

Proposal 278
5 AAC 35.508 Bering Sea District
***C. bairdi* Tanner crab harvest strategy**

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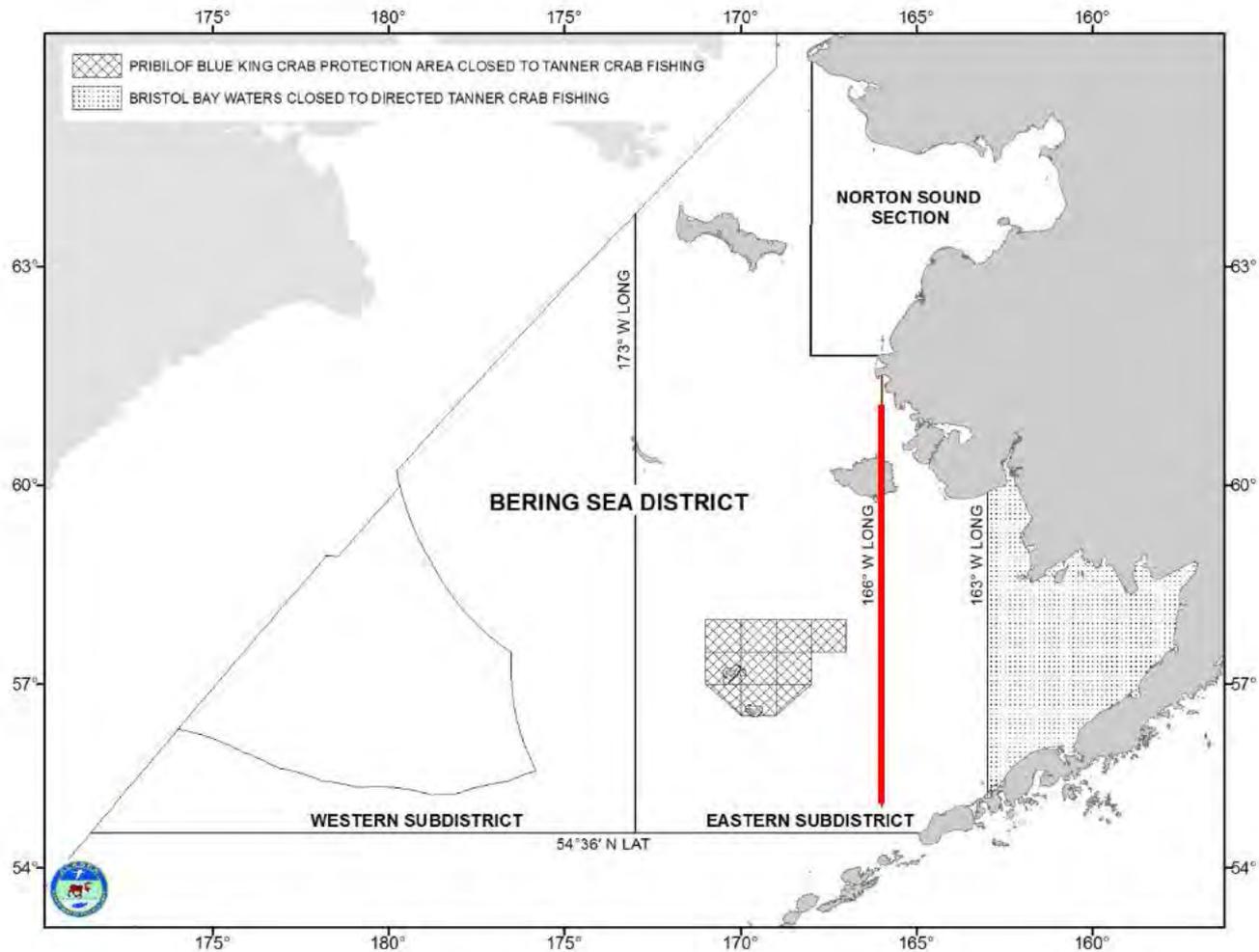
Current Regulations

The Bering Sea District Tanner crab harvest strategy, 5 AAC 35.508, has three components relevant to this proposal:

1. A mature female biomass threshold that must be met or exceeded before a commercial fishery in the Bering Sea District may be opened;
2. Rules for opening and computing TAC for the fisheries in the areas east and west of 166° W long.; and
3. Factors that the department is directed to consider when implementing the harvest strategy (e.g., reliability of estimates, manageability of the fishery, uncertainty, best available science).

Current Regulations

Managed as a single stock, but with TACs established separately for the areas east and west of 166° W long.



What would the proposal do?

1. Removes the mature female biomass threshold for opening Bering sea fishery.
2. Removes the rule that reduces total allowable catch (TAC) by one-half from computed values if the prior year's estimate was below the mature female threshold.
3. Removes the rules for opening the commercial fishery and computing TAC in the area east of 166° W long.
4. Adds the provision that the department maintain consistency with the board's *Policy on King and Tanner Crab Resource Management* in implementing the harvest strategy.

Current Regulations: Subsection (a)

Female threshold: Mature female biomass must be at or above 40 percent of the 1975–2010 average female biomass in the Eastern Subdistrict for fisheries east or west of 166° W long. to open.

*5 AAC 35.508 (a) In the Bering Sea District, the commercial *C. bairdi* Tanner crab fishery may open only if an analysis of preseason survey data indicates that the population at the time of the survey is at or above 40 percent of the long-term average (1975-2010) of mature female crab biomass in the Eastern Subdistrict.*

The proposal removes subsection (a) from the harvest strategy

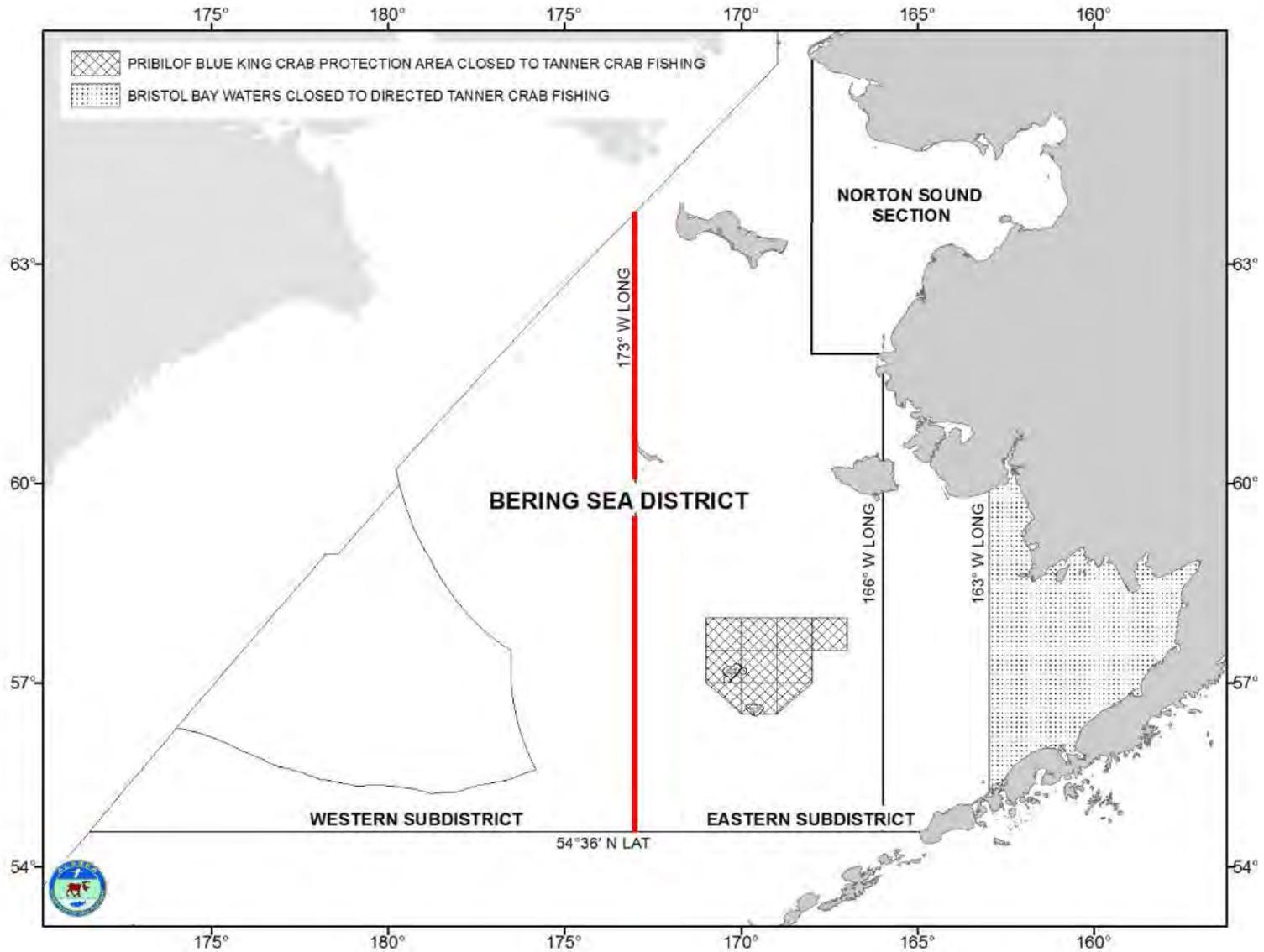
Current Regulations: Subsection (a)

Mature females defined as:

- East of 166° W long.: > 84 mm carapace width
- West of 166° W long.: > 79 mm carapace width

Eastern Subdistrict: the area east of 173° W long. in Bering Sea District.

Eastern Subdistrict: east of 173° W



Current Regulations

If the threshold requirement for opening the Bering Sea District fishery specified in subsection (a) is met, subsections (b), (c), (d) and (e) establish the provisions for opening and computing separate TACs in the area east and west of 166° W long.

Current Regulations: Subsection (b)

(b) If preseason survey data indicates that the population at the time of the survey is at or above 40 percent of the long-term average of mature female crab biomass in the Eastern Subdistrict for the second consecutive year, the department shall establish a separate total allowable catch level for that portion of the Bering sea District that is east of 166° W long. and for that portion that is west of 166° W long. under provisions (c) and (d) of this section. If the commercial *C. bairdi* Tanner crab fishery in the Bering Sea District did not open in the previous season because the threshold requirements specified in (a) of this section were not met, the total allowable catch level for that portion of the Bering Sea District that is east of 166° W long. and for that portion that is west of 166° W long., as computed under (c) and (d) of this section, shall be reduced by one-half.

The proposal removes subsection (b) from the harvest strategy

Understanding Subsection (b)

Assuming the current year is at or above the female threshold:

Was the previous year at or above the female threshold?

If **yes**, the current year TACs for east and west of 166° W long. are established according to subsections (c) and (d).

If **no**, the current year TACs for east and west of 166° W long. are computed according to subsections (c) and (d), and those values are reduced by one half.

The proposal removes subsection (b) from the harvest strategy

Current Regulations: Subsections (c) and (d)

(c) In that portion of the Bering Sea District that is east of 166° W long., and under restrictions of (e) and (f) of this section, the total allowable catch level shall be established as follows:

- (1) if B_E is less than 25 percent of $B_{E,(1975-2010)}$, the fishery will not open;
- (2) if B_E is at least 25 percent but not greater than 100 percent of $B_{E,(1975-2010)}$, the total allowable catch will be computed as $(0.9) \times (B_E / B_{E,(1975-2010)}) \times C_{E,MSY}$; and
- (3) if B_E is greater than 100 percent of $B_{E,(1975-2010)}$, the total allowable catch will be computed as $(0.9) \times C_{E,MSY}$.

The proposal removes subsection (c) from the harvest strategy

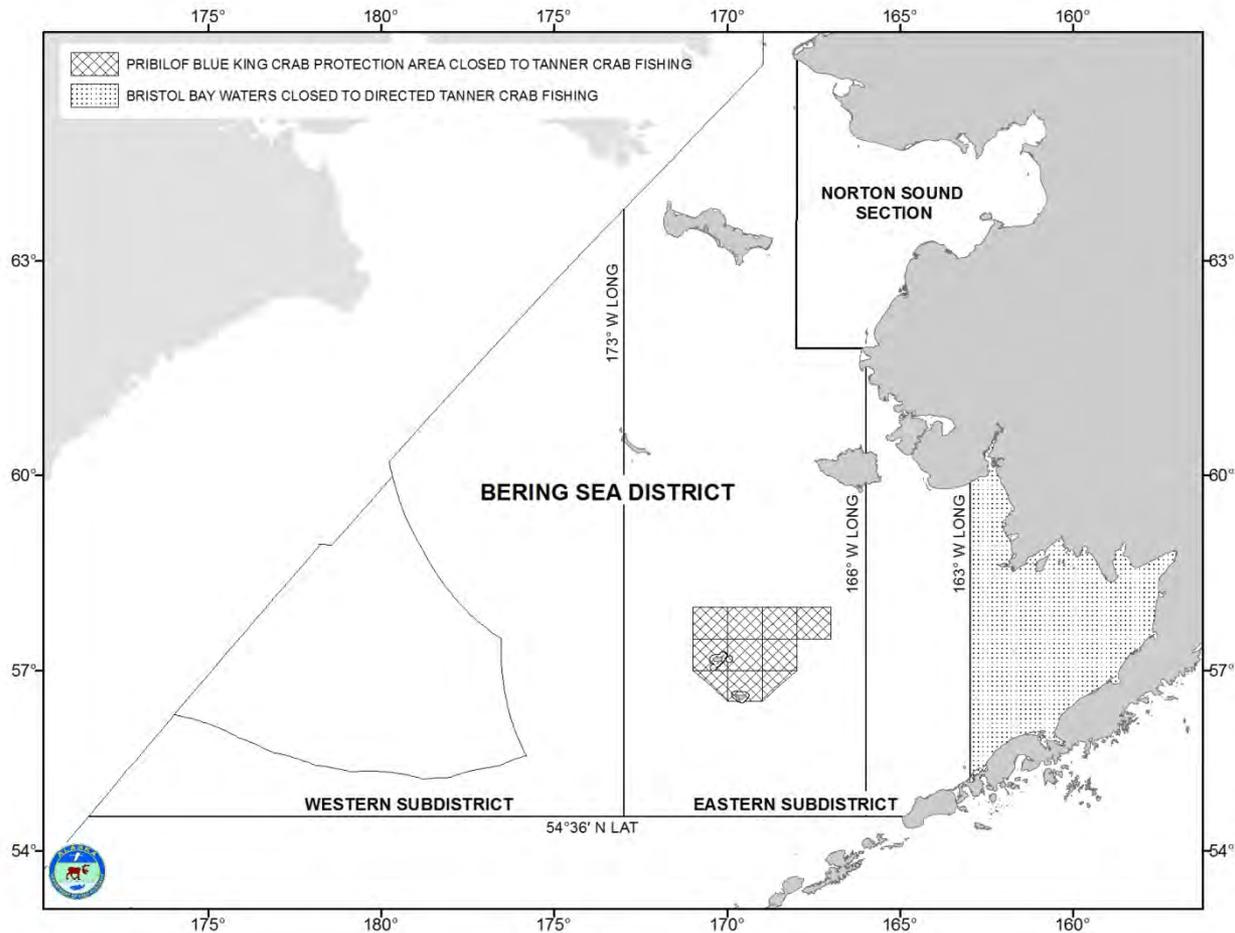
(d) In that portion of the Bering Sea District that is west of 166° W long., and under restrictions of (e) and (f) of this section, the total allowable catch level shall be established as follows:

- (1) if B_W is less than 25 percent of $B_{W,(1975-2010)}$, the fishery will not open;
- (2) if B_W is at least 25 percent but not greater than 100 percent of $B_{W,(1975-2010)}$, the total allowable catch will be computed as $(0.9) \times (B_W / B_{W,(1975-2010)}) \times C_{W,MSY}$; and
- (3) if B_E is greater than 100 percent of $B_{W,(1975-2010)}$, the total allowable catch will be computed as $(0.9) \times C_{W,MSY}$.

The proposal retains subsection (d) in the harvest strategy

Current Regulations

Managed as a single stock, but with TACs established separately for the areas east and west of 166° W long.



Current Regulations: Subsection (f)

(f) Notwithstanding (b) – (e) of this section, in implementing this harvest strategy, the department shall consider the reliability of the estimates of *C. bairdi* Tanner crab, the manageability of the fishery, and other factors the department determines necessary to be consistent with sustained yield principles and to use the best scientific information available and consider all sources of uncertainty as necessary to avoid overfishing.

The proposal amends subsection (f) by adding that the department shall also “maintain consistency with the [Board’s] *Policy on King and Tanner Crab Resource Management*” in implementing the harvest strategy.

What would be the effect if the proposal is adopted?

1. Removal of subsection (a) excludes Eastern Subdistrict mature female biomass data from establishment of threshold (an estimate of broodstock adequate for stock rebuilding; see BOF policy #5).
2. Removal of subsection (b) removes precautionary measure that reduces the TAC from the computed value in the first year that a stock is above threshold after having been below threshold.
3. Removal of subsection (c) removes the rules for a fishery opening and computing TAC east of 166°W, effectively closing the fishery east of 166° W without any provision for re-opening that fishery in the future.
4. Retention of subsection (d) allows for opening a fishery west of 166° W if the estimate of mature male biomass is at least 25 percent of the 1975–2010 average, with TAC computed according to the current regs, regardless of mature female biomass.
5. Effects 1, 2, 3, and 4 together result in a harvest strategy that manages Tanner crab west of 166° W as a distinct stock that is biologically independent of and disconnected from Tanner crab east of 166° W.

Background on effect 1

Effect 1: Removal of subsection (a) excludes Eastern Subdistrict mature female biomass data from establishment of threshold (an estimate of brood stock adequate for stock rebuilding; see BOF policy #5).

Background on effect 1: Female Threshold

Regulation 5 AAC 35.080: *“.....If adequate data are available, the department shall establish a threshold level of abundance for each [Tanner crab] stock and may not allow fishing on any stock that is below its threshold level of abundance”*

BOF and ADF&G Policy on King and Tanner Crab Resource Management (90-04-FB), Policy 5: *“Maintain an adequate brood stock to rebuild king or Tanner crab populations when they are depressed. Maintenance of an adequate brood stock takes precedence over short term economic considerations. When populations are at or below threshold, the minimum stock size that allows sufficient recruitment so that the stock can rebuild itself, fisheries must be closed and must remain closed until there is adequate brood stock.”*

Policy 5:

⇒ **Threshold establishment is based on a measure of stock's capacity to produce future recruitment – not on the biomass of harvestable crab.**

Background on effect 1: Female Threshold

Two key considerations in establishing threshold:

1) Are there “adequate data” available for precisely and accurately estimating the “minimum stock size that allows for sufficient recruitment so that the stock can rebuild itself”?

– Rarely/never and not in the case of Bering Sea Tanner crab

- Only way to find “minimum” is by going below it, in which case it is too late

⇒ Threshold should be set at precautionary level

Background on effect 1: Female Threshold

Two key considerations in establishing threshold:

2) What data are available and adequate to estimate “brood stock” for threshold establishment?

- Ideally “brood stock” is a direct measure of the capacity of the stock to produce future recruitment; e.g.,
 - “effective spawning biomass” (Bristol Bay red king crab threshold)
 - The portion of mature female biomass that can be mated by available males
 - Fertilized egg production
- The department believes that mature female biomass provides the best proxy for direct measure of stock productive capacity when data are not adequate for estimating a direct measure of stock productive capacity, but data are adequate for estimating mature female biomass
 - That is the case for Bering Sea Tanner crab

⇒ The threshold for Bering Sea Tanner crab is established in terms of mature female biomass

Background on effect 1: Female Threshold

Rational for mature female biomass threshold

Recruitment is highly variable/episodic, with pulses of high recruitment and periods of low recruitment (next slides).

- 1) If mature female biomass is low
 - ⇒ Stock has low potential for fertilized egg production
 - ⇒ Stock is in period of low capacity to produce future recruitment
- 2) If mature female biomass has declined to low level
 - ⇒ Stock has been in period of poor recruitment of juvenile and mature crab (females and males)

1) & 2):

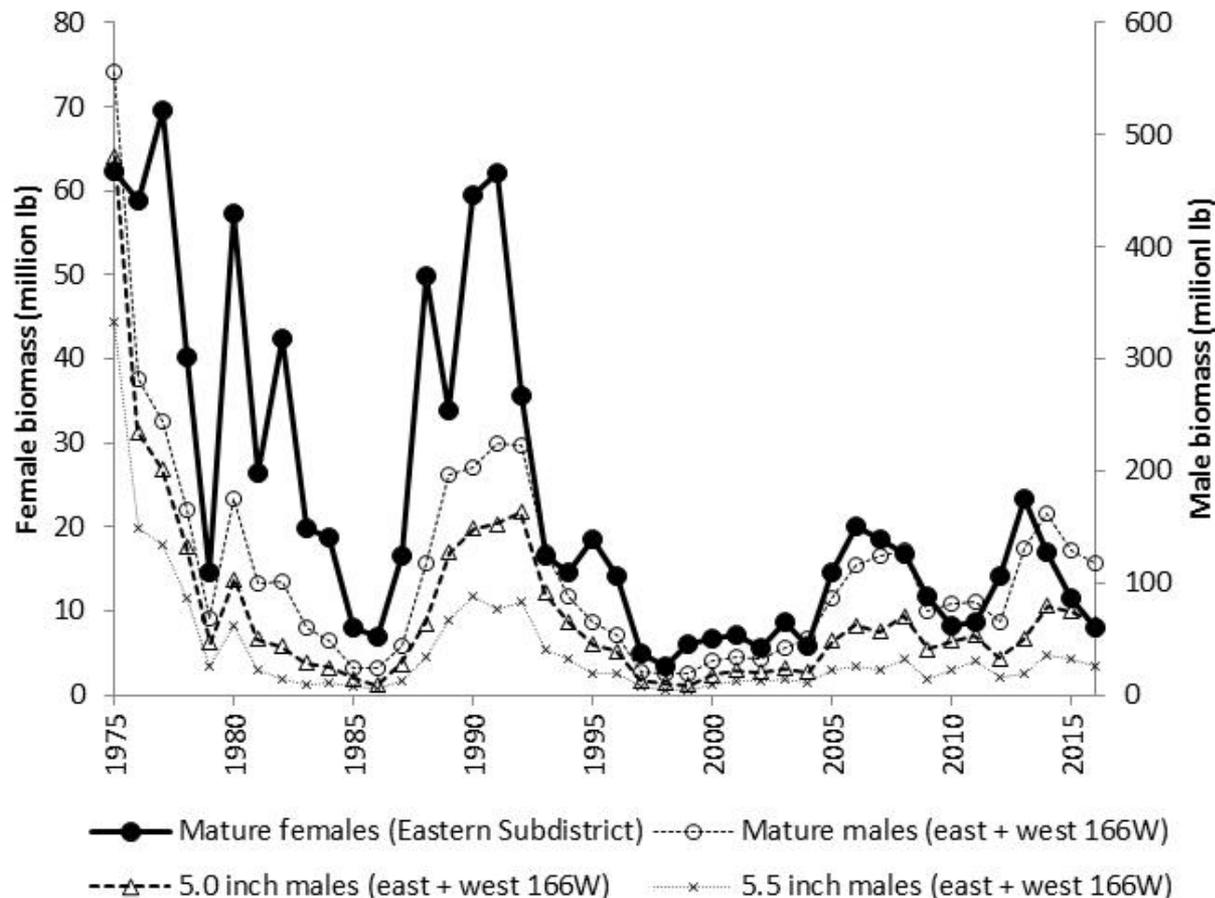
⇒ When mature female biomass is low, fishery should be closed to preserve existing mature biomass (female and male)

Background on effect 1: Female Threshold

Highly variable/episodic recruitment:

Trends in biomass of mature female and male crab, harvestable males

- Note: Male increases/decreases tend to lag those of females by 1-2 years
 - Female Tanner crab mature at younger age/smaller size than males

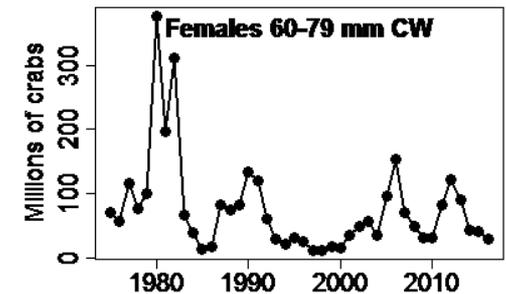
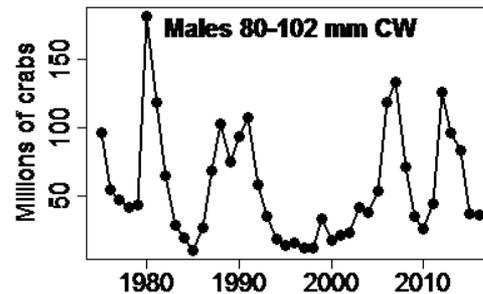
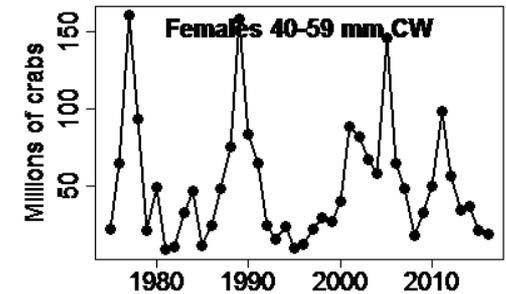
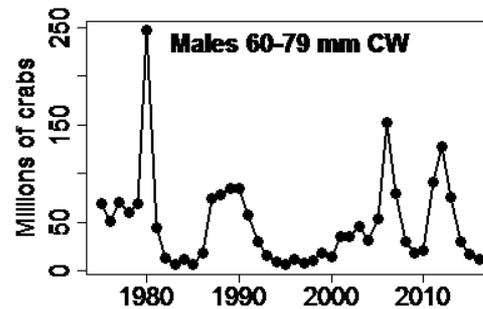
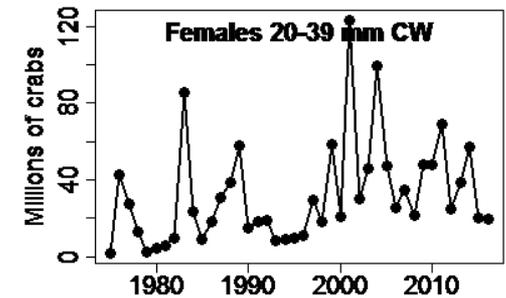
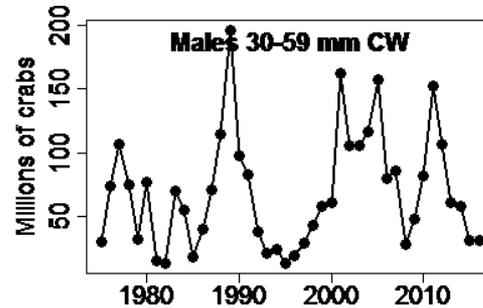


Background on effect 1: Female Threshold

Highly variable/episodic recruitment:

Trends in juvenile males and females

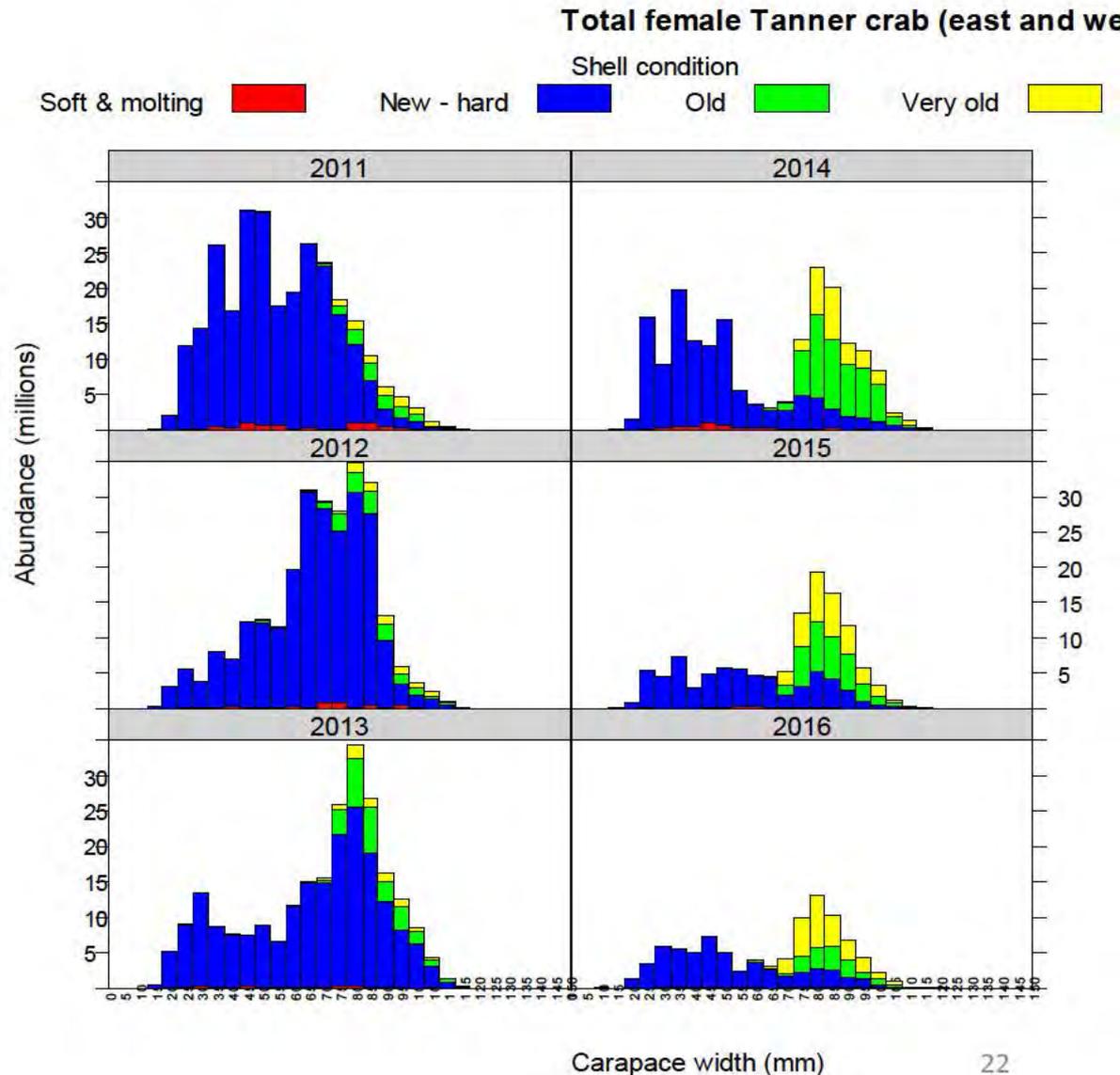
- Pulses of high abundance
- Periods of low abundance
 - e.g. recent years (next 2 slides)



Background

Size/shell composition, 2011-2016: females

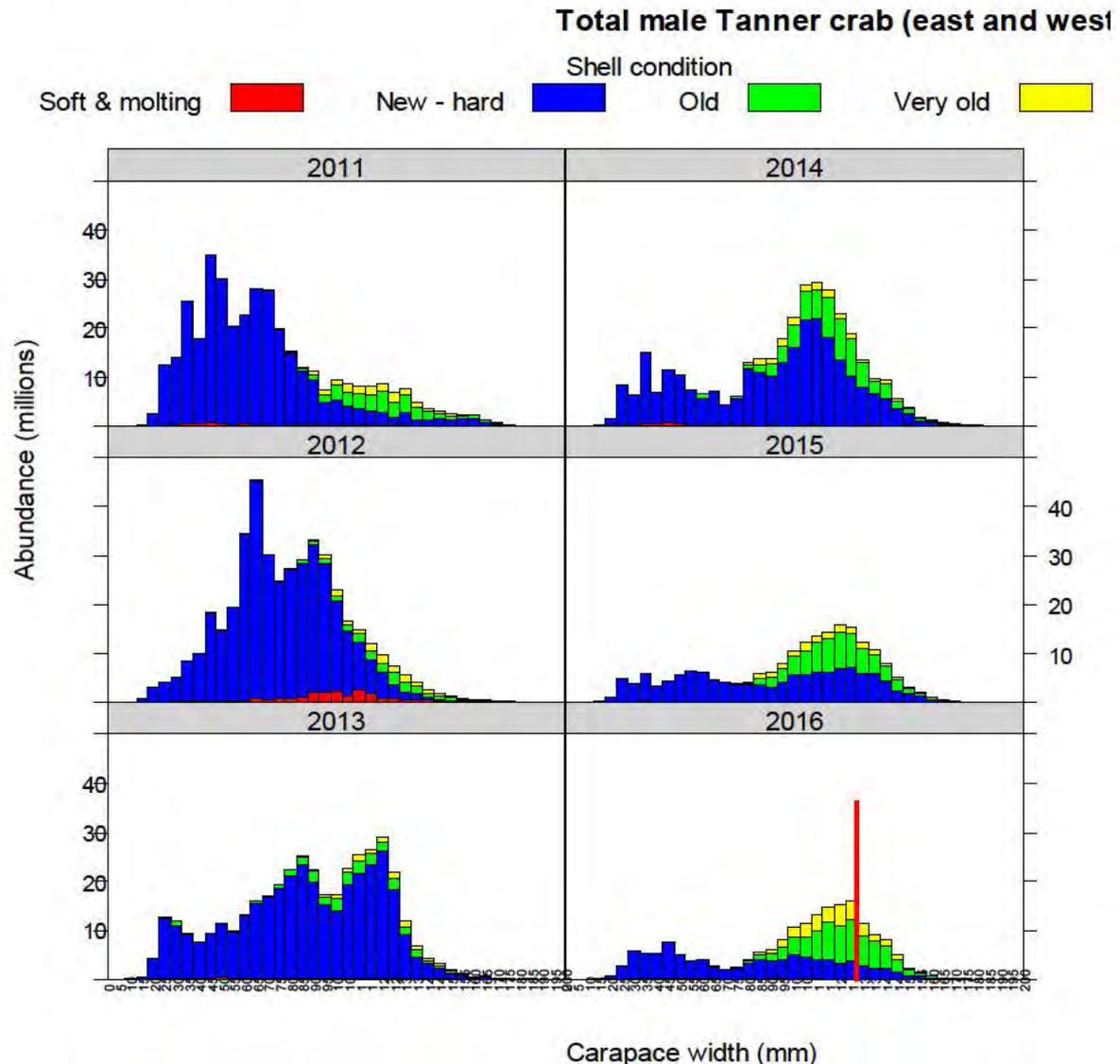
- Juvenile recruitment reduced to low levels in 2015, 2016
- Recruitment to and decreases in mature-sized crabs lag behind that of juveniles
 - Low abundance of new-shell recruits to mature size in 2015, 2016



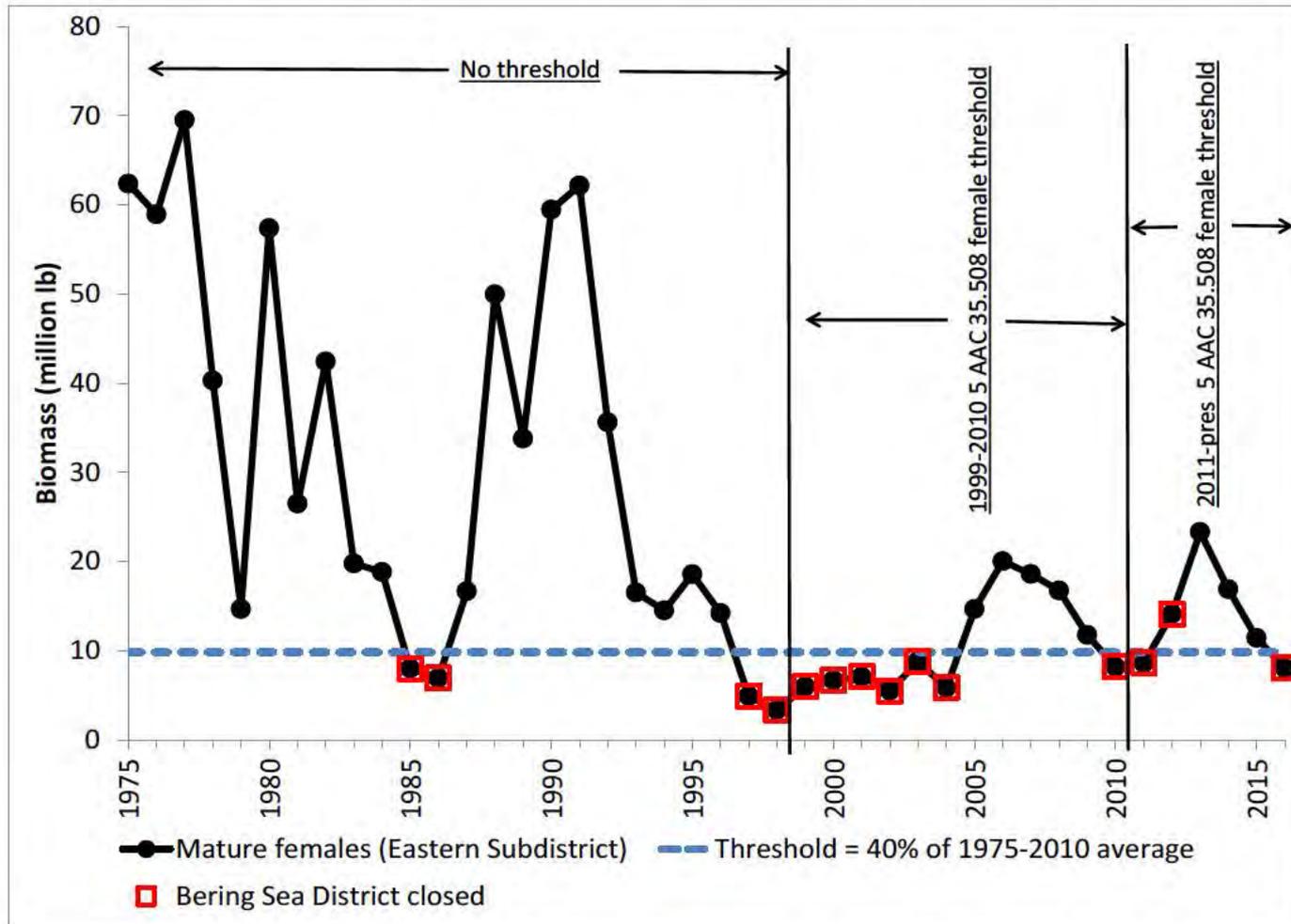
Background

Size/shell composition, 2011-2016: males

- Juvenile recruitment reduced to low levels in 2015, 2016
- Recruitment to and decreases in mature-sized crabs lag behind that of juveniles
 - Low abundance of new-shell recruits to mature size in 2015, 2016



Background on effect 1: Female Threshold



Threshold as currently defined in 5 AAC 35.508 (a) is a precautionary estimate of the “minimum stock size that allows for sufficient recruitment so that the stock can rebuild itself.”

Background on effect 1: Female Threshold

Final note on mature female biomass threshold:

What if mature female biomass is above threshold, but reproductive capacity is limited due to low sex ratios – low abundance of mature males?

5 AAC 35.508 (c) and (d) provides protection to stock reproductive capacity in that case:

- If stock is above the mature female biomass threshold, the rules for opening and calculating TAC for the fisheries east and west of 166° W long. are based on mature male biomass relative to long-term (1975-2010) average.

Background on effect 2

Effect 2: Removal of subsection (b) removes a precautionary measure that reduces the TACs from the computed values in the first year that a stock is above threshold after having been below threshold.

Background: TAC reduction by 1/2

Subsection (b) in the harvest strategy reduces the TACs east and west of 166° W long. by **one-half from the computed values** in the first year that the stock is above threshold after having been below threshold.

Precautionary measure:

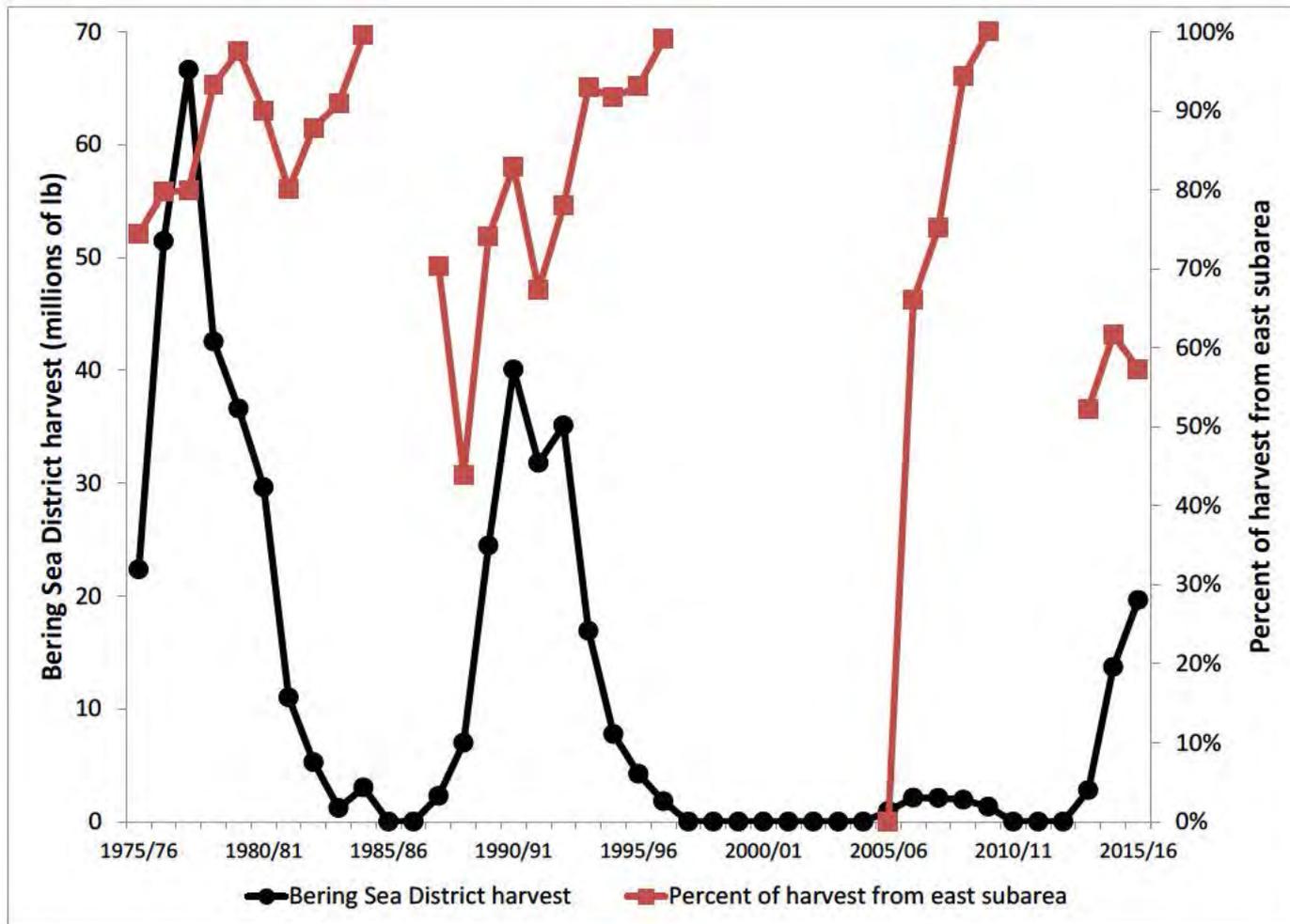
1. Provides a buffer against the effect of erroneously determining the stock to be above threshold due to random survey error.
2. Due to the lag in maturation of males behind females, the ratio of preferred-sized legal male crab to mature male crab is likely to be low in the first year that the stock is above threshold. This provision protects against a high harvest rate on preferred-sized legal males that could occur under such conditions.

Background on effects 3 & 4

Effect 3: Removal of subsection (c) removes the rules for a fishery opening and computing TAC east of 166°W, effectively closing the fishery east of 166° W without any provision for re-opening that fishery in the future.

Effect 4: Retention of subsection (d) allows for opening a fishery west of 166° W if the estimate of mature male biomass is at least 25 percent of the 1975–2010 average, with TAC computed according to the current regs, regardless of mature female biomass.

Background on effects 3 & 4:



>50% of harvest in Bering Sea District occurred in east subarea in most open seasons.
(east subarea: east of 168° W prior to 2005/06; east of 166° W since 2005/06)

Background on effect 5

Effect 5: Effects 1, 2, 3, and 4 together result in a harvest strategy that manages Tanner crab west of 166° W as a distinct stock that is biologically independent of and disconnected from Tanner crab east of 166° W.

Background on effect 5:

Single-stock management with separate TACs E/W of 166°

*Tanner crab **stock structure** and the connectivity among Bering Sea subregions remains **poorly understood***

- Evidence suggesting east-west stock substructure:
 - Size-at-maturity
 - East-to-west decline in size-at-maturity has been established since 1980
 - Larval advection patterns simulated from ocean circulation model
 - Suggest subareas exist with high larval retention (e.g., Bristol Bay)
 - Genetics
 - Previously published genetic analysis suggesting eastern-western genetic differentiation was not supported by a more-recent reanalysis of the data
- Evidence suggesting single stock with connectivity among subregions:
 - Size-at-maturity
 - East-to-west variation in size at maturity may reflect environmental effects
 - Larval advection patterns simulated from ocean circulation model
 - Suggest varying degrees of connectivity among subareas
 - Distribution of Tanner crab in the annual NMFS EBS trawl survey
 - Widely distributed over EBS surveyed area without discontinuity between areas

Background on effect 5:

Single-stock management with separate TACs E/W of 166°

*Tanner crab **stock structure** and the connectivity among Bering Sea subregions remains **poorly understood**.*

- The current harvest strategy addresses uncertainty on stock structure:
 - Bering Sea District Tanner crab are **managed as one stock with one threshold for opening** the District to fishing
 - ⇒ Considers condition of stock overall before opening the fishery
 - Rules for **separately opening and establishing TAC** in the eastern and western subareas if the District is opened
 - ⇒ Protects against depletion of stock within subareas

Background on effect 5:

Single-stock management with separate TACs E/W of 166°

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 - ⇒ Protects against depletion of stock within subareas

Additional reason for establishing east/west TACs separately:

- Different legal size between east and west (difference in size at maturity)
- Past (and future?) difference in preferred size for retention, east and west

Policy on King and Tanner Crab Resource Management

- 1. Maintain crab stocks comprised of various size and age classes of mature animals in order to maintain the long-term productive viability of the stock and reduce industrial dependency on annual recruitment, which is extremely variable. Benefits of this policy are most apparent when weak recruitment occurs. As population abundance and structure change with declining recruitment, harvests should be reduced.**
- 2. Routinely monitor crab resources to provide information on abundance of females as well as prerecruit, recruit, and postrecruit males. This is necessary to detect changes in the population which may require adjustments in management to prevent irreversible damage to the reproductive potential of each stock and to better achieve the benefits listed above. Harvests must be conducted in a conservative manner in the absence of adequate information on stocks.**
3. Protect king and Tanner crab stocks during biologically sensitive periods of their life cycle. Closure of the season is necessary at times surrounding annual mating, molting, and egg hatching periods in order to reduce unnecessary mortality of soft animals, disturbance during mating, and damage to egg clutches.
4. Minimize handling and unnecessary mortality of non-legal crabs and other non-target animals. Capture and handling of females, sublegal males, and animals of other species results in a loss of reproductive ability and biomass that may be detrimental to a stock.
- 5. Maintain an adequate brood stock to rebuild king or Tanner crab populations when they are depressed. Maintenance of an adequate brood stock takes precedence over short term economic considerations. When populations are at or below threshold, the minimum stock size that allows sufficient recruitment so that the stock can rebuild itself, fisheries must be closed and must remain closed until there is adequate brood stock.**
- 6. Establish management measures in each fishing area based on the best available information. Stock and fishery characteristics, as well as available data, vary from area to area within Alaska. Actual management practices in each area will vary accordingly.**
7. Establish regulations which will help improve the socio-economic aspects of management by: harvesting crab when their meat yield is highest; providing for fair starts and closures to seasons; insuring enforceability of regulations; and other measures providing for an orderly fishery.

Policy on King and Tanner Crab Resource Management

“The board recognizes these policies may not result in maximization of physical or economic yield. They will, however, provide better biological protection and help preserve the reproductive viability of king and Tanner crab stocks which inherently vary in abundance due to environmental conditions. It will also increase the stability and longevity of the king and Tanner crab fisheries beyond that provided by a recruits-only fishery.”

Department comments

The department is **OPPOSED** to this proposed change in harvest strategy.

- The female threshold is necessary for establishing “adequate broodstock”.
- The one-half reduction rule protects against overharvest due to random survey error.
- No new evidence to suggest Tanner crab west of 166° W comprise a distinct stock that is biologically independent of and disconnected from the Tanner crab east of 166° W.
- No provisions for re-opening the fishery east of 166° W.

Final note: FMP Management

Bering Sea Tanner crab fishery is co-managed by the State of Alaska and the federal government under the federal *Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs* (FMP).

Harvest levels are a Category 2 management measure under the FMP (i.e., a framework-type measure that the State can change following criteria set out in the FMP).

FMP stipulates that the board will consider the National Standards of the Magnuson-Stevens Act and take into account the factors listed in FMP Section 8.2.2 when developing harvest strategies.

Questions?