8   *Aleutian Islands Golden King Crab*

Fishery information relative to OFL setting

The directed fishery has been prosecuted annually since the 1981/82 season. Retained catch peaked in 1986/87 at 14.7 million lb and averaged 11.9 million lb over the 1985/86-1989/90 seasons. Average harvests dropped sharply from 1989/90 to 1990/91 to a level of 6.9 million lb for the period 1990/91–1995/96. Management based on a formally established GHL began with the 1996/97 season. The 5.9 million lb GHL established for the 1996/97 season, which was based on the previous five-year average catch, was subsequently reduced to 5.7 million lb beginning in 1998/99. The GHL (or TAC, since 2005/06) remained at 5.700 million lb for 2007/08, but was increased to 5.985 million lb for the 2008/09-2011/12 seasons, and to 6.290 million lb starting with the 2012/13 season. The TAC was reduced to 5.545 million lb for the 2016/17 season. This fishery is rationalized under the Crab Rationalization Program.

Total mortality of AI golden king crab includes retained catch in the directed fishery, mortality of discarded catch, and bycatch in fixed-gear and trawl groundfish fisheries, though bycatch in other fisheries is low compared to mortality in the directed fishery. Retained catch in the post-rationalized fishery (2005/06-2016/17) has ranged from 5.245 million lb in 2006/07 to 6.379 million lb in 2013/14. Total mortality ranged from 5.427 to 6.803 million lb for the same period.

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 EAG and WAG owing to different abundance trends in each area. A modeling framework for AI golden king crab was under development for a number of years, with model assumptions and data inputs refined by reviews by the SSC and CPT. The modeling framework was recommended by the CPT in September 2016 and approved by the SSC in October 2016 for use in the 2017/18 specifications cycle.

The model-based stock assessment involves fitting male-only population dynamics models to data on catches and discards in the directed fishery, discards in the groundfish fishery, standardized indices of abundance based on observer data, fish ticket CPUE data, length-frequency data for the directed fishery (landing and total catch), and mark-recapture data. These data are available through the 2016/17 season.

The assessment author examined seven model scenarios for EAG and six model scenarios for WAG in this assessment. Model 17_0 is the base model, which is the model for last year updated with new data. Model 17_0a used an abundance index from a VAST analysis of CPUE data rather than the standard GLM approach. Model 17_0b used an abundance index from a GLM analysis that uses AIC rather than r^2 for model selection. Model 17_0c used an abundance index from a GLM analysis that includes year-area interaction terms in the CPUE analysis. Model 17_0d added a third catchability and selectivity period for 2013-2016. Model 17_0e used the McAllister and Ianelli method for tuning the length composition data rather than the Francis method. Model 17_0f included first two years' index from a GLM analysis of the three years of collaborative pot survey data. This index was only evaluated in the EAG model because the survey is conducted only in EAG.

The CPT identified technical issues with each of the new model scenarios that would prevent them from being used for management advice. It is important to note that several of the model scenarios show promise and could potentially be used after additional development and review. The CPT recommends adopting the base model 17_0 for harvest projections.

This is the only crab assessment that relies solely on fishery CPUE as an index of abundance, with the CPUE index standardization process subject to past CPT and SSC review. The CPT recommended that the

model be used to provide management reference points based on the Tier 3 control rule in January 2017 and this tier recommendation was endorsed by the SSC in February 2017.

An industry-ADF&G collaborative survey has been conducted for this stock during 2015-2017. A preliminary model using the first two years' index from this survey was evaluated in the assessment, however additional index development is needed before this model is suitable to provide management advice.

Stock biomass and recruitment trends

Estimated mature male biomass (MMB) for the EAG decreased from high levels until the 1990s after which the trend has been increasing. In contrast, the MMB for WAG increased from a low in the 1990s until 2007/08 and then declined again. There has been a slight increase in MMB in WAG in the last several years. Recruitment for the EAG is variable with a generally increasing trend while recruitment for WAG is lower in recent years than during the 1980s. However, recruitment in 2015 for WAG appears to be relatively strong. Stock trends reflected the fishery standardized CPUE trends in both areas.

Summary of major changes

The assessment model recommended by CPT is the same as the model used in the previous assessment. There were minor changes in the CPUE standardization and maturity breakpoint analysis that had negligible effects on assessment results.

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 2018/19. A single OFL and ABC is defined for AIGKC. However, separate models are available by area. The CPT recommends that stock status be determined by adding the estimates of current MMB and B_{MSY} by area. This stock status is then 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 added together to calculate an OFL for the entire stock. The SSC has concurred with this approach. The stock is currently estimated to be above B_{MSY} in both areas therefore no adjustment is needed to the F_{OFL} to determine the combined OFL for both areas.

The CPT recommends that the B_{MSY}proxy for the Tier 3 harvest control rule be based on the average recruitment from 1987-2012, years for which recruitment is relatively precisely estimated.

Status and catch specifications (1000 t) of Aleutian Islands golden king crab.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch[a]	OFL	ABC
2014/15	N/A	N/A	2.853	2.771	2.967	5.69	4.26
2015/16	N/A	N/A	2.853	2.729	2.964	5.69	4.26
2016/17	N/A	N/A	2.515	2.593	2.829	5.69	4.26
2017/18	6.044	14.205	2.515	NA	NA	6.048	4.536
2018/19	6.046	17.952				5.514	4.136

   a. Total retained catch plus estimated bycatch mortality of discarded bycatch during crab fisheries and groundfish fisheries.

Status and catch specifications (million lb) of Aleutian Islands golden king crab.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch[a]	OFL	ABC
2014/15	N/A	N/A	6.290	6.11	6.54	12.53	9.40
2015/16	N/A	N/A	6.290	6.016	6.54	12.53	9.40
2016/17	N/A	N/A	5.545	5.716	6.24	12.53	9.40
2017/18	13.325	31.315	5.545	NA	NA	13.33	10.00
2018/19	13.329	39.577				12.16	9.12

   a. Total retained catch plus estimated bycatch mortality of discarded bycatch during crab fisheries and groundfish fisheries.

Overfishing for the 2017/18 season will be assessed in September 2018.

Additional Plan Team recommendations

The CPT recommended additional assessment work in a number of areas. Additional development is needed for CPUE standardization, including consideration of year-area interactions, and continued development of the VAST spatial modeling approach. The chela measurement data should be reanalyzed to better estimate the maturity of AI golden king crab. Improvements are needed in the method used to project the OFL and ABC for the upcoming fishing year. Finally, additional work is needed to obtain an index using the cooperative pot survey data for use in the EAG assessment model.