

8. Aleutian Islands Golden King Crab

Fishery information relative to OFL setting

During the 2023/24 fishery, the estimated retained catch was 2.578 kt (5.7 million lb), while the estimated total catch mortality was 2.755 kt (6.1 million lb). At the time of the 2023/24 assessment, the groundfish fisheries had not been completed, so total catch mortality is an estimate, and the total fishery mortality will be updated in September 2024.

Data and assessment methodology

The assessment for AI golden king crab establishes a single OFL and ABC for the whole stock. However, separate models are evaluated for the EAG and the WAG owing to, *inter alia*, different abundance trends in each area. A Tier 3 modeling framework for AI golden king crab based on fisheries-only data was developed over several years starting in 2011 with model assumptions and data inputs refined by reviews by the SSC and CPT. This modeling framework was recommended for the assessment by the CPT in September 2016 and approved by the SSC in October 2016. The CPT endorsed, and the SSC subsequently approved, the GMACS model for this stock in January 2023, and GMACS formed the basis for the 2023 and the current assessment.

The model-based stock assessment involves fitting a male-only population dynamics model to data on catches and discards in the directed fishery, discards in the groundfish fishery, standardized indices of abundance based on observer and fish ticket data, length-frequency data for the directed fishery (landings and total catch), and mark-recapture data. The groundfish fisheries in both areas were still operating when the assessment was conducted, but the difference in total catch mortality from that in the assessment is likely to be low. A cooperative survey was conducted by the Aleutian King Crab Research Foundation (an industry group) and ADF&G during the fishery in the EAG since 2016, and in the WAG during 2018 only. Indices based on the cooperative survey are not included in the current assessment.

The assessment author examined three models for the EAG and WAG this assessment cycle. Model 23.0a was the 2023 assessment model with updated catch and size-composition time series, and a CPUE index based on fitting GAMs. This model included three catchability periods, knife-edge male maturity size at 116 mm CL, M set to 0.22 yr^{-1} , a fixed period (1987–2020; updated from 1987–2017 for the 2023 assessment) for reference points calculation. Model 23.1 was model 23.0a with truncated size-composition data, i.e. excluding data for crab ≤ 100 mm carapace length, and Model 23.1b was the same as Model 23.1, except there are two selectivity periods during the pre-rationalized period (1985–1996; 1997–2004).

For the EAG, the three models provided very similar results. All three fit the retained catch, total catch, and groundfish bycatch data well. Otherwise, the three models fit the catch data almost identically. All three models also fit the standardized CPUE indices similarly, but the overall fits were poor. The fits to the retained catch and total catch size compositions were good, except that model 23.0a did not fit the data for the smallest size bin for total catch prior to 2005/06, where the model substantially underestimated the relative abundance. This was the reason for the development of model 23.1 which excludes the data for crab smaller than the lower limit of the smallest size bin in the model.

For the WAG, all three models fit the respective catch data and standardized CPUE indices equally well and produced similar estimates for the recruitment and MMB time series. The models followed the trends in standardized CPUE much better than the EAG models. However, the issue with the high relative abundances of small crab in the total catch size compositions was also evident in the data for model 23.0a.

The author-preferred models were 23.1 for both areas.

Stock biomass and recruitment trends

Estimated mature male biomass (MMB) for the EAG decreased from the 1980s to the 1990s, then increased during the 2000s, decreased marginally during the early 2010s, increased from 2014 to 2022 and declined slightly in 2023. Estimated MMB for the WAG decreased substantially during the late 1980s and 1990s, increased somewhat during the 2000s, decreased for several years after 2008 and has since declined steadily to a low in 2021 followed by slight increase since 2022. Recruitment to the EAG has declined from a high in 2017 to low but stable recruitment since 2021. Recruitment to the WAG has declined slowly since 1985, although 2023 recruitment is the highest since 2013.

Summary of major changes

The assessment model recommended by the CPT, Model 23.1, is identical to the model used in the previous assessment, except that it is based on revised (and new) catch and CPUE time-series and excludes the size-composition data for crab smaller than the lower limit of the first size bin the model. Model 23.1b fits the data better than Model 23.1, but the CPT agreed that the same model should be used for both the EAG and WAG; the differences in results between models 23.1 and 23.1b are minimal and ongoing work may lead to a changed model structure.

Tier determination/Plan Team discussion and resulting OFL and ABC determination

The CPT recommends that this stock be managed as a Tier 3 stock in 2024/25. A single OFL and ABC is defined for AIGKC. However, separate models are available by area. During its May 2017 meeting, the CPT recommended that stock status be determined by adding the area-specific estimates of current MMB and B_{MSY} to ensure that there would only be one stock status for the AIGKC stock. However, area-specific stock status is used to determine the ratio of F_{OFL} to $F_{35\%}$ by area, which is then used to calculate the OFLs by area, which are then summed to calculate an OFL for the entire stock. The SSC has concurred with this approach. The CPT recommends that the B_{MSY} proxy for the Tier 3 harvest control rule be based on the average recruitment from 1987-2020, years for which recruitment estimates are relatively precise.

This is the only crab assessment that relies solely on fishery CPUE as an index of abundance. The CPUE index standardization process, subject to past CPT and SSC review, is a key reason for the 25% buffer between the OFL and the ABC used in past years. Concerns raised in recent assessments are summarized in the following table:

Concern	year expressed	CPT 2024 concern?	Reason
Only crab assessment that relies entirely on fishery CPUE as an index of abundance	2020	Yes	No change.
Uncertainty in natural mortality	2020	Yes	No change.
The limited spatial coverage of the fishery with respect to the total stock distribution	2020	Yes	No change.
The small number of vessels on which CPUE is based	2020	Yes	No change.

Retrospective pattern for the EAG	2020	Yes	No change
CPUE standardization is still subject to some methodological concerns	2020	Less	The data on which the standardization is based have been checked and improved diagnostics are now available.
Catches from the WAG that were not included in the assessment	2021	Less	Only the total catch was not final at the time of the assessment
Model convergence concerns reflecting potential parameter confounding (jitter analysis resulted in multiple solutions for MMB and $B_{35\%}$ at same likelihood values)	2024	Yes	Some of the models converged to implausible but better fits to the data, which should be explored in future work.
Model does not fit the trend in the index for the EAG.	2024	Yes	The fit to the standardized CPUE index for the EAG remains poor – the retrospective pattern observed for the EAG is likely related to this poor fit.

The SSC adopted a 30% buffer for the ABC in 2021/22 based primarily on concerns raised by a jitter analysis that suggested the model may be converging to local minima, exhibiting multiple values for reference points associated with a single value for the likelihood. In 2022/23, the CPT recommended, and the SSC concurred with, reducing the buffer for the ABC back to 25%, its value before 2021/22, principally because no problems of this sort occurred for the 2022 recommended models and the CPT found reasons to reduce or eliminate several other concerns. For 2023/24 and 2024/25, the CPT found that several previously expressed concerns continued to exist, the principal one being the retrospective patterns for the recommended EAG model. Thus, the CPT recommends continuing to use a 25% buffer, its value last year, on the OFL for the ABC.

Status and catch specifications (1000 t) for Aleutian Islands golden king crab. Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2020/21	6.026	16.207	2.999	3.000	3.444	4.798	3.599
2021/22	5.859	12.592	2.690	2.699	3.056	4.817	3.372
2022/23	5.832	13.600	2.291	2.369	2.612	3.761	2.821
2023/24	5.772	12.716	2,508	2,578	TBA ^a	4.182	3.137
2024/25		11.388				3,725	2,794

Status and catch specifications (million lb) for Aleutian Islands golden king crab. Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2020/21	13.284	35.730	6.610	6.614	7.593	10.579	7.934
2021/22	12.917	27.760	5.930	5.951	6.737	10.620	7.434
2022/23	12.857	29.984	5.051	5.223	5.758	8.291	6.219
2023/24	12.725	28.034	5.530	5,684	TBA ^a	9.220	6.916
2024/25		25,107				8.212	6.159

^a The groundfish fisheries were still being prosecuted when the 2024 assessment was conducted. At the time the assessment was conducted, the total catch was 2,755 kt (6.1 million lb).

The total fishery mortality in 2023/24 will be updated in September 2024.