors



Tanner crab outlook

- Mature females are still in a declining trend, but there is a strong cohort population, which has carried forward from the 2017 cohorthope for the future
- East: portion of large male crab is senescing but weak sign of recruits in the 75-100 mm size class
- West: portion of large male crab is senescing but strong sign of recruits across juvenile cohorts
 - Years from reaching legal size
 - Hope for the future
- Expect continued declines in legal male abundance next year

Intermission:
Snow crab next