C1 Snow Crab Rebuilding
Final Action

Jon McCracken, Sarah Rheinsmith, February 9, 2023

Changes from December 2022

- Addition of projected removals based off the model projections (time frame 1982-2017). (SSC request)
  - Projected removals were used to inform the status of EBS snow crab throughout rebuilding and to evaluate potential economic effects throughout the rebuilding time frame as seen in section 3.2 and 3.6.
- Preliminary estimated gross ex-vessel and first wholesale revenue and price data were provided for the 2021/2022 EBS snow crab fishery (Table 3-13).
- Available information on CDQ ownership and participation was provided in Table 3-35 and Table 3-36. (SSC request)
- Alternative 1 was addressed and analyzed for all resource components in the section on the expected effects of the alternatives. (Council request)

Outline

1.Introduction

- Description of the alternatives

2. Proposed Rebuilding Parameters

3.Environmental Assessment

- Eastern Bering Sea Snow Crab
- Impacts of Snow crab Bycatch
- Marine Mammals
- Habitat
- Socioeconomic considerations
- Monitoring Rebuilding

Introduction

- Oct 19, 2021 - NMFS notified Council that BS snow crab status has been changed to overfished therefore MSA section 304 requires a rebuilding plan be developed and implemented within two years of stock being declared overfished
- June 2022 - Council selected a purpose and need (section 1.1 on page 8) to facilitate compliance with MSA to rebuild the overfish stock
- Oct 2022 - SSC selected rebuilding parameters of T_{min}= 6 years (T_{max} =10 years) with recruitment and mortality time frame scenarios 1982-2017
- Dec 2022 – Council reviewed initial review analysis and recommended analysis for final action and selected Alt 2/option 2 as PPA

Description of Alternatives

- Alternative 1: No Action
- Alternative 2 (PPA): Set target rebuilding time frame for the number of years necessary to rebuild the stock to the B_{MSY} level at a probability ≥ 50%. The stock will be considered “rebuilt” once it reaches B_{MSY}
  - Option 1: No directed fishing until that stock is rebuilt.
  - Option 2 (PPA): Allow the directed fishery to open based on the state harvest strategy while the stock is rebuilding.

ALTERNATIVE 2 DETAILS

- Based on projections in section 2.2.1, the time with a greater than 50% probability of rebuilding to B_{msy} at F=0 is T_{min}= 6 years. Since T_{min} = 6 years, then T_{max} = 10 years
- Under Alt 2, a federal rebuilding plan for EBS snow crab will be incorporated into the BSAI King and Tanner Crab FMP.
  - Under Option 1, the FMP language would be amended to reflect a prohibition on directed harvest of EBS snow crab until stock is declared rebuilt and would prohibit the State of Alaska from setting a TAC under the State harvest strategy(SHS).
  - Option 2 would allow for a directed fishery as defined by the SHS

Projection specifications					
Fishing Scenario	Recruitment	Mortality	**Median**	5%	95%
No fishing	1982-2017	1982-2017	**2029 (T_{min})**	2027	2034
bycatch	1982-2017	1982-2017	**2029**	2027	2034
State + bycatch	1982-2017	1982-2017	**2029**	2027	Inf
State - bycatch	1982-2017	1982-2017	**2029**	2027	Inf
ABC	1982-2017	1982-2017	**2030**	2027	Inf

Modified Table 4; Section 2.2.1

Environmental Assessment

SECTION 3

Potentially affected resource component					
Eastern Bering Sea Snow Crab	**Non-Target Species**	**Marine Mammals**	**Seabirds**	**Habitat**	**Social and Economic**
Y	Y	Y	N	Y	Y

EBS SNOW CRAB

SECTION 3.2

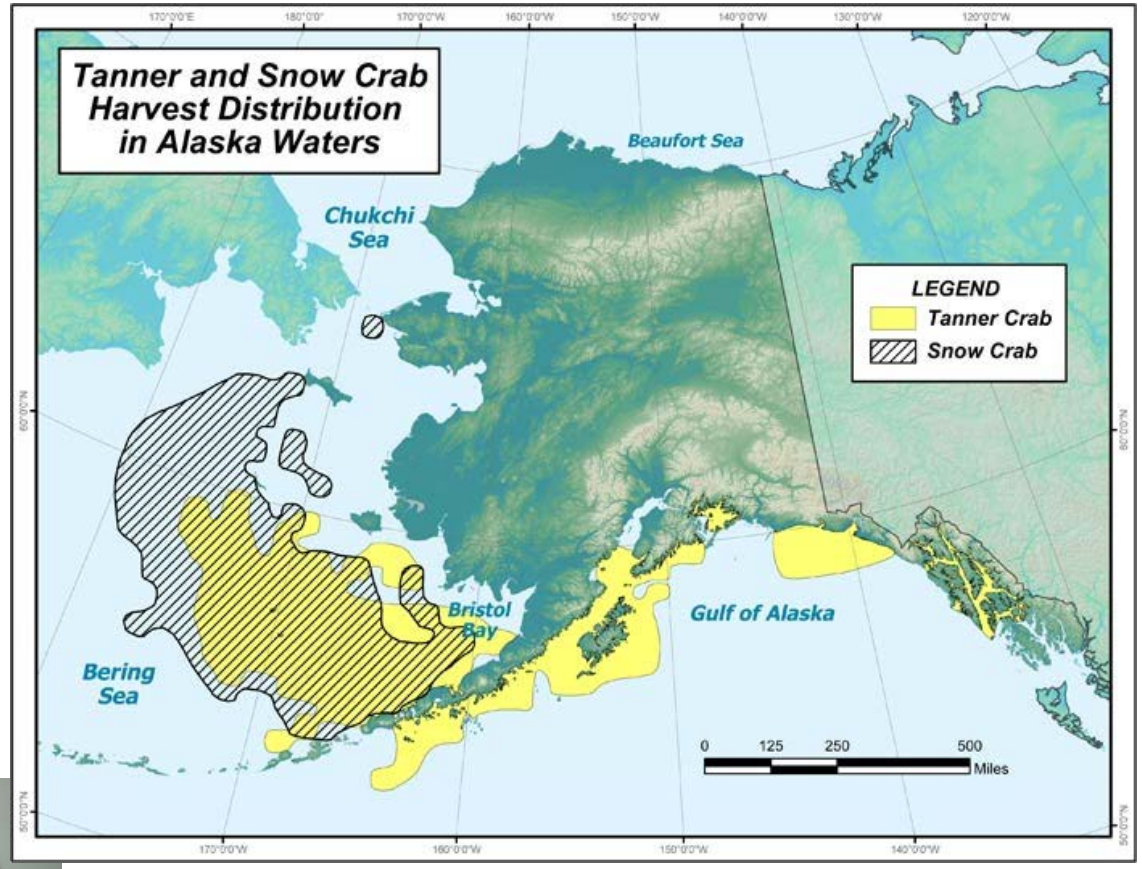

Figure 3-1

- Snow crab (*Chionoecetes opilio*) commercial catches in Alaska are concentrated in the Bering Sea.
- EBS Snow crab are managed as a single stock
- Distributed across the shelf
  - Common at depths <200m

EBS SNOW CRAB

- 2022 BSAI Crab SAFE, the model estimate of mature male biomass for the 2021/22 fishing season (41.2 kt) was below the MSST; 91.6 kt, and so the stock remains in an overfished status.
- The 2019/2020 season was the first time a mass mortality event appears to have occurred for snow crab since the survey began and the biomass of important size categories of crab are at historic lows
- For the first time in history, the fishery will remain closed for the 2022/2023 fishing season.

Projected Removals

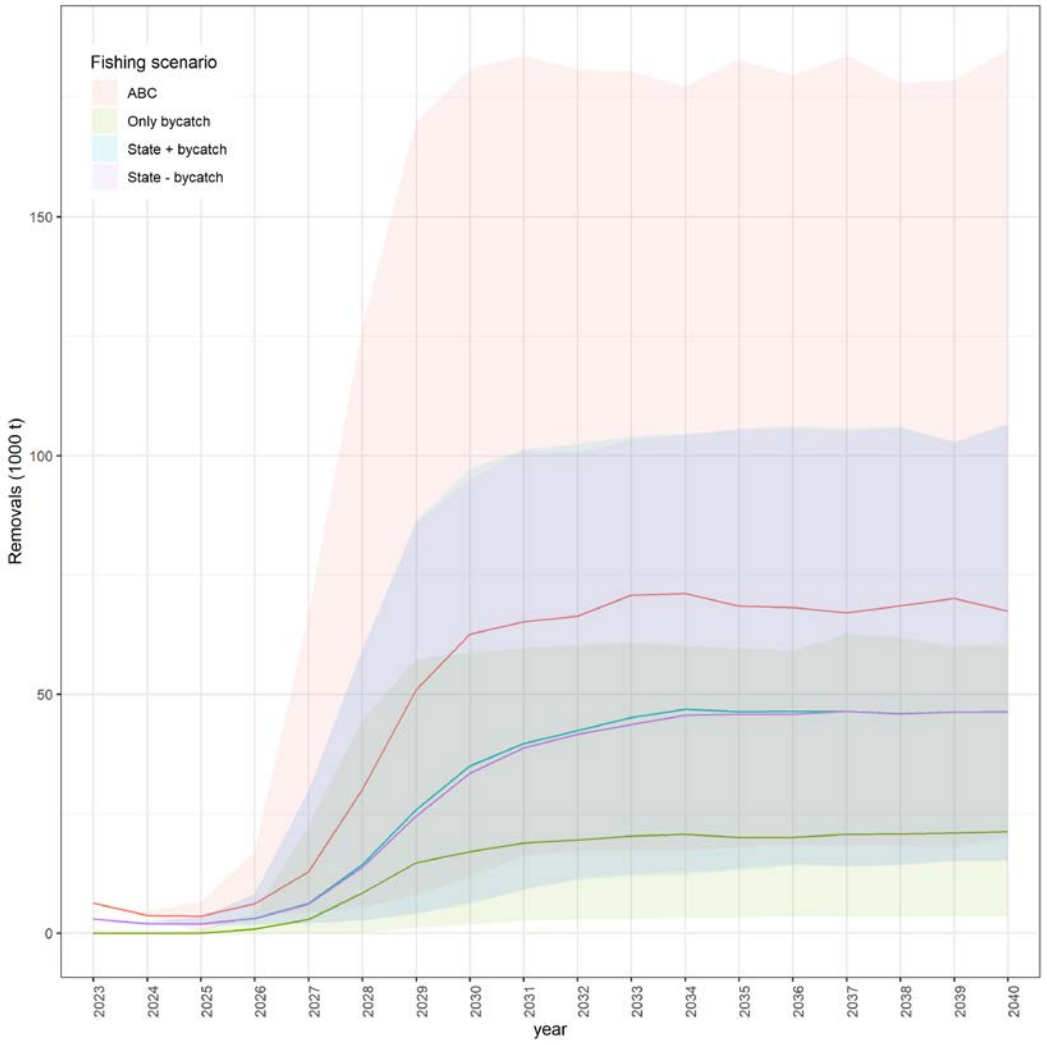

Figure 3-10

Sum of removals (mil lbs)		
Year	bycatch only*	state + bycatch*
2023	0.05	6.53
2024	0.02	4.43
2025	0.03	4.33
2026	1.93	6.89
2027	6.37	13.83
2028	18.57	31.62
2029	32.56	57.01
2030	37.59	77.13
2031	41.62	87.56
2032	43.06	93.55
2033	44.93	99.51
2034	45.68	103.43
2035	44.30	102.24
2036	44.30	102.50
2037	45.65	102.41
2038	45.76	101.31
2039	46.27	102.22
2040	46.85	102.30

Table 3-6

Effects of the Alternatives on EBS snow crab

- Alternative 2/Option 1 would designate no directed EBS snow crab fishery, with bycatch removals only, and implications to the stock will be similar to those seen as a result of the 2022/2023 fishery closure.
  - Given the current biomass and abundance estimates, it is likely that with no directed fishery and bycatch removals only, there would be an increased opportunity for the stock to continue an upward tick in recruitment.
- There existed no difference in median rebuilding time under the bycatch-only fishing mortality scenario when compared to the state harvest strategy scenario.

Effects of the Alternatives on EBS snow crab

- Alternative 2/Option 2: The EBS snow crab stock is likely to have similar rebuilding trajectories under Alternative 1 and Alternative 2/Option 2, due to the nature of the current FMP delegation of TAC setting to the state of Alaska.
    - Constraints on fishing mortality could be made more conservative by further restricting fishery operations if necessary to ensure adequate progress.

Effects of the Alternatives on EBS snow crab

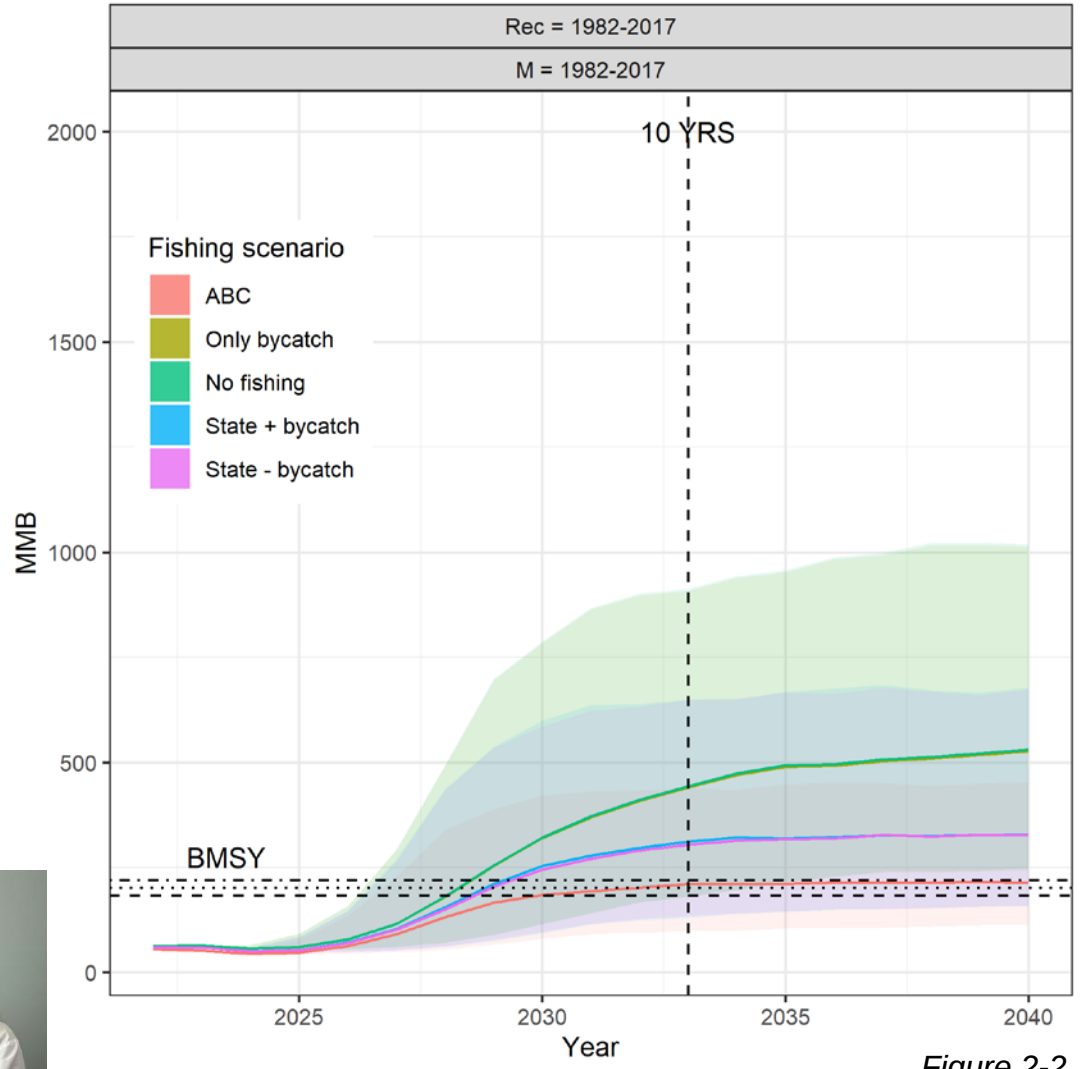

Figure 2-2

- Uncertainty in stock growth persists under all Fishing mortality scenarios
- High variability between biomass projections
- Median rebuilding times are the same between Alternative 2/Option 1 and Alternative 2/Option 2

Effects of the Alternatives on EBS snow crab

Summary

- Time: no difference in median rebuilding timeframe metrics.
- Recruitment and ecosystem conditions are likely the main drivers in time for rebuilding
    - Addition of estimated removals further emphasize low recruitment in the first 3-4 years of the rebuilding plan
- If current ecosystem conditions prevail and recruitment remains at low levels, the population may take substantially longer to show rebuilding progress

Impacts of snow crab bycatch

- Impacts of EBS snow crab bycatch were evaluated as potential factor in stock recovery using the average snow crab bycatch for the last 10 years
- The median rebuilding time of 6-years were the same with and without bycatch included in the projections
- Reasons for no difference in median rebuilding time:
  - Stock productivity which is a function of ecosystem conditions overwhelms bycatch effect

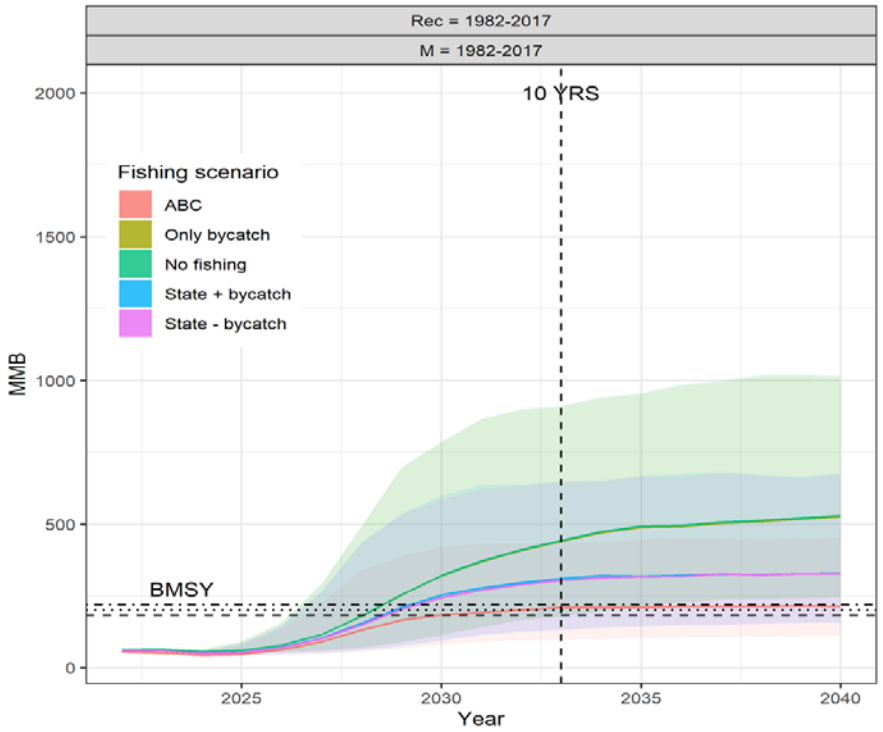

Figure 2-2

Projection specifications			T_{min}
Fishing Scenario	Recruitment	Mortality	Median
No fishing	1982-2017	1982-2017	2029
bycatch	1982-2017	1982-2017	2029
State + bycatch	1982-2017	1982-2017	2029
State - bycatch	1982-2017	1982-2017	2029
ABC	1982-2017	1982-2017	2030

Impacts of snow crab bycatch

- Model sensitivities concerning unobserved mortality were also explored in which the 10-year average bycatch was multiplied by 5 and 100
- Results from projections are provided in Figures 3-14 & 3-15 & Tables 3-11 & 3-12 on pages 64 and 65
- Projected rebuilding times were similar to projections without the additional mortality
  - The 100x did add one more year to the projected median rebuilding period
  - Once again, stock productivity likely overwhelms the effects of unobserved mortality

Projection specifications – 5x			T_{min}		
Fishing Scenario	**Recruitment**	**Mortality**	**Median**	**5%**	**95%**
No fishing	1982-2017	1982-2017	2029	2027	2035
bycatch	1982-2017	1982-2017	2029	2027	2036
State + bycatch	1982-2017	1982-2017	2030	2027	Inf
State - bycatch	1982-2017	1982-2017	2030	2027	Inf
ABC	1982-2017	1982-2017	2035	2027	Inf

Projection specifications – 100x			Tmin		
Fishing Scenario	**Recruitment**	**Mortality**	**Median**	**5%**	**95%**
No fishing	1982-2017	1982-2017	2029	2027	2036
bycatch	1982-2017	1982-2017	2030	2027	Inf
State + bycatch	1982-2017	1982-2017	2030	2027	Inf
State - bycatch	1982-2017	1982-2017	2030	2027	Inf
ABC	1982-2017	1982-2017	2035	2027	Inf

HABITAT

SECTION 3.4

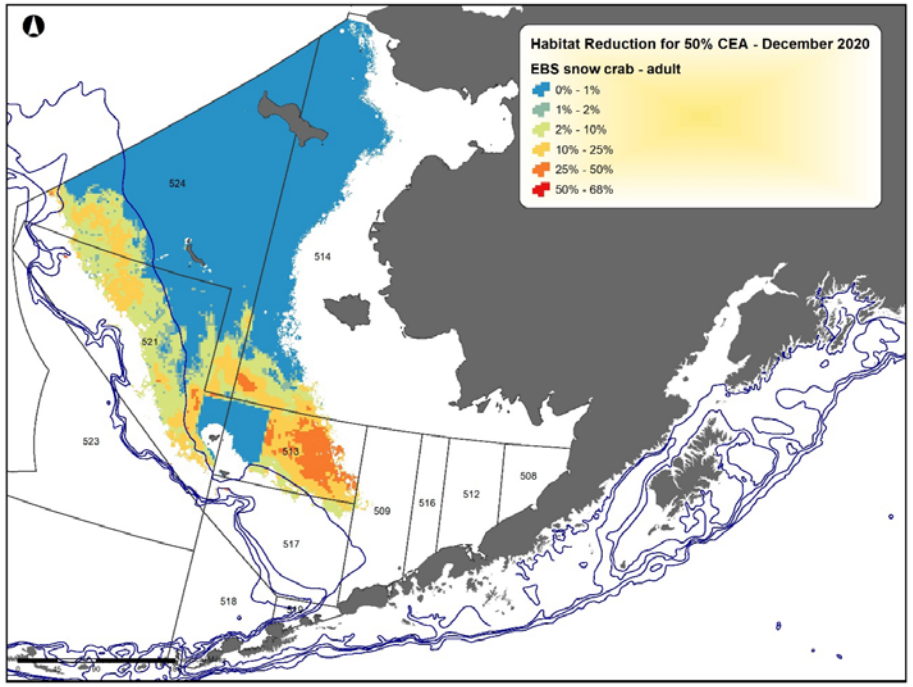

Figure 3-18

- **Summary: There are likely no effects on habitat as a direct result of implementing a rebuilding plan under the proposed alternatives (Alt 2)**
- **No additional adverse effects to habitat under Alternative 1- status quo**
- Continued monitoring of habitat should occur throughout the duration of the rebuilding plan
  - Next EFH 5 year review
  - Continued use of the ESP and ESR

Marine Mammals

SECTION 3.5

- Bearded Seal (*Erignathus barbatus)* known to forage on invertebrates, specifically snow crab. Snow crab has been present in 54%-91% frequency of occurrence in biosampled stomachs.
- Mainly smaller (mean carapace width=57mm)
- Bearded seals and benthic foragers and can likely switch prey types.
  - There is likely minimal effect on bearded seals due to the decline in snow crab abundance.
- **Summary: No effect on marine mammals under Alternative 2**
  - **Potential for adverse effects under Alternative 1 if a rebuilding plan was not to be implemented and there was no intention to rebuild the stock.**

Economic and Social Impacts

- Section 3.6.2 (starting on page 73) provides a brief overview of the economic status and trends of the EBS snow crab fishery
- Table 3-13 provides general stats on harvesting and processing of snow crab through the 2021/2022 season
  - As requested by Council in December - included preliminary price data for 2021/2022 season
- Figures 3-20 – 3-22 provide annual vessel counts, catch data, and price data from 2005/2006 season through the 2021/2022 season
  - As requested by Council in December - included preliminary price data for 2021/2022 season

Snow crab year	TAC/GHL 1000t	TAC/GHL million lbs	Vessels	Retained catch 1000t	Retained catch million lbs	Gross ex-vessel revenue $ million	Ev-vessel price $/lb	Plants	Gross first wholesale revenue $ million	Gross first wholesale price $/lb
2005-2006	16.86	37.18	78	16.77	36.97	$55.79	$1.51	13	$96.27	$2.60
2006-2007	16.59	36.57	69	16.47	36.31	$72.67	$2.00	18	$118.89	$3.27
2007-2008	28.59	63.03	78	28.59	63.02	$133.69	$2.12	17	$209.31	$3.32
2008-2009	26.56	58.55	77	26.55	58.54	$101.24	$1.73	16	$163.64	$2.80
2009-2010	21.78	48.02	69	21.69	47.82	$76.48	$1.60	11	$125.92	$2.63
2010-2011	24.62	54.28	68	24.61	54.26	$164.80	$3.04	14	$231.51	$4.27
2011-2012	40.32	88.89	72	39.99	88.16	$224.00	$2.54	13	$323.57	$3.67
2012-2013	30.1	66.35	70	29.71	65.49	$173.96	$2.66	12	$259.17	$3.96
2013-2014	24.48	53.98	70	24.49	53.98	$144.25	$2.67	10	$222.86	$4.13
2014-2015	30.82	67.95	70	30.79	67.88	$157.49	$2.32	11	$227.73	$3.36
2015-2016	18.42	40.61	69	18.41	40.60	$119.89	$2.95	9	$174.12	$4.29
2016-2017	9.78	21.57	63	9.76	21.53	$75.82	$3.52	10	$127.00	$5.90
2017-2018	8.6	18.96	63	8.60	18.95	$76.25	$4.02	9	$86.39	$4.56
2018-2019	12.51	27.58	61	12.47	27.50	$109.49	$3.98	9	$154.02	$5.60
2019-2020	15.4	33.95	59	15.43	34.02	$133.53	$3.92	9	$177.81	$5.23
2020-2021	20.4	44.97	62	20.41	45.00	$219.16	$4.87	9	$286.37	$6.36
2021-2022*	2.5	5.51	42	2.5	5.51	$33.56	$6.09	Not available	$40.61	$7.37

Source: AKFIN (ADF&G fish ticket data and ADF&G COAR data). 2021/2022 retained catch from 2021/2022 Snow Crab SAFE. Source for 2021/2022 vessel count from September 2022 Ecosystem & Socieconomic Profile for Eastern Bering Sea Snow Crab.
Data includes CDQ harvest
All price data is in real 2021 dollars
*Note that 2022 official ex-vessel prices are not yet available so preliminary prices were estimated using in-season ex-vessel prices inflated for post-season adjustment and first wholesale prices were estimated using the 2021/2022 preliminary ex-vessel price plus the average difference between ex-vessel price and first wholesale pric
2005/2006 - 2020/2021 seasons.

Economic and Social Impacts

- As requested, staff updated the overview of the CDQ snow crab allocation and a description of the CDQ groups (Section 3.6.3.5 (starting on page 111)
  - Table 3-35 which is annual percent of EBS snow crab CP owner shares, CV owner shares, and processor shares owned by all CDQ groups in aggregate
  - Table 3-36 shows percent of EBS snow crab CP owner shares, CV owner shares, and processors shares owned by the CDQ groups for 2021
    - Data in table was masked to protect confidential information

Year	Percent of EBS snow catcher processor owner shares owned by all CDQ groups combined	Percent of EBS snow crab catcher vessel owner shares owned by all CDQ groups combined	Percent of EBS snow crab processor shares owned by all CDQ groups combined
2005	19.8%	6.9%	0.1%
2006	19.8%	7.4%	0.1%
2007	19.8%	10.7%	0.0%
2008	23.9%	12.9%	0.0%
2009	43.8%	14.1%	11.5%
2010	43.8%	14.5%	11.5%
2011	43.8%	16.6%	11.5%
2012	43.8%	16.6%	11.5%
2013	43.8%	16.6%	11.1%
2014	54.1%	18.4%	11.1%
2015	54.1%	20.0%	22.9%
2016	54.1%	20.0%	22.9%
2017	54.1%	20.0%	23.0%
2018	54.1%	20.0%	22.9%
2019	54.1%	20.0%	22.9%
2020	54.1%	20.0%	22.9%
2021	54.1%	20.0%	23.0%

Source: AKFIN; source file Crab_QS_by_CDQ_BSS(12-29--22)

Groupings	Percent of EBS snow crab catcher processor owner shares owned by individual CDQ groups	Percent of EBS snow crab catcher vessel owner shares owned by individual CDQ groups	Percent of EBS snow crab processor shares owned by individual CDQ groups
CDQ group 1	0.0%	0.8%	5.7%
CDQ group 2	0.0%	6.2%	0.0%
CDQ group 3	9.7%	2.9%	17.3%
CDQ group 4	10.6%	4.4%	0.0%
CDQ group 5	7.7%	2.4%	0.0%
CDQ group 6	26.2%	3.2%	0.0%
Non-CDQ Group	45.9%	80.0%	77.0%

Source: AKFIN; source file Crab_QS_by_CDQ_BSS(12-29--22)(1)

Economic and Social Impacts

- Section 3.6.4 provides a qualitative overview of the likely impacts of the two rebuilding options associated with Alternative 2 on vessel owners, crew, quota shareholders and communities
- Effects section focuses solely on the impacts to the directed snow crab fishery participants and communities

Economic and Social Impacts – Harvesters, Crew, and Shareholders

- Section 3.6.4.1 (starts on page 116) provide an overview of the impacts to vessel owners, crew, quota shareholders, and associated communities
  - Under **option 1**, the loss of the snow crab fishery for 6-years for vessel owners, crew, and quota shareholders would likely range from substantial to severe
  - As noted in Table 3-20, in 2021, 40 of the 60 vessels that participated in the snow crab fishery received 90% to 100% of their ex-vessel revenue from the snow crab fishery therefore many vessel owners, crew, and quota share holders would receive no ex-vessel revenue
  - Those highly dependent on snow crab revenue could have difficulty maintaining their credit and debt instruments forcing some to refinance or business sale and/or bankruptcy
  - When combined with the closure of the BBRKC fishery, there would likely be substantial declines in payments on debt instruments which could lead to consolidation of the snow crab fleet and losses of crew positions
  - From the perspective of the communities of vessel owners, crew, and quota shareholders they would also likely be negatively impacted under option 1 due to the loss of direct expenditures by these participants in the community and the associated loss of indirect and induced expenditures
    - Communities most impacted include Seattle MSA, Kodiak, Homer/Seldovia, and Anchorage/Palmer/Wasilla
    - Impacts to these communities would depend on their economic diversification

Economic and Social Impacts – Harvesters, Crew, & Shareholders

- Continue Section 3.6.4.1
  - **Option 2** would allow a directed fishery based on state harvest strategy which could improve the socioeconomic outlook
  - However, based on projected snow crab removals, there is a potential for the snow crab fishery to be closed during the early years of the rebuilding period
  - Assuming there is a directed fishery, the ex-vessel payments from snow crab harvest would likely keep the vessels and crew active and provide downstream benefits for owners, crew, quota shareholders and communities
  - Based on projected removals:
    - Harvesting operations that are highly dependent on the snow crab fishery and not diversified in other fisheries may have greater difficulty maintaining their credit and debt instruments and could be forced to refinance or business sale/bankruptcy during this period
    - The losses for less diversified harvesting operations during this period would be vessels, crew positions, revenue for share holders, and communities of these participants

Economic and Social Impacts – Shore Processors

- Section 3.6.4.2 (starts on page 119) provides an overview of impacts to processors and their associated communities
- Under **option 1**, loss of operating revenue could range from minor to severe impacts and depends on the how dependent the processor is on snow crab deliveries and its ability to adapt or diversify
  - For processors with little reliance on snow crab, it would be expected these processors would experience reduce operating revenue which could result in some reduced processor workers and/or reduced worker wages and the subsequent drop in expenditures by the processor and workers in the community
  - For processors that are highly reliant on snow crab, likely socioeconomic impacts would be severe for the processor and the plant workers due to no operational revenue from the fishery. Communities would also be severely impacted due to the loss of expenditures of goods and services in the community by the processor and its workers and the associated indirect and induced impacts

Economic and Social Impacts – Shore Processors

- As noted in Table 32 (page 91), at least one shorebased processor is 90% to 100% dependent on the snow crab fishery
  - Of 11 processors shown in Table 3-30, the shorebased processor in Saint Paul is likely one of the processors most impacted under option 1
    - The socioeconomic relationship between the Saint Paul processor and the community of Saint Paul result in severe consequences from option 1 since both are highly dependent on snow crab fishery:
      - Loss of processor purchases of goods and services in the community
      - Loss of purchases by local plant workers in the community
      - Potential loss of processor's ability to process local halibut IFQ landings
      - Loss of tax revenue from local sales tax on the sale of seafood
      - CBSFA's loss of operating revenue from its share of the CDQ snow crab allocation and its ownership in snow crab harvesting and processing quota which flows to the community of Saint Paul
      - When combined with the closure of the BBRKC fishery, the socioeconomic impacts to the Saint Paul shorebased processor and the community are even more severe

Economic and Social Impacts – Shore Processors

- **Option 2** would provide opportunity for a directed fishery under State harvest strategy providing valuable operating revenue to pay processor worker wages, expenditures by processor and workers in the community, tax revenue to the communities, and operating revenue from CDQ allocations and ownership of snow crab quota
  - However, based on projected snow crab removals, there is the potential for the fishery to be closed during these early years of the rebuilding period
- Given the potential for lower processor revenue during the first 4 years of the rebuilding plan:
  - Processors with little dependency on the snow crab fishery would likely see some reduced operating revenue from loss of snow crab deliveries which could result in reduced processor workers and/or reduced wages and subsequent expenditures in the local communities
  - For those processors highly dependent on snow crab and limit diversification, the low projected removals of snow crab during first 4 years of rebuilding period could result in these processors not operating during this period would represent a severe socioeconomic impact to the processor, plant workers, and the local community

Economic and Social Impacts - CDQ

- Section 3.6.4.3 (page 110) provides an overview of likely impacts to CDQ groups
  - Under **option 1**, the loss of revenue from the CDQ snow crab fishery would also impact vessel owners, crew, processors
  - Additionally, several communities would also be impacted due to the loss of expenditures by snow crab participants (vessel owners, crew, and quota share holders) in the local community as well as loss of operating revenue from the harvesting and processing of the CDQ allocations that flows to the CDQ communities
  - CDQ groups with ownership in harvesting vessels and harvesting and processing quota would also be negatively impacted under option 1 due to the loss of snow crab revenue which could impact communities that rely on revenue from the CDQ groups
  - **Option 2** would provide opportunity for a directed fishery under State harvest strategy which would likely provide earnings from their CDQ allocation of snow crab and CDQ owned snow crab assets (vessels and quota shares) which would allow continued funding of CDQ programs

Monitoring Progress of the Rebuilding Plan

SECTION 3.7

- The Secretary must ensure that progress made under a rebuilding plan is adequate
  - Biennial assessment of the rebuilding plan
    - NMFS AKRO makes the determination
  - Continued annual stock assessments

Draft FMP Language

- Section 3.8 on page 124 provides draft FMP language for snow crab rebuilding
- As part of the draft FMP language, staff has also included draft language to remove three outdate/inapplicable crab rebuilding plans that are currently in the FMP
  - BS Tanner crab declared overfished March 3, 1999
  - BS snow crab declared overfished September 24, 1999
  - St. Matthew blue king crab declared overfish September 24, 1999
- All these crab rebuilding plans are no longer needed in the crab FMP since they are either rebuilt (BS Tanner crab), being replaced with new rebuilding plan (EBS snow crab) or have been replaced with a new rebuilding plan (St. Matthew blue king crab)
- Absent Council motion on housekeeping update to crab FMP, it is assumed the Council recommends the housekeeping change

Rebuilding Timeline

October 19, 2021: Snow Crab was declared overfished

- Rebuilding of overfished stocks is required by the MSA section 304 within 2 years (October 2023)
  - MSA section 304 and the NS 1 guidelines for rebuilding overfished stocks

June 2022: The Council selected snow crab rebuilding alternatives for analysis

October 2022 SSC meeting – establish rebuilding parameters

December 2022 Council Meeting: initial review of the snow crab rebuilding plan and the Council selected Alt 2/Option 2 as the preliminary preferred alternative (PPA)

February 2023 Council meeting – Council will take final action and select a preferred alternative to recommend to the Secretary of Commerce

- Following the selection of preferred alternative, NMFS prepares proposed FMP amendment text, draft notice of availability, draft Environmental Assessment, and, if required, a draft regulatory package

October 19,2023: A rebuilding plan must be implemented to comply with MSA guidelines in rebuilding overfished stocks.

Questions

Special Thanks

Cody Szuwalski (NMFS)
Kate Haapala (NPFMC)
Mike Litzow (AFSC Kodiak)
Felipe Restrepo (APU Fast Lab)
Scott Smeltz (APU Fast Lab)

Crab PRT Snow Crab Minutes

- Staff provided an overview of the Council's December meeting selecting of Alt 2/option 2 as PPA
- Staff also presented projected catch and removals during rebuilding
    - CPT discussed the changing ratio between bycatch and directed fishery removals over time and it was noted that examining projected model output might resolve these concerns
- During a presentation of economic impacts (ex-vessel revenue), it was noted that estimates focused on the median population projections and that including the 5th and 95th percentiles for population projections might be a better basis for characterizing the full range of expected variability
- Finally, the expected effects of Alt 1 were discussed

Questions

Effects of the Alternatives on EBS snow crab

- Uncertain Nature of snow crab stock in recent years, and several possibilities may influence the effectiveness of rebuilding
  - Highly specific thermal optimums and habitat requirements of EBS snow crab may alter physiological demands as a response to warmer than average bottom temperatures.
  - Warmer temperatures may alter prey-predator relationships and predator distribution, resulting in a shift in predator-prey interactions, and food web dynamics.
  - Constraints on recruitment will likely persist for an extended period of time despite the implementation of a rebuilding plan.