Bering Sea – Aleutian Islands crab overview

Alaska Bycatch Review Task Force
BSAI Alaska Crab Committee
June 17, 2022

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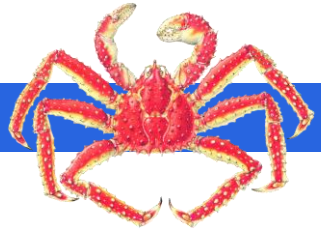
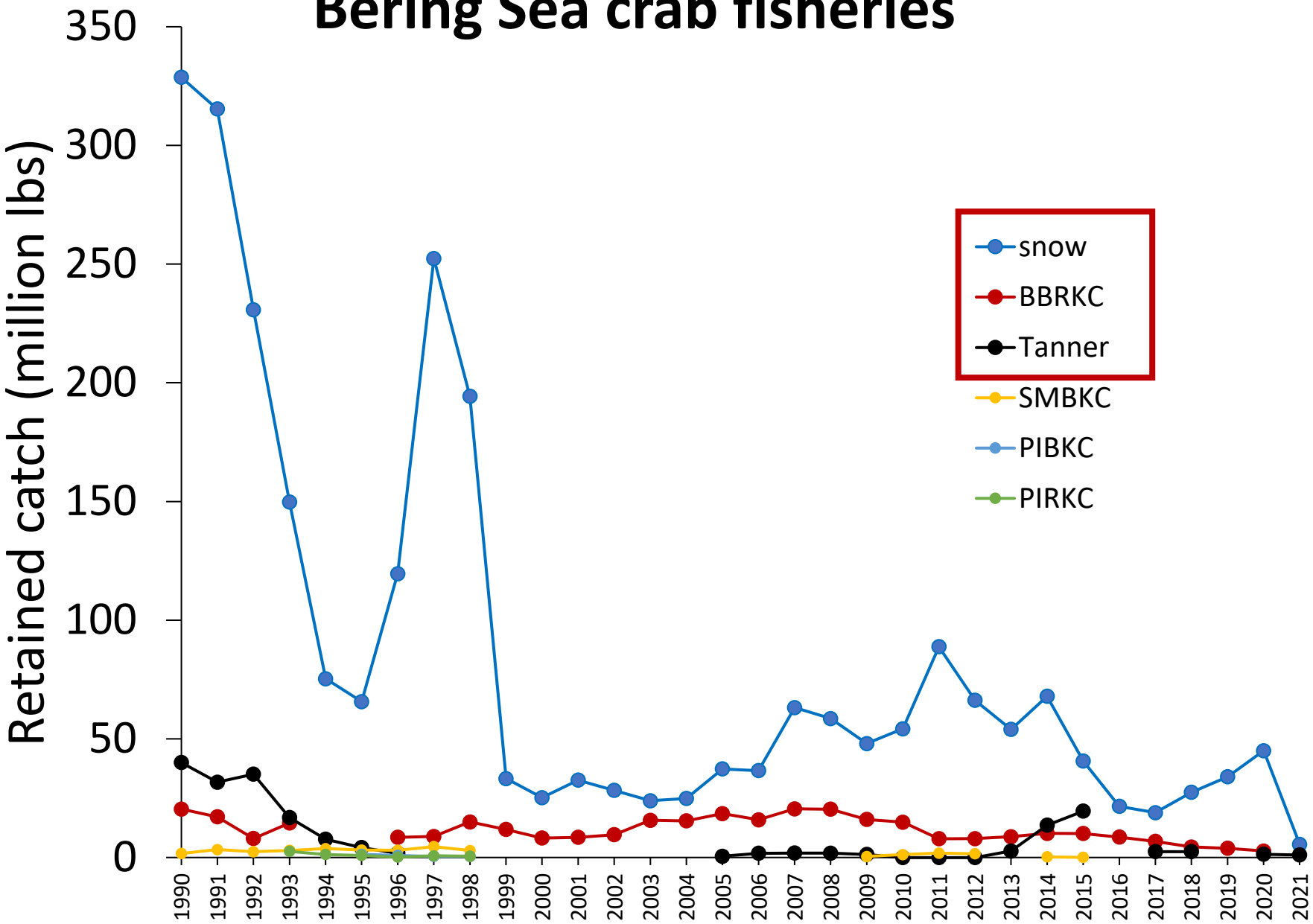
Alaska Department of Fish and Game
Division of Commercial Fisheries



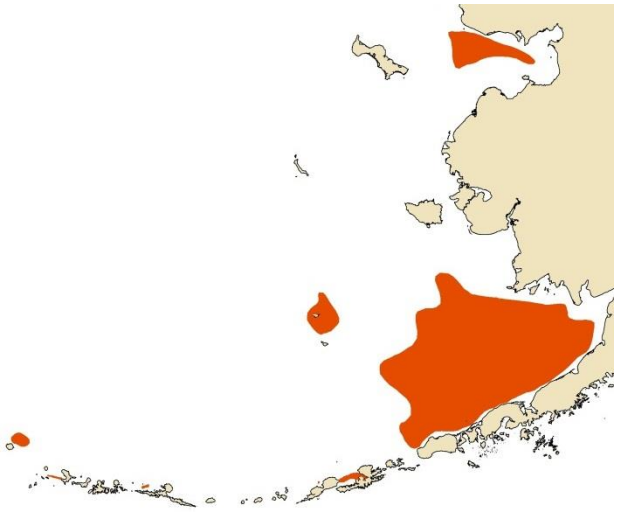
Fishery Overview

Bering Sea crab fisheries



*PIGKC fishery not shown here because of confidentiality restrictions

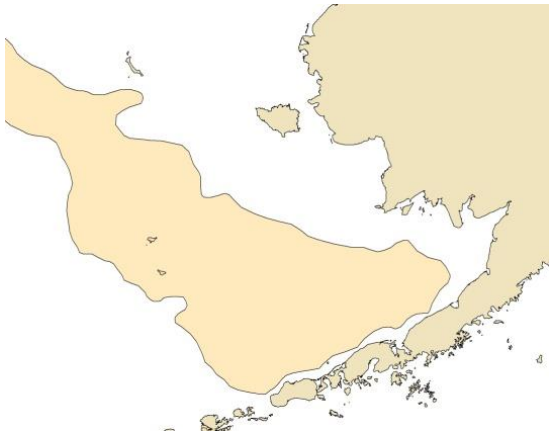
Red King Crab
(*Paralithodes camtschaticus*)



- Young-of-the-year live

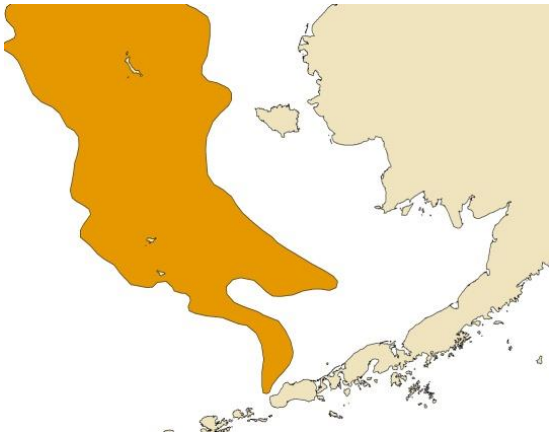
  <50 m in high-relief habitat
- Juveniles form aggregations (pods)
- Young molt several times per year through age 3
- After age 3, molting is annual
- In Bristol Bay, 50% maturity is reached by 120 mm CL (males) and 90 mm CL (females), about age 7
- Females produce 43,000 – 500,000 eggs
- Males are recruited to the fishery at ages ~8-9 years

Tanner Crabs
(*Chionoecetes bairdi*)



- Prefer soft sediments
- Males and females experience a terminal molt
- In Bristol Bay, 50% maturity is reached by 110 mm CW (males) and 90 mm CW (females), about age 6
- Females produce 50,000 to 400,000 eggs
- Males recruit to fishery at age ~7 years
- Fertilization is internal; sperm may be retained 3 years
- Females form mounds – aggregative mating

Snow Crab
(*Chionoecetes opilio*)

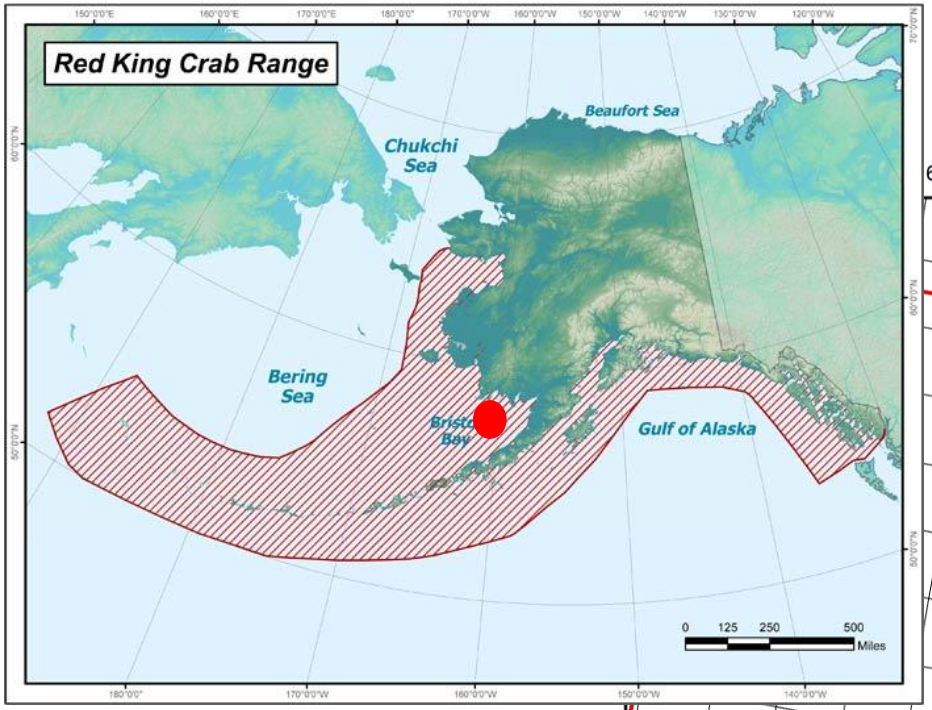


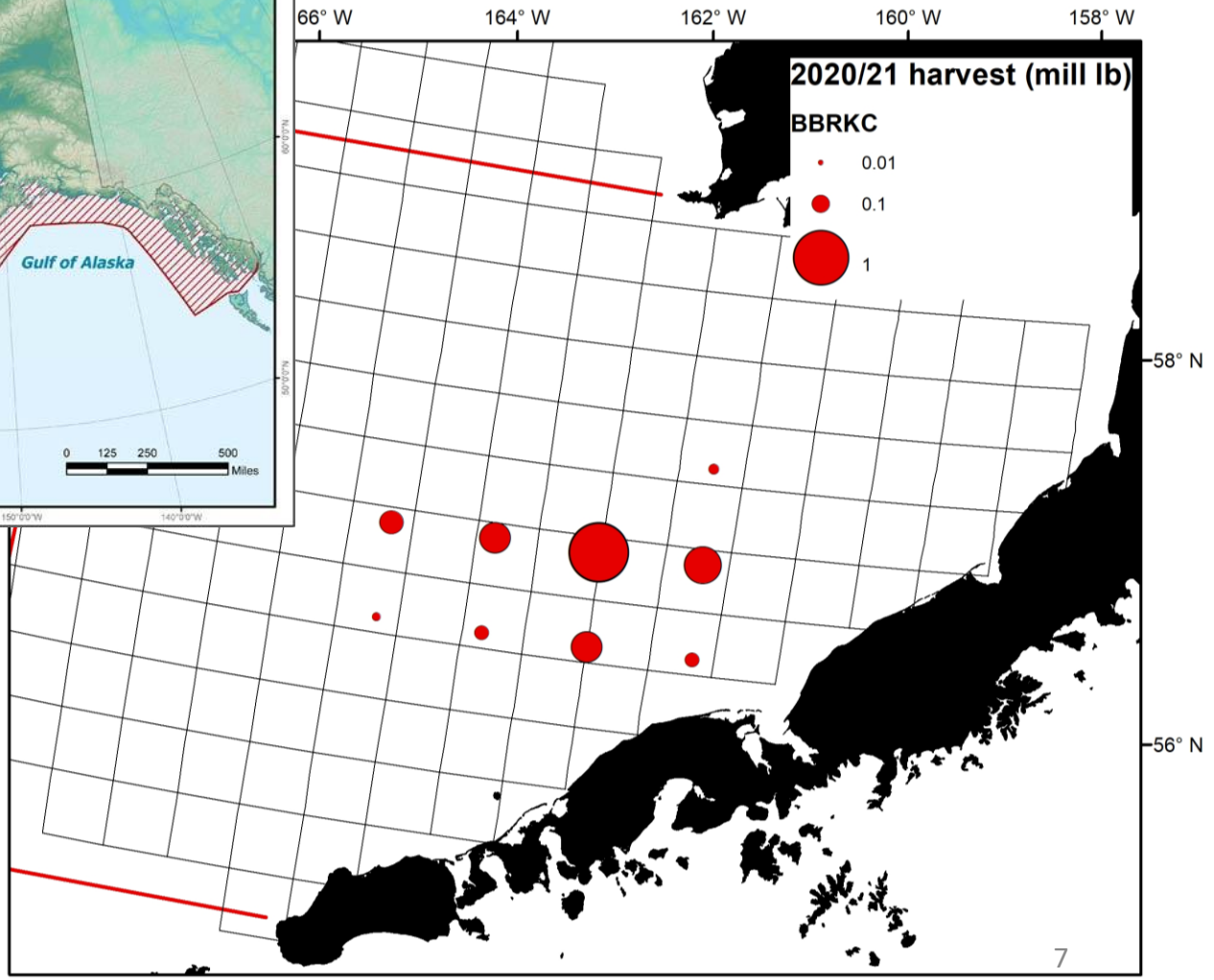
- Prefer soft sediments
- Males and females experience a terminal molt
- Size of 50% maturity is 65 mm CW (males, chela-based regression) and 50 mm

  CW (females), about age 4-6
- Females produce 5,500 to 150,000 eggs
- Fertilization is internal; sperm may be retained 3 years
- Related species – grooved Tanner crab and Triangle

  Tanner crab

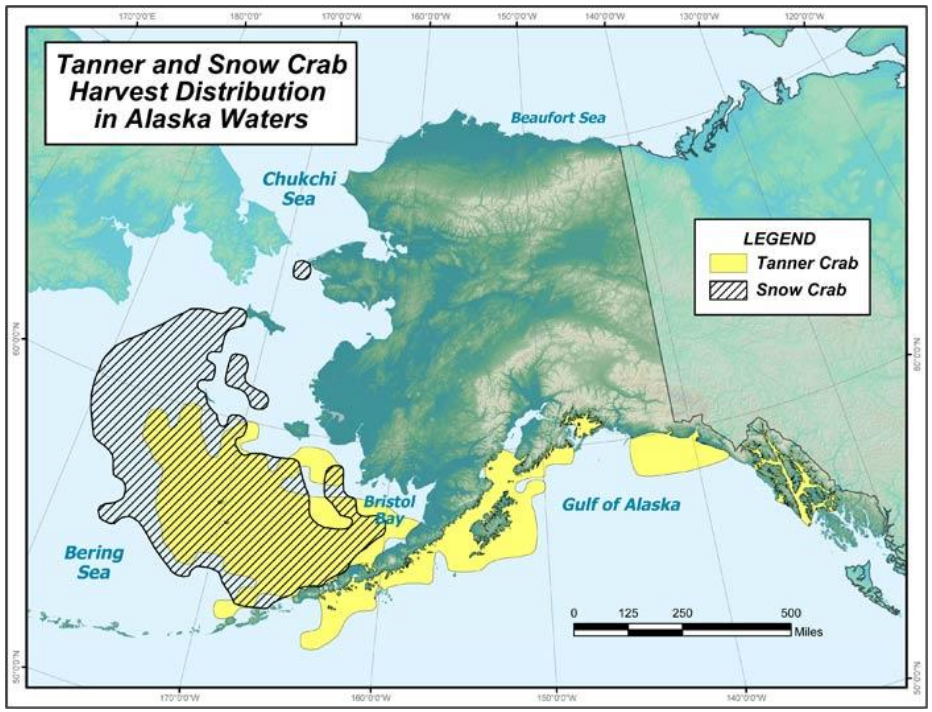
BBRKC

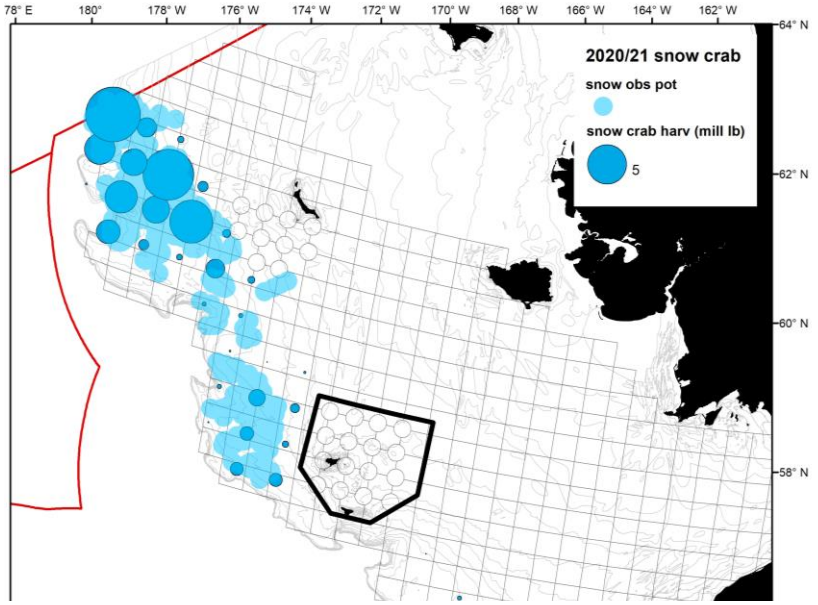


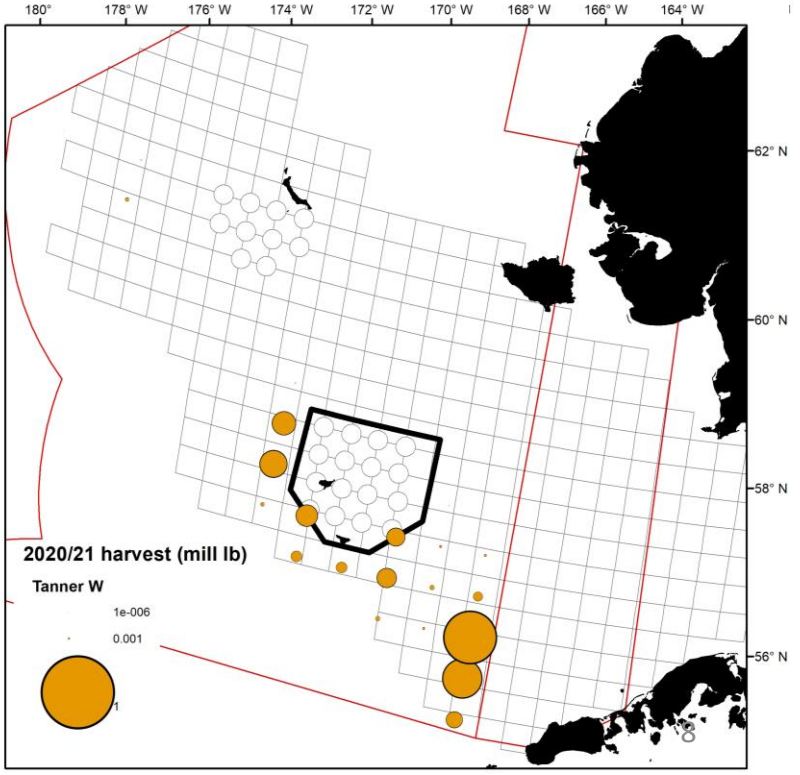


Season:
October 15 to January 15

Tanner + snow







Season:

Tanner: October 15 to March 31

snow: October 15 to May 31

Management Framework

Bering Sea-Aleutian Island Crab Management

Cooperative management between federal and state agencies

- Federal
  - NPFMC: develops regulations, management plans
  - NMFS: conducts surveys to estimate population abundance, fishery research (set OFL/ABC)
- State
  - BOF: makes allocative decisions, establishes policy for management
  - ADF&G: implements fishery regulations and harvest strategies (set TAC)

BSAI Crab Management Process

May

- Fisheries conclude
- NPFMC Crab Plan Team meets to discuss model scenarios to review in September with new fishery and survey data

June/July

- NOAA EBS bottom trawl survey

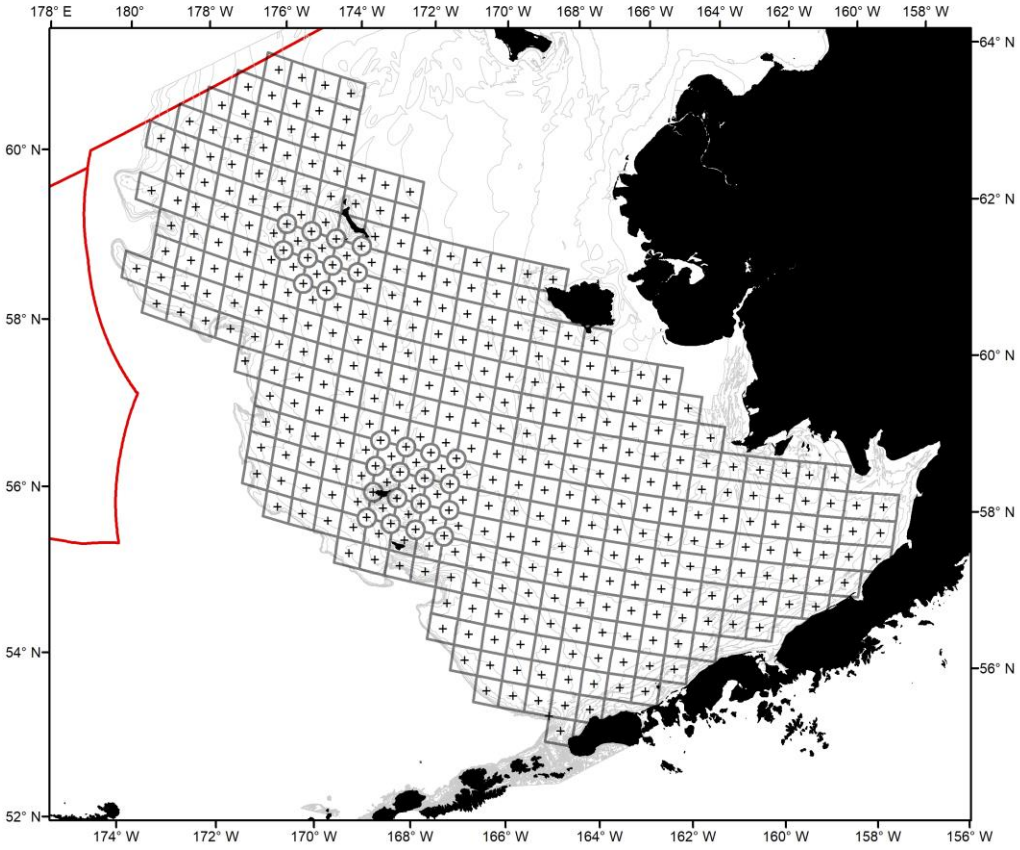
August

- Survey data disseminated to assessment authors

September/October

- NPFMC Crab Plan Team meet to discuss model performance and recommend OFL/ABC
- NPFMC Scientific and Statistical Committee reviews CPT recommendations and advises Council action
- ADF&G reviews all survey, assessment, fishery, environmental information,..... sets TAC

NOAA EBS bottom trawl survey



375 stations in standardized grid

- 20 x 20 nmi grid + corner stations (high-density strata)

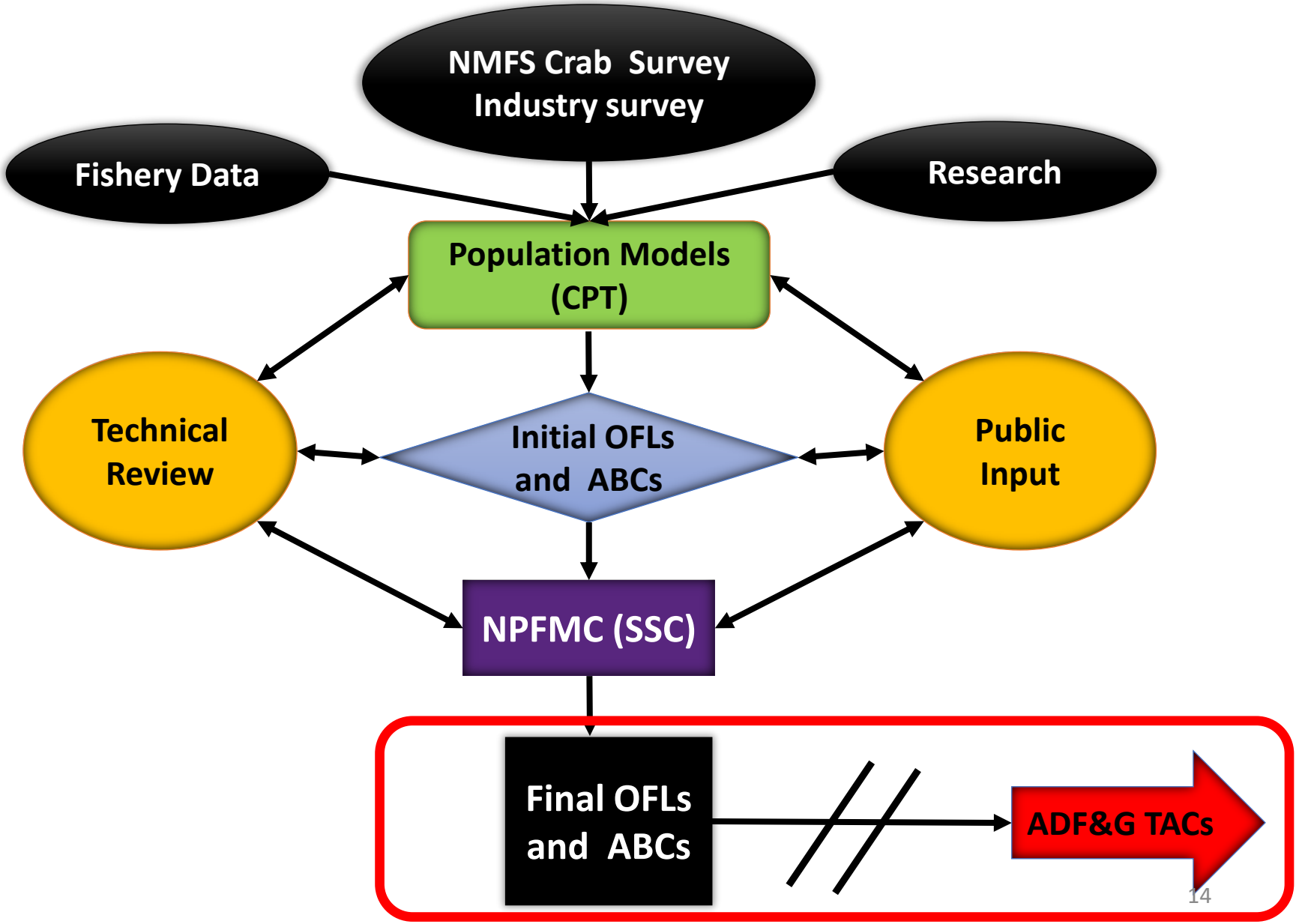
- Multi-species: crab + groundfish
- 83-112 Eastern otter trawl (83 ft head rope, 112 ft footrope)
  - Same gear since 1982
- Net mensuration gear
  - Bottom contact sensor
  - Net height + *width* sensors
  - GPS used for tow distance
  - Distance fished x net width data yield area-swept estimates for each haul

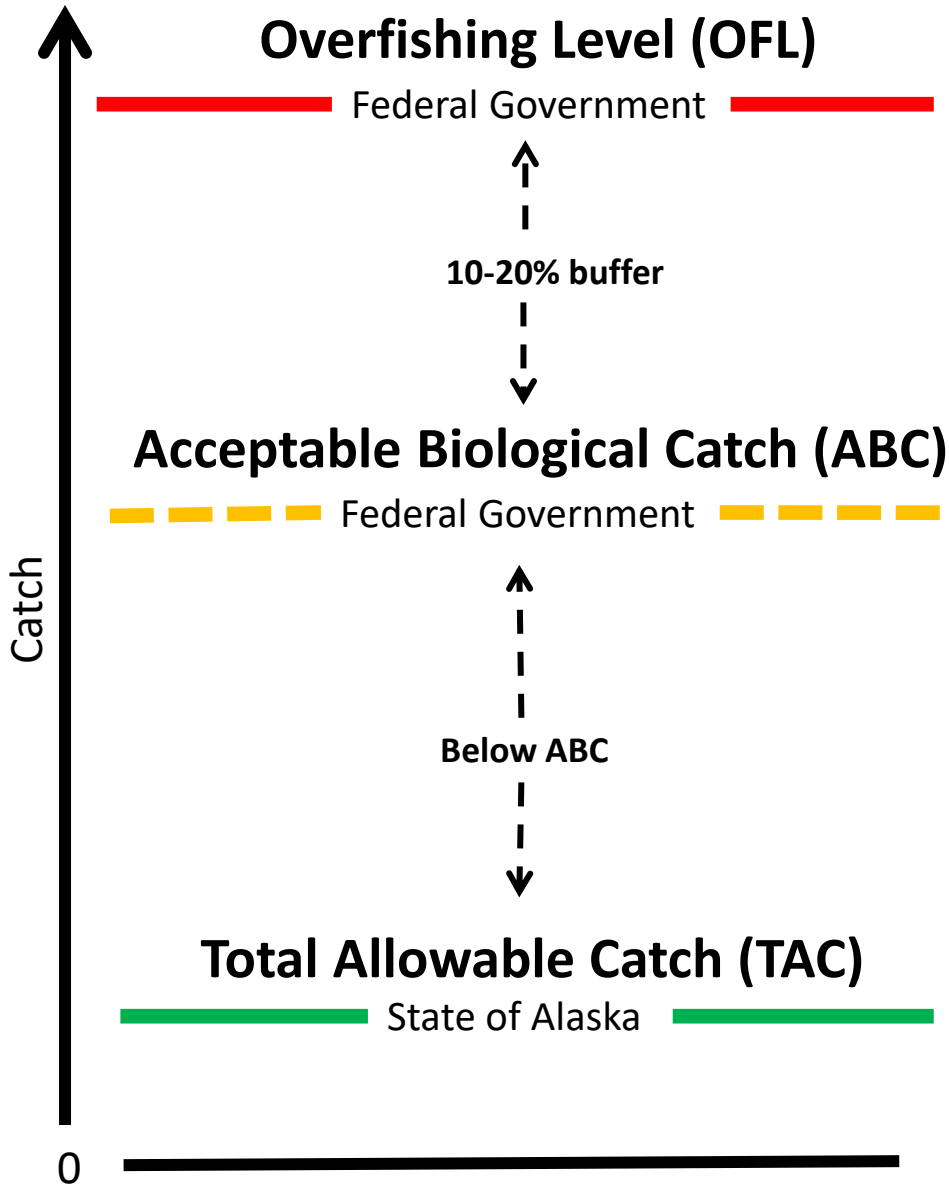
Population Abundance

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

Federal Crab Stock Assessment Process





OFL: Level of fishing mortality that jeopardizes the capacity of a stock to produce the maximum sustained yield on a continuing basis.

ABC: Level of annual catch that accounts for scientific uncertainty and is set to prevent the OFL from being exceeded.

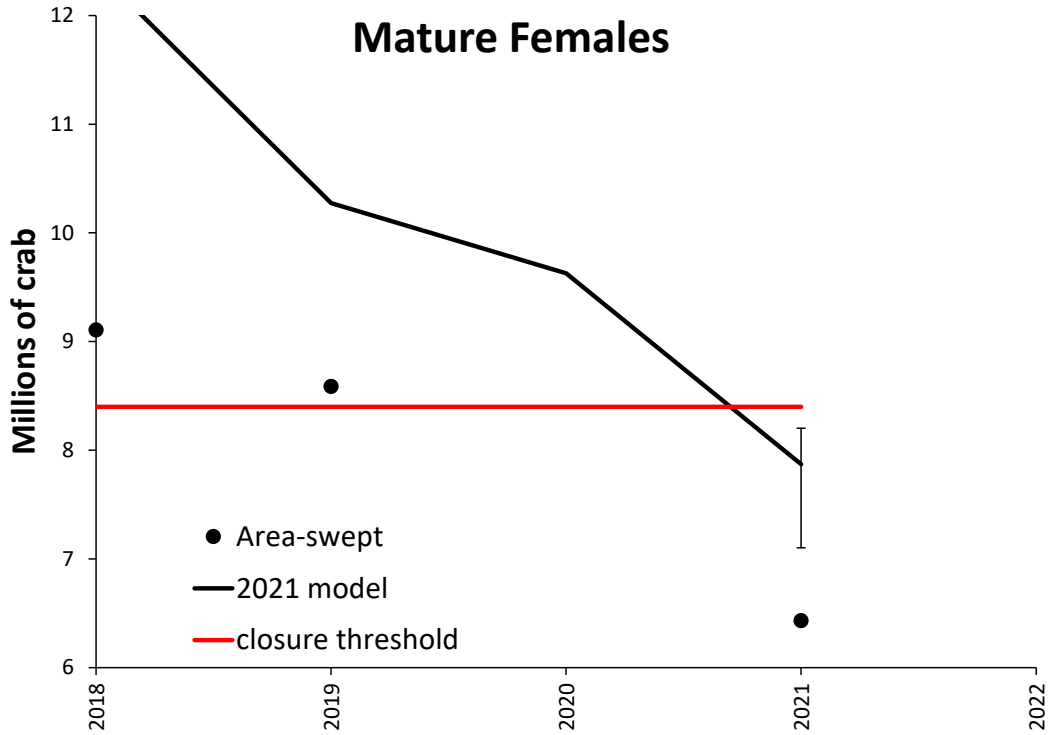
In practice ABC limits mortality of **ALL** male and female crabs regardless of size, from all sources of fishery mortality (i.e. retained catch, bycatch in directed and nondirected crab fisheries, and groundfish fisheries).

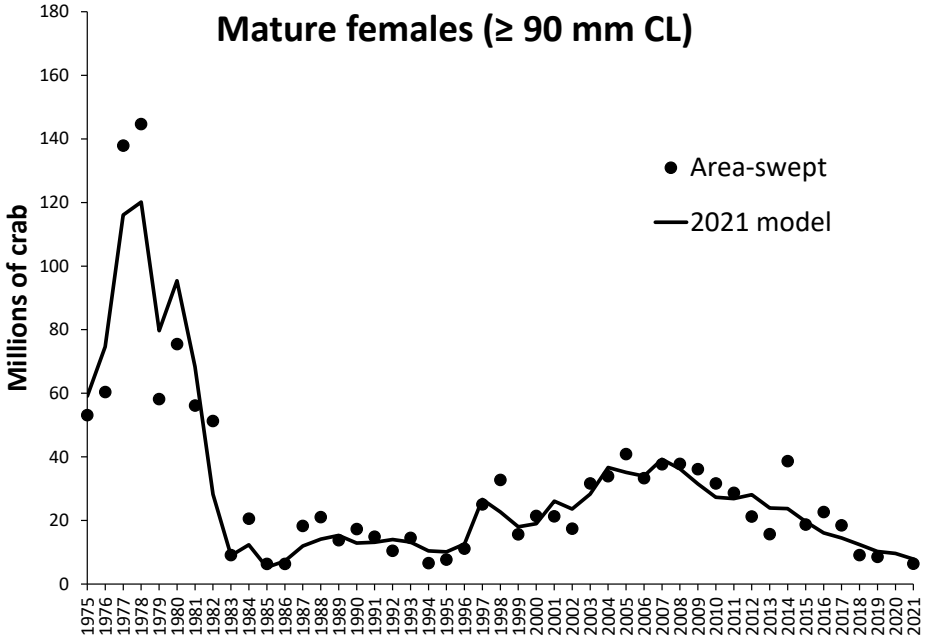
TAC: Annual catch target for the directed fishery, set to prevent exceeding the ABC for that stock. **Limits legal sized males**, but must consider all sources of mortality to ensure the ABC is not exceeded.

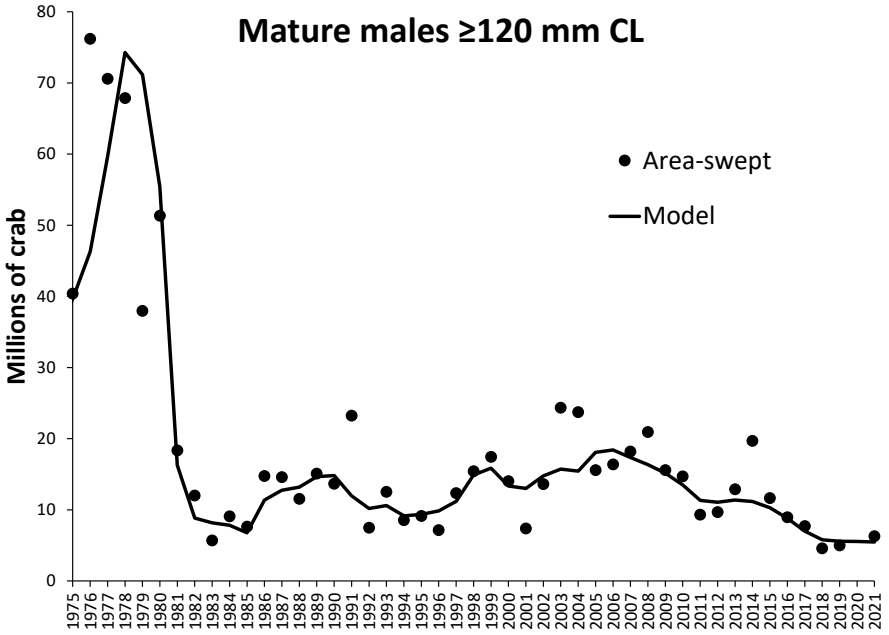
Stock Status

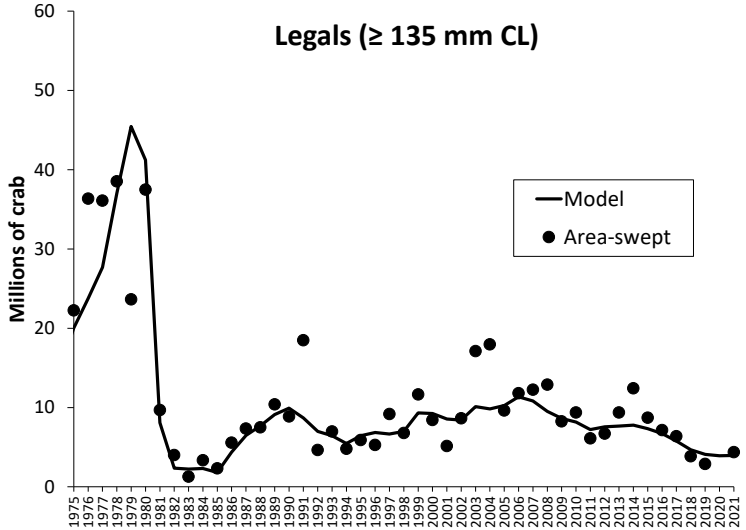
BBRKC

- Stock status: 62% of B_{MSY}
- 2021/22 fishery closed due to mature female abundance below harvest strategy threshold

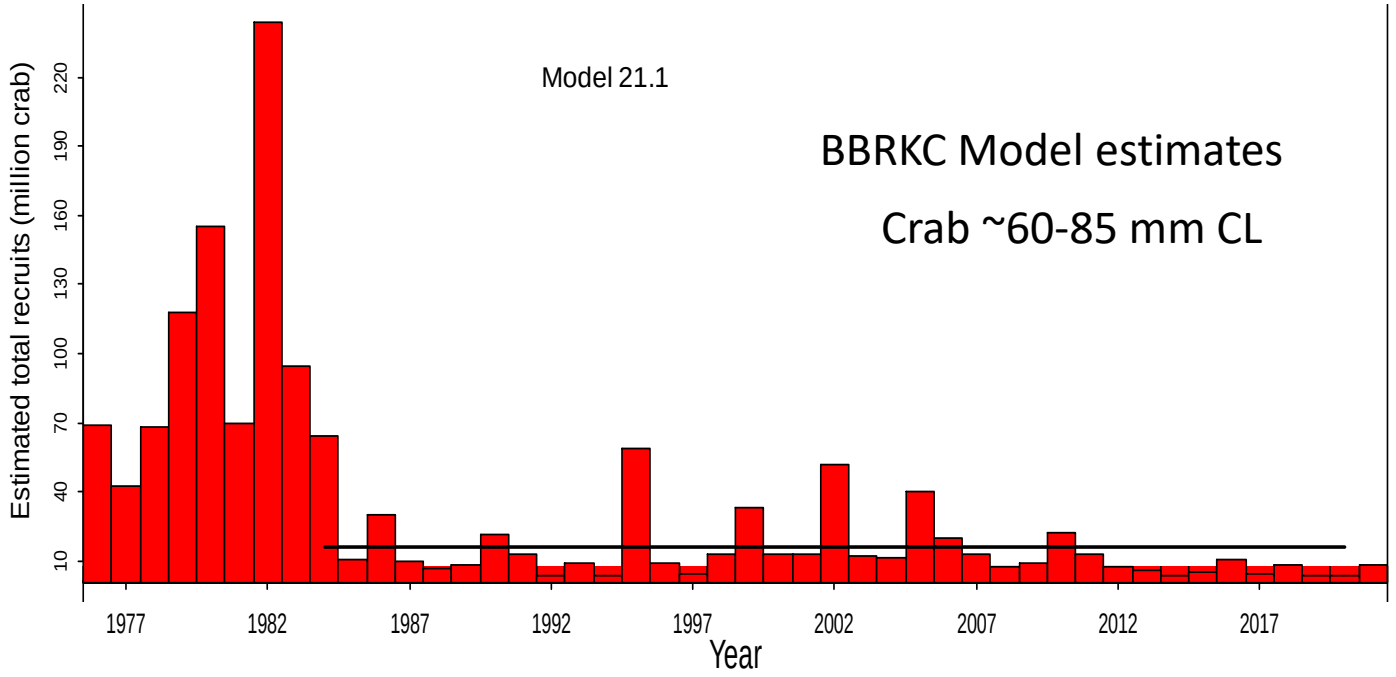



Mature females (≥ 90 mm CL)
Millions of crab
Area-swept
2021 model


Mature males ≥120 mm CL
Millions of crab
Area-swept
Model


Legals (≥ 135 mm CL)
Millions of crab
Model
Area-swept

Recruitment: New individuals entering population (or model)



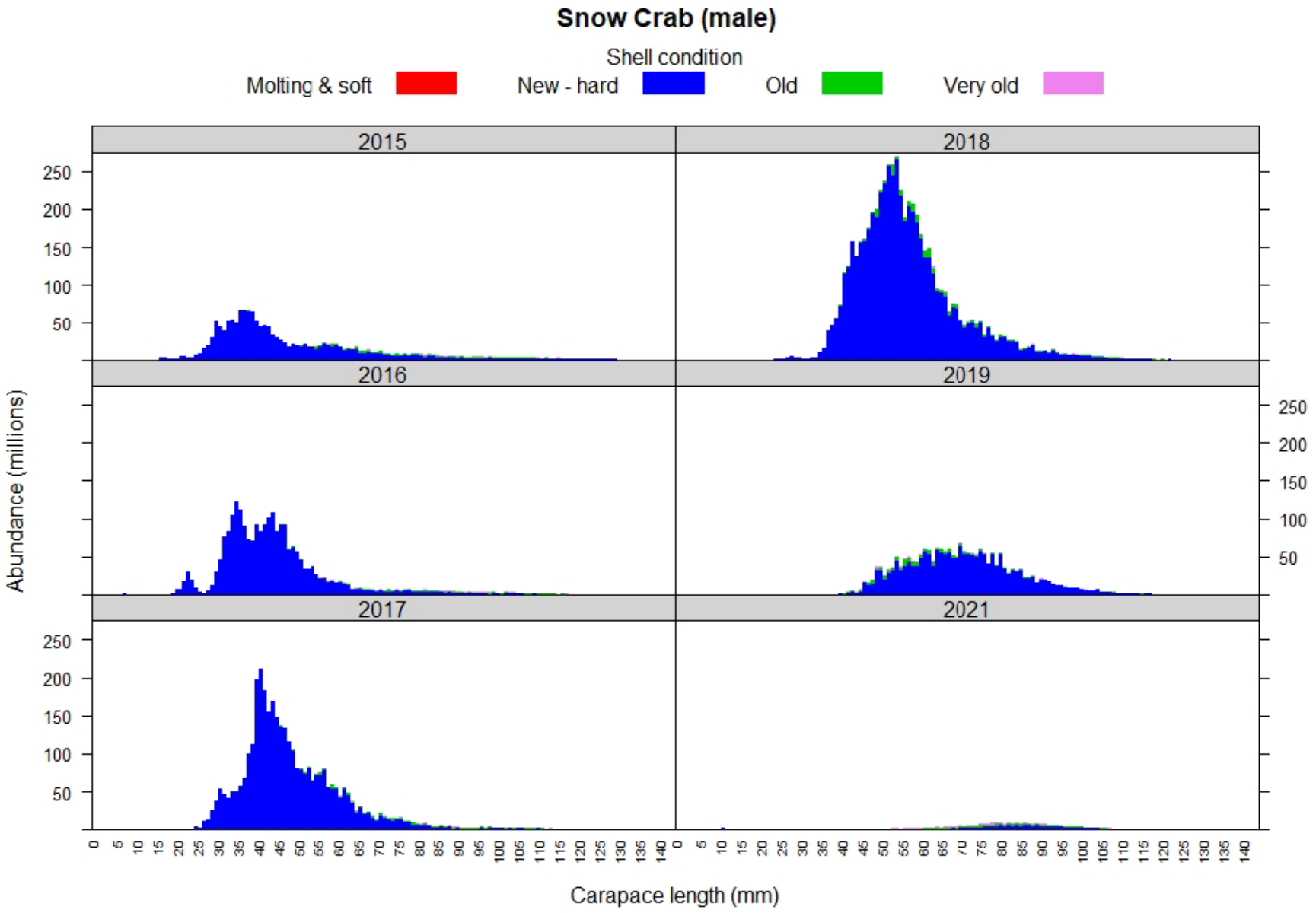
What causes low recruitment?

- Low female abundance
- Poor survival in early life history stages
  - Predation, starvation, thermal stress, OA, etc
- Unfavorable larval advection

Snow crab

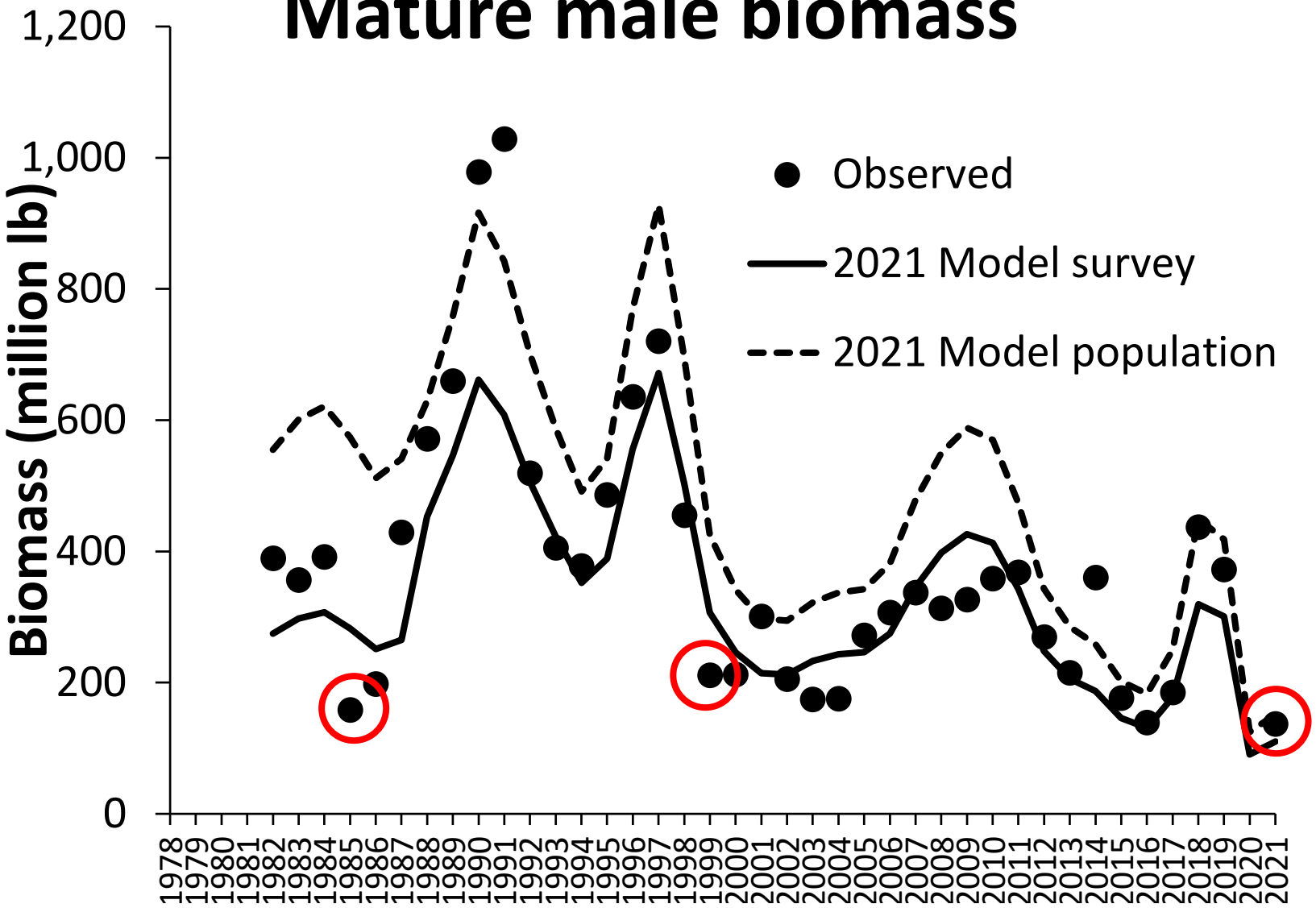
Stock status: 33% B_{MSY}

- **"Overfished"**: Below MSST (50% of B_{MSY})
- Above federal threshold (25% B_{MSY}) for fishery closure



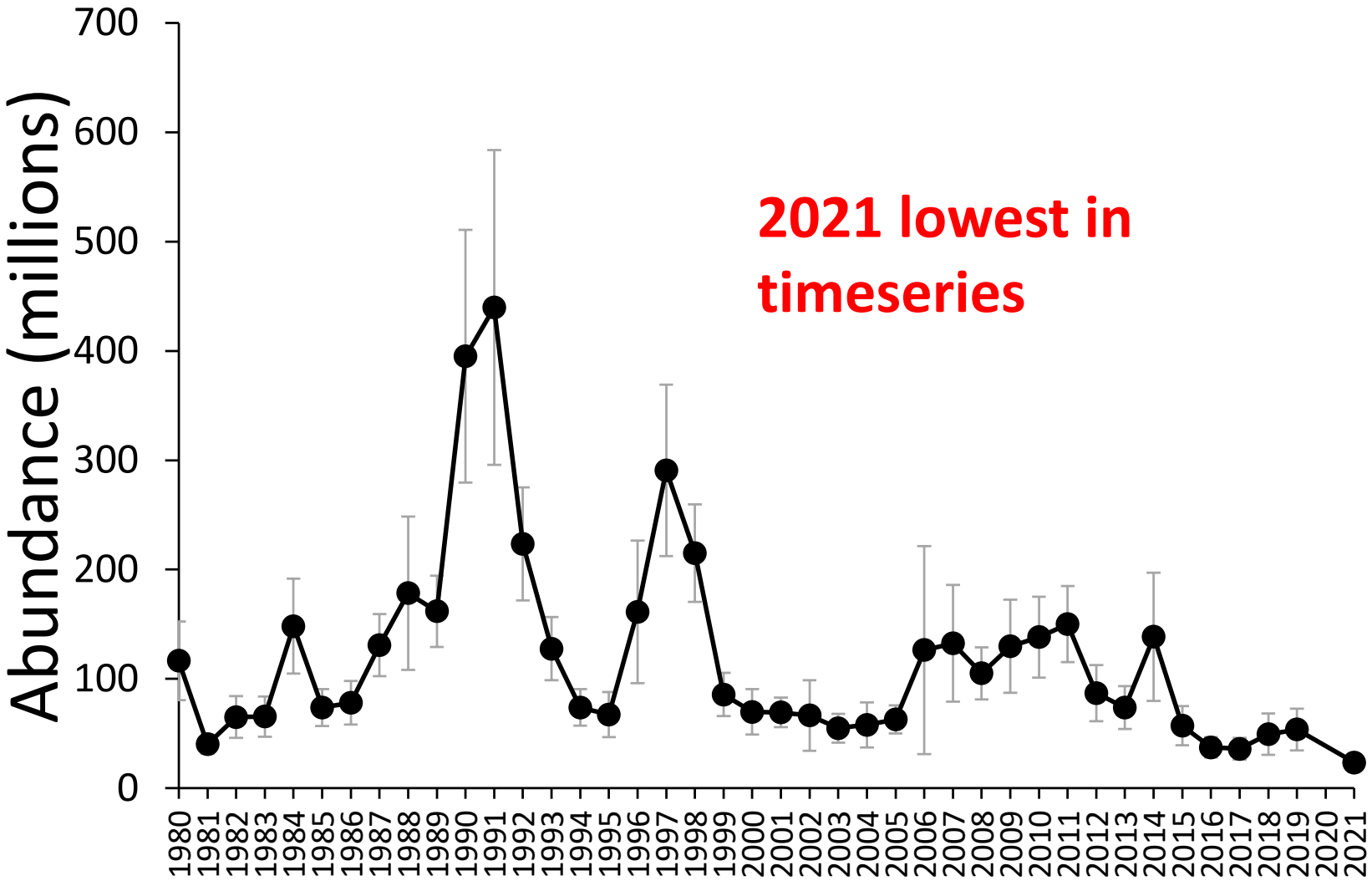
NOAA survey area-swept

Mature male biomass



2021 lowest in timeseries

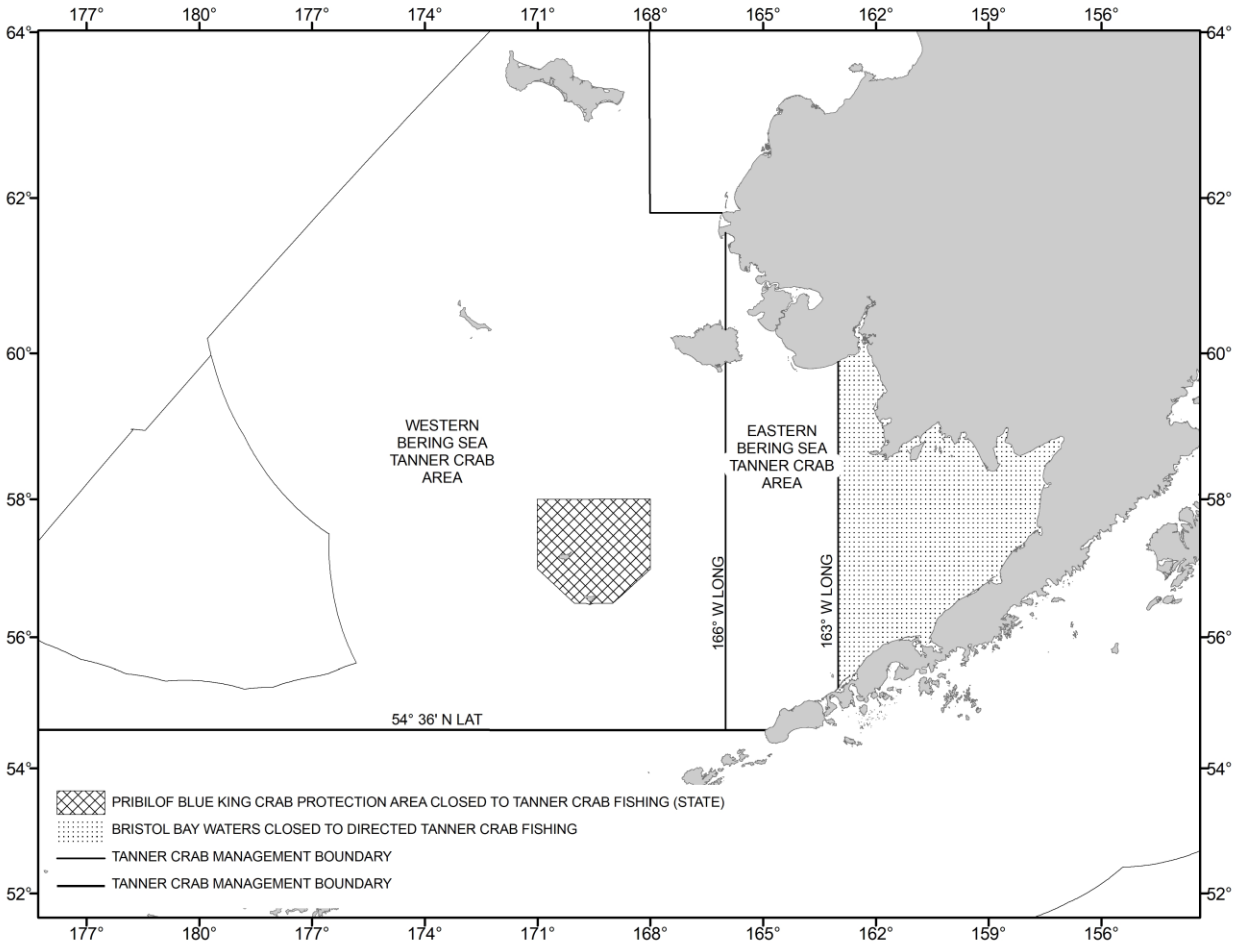
4 inch males



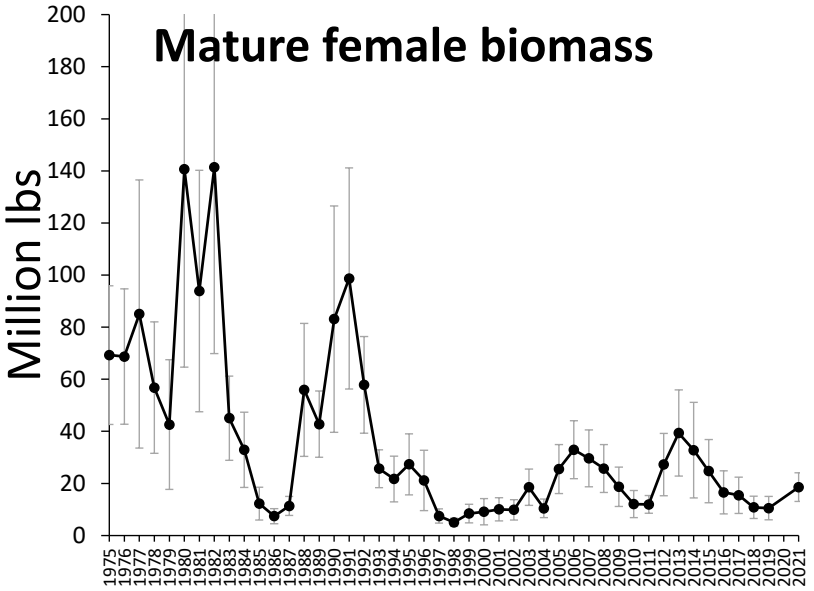
NOAA survey area-swept

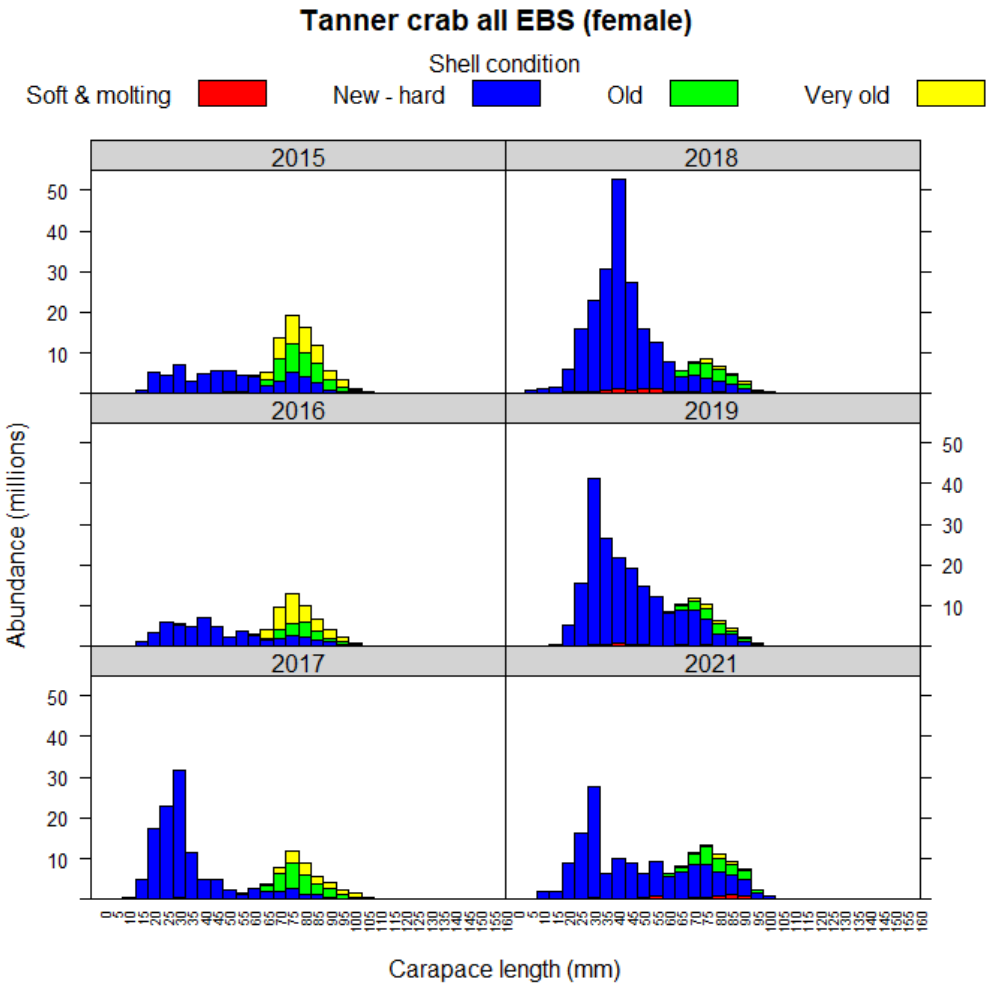
Tanner crab

Stock status: 118% of B_{MSY}



Mature females: EBS-wide

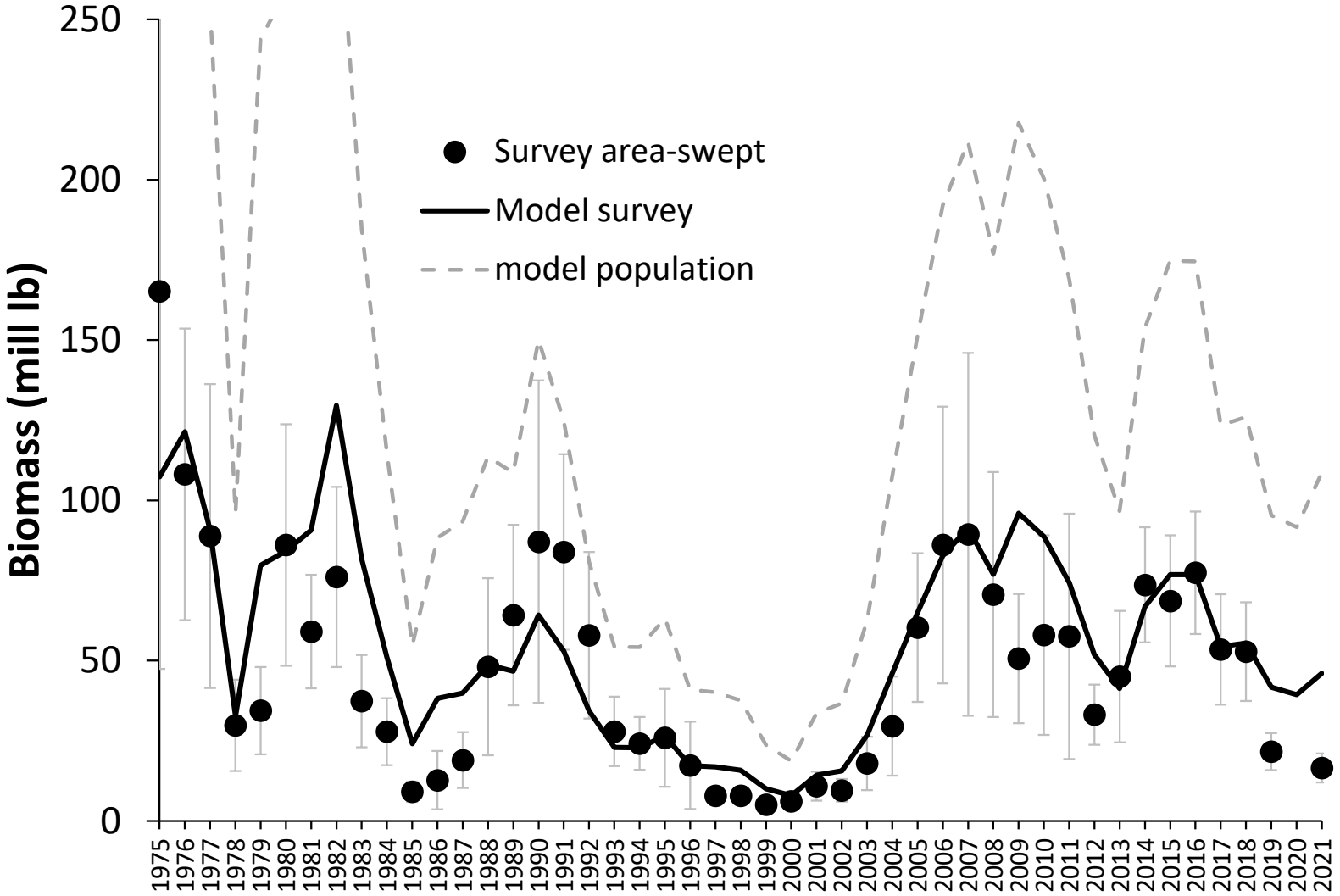




Increase in mature female biomass

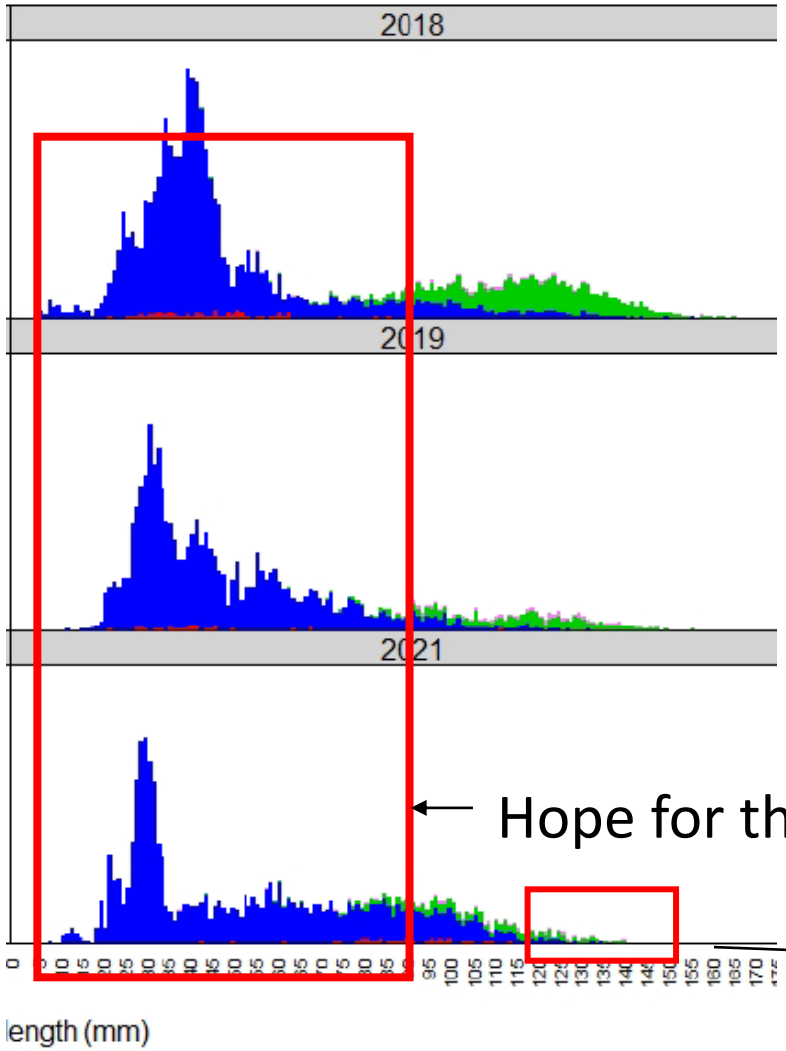
NOAA survey area-swept

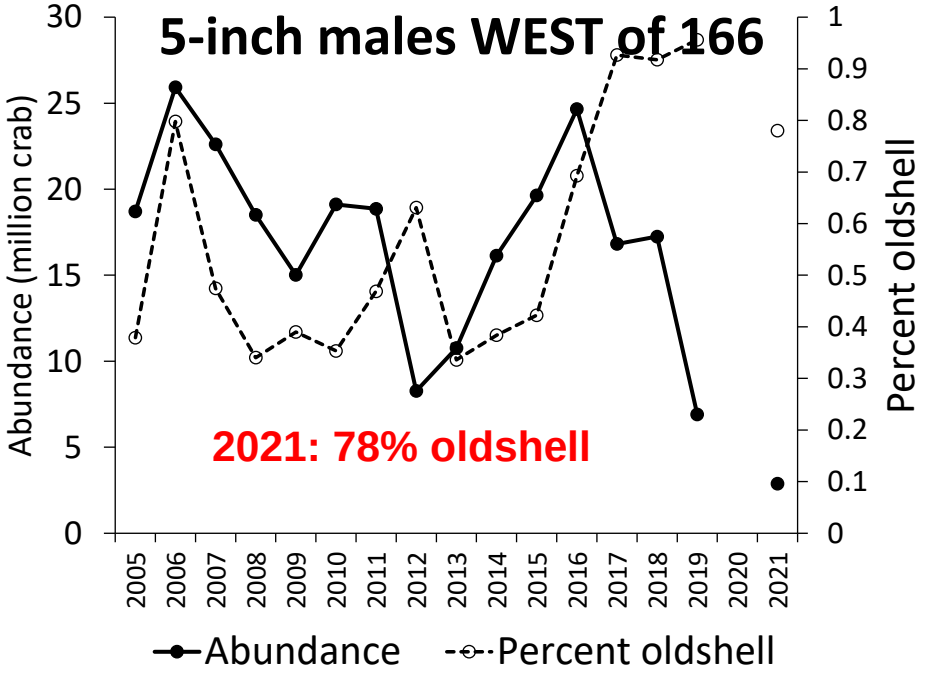
Mature males WEST of 166 W



WEST

WEST males





Hope for the future

Haven't reached the 5 inch size class yet

NOAA survey area-swept

Observer Program

BSAI Crab Observer Program Overview and Deployment Plan

ADF&G crab observer program started in 1988 - modern era since late 1990s

Primary functions: 1) catch accounting 2) biological data 3) research/monitoring

Catcher Vessels

- Observers provided by single third-party provider under 3-5 yr contracts with ADF&G
- Deployment costs (daily rate) fixed in each contract (~$400/day)
- ADF&G conducts annual cost recovery fisheries (BBRKC and AIGKC) to fund program
  - Report annual financial statement to industry Crab Observer Oversight Taskforce (COOTF)
- Vessel selection deployment strategy
  - All vessels (~65) required to preseason register for each fishery
  - Subset of vessels randomly selected according to target coverage rate
  - Selected vessels carry 100% coverage

Catcher/Processor

- Mandatory 100% coverage, any provider, cost sharing agreement w/ADF&G

BSAI Catcher Vessel Crab Observer Coverage Levels[1]

Fishery	Observer Coverage
Eastern Aleutian Islands golden king[2]	50%
Western Aleutian Islands golden king[2]	50%
Bristol Bay red king	20%
Bering Sea snow	30-100%
Western Bering Sea Tanner	30-100%
Eastern Bering Sea Tanner	30-100%
St. Matthew Island blue king	100%
Grooved Tanner	100%
Bering Sea golden king	100%
Triangle Tanner	100%
Scarlet king	100%

[1]Catcher processors are require to carry an observer for 100% of crab fishing activity.
[2]For catcher vessels in the Aleutian Islands golden king crab fisheries, a crab observer must be on board during harvest of 50% of the total weight harvested during each of three trimesters dated August 1 through October 31, November 1 through January 31, and February 1 through April 30 during each registration year.

Catch Reporting and Accounting

Daily and trip level account of fishing activity

- Area fished
- Pot location/lifts, depth, soak time (CPUE)
- Total crab, number of crab retained, average weight
- Sampling conditions (quality)

Deployment account of all sampling and fishing activities

- Vessel and crew summary
- Lost pots
- Safety/compliance/enforcement issues
- Endangered and marine mammal interactions

Biological Sampling (Species Composition)

Pot-by-pot assessment of the animals caught in the fishery

Count Pots

- Identify and count all species
- Determine sex for all commercially important crabs
- Measure legal/preferred size of all commercially important crabs

Measure Pots

- Identify and count all species
- Measure size of all commercially important species
- Determine sex, maturity, condition for commercially important crabs
- Document parasites, disease, and injuries

Daily Sampling Goals (# sample pots/day)

	Catcher Vessel		Catcher Processor	
Fishery	Count	Measure	Count	Measure
Aleutian Islands golden king (East and West)	0	7	0	4
Bristol Bay red king	0	7	0	4
Bering Sea Tanner (East and West)	3	3	2	2
Bering Sea snow	3	1	2	1

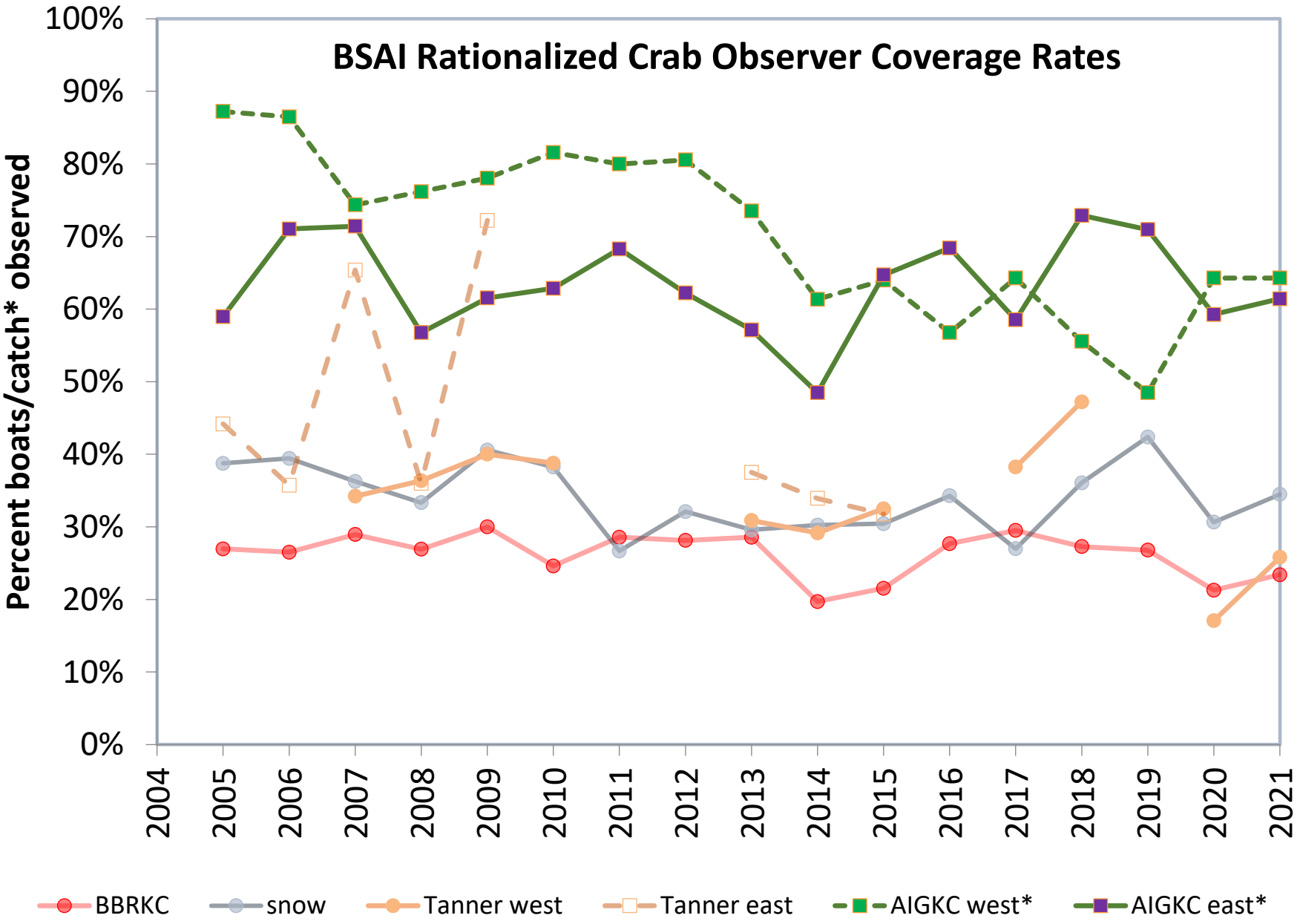
Observer Data Collection 2020/21 BSAI Rationalized Crab Season							
Fishery	Observed vessels (C/V)	Observer days	Pots sampled for species composition	Vessel operator interviews	Animals measured for species comp samples	Retained target-species measured for species comp samples	Retained crab measured at offload
WAG	3	229	1,245	18	35,082	18,588	1,800
EAG	4	106	523	16	32,854	18,763	1,500
BBRKC	10	58	256	12	19,422	15,636	1,400
BSS	23	790	1,687	116	535,446	528,706	15,400
WBT	8	107	421	18	59,567	13,309	1,800
Totals	**48**	**1,290**	**4,132**	**180**	**682,371**	**595,002**	**21,900**

WAG = Western Aleutian Islands golden king crab
EAG = Eastern Aleutian Islands golden king crab
BBRKC = Bristol Bay red king crab
BSS = Bering Sea snow crab
WBT=Western Bering Sea Tanner crab

2021 EBS Trawl Survey	Total number of crab captured
BBRKC	742
BSS	49,190
WBT	11,417

Research/Monitoring

- Maturity/chela height sampling (bairdi, opilio, and golden)
- Tagging
- Chionoecetes spp. black eye condition
- Species of interest: coral/blue king crab reporting


BSAI Rationalized Crab Observer Coverage Rates
Percent boats/catch* observed
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
BBRKC
snow
Tanner west
Tanner east
AIGKC west*
AIGKC east*

Discard and Bycatch

Assumed Discard Mortality Rates

Crab Fisheries

- BBRKC
  - Directed fishery: 20%
  - Tanner fishery: 25%
- Snow
  - Directed fishery: 30%
  - Tanner fishery: 30%
- Tanner
  - Directed fishery: 32.1%
  - snow fishery: 32.1%
  - BBRKC fishery: 32.1%
- AIGKC
  - Directed: 20%

- Short-term mortality mostly due to time out of water, air temperature, injuries, with freezing more of a factor for snow and Tanner given the fishery timing
- Difficult to estimate long-term handling effects
- Snow + Tanner: based on RAMP approach
  - Short-term mortality ~20%
- King crabs: mostly based on research done in 1990s and 2000s
  - Short-term mortality <6%
- Current approach: buffer estimated short-term mortality rates to account for long-term effects

Assumed Discard Mortality Rates

Groundfish Fisheries

- Trawl: 80%
- Pot: 50%
- Longline: 50%

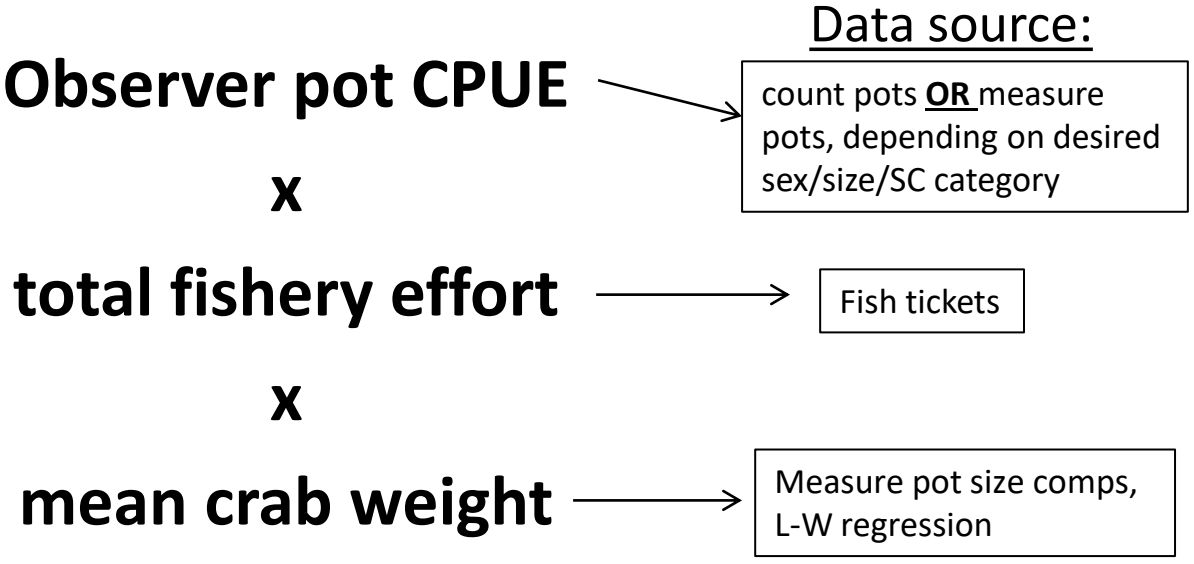
- Trawl rate primarily based on Stevens 1990
  - soft shell crab are much more vulnerable to impacts from trawling than hard shell crab, and that mortality appears to be directly correlated with time out of water
- No direct research studies conducted on mortality of crab caught as bycatch in the longline or pot groundfish fisheries.

Stevens, B.G. 1990. Survival of king and Tanner crabs captured by commercial sole trawls. Fish. Bull. U.S. 88: 731-744.

Crab Fishery Discard Mortality

Estimated via at-sea observer and fish ticket data

- **Step 1**: Calculate **total catch** (all crab captured prior to retention or discarding)

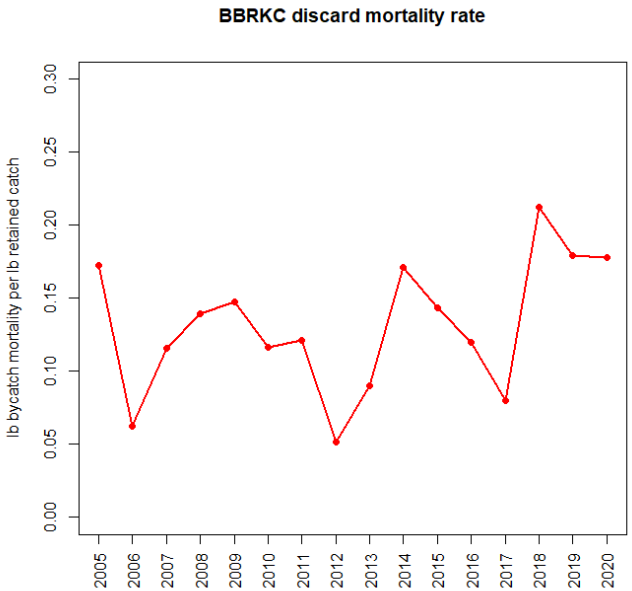


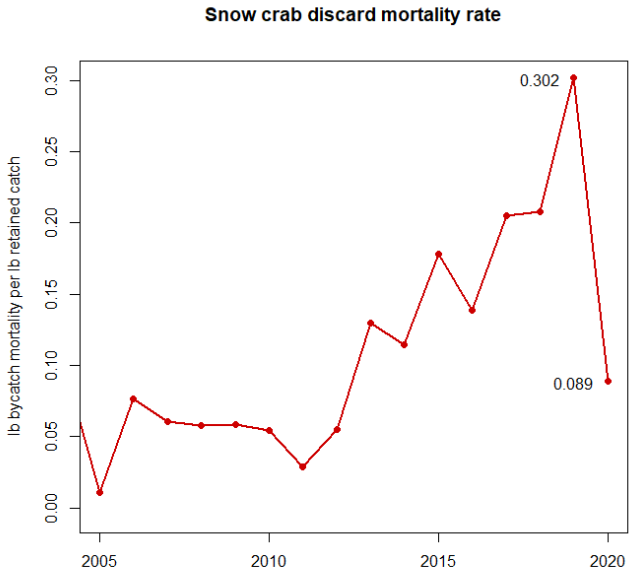
Crab Fishery Discard Mortality

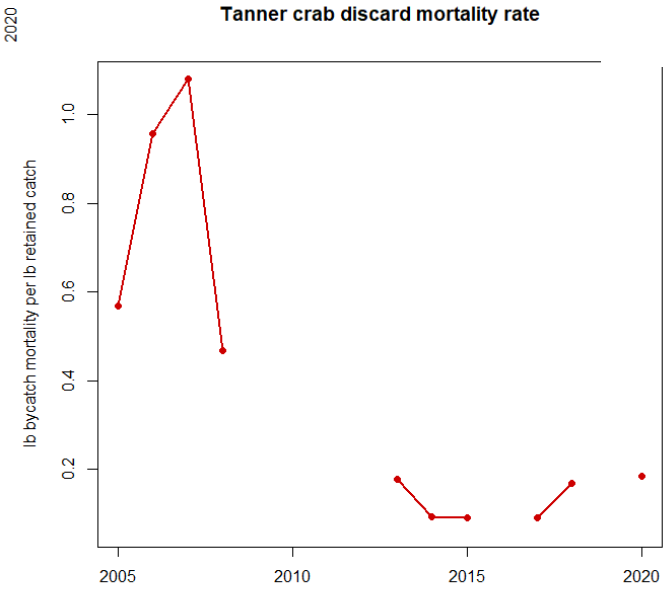
Estimated via at-sea observer and fish ticket data

- **Step 2**: Calculate **discards** by subtracting retained catch from total catch
- **Step 3**: Calculate **discard mortality** by applying handing mortality rate to discards
- **Step 4** (optional): Calculate **discard mortality rate** by dividing discard mortality by retained catch

Discard mortality: directed fisheries







Bycatch Research Priorities: crab fisheries

- Gear modification, soaktime, mesh size, etc
  - BREP (bycatch reduction engineering program) work
- Delayed mortality and long-term effects
- Apply RAMP to king crab
- Retention size
- Effects of repeated capture/discarding of females and sublegals

Bycatch Research Priorities: groundfish fisheries

- Unobserved mortality
  - Overlap of crab and trawling distributions
  - Pelagic trawl bottom contact rates
  - On-trawl cameras?
  - Timing overlap of fisheries and periods of molting
  - Application of Rose et al work on creating estimates
- RAMP studies at varying times of the years
- Crab mortality in the longline or pot fisheries