

**Amendment 24**  
**To the Fishery Management Plan for**  
**Bering Sea/Aleutian Islands King and Tanner Crabs**

**(1) Revise the following definitions in 4.0 DEFINITIONS OF TERMS to read:**

Maximum sustainable yield (MSY) is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions. MSY is estimated from the best information available.

F<sub>MSY</sub> control rule means a harvest strategy which, if implemented, would be expected to result in a long-term average catch approximating MSY.

B<sub>MSY</sub> stock size is the biomass that results from fishing at constant F<sub>MSY</sub> and is the minimum standard for a rebuilding target when a rebuilding plan is required.

Maximum fishing mortality threshold (MFMT) is defined by the F<sub>OFL</sub> control rule, and is expressed as the fishing mortality rate.

Minimum stock size threshold (MSST) is one half the B<sub>MSY</sub> stock size.

\* \* \* \* \*

Overfished is determined by comparing annual biomass estimates to the established MSST. For stocks where MSST (or proxies) are defined, if the biomass drops below the MSST (or proxy thereof) then the stock is considered to be overfished.

Overfishing is defined as any amount of catch in excess of the overfishing level (OFL). The OFL is calculated by applying the F<sub>OFL</sub> control rule annually estimated using the tier system in Chapter 6.0 to abundance estimates.

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**(2) Revise the first paragraph of 5.0 DESCRIPTION OF FISHERY MANAGEMENT UNIT to read:**

This FMP applies to commercial fisheries for red king crab Paralithodes camtschaticus, blue king crab P. platypus, golden (or brown) king crab Lithodes aequispinus, Tanner crab Chionoecetes bairdi, and snow crab C. opilio in the BS/AI area, except for the following stocks exclusively managed by the State of Alaska: Aleutian Islands Tanner crab, Dutch Harbor red king crab, St. Matthew golden king crab, and St. Lawrence blue king crab.

The common and scientific names used in this FMP are those included in Williams et al. (1988), appropriately amended, with secondary common names sometimes used in the

fishery included in parentheses. Members of the genus Chionoecetes are often collectively referred to as Tanner crabs; to avoid confusion, the name Tanner crab is used for C. bairdi and snow crab is used for C. opilio. Through 1989, commercial landings had only been reported for red, blue, and golden king crab; and Tanner, snow, and hybrids of these two species.

**(3) Replace Chapter 6.0 SPECIFICATION OF MAXIMUM SUSTAINABLE YIELD, OPTIMUM YIELD, MINIMUM STOCKS SIZE THRESHOLDS, OVERFISHING LEVELS, ANNUAL HARVEST, AND ANNUAL PROCESSING with the following:**

**6.0 STATUS DETERMINATION CRITERIA**

Status determination criteria for crab stocks are annually calculated using a five-tier system that accommodates varying levels of uncertainty of information. The five-tier system incorporates new scientific information and provides a mechanism to continually improve the status determination criteria as new information becomes available. Under the five-tier system, overfishing and overfished criterion are annually formulated and assessed to determine the status of the crab stocks and whether (1) overfishing is occurring or the rate or level of fishing mortality for a stock or stock complex is approaching overfishing, and (2) a stock or stock complex is overfished or a stock or stock complex is approaching an overfished condition.

Overfishing is determined by comparing the overfishing level (OFL), as calculated in the five-tier system for the crab fishing year, with the catch estimates for that crab fishing year. For the previous crab fishing year, NMFS will determine whether overfishing occurred by comparing the previous year's OFL with the catch from the previous crab fishing year. This catch includes all fishery removals, including retained catch and discard losses, for those stocks where non-target fishery removal data are available. Discard losses are determined by multiplying the appropriate handling mortality rate by observer estimates of bycatch discards. For stocks where only retained catch information is available, the OFL will be set for and compared to the retained catch.

NMFS will determine whether a stock is in an overfished condition by comparing annual biomass estimates to the established MSST, defined as  $\frac{1}{2} B_{MSY}$ . For stocks where MSST (or proxies) are defined, if the biomass drops below the MSST (or proxy thereof) then the stock is considered to be overfished. MSSTs or proxies are set for stocks in Tiers 1-4. For Tier 5 stocks, it is not possible to set an MSST because there are no reliable estimates of biomass.

If overfishing occurred or the stock is overfished, section 304(e)(3)(A) of the Magnuson-Stevens Act, as amended, requires the Council to immediately end overfishing and rebuild affected stocks.

Annually, the Council, Scientific and Statistical Committee, and Crab Plan Team will review (1) the stock assessment documents, (2) the OFLs and total allowable catches or guideline harvest levels for the upcoming crab fishing year, (3) NMFS's determination of whether overfishing occurred in the previous crab fishing year, and (4) NMFS's determination of whether any stocks are overfished.

### Five-Tier System

The OFL for each stock is annually estimated for the upcoming crab fishing year using the five-tier system, detailed in Table 6-1 and 6-2. First, a stock is assigned to one of the five tiers based on the availability of information for that stock and model parameter choices are made. Tier assignments and model parameter choices are recommended through the Crab Plan Team process to the Council's Scientific and Statistical Committee. The Council's Scientific and Statistical Committee will recommend tier assignments, stock assessment and model structure, and parameter choices, including whether information is "reliable," for the assessment authors to use for calculating the OFLs based on the five-tier system.

For Tiers 1 through 4, once a stock is assigned to a tier, the stock status level is determined based on recent survey data and assessment models, as available. The stock status level determines the equation used in calculating the  $F_{OFL}$ . Three levels of stock status are specified and denoted by "a," "b," and "c" (see Table 6-1). The  $F_{MSY}$  control rule reduces the  $F_{OFL}$  as biomass declines by stock status level. At stock status level "a," current stock biomass exceeds the  $B_{MSY}$ . For stocks in status level "b," current biomass is less than  $B_{MSY}$  but greater than a level specified as the "critical biomass threshold" ( $\beta$ ).

Lastly, in stock status level "c," current biomass is below  $\beta * (B_{MSY}$  or a proxy for  $B_{MSY}$ ). At stock status level "c," directed fishing is prohibited and an  $F_{OFL}$  at or below  $F_{MSY}$  would be determined for all other sources of fishing mortality in the development of the rebuilding plan. The Council will develop a rebuilding plan once a stock level falls below the MSST.

For Tiers 1 through 3, the coefficient  $\alpha$  is set at a default value of 0.1, and  $\beta$  set at a default value of 0.25, with the understanding that the Scientific and Statistical Committee may recommend different values for a specific stock or stock complex as merited by the best available scientific information.

In Tier 4, a default value of natural mortality rate ( $M$ ) or an  $M$  proxy, and a scalar,  $\gamma$ , are used in the calculation of the  $F_{OFL}$ .

In Tier 5, the OFL is specified in terms of an average catch value over an historical time period, unless the Scientific and Statistical Committee recommends an alternative value based on the best available scientific information.

OFLs will be calculated by applying the  $F_{OFL}$  and using the most recent abundance estimates. The Crab Plan Team will review stock assessment documents, the most recent

abundance estimates, and the proposed OFLs. The Alaska Fisheries Science Center will set the OFLs consistent with this FMP and forward OFLs for each stock to the State of Alaska prior to its setting the total allowable catch or guideline harvest level for that stock's upcoming crab fishing season.

### Tiers 1 through 3

For Tiers 1 through 3, reliable estimates of  $B$ ,  $B_{MSY}$ , and  $F_{MSY}$ , or their respective proxy values, are available. Tiers 1 and 2 are for stocks with a reliable estimate of the spawner/recruit relationship, thereby enabling the estimation of the limit reference points  $B_{MSY}$  and  $F_{MSY}$ .

- Tier 1 is for stocks with assessment models in which the probability density function (pdf) of  $F_{MSY}$  is estimated.
- Tier 2 is for stocks with assessment models in which a reliable point estimate, but not the pdf, of  $F_{MSY}$  is made.
- Tier 3 is for stocks where reliable estimates of the spawner/recruit relationship are not available, but proxies for  $F_{MSY}$  and  $B_{MSY}$  can be estimated.

For Tier 3 stocks, maturity and other essential life-history information are available to estimate proxy limit reference points. For Tier 3, a designation of the form " $F_x$ " refers to the fishing mortality rate associated with an equilibrium level of fertilized egg production (or its proxy) per recruit equal to  $X\%$  of the equilibrium level in the absence of any fishing.

The OFL calculation accounts for all losses to the stock not attributable to natural mortality. The OFL is the total catch limit comprised of three catch components: (1) non-directed fishery discard losses; (2) directed fishery discard losses; and (3) directed fishery retained catch. To determine the discard losses, the handling mortality rate is multiplied by bycatch discards in each fishery. Overfishing would occur if, in any year, the sum of all three catch components exceeds the OFL.

### Tier 4

Tier 4 is for stocks where essential life-history, recruitment information, and understanding are lacking. Therefore, it is not possible to estimate the spawner-recruit relationship. However, there is sufficient information for simulation modeling that captures the essential population dynamics of the stock as well as the performance of the fisheries. The simulation modeling approach employed in the derivation of the annual OFLs captures the historical performance of the fisheries as seen in observer data from the early 1990s to present and thus borrows information from other stocks as necessary to estimate biological parameters such as  $\gamma$ .

In Tier 4, a default value of natural mortality rate ( $M$ ) or an  $M$  proxy, and a scalar,  $\gamma$ , are used in the calculation of the  $F_{OFL}$ . Explicit to Tier 4 are reliable estimates of current survey biomass and the instantaneous  $M$ . The proxy  $B_{MSY}$  is the average biomass over a

specified time period, with the understanding that the Council's Scientific and Statistical Committee may recommend a different value for a specific stock or stock complex as merited by the best available scientific information. A scalar,  $\gamma$ , is multiplied by  $M$  to estimate the  $F_{OFL}$  for stocks at status levels a and b, and  $\gamma$  is allowed to be less than or greater than unity. Use of the scalar  $\gamma$  is intended to allow adjustments in the overfishing definitions to account for differences in biomass measures. A default value of  $\gamma$  is set at 1.0, with the understanding that the Council's Scientific and Statistical Committee may recommend a different value for a specific stock or stock complex as merited by the best available scientific information.

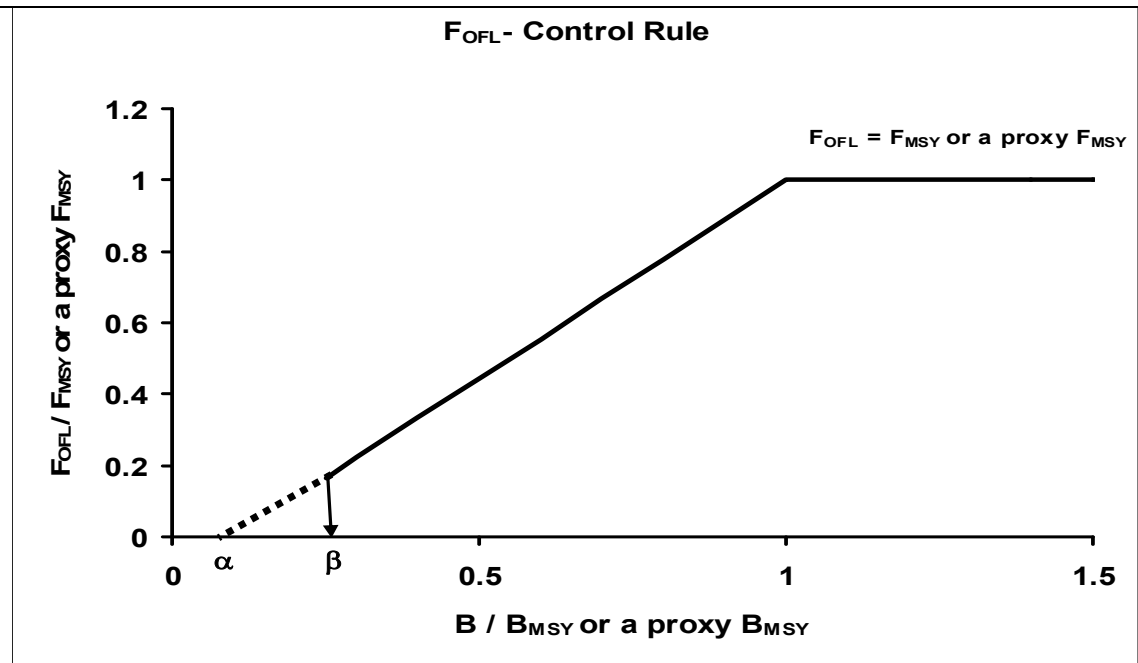
If the information necessary to determine total catch OFLs is not available for a Tier 4 stock, then the OFL is determined for retained catch. In the future, as information improves, data would be available for some stocks to allow the formulation and use of selectivity curves for the discard fisheries (directed and non-directed losses) as well as the directed fishery (retained catch) in the models. The resulting OFL from this approach, therefore, would be the total catch OFL.

#### Tier 5

Tier 5 stocks have no reliable estimates of biomass or  $M$  and only historical data of retained catch is available. For Tier 5 stocks, the historical performance of the fishery is used to set OFLs in terms of retained catch. The OFL represents the average retained catch from a time period determined to be representative of the production potential of the stock. The time period selected for computing the average catch, hence the OFL, would be based on the best scientific information available and provide the appropriate risk aversion for stock conservation and utilization goals. In Tier 5, the OFL is specified in terms of an average catch value over a time period determined to be representative of the production potential of the stock, unless the Scientific and Statistical Committee recommends an alternative value based on the best available scientific information.

For most Tier 5 stocks, only retained catch information is available so the OFL will be estimated for the retained catch portion only, with the corresponding overfishing comparison on the retained catch only. In the future, as information improves, the OFL calculation could include discard losses, at which point the OFL would be applied to the retained catch plus the discard losses from directed and non-directed fisheries.

Figure 6-1 Overfishing control rule for Tiers 1 through 4. Directed fishing mortality is 0 below  $\beta$ .



**Table 6-1 Five-Tier System for setting overfishing limits for crab stocks. The tiers are listed in descending order of information availability. Table 6-2 contains a guide for understanding the five-tier system.**

Information available	Tier	Stock status level	$F_{OFL}$
$B, B_{MSY}, F_{MSY}$ , and pdf of $F_{MSY}$	1	a. $\frac{B}{B_{msy}} > 1$	$F_{OFL} = \mu_A$ = arithmetic mean of the pdf
		b. $\beta < \frac{B}{B_{msy}} \leq 1$	$F_{OFL} = \mu_A \frac{B/B_{msy} - \alpha}{1 - \alpha}$
		c. $\frac{B}{B_{msy}} \leq \beta$	Directed fishery $F = 0$ $F_{OFL} \leq F_{MSY}^\dagger$
$B, B_{MSY}, F_{MSY}$	2	a. $\frac{B}{B_{msy}} > 1$	$F_{OFL} = F_{msy}$
		b. $\beta < \frac{B}{B_{msy}} \leq 1$	$F_{OFL} = F_{msy} \frac{B/B_{msy} - \alpha}{1 - \alpha}$
		c. $\frac{B}{B_{msy}} \leq \beta$	Directed fishery $F = 0$ $F_{OFL} \leq F_{MSY}^\dagger$
$B, F_{35\%}, B_{35\%}$	3	a. $\frac{B}{B_{35\%}^*} > 1$	$F_{OFL} = F_{35\%}^*$
		b. $\beta < \frac{B}{B_{35\%}^*} \leq 1$	$F_{OFL} = F_{35\%}^* \frac{B/B_{35\%}^* - \alpha}{1 - \alpha}$
		c. $\frac{B}{B_{35\%}^*} \leq \beta$	Directed fishery $F = 0$ $F_{OFL} \leq F_{MSY}^\dagger$
$B, M, B_{msy,prox}$	4	a. $\frac{B}{B_{msy,prox}} > 1$	$F_{OFL} = \gamma M$
		b. $\beta < \frac{B}{B_{msy,prox}} \leq 1$	$F_{OFL} = \gamma M \frac{B/B_{msy,prox} - \alpha}{1 - \alpha}$
		c. $\frac{B}{B_{msy,prox}} \leq \beta$	Directed fishery $F = 0$ $F_{OFL} \leq F_{MSY}^\dagger$
Stocks with no reliable estimates of biomass or M.	5		OFL = average catch from a time period to be determined, unless the SSC recommends an alternative value based on the best available scientific information.

\*35% is the default value unless the SSC recommends a different value based on the best available scientific information.

† An  $F_{OFL} \leq F_{MSY}$  will be determined in the development of the rebuilding plan for that stock.

**Table 6-2 A guide for understanding the five-tier system.**

<ul style="list-style-type: none"> <li>• <math>F_{OFL}</math> — the instantaneous fishing mortality (F) from the directed fishery that is used in the calculation of the overfishing limit (OFL). <math>F_{OFL}</math> is determined as a function of:             <ul style="list-style-type: none"> <li>○ <math>F_{MSY}</math> — the instantaneous F that will produce MSY at the MSY-producing biomass                 <ul style="list-style-type: none"> <li>▪ A proxy of <math>F_{MSY}</math> may be used; e.g., <math>F_{x\%}</math>, the instantaneous F that results in x% of the equilibrium spawning per recruit relative to the unfished value</li> </ul> </li> <li>○ B — a measure of the productive capacity of the stock, such as spawning biomass or fertilized egg production.                 <ul style="list-style-type: none"> <li>▪ A proxy of B may be used; e.g., mature male biomass</li> </ul> </li> <li>○ <math>B_{MSY}</math> — the value of B at the MSY-producing level                 <ul style="list-style-type: none"> <li>▪ A proxy of <math>B_{MSY}</math> may be used; e.g., mature male biomass at the MSY-producing level</li> </ul> </li> <li>○ <math>\beta</math> — a parameter with restriction that <math>0 \leq \beta &lt; 1</math>.</li> <li>○ <math>\alpha</math> — a parameter with restriction that <math>0 \leq \alpha \leq \beta</math>.</li> </ul> </li> <li>• The maximum value of <math>F_{OFL}</math> is <math>F_{MSY}</math>. <math>F_{OFL} = F_{MSY}</math> when <math>B &gt; B_{MSY}</math>.</li> <li>• <math>F_{OFL}</math> decreases linearly from <math>F_{MSY}</math> to <math>F_{MSY} \cdot (\beta - \alpha) / (1 - \alpha)</math> as B decreases from <math>B_{MSY}</math> to <math>\beta \cdot B_{MSY}</math></li> <li>• When <math>B \leq \beta \cdot B_{MSY}</math>, <math>F = 0</math> for the directed fishery and <math>F_{OFL} \leq F_{MSY}</math> for the non-directed fisheries, which will be determined in the development of the rebuilding plan.</li> <li>• The parameter, <math>\beta</math>, determines the threshold level of B at or below which directed fishing is prohibited.</li> <li>• The parameter, <math>\alpha</math>, determines the value of <math>F_{OFL}</math> when B decreases to <math>\beta \cdot B_{MSY}</math> and the rate at which <math>F_{OFL}</math> decreases with decreasing values of B when <math>\beta \cdot B_{MSY} &lt; B \leq B_{MSY}</math>.             <ul style="list-style-type: none"> <li>○ Larger values of <math>\alpha</math> result in a smaller value of <math>F_{OFL}</math> when B decreases to <math>\beta \cdot B_{MSY}</math>.</li> <li>○ Larger values of <math>\alpha</math> result in <math>F_{OFL}</math> decreasing at a higher rate with decreasing values of B when <math>\beta \cdot B_{MSY} &lt; B \leq B_{MSY}</math>.</li> </ul> </li> </ul>
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**(4) Modify sections 8.1.5, 8.3.5. and 8.3.7 to remove references to grooved Tanner crab, St. Matthew golden king crab, AI Tanner crab, St. Lawrence Island blue king crab, scarlet king crab, triangle Tanner crab, and Dutch Harbor red king crab, to read:**

8.1.5 Superexclusive Registration in Norton Sound

This FMP establishes the Norton Sound Section of the Northern District of the king crab fishery as a superexclusive registration area. Any vessel registered and participating in this fishery would not be able to participate in other BSAI red and blue king crab fisheries, such as Adak, Bristol Bay, ~~Dutch Harbor~~, Pribilof, ~~St. Lawrence~~, or St.



Matthew, during that registration year. The Norton Sound fishery is the only superexclusive registration area authorized by this FMP.

### 8.3.5 Gear Modifications

The FMP defers design specifications required for commercial crab pots and ring nets to the State. Pots and ring nets are the specified legal commercial gear for capturing crab in the BS/AI area (see Section 8.1.1). Multiple pots attached to a ground line are currently allowed by the State in the brown (golden) king crab; ~~scarlet king crab (*Lithodes couesi*); grooved Tanner crab (*C. tanneri*); and triangle Tanner crab (*C. angulatus*)~~ fisheries. Various devices may be added to pots to prevent capture of other species; to minimize king crab bycatch, the State currently requires tunnel-eye heights to not exceed 3 inches in pots fishing for *C. bairdi* or *C. opilio* in the Bering Sea. Escape mechanisms may be incorporated or mesh size adjusted to allow female and sublegal male crab to escape; the State currently specifies escape rings or mesh panels in regulation for pots used in the BS/AI *C. bairdi*, *C. opilio*, and brown (golden) king crab fisheries, in the Bristol Bay king crab fishery, and in the Pribilof District king crab fishery. State regulations also currently require incorporation of biodegradable twine as an escape mechanism on all pots which will terminate a pot's catching and holding ability in case the pot is lost.

### 8.3.7 State Observer Requirements

The FMP defers the State Observer requirements to the State. The State may place observers aboard crab fishing and/or processing vessels when the State finds that observers provide the only practical mechanism to obtain essential biological and management data or when observers provide the only effective means to enforce regulations. Data collected by onboard observers in crab fisheries include effort data and data on the species, sex, size, and shell-age/shell-hardness composition of the catch. The State currently requires onboard observers on all catcher/processor or floating-processor vessels processing king or Tanner crab and on all vessels participating in the Aleutian Islands red or brown (golden) king crab fisheries. ~~The State currently may require observers as part of a permit requirement for any vessel participating in the scarlet king crab (*Lithodes couesi*), grooved Tanner crab (*C. tanneri*), or triangle Tanner crab (*C. angulatus*) fisheries.~~ The State currently may require observers on selected catcher vessels taking red or blue king crab in the Norton Sound section, if ADF&G provides funding for the observer presence. ~~The State currently may require observers on vessels taking red or blue king crab in the St. Lawrence Island Section.~~ The State may also require onboard observers in other crab fisheries (e.g., the Pribilof Islands Korean hair crab, *Erimacrus isenbeckii*, fishery) to, in part, monitor bycatch of king or Tanner crab. Observers provide data on the amount and type of bycatch occurring in each observed fishery and estimates of bycatch by species, sex, size, and shell-age/shell-hardness for each observed fishery are currently provided in annual reports by ADF&G.

**(5) Revise Appendix E Description of the Fisheries and Stocks to remove references to grooved Tanner crab, St. Matthew golden king crab, Aleutian Islands Tanner**

**crab, St. Lawrence Island blue king crab, scarlet king crab, triangle Tanner crab,  
and Dutch Harbor red king crab.**

Harrington

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