Aleutian Islands Golden King Crab Model Scenarios for May 2023 Assessment

M.S.M. Siddeek[1], T. Jackson[2] , B. Daly[2], C. Siddon[1], M.J. Westphal[3], and L. Hulbert[1]

Alaska Department of Fish and Game, Juneau[1], Kodiak[2], and Dutch Harbor[3], Alaska

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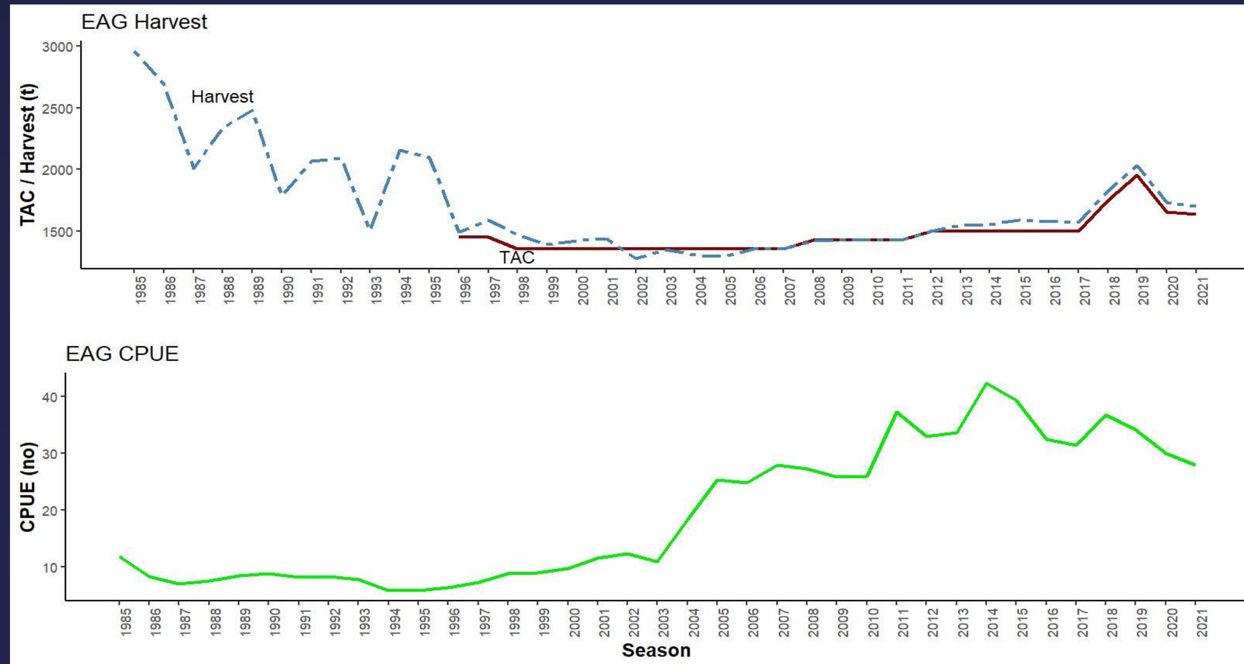
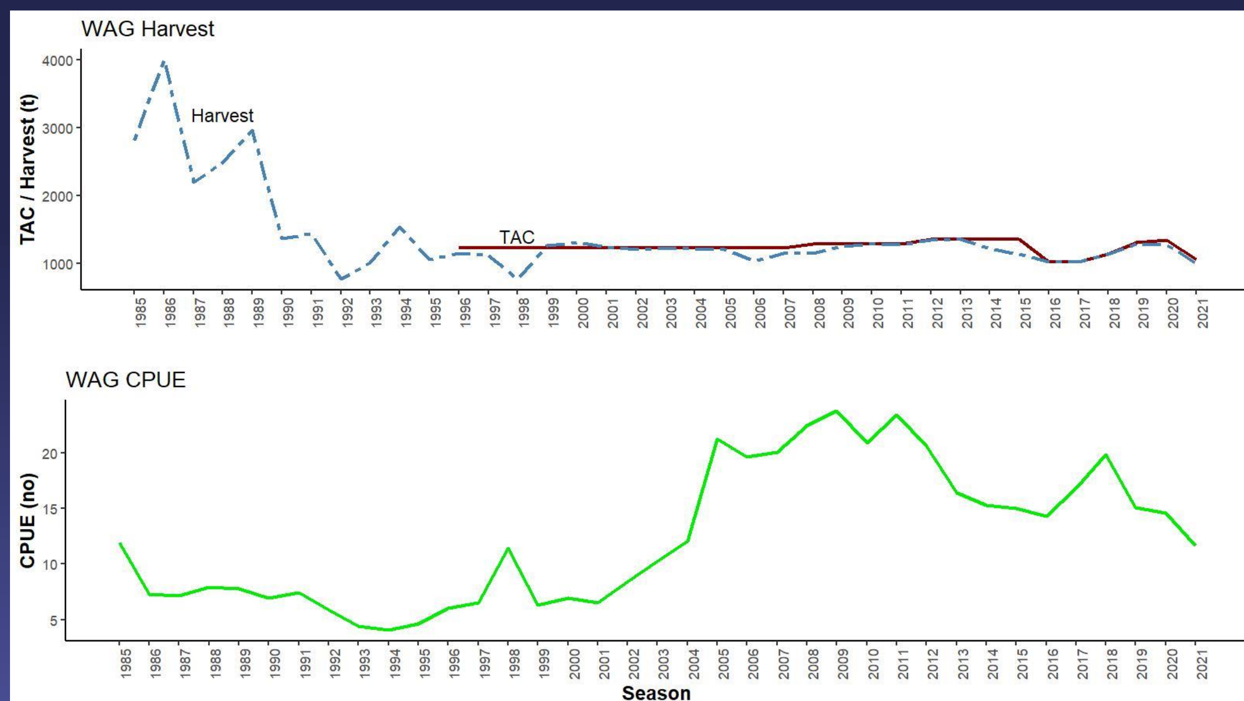
Catch (t) and CPUE (number of crab per pot lift), 1985/86–2021/22

EAG



WAG



TACs :
2021/22:
(1) EAG: 3.61 million lbs
(2) WAG: 2.32 million lbs

Selected May 2022 CPT comments

- Comment 2: Continue work to obtain an index using the cooperative pot survey data for use in the EAG assessment model.

Response:

Done. See Appendix C.

Comment 3: Identify and eliminate the conflict between the model and the data giving rise to the retrospective patterns for EAG models.

Response:

Models with variable catchability (see response 4), removal of some years' (above 2014) size composition data, and weighting CPUE likelihoods reduced the MMB retrospective patterns in the EAG (Figures Resp.1 and Resp.2).

Better CPUE fits were obtained for models with removal of some years' size composition data and CPUE likelihood weighting.

Fig. Resp1

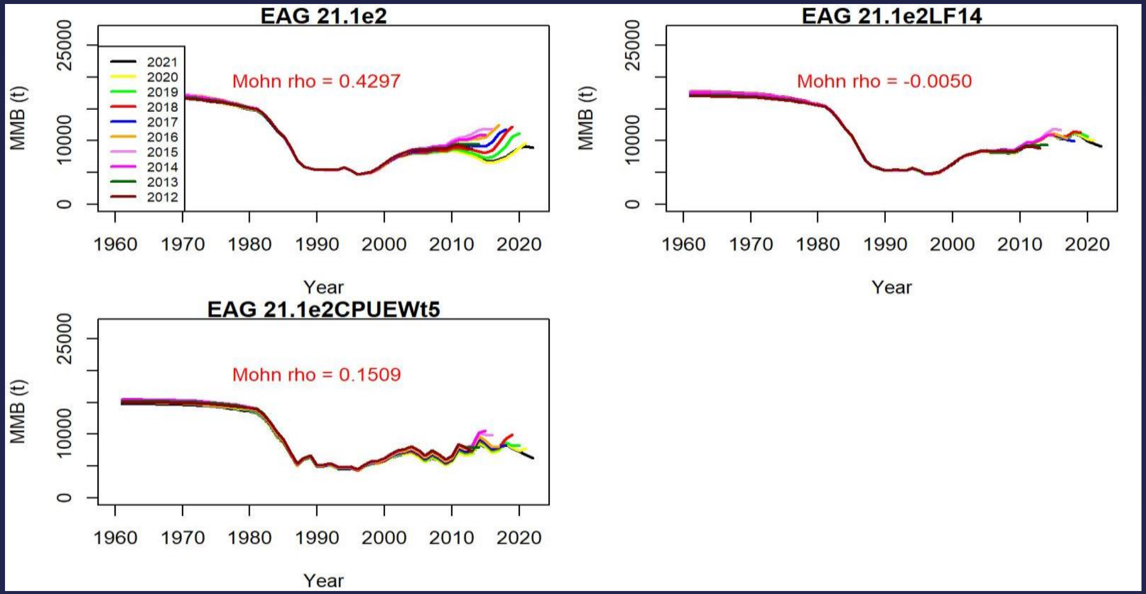
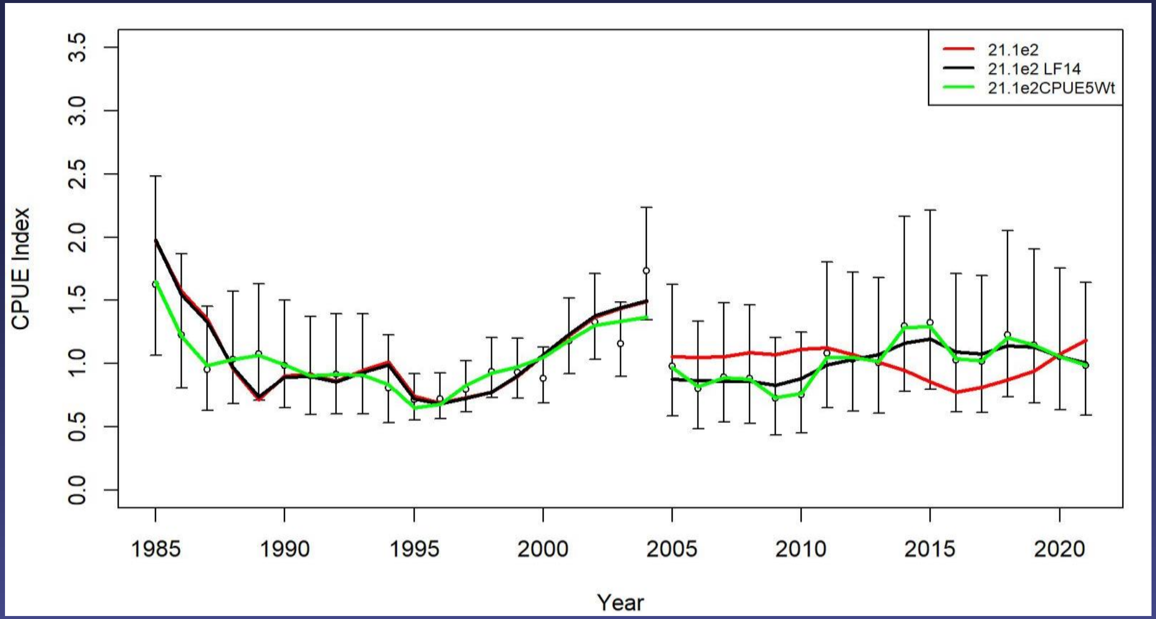


Fig. Resp2



May 2022 CPT comments continued

- Comment 4: Revisit the analysis considering a model with time-varying catchability but impose a penalty on the devs to allow the index data to inform the model.

Response:

To address this question, we formulated the following time varying catchability sub-model for the post-rationalization period and fitted this sub-model (21.1e2Q):

$$Q_t = \bar{Q} e^{\sigma e_t - \frac{\sigma^2}{2}}$$

The variable catchability model reduced the EAG retrospective pattern with a low Mohn rho value (see Figure Resp.3).

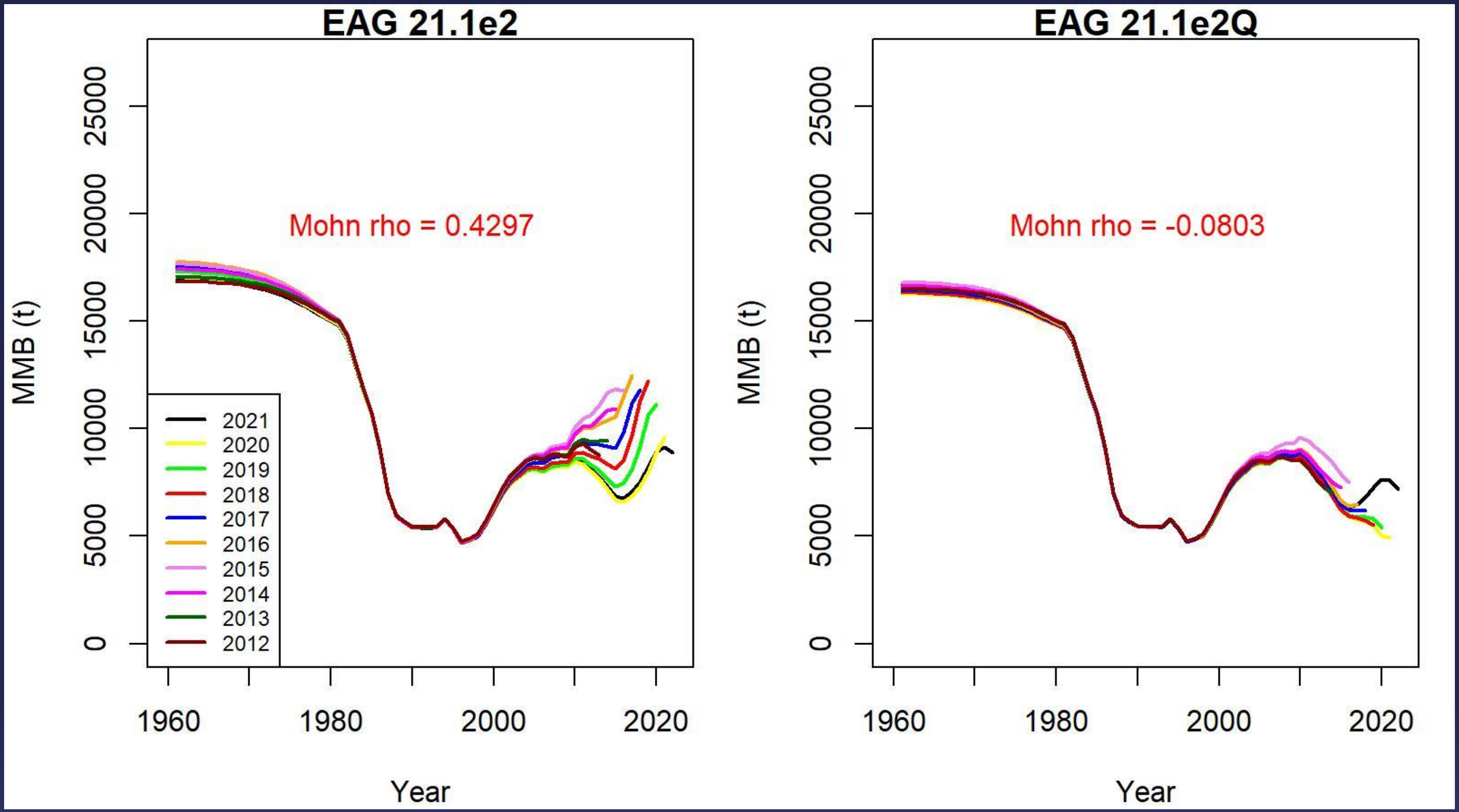


Fig. Resp3. Retrospective fits of MMB following systematic nine peels of terminal year data under models 21.1e2 (base three constant catchability model) and 21.1e2Q (time varying catchability model) for golden king crab in EAG, 1961–2022.

May 2022 CPT comments continued

- Comment 7: Perform retrospective analyses for all models that have the potential to serve as the basis for calculating reference points.

Response:

Retrospective plots of all models for EAG and WAG that have the potential to serve as the basis for calculating reference points are shown in Figures Resp.6 and Resp.7. Removal of some years' size composition data has vastly reduced the retrospective pattern with lower values of Mohn rho for EAG but not so much for WAG.

Fig. Resp6.
EAG

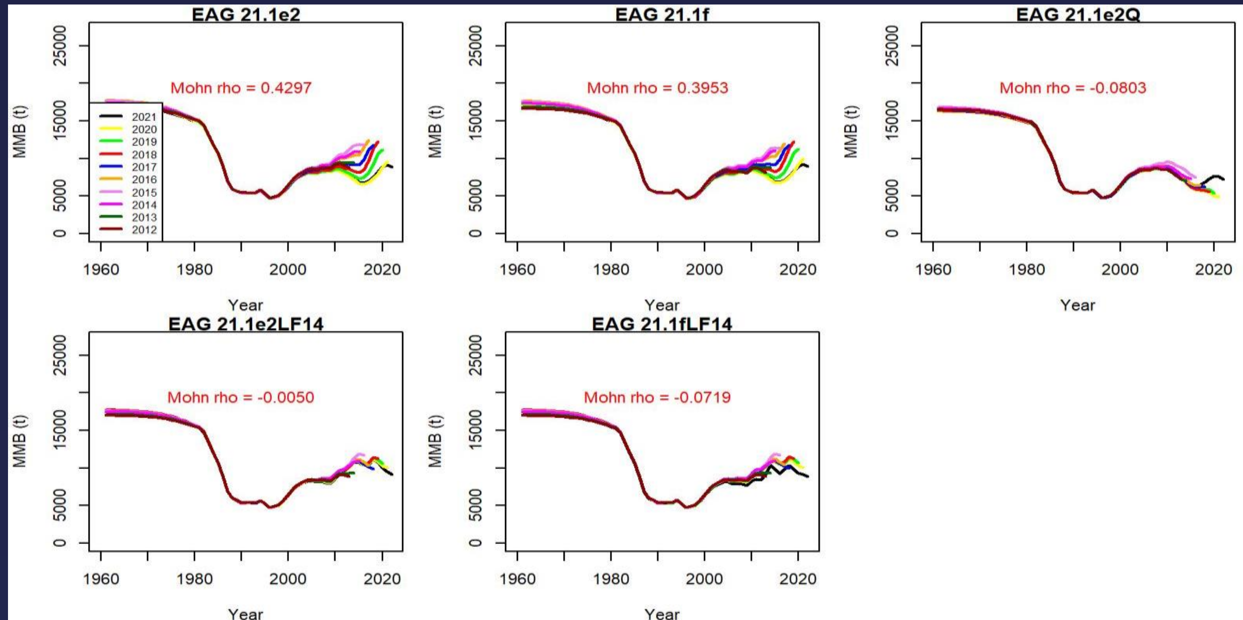
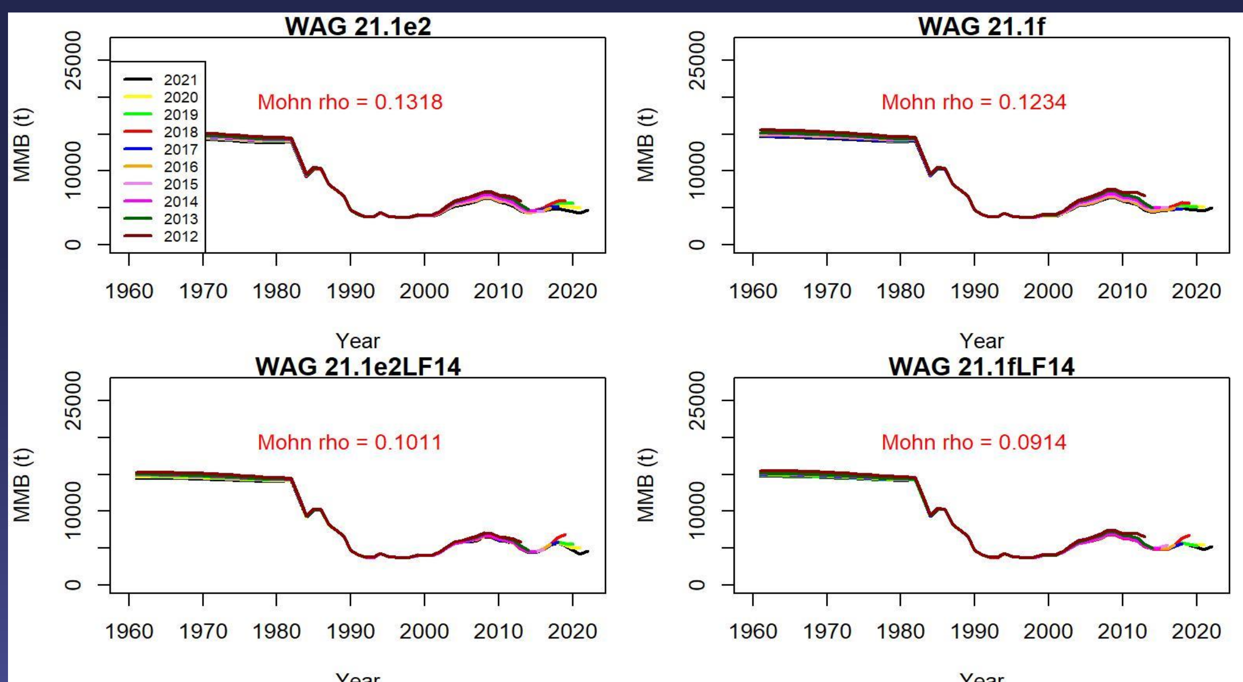


Fig. Resp7
WAG



May 2022 CPT comments continued

Comment 8: Calculate reference points using both combined-area and area-specific size-at-maturity values.

Response:

Table Resp.2 lists the reference points estimated at combined-area and area-specific knife-edge size at maturity. First row values are reference points estimated at the common knife-edge maturity size of 116 mm CL (combined area estimate), whereas the second-row values are those estimated at area specific maturity sizes.

EAG

Model	Tier	$MMB_{35\%}$	Current MMB	MMB/ $MMB_{35\%}$	F_{OFL}	$F_{35\%}$	M(yr^{-1})	OFL	MaxABC (P*=0.49)	ABC (0.75*OFL)
21.1e2 Maturity 116	3a	6,524	7,545	1.16	0.56	0.56	0.22	2,898	2,884	2,174
21.1e2 Maturity 111	3a	6,747	7,824	1.16	0.64	0.64	0.22	3,213	3,198	2,410

WAG

Model	Tier	$MMB_{35\%}$	Current MMB	MMB/ $MMB_{35\%}$	F_{OFL}	$F_{35\%}$	M(yr^{-1})	OFL	MaxABC (P*=0.49)	ABC (0.75*OFL)
21.1e2 Maturity 116	3a	4,905	4,911	1.00	0.54	0.54	0.22	1,340	1,335	1,005
21.1e2 Maturity 121	3b	4,717	4,526	0.96	0.45	0.47	0.22	1,152	1,145	864

AI

Model	M(yr^{-1})	OFL	MaxABC (P*=0.49)	ABC (0.75*OFL)
21.1e2 Maturity 116	0.22	4,238	4,219	3,179
21.1e2 Maturity EAG 111, WAG 121	0.22	4,410	4,391	3,307

May 2022 CPT comments continued

- Comment 9: Perform a retrospective analysis on the ability to predict year-end CPUE prior to the end of the season.

Response:

*Total Catch = Nominal Total CPUE * Effort.*

For an incomplete fishery (2020/21 and 2021/22), end of season total effort was predicted by dividing the TAC by the current retained CPUE to determine total catch.

CPT/SSC suggested to do a retrospective analysis to predict year-end nominal total CPUE prior to end of the season to improve total catch prediction capability. We used an exponential CPUE prediction model to address this issue:

$$CPUE_y = [a * e^{-b * f_y}]\, e^{\sigma e_t - \frac{\sigma^2}{2}}$$

To predict year-end CPUE and use it for year y+1 CPUE, the model was fitted with CPUE and fishing effort for completed fishing seasons, 1990 to year y. The estimated parameters were used to predict the CPUE as year-end CPUE (see Table Resp.3).

Table Resp3. Fishing effort and predicted year-end CPUE for 2016/17–2021/22 and estimated total catch for incomplete and complete fishing seasons, 2020/21–2021/22.

	Incomplete Fishery			Completed Fishery		
Terminal Season	Previous Season Incomplete Effort	Predicted Year-end Nominal Total CPUE	Estimated Total Catch	Total Effort	Nominal Total CPUE	Estimated Total Catch
2016/17		26.3572			24.2900	
2017/18		26.6218			25.5289	
2018/19		27.4734			30.6098	
2019/20		27.9075			22.7350	
2020/21	38,733	25.9151	1,003,768	46,701	22.7917	1,064,397
2021/22	37,478	25.3407	949,718	46,161	20.9729	968,132

May 2022 CPT comments continued

- Comment 10: Re-evaluate the time frame over which to calculate mean recruitment every year.

Response:

Years selected to calculate mean recruitment for reference points estimation and equilibrium initialization for model simulation are the same. So, the change in the selected time for mean recruitment calculation did not affect the MMB time series (1960–2021) or OFL but slightly changed the $MMB_{35\%}$ estimates for EAG and WAG, respectively (Table Resp4)

Table Resp4. Estimates of reference points for the base model, 21.1e2, for different mean recruitment calculation periods. Biomass and OFL are in t. Current MMB = MMB in 2022.

EAG

Years Selected for Mean R	Tier	$MMB_{35\%}$	Current MMB	MMB/ $MMB_{35\%}$	F_{OFL}	$F_{35\%}$	M(yr^{-1})	OFL
1987–2017 (status quo)	3a	6,524	7,545	1.16	0.56	0.56	0.22	2,898
1987–2018	3a	6,649	7,545	1.13	0.56	0.56	0.22	2,898
1987–2019	3a	6,659	7,545	1.13	0.56	0.56	0.22	2,898
1987–2020	3a	6,630	7,545	1.14	0.56	0.56	0.22	2,898

WAG

Years Selected for Mean R	Tier	$MMB_{35\%}$	Current MMB	MMB/ $MMB_{35\%}$	F_{OFL}	$F_{35\%}$	M(yr^{-1})	OFL
1987–2017 (status quo)	3a	4,905	4,911	1.00	0.54	0.54	0.22	1,340
1987–2018	3a	4,888	4,911	1.00	0.54	0.54	0.22	1,340
1987–2019	3a	4,868	4,911	1.01	0.54	0.54	0.22	1,340
1987–2020	3a	4,879	4,911	1.01	0.54	0.54	0.22	1,340

May 2022 CPT comments continued

- Comment 11: Compare biomass trends from the RACE AI survey and the standardized assessment CPUE.

Response:

Compared the RACE survey abundance index with the fishery (observer) CPUE index separately for EAG and WAG (Figure Resp.9).

For this comparison, each year's RACE survey total abundance estimate was standardized by dividing by the geometric mean of the survey abundance estimates for 1986 to 2018.

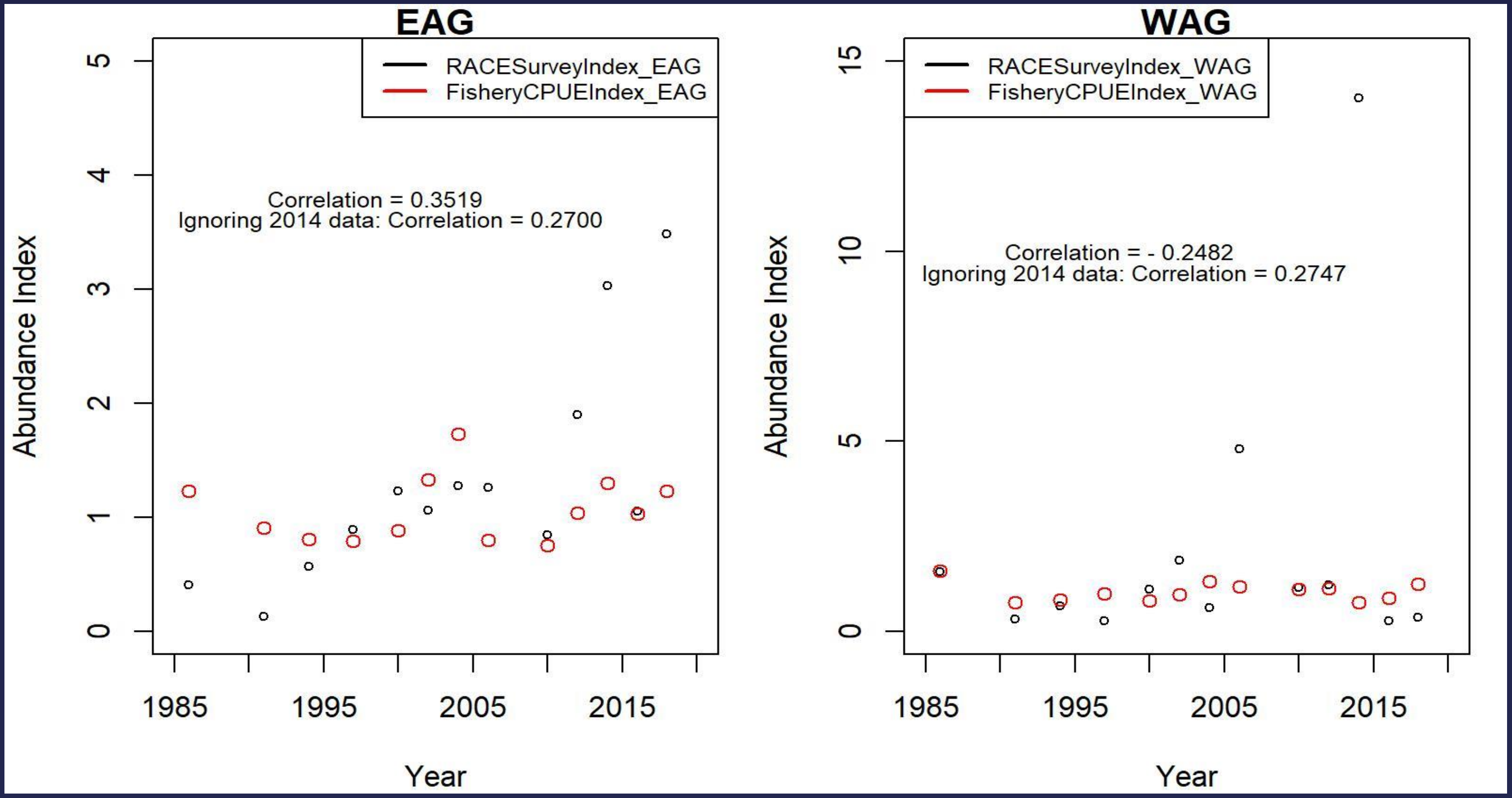


Fig. Resp9. Comparison of Race survey index and fishery CPUE index for EAG (left) and WAG (right), 1986 to 2018. The 2014 survey index for WAG appears to be an outlier and correlation coefficients with and without this data point are provided in the plots.

May 2022 CPT comments continued

Comment 12: Develop a single-area model

Response:
Table Resp. 5 and Figure Resp. 10 provide estimates of reference points and MMB retrospective fits for AI.

Table Resp5. Estimates of reference points for AI: Biomass and OFL are in t. Current MMB = MMB in 2022.

Model	Tier	$MMB_{35\%}$	Current MMB	MMB/ $MMB_{35\%}$	F_{OFL}	$F_{35\%}$	M(yr^{-1})	OFL
21.1e2	3a	11,363	12,521	1.10	0.55	0.55	0.22	4,244
21.1f	3a	11,740	16,707	1.42	0.54	0.54	0.22	6,206
21.1e2 LF14	3a	12,208	14,424	1.18	0.54	0.54	0.22	5,212
21.1f LF14	3a	12,800	20,008	1.56	0.53	0.53	0.22	8,457

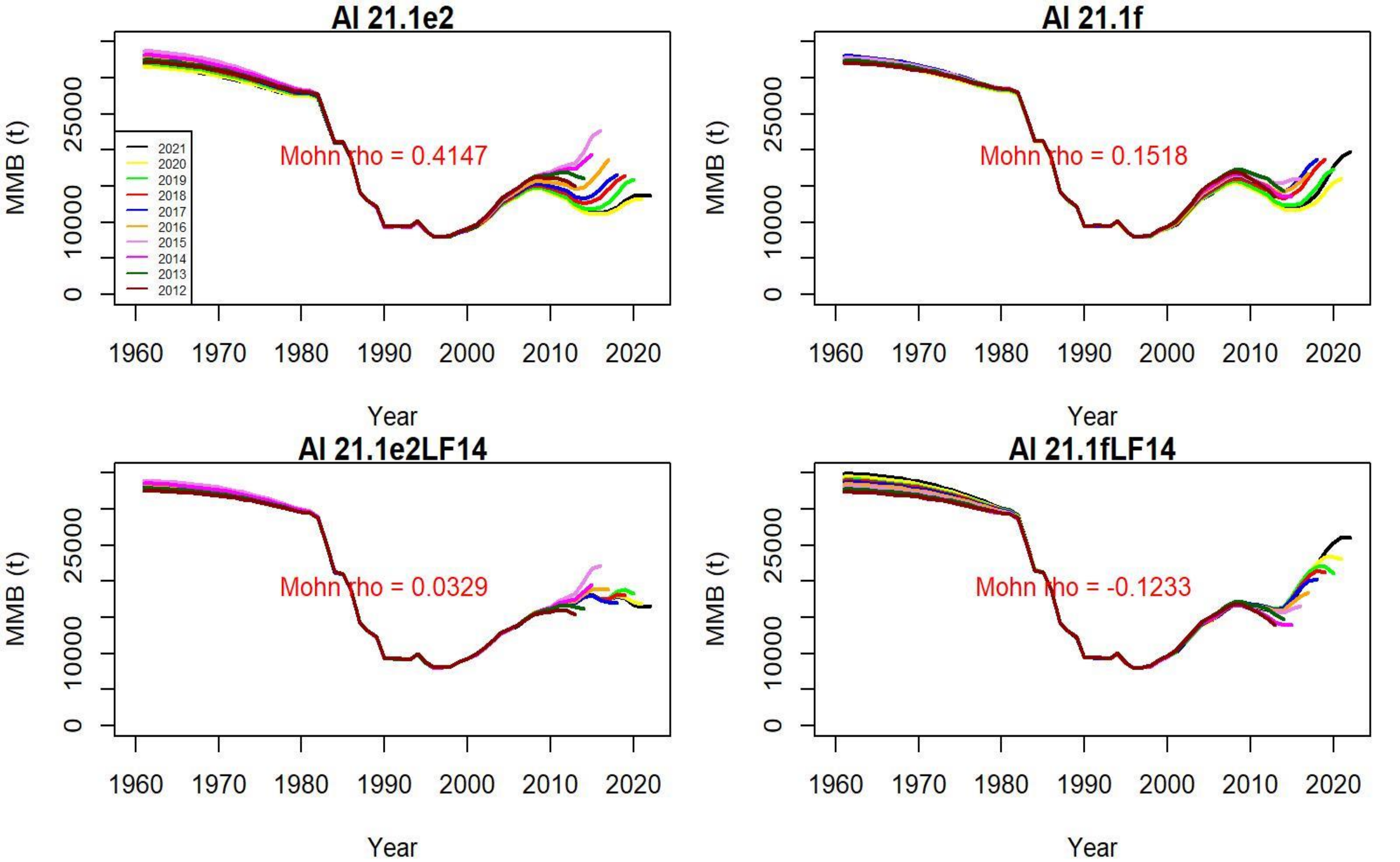


Figure Resp.10. Retrospective fits of MMB following systematic nine peels of terminal year data for all representative models (21.1e2, 21.1f, 21.1e2LF14, and 21.1fLF14) for golden king crab in AI, 1961–2022.

Selected June 2022 SSC comments

- Comment 3: The SSC requests that a future analysis consider the spatial footprint of the historical and new data sets to determine if the data exist to show a temporal trend in the spatial variability in size at maturity.

  Response:
  We plan to do this investigation soon. Our group is currently investigating area specific maturity.

- Comment 4: In the next assessment cycle, provide a model that includes year:area interaction in the CPUE index that includes all diagnostic tools, in particular, a retrospective analysis.

  Response:

  Diagnostics results on Year:Area interaction analysis are provided in Appendix B. Retrospective plots for Year:Area interaction models are also provided in Figures Resp.6, 7, and 10 for EAG, WAG, and AI, respectively.

June 2022 SSC comments continued

- Comment 6: As the GMACS analysts develop and combine code, consider the ability of the model to accommodate 1) a unified (east and west) single-area AIGKC stock assessment model; 2) a two-area spatial model with some shared parameters and connectivity; and 3) the time series of cooperative survey data now available in both regions.

Response:
1. GMACS models have been developed as separate area (EAG and WAG) models. A preliminary analysis on unified single-area model was carried out in this cycle (see our response to CPT comment#12). Once this approach is accepted, it will be possible to implementing a single area model in GMACS.

2. We have still not figured out a two-area spatial model with some shared parameters and connectivity because AIGKC stock is still data poor. This can be identified as a future goal.

3. Cooperative survey data analysis is presented in Appendix C. Model 21.1g considered EAG cooperative survey indices. Once the approach and results are accepted by CPT/SSC, it can be implemented in GMACS.

June 2022 SSC comments continued

- **Comment 7:** Consider a focused AIGKC GMACS item on the January 2023 modeling workshop for comparison with the non-GMACS model.

Response:
Done (see Appendix D).

- Comment 8: Based on public testimony regarding increasing trawl overlap with the AIGKC distribution, provide a map of historical trawl fishery distribution relative to the AIGKC fishery.

Response:
The groundfish fishery and the golden king crab fishery overlap is shown in Figure Resp.12.

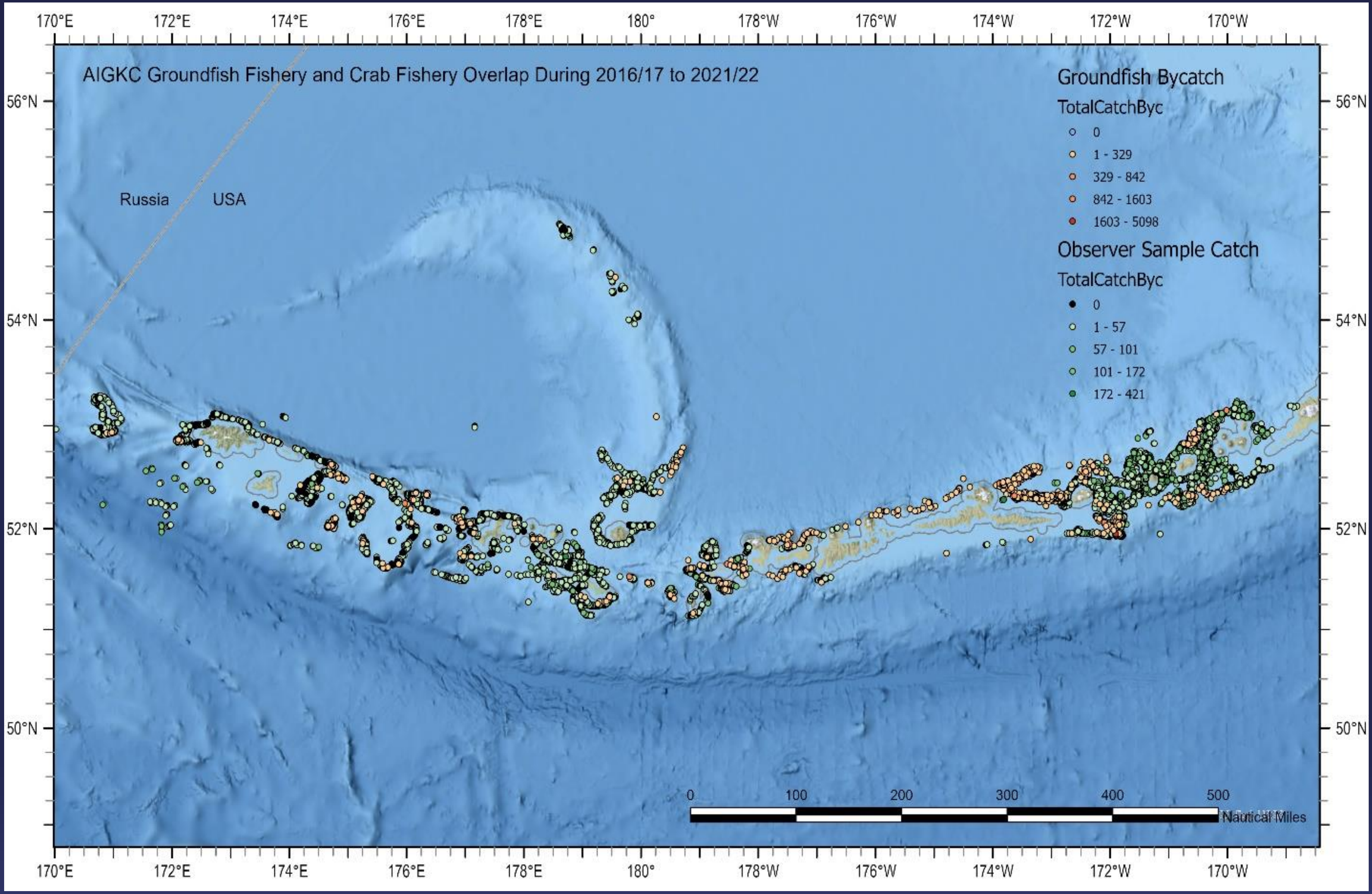


Fig. Resp.12. AIGKC groundfish (trawl and contact gear) fishery and golden king crab fishery overlap during 2016/17–2021/22 in the Aleutian Islands. Observer sample catch and groundfish fishery bycatch locations are plotted to show the overlap.

Appendix C: Cooperative survey

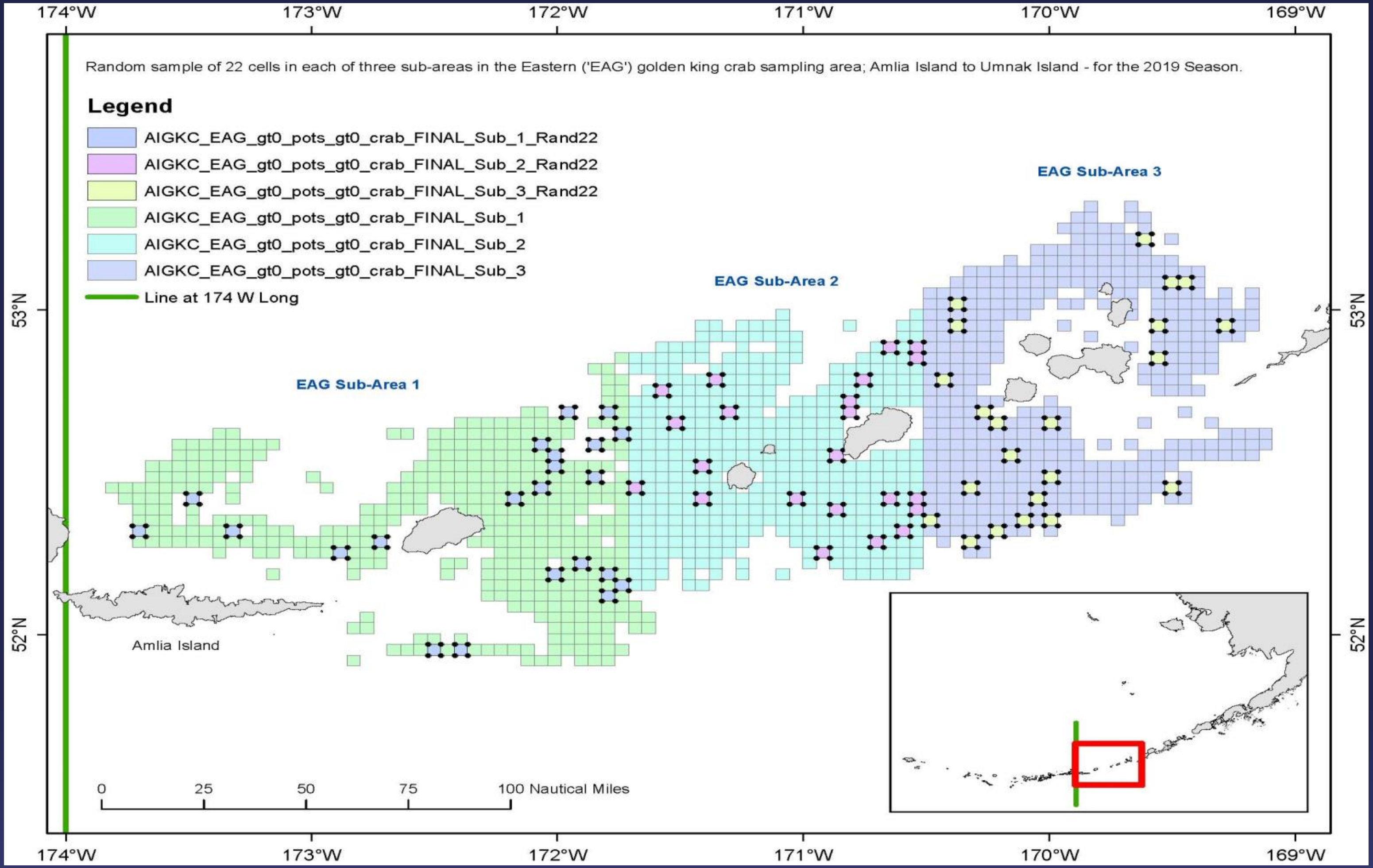


Figure C.3. Survey design: 2 nmi x 2 nmi grids stratified by three equal sizes for selecting random pot sampling locations in EAG. e.g., Random sample of 22 cells selected in each of three sub strata in EAG during the 2019 fishery.

Cooperative survey continued

- Summary of survey method:

1. The ADF&G and industry collaborative pot survey was started in 2015 in the EAG. All samples were taken in EAG except for 2018/19, during which measurements were also taken from WAG.
2. A stratified two-stage sampling design has been implemented in a 2 nmi x 2 nmi grids within 1000 m depth covering the entire golden king crab fishing area.
3. Surveys occur during the first month of each fishing season. Fishing operation takes place in a randomly selected set of grids in each stratum with long-line pots. The number of pots per string ranges from 30 to 40, 200 m apart, and a vessel carries on average 35 strings.
4. There are multiple pots (typically about 5 pots) sampled for each long-line string with approximately 35 crab measurement made per pot.

Cooperative survey continued

- Example of a data entry record:

fishery	year	vessel	skipper	String#	pot_size	mesh_ size	bait	subsample _rate	species_ code	sex	size	legal
EAG	2015	20556	Chad_ Hoefer	1	5x5	king(lar ge)	halibut	2	923	1	187	1

Pot#	date_in	time_in	depth_ start	start_lat	start_lon	depth _out	end_lat	end_lon	date_out	time_out	soak_time
1	8/4/15	17:00	132	52.74133	-170.692	133	52.7515	-170.675	8/17/15	3:00	12.41667

Cooperative survey continued

- Data preparation and model formulation for CPUE standardization:

  - Created two new columns by concatenating Vessel code with String# as well as with String# and Pot# because String# and Pot# are not unique numbers to each vessel. The new column names were identified as VesString and VesStingPot.
  - Summed up the catch across sizes for each Pot# and labelled it as SumCatch (response variable). Thus, each Pot# has a single catch number.
  - The dispersion parameter for the negative binomial error model and the degrees of freedom for cubic splines for soak time and depth variables were estimated by a fixed effect GLM model using survey data.

  - Selected random intercept model:

Sum Catch = Y+ns (Depth, df=2)+ns (Soak, df=9)+Captain+(1|Block/VesselString) (C.3)
family= negative binomial (θ=6.08).

Results

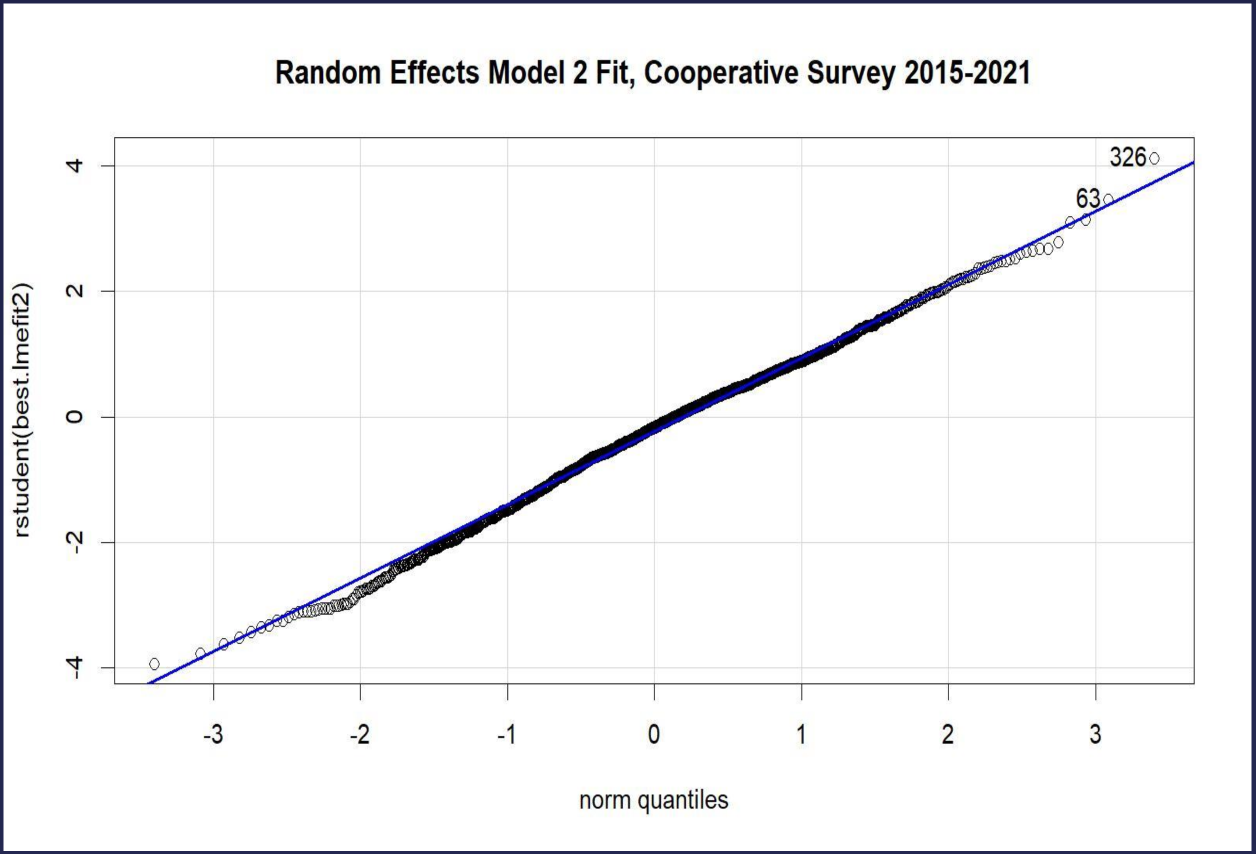


Figure C.10. Studentized residual plot for the mixed random effects model fit using the 2015–2019, 2021 EAG data.

Cooperative survey continued

CPUE standardization:

- Mixed effects model predicted CPUEs were used to estimate, first yearly mean predicted survey CPUEs and then yearly CPUE indices by standardizing the yearly survey CPUE by the geometric mean of survey CPUEs.

- The variance of $CPUE\ index_t = var(\log(CPUE))/n_t$

- Model 21.1g uses cooperative survey indices (Table C.3).

Table C.3.

Year	Predicted CPUE index	SE	Lower Limit	Upper Limit	Sample size
2015	1.27802	0.03227	1.19815	1.36321	274
2016	0.99140	0.03174	0.93042	1.05637	288
2017	1.20299	0.04150	1.10718	1.30710	200
2018	1.20225	0.03556	1.11972	1.29086	230
2019	0.71618	0.03633	0.66598	0.77016	263
2021	0.76197	0.03155	0.71538	0.81160	227

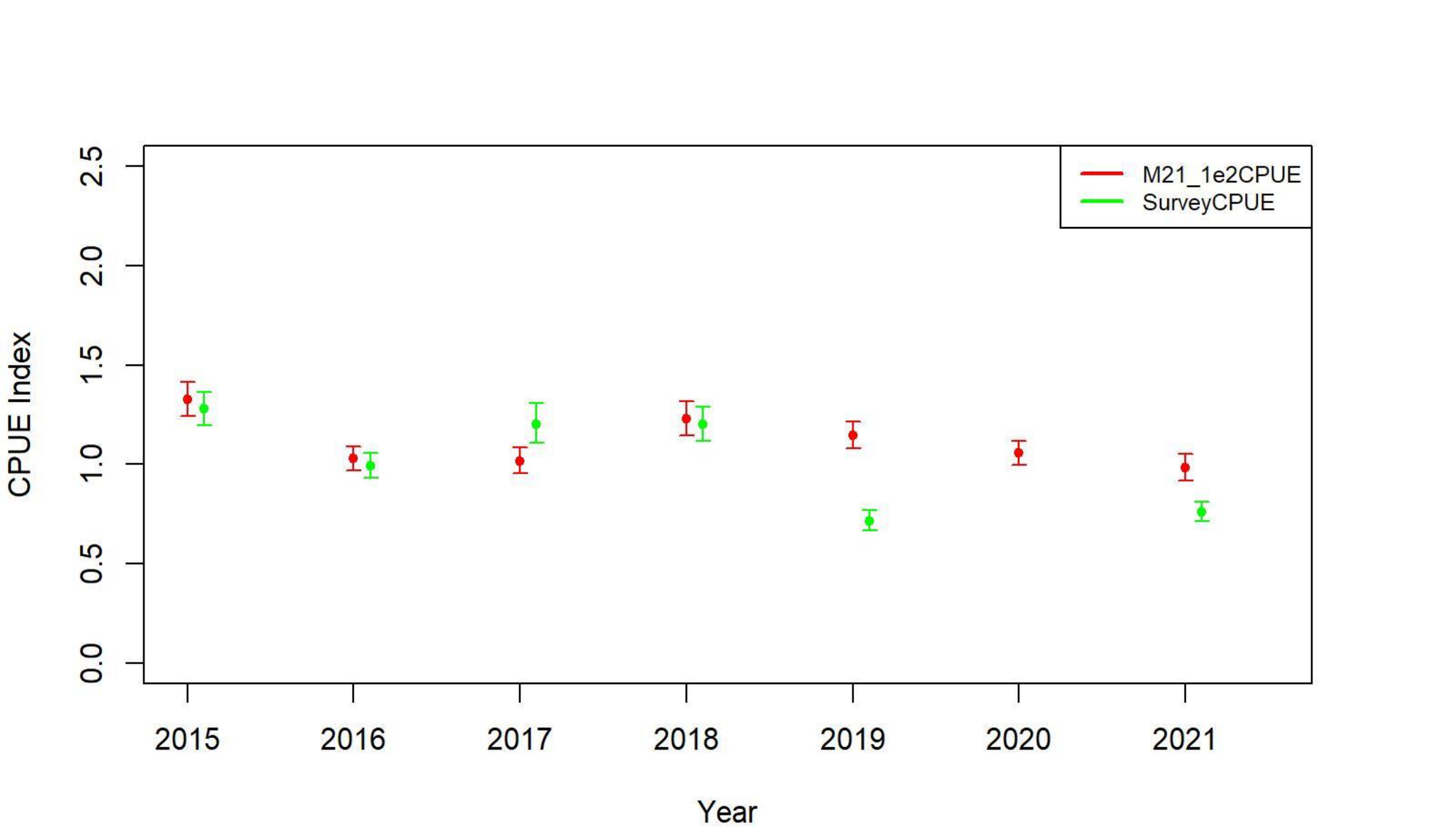


Figure C.11. Comparison of survey random effects model CPUE indices (green) and observer non interaction factor model CPUE indices (red, M21.1e2) for EAG. The confidence limits are calculated with ±2SE. Note: (a) No additional variance was added to observer indices. (b) There was no cooperative survey in 2020.

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Model Scenarios

Table T1

Model	Area	CPUE Data Type and Maturity Option	Period for Mean Number of Recruit Calculation for (a) Initial Equilibrium Abundance and (b) Reference Points Estimations; and Remarks
21.1e2 (accepted model in May/June 2022, implemented with up to 2021/22 data)-core/base model	AI, EAG, WAG	Observer data from 1995/96–2021/22; Fish ticket data from 1985/86–1998/99; Observer and fish ticket CPUE standardization by the negative binomial model; the knife-edge maturity size of 116 mm CL; M = 0.22; and three catchability and additional CVs during 1985–1998; 1995–2004; and 2005–2021.	1987–2017; CPT/SSC suggested base model.
21.1f (core model)	AI, EAG, WAG	21.1e2 + observer CPUE data standardized including Year: Block interaction.	1987–2017
21.1e2 LF14	AI, EAG, WAG	21.1e2 + size composition limited to 2014/15	1987–2017
21.1f LF14	AI, EAG, WAG	21.1f + size composition limited to 2014/15	1987–2017
21.1e2CPUE5Wt	EAG, WAG	21.1e2 + CPUE likelihood weighted by 5	1987–2017
21.1fCPUE5Wt	EAG, WAG	21.1f + CPUE likelihood weighted by 5	1987–2017
21.1e2Q	EAG	21.1e2 + variable catchability	1987–2017
21.1g	EAG	21.1e2 + EAG cooperative pot survey standardized CPUE	1987–2017
21.1e2 a, b, c	AI, EAG, WAG	21.1e2 +variable period for mean recruitment estimation	a: 1987–2019; b: 1987–2020; c: 1987–2021
	GMACS version of core models, 21.1e2 and 21.1f, for EAG and WAG		

Table 9. Negative log-likelihood values of the fits for models 21.1e2 (base), 21.1f, 21.1e2 LF14, 21.1f LF14, 21.1g, 21.1e2CPUE5Wt, and 21.1fCPUE5Wt for golden king crab in the EAG. Likelihood components with zero entry in the entire rows are omitted.

Likelihood Component	21.1e2	21.1f	21.1e2 LF14	21.1f LF14	21.1g	21.1e2CPUE5Wt	21.1fCPUE5Wt
Number of free parameters	157	157	157	157	158	157	157
Retlencomp	-2155.9400	-2150.5900	-1609.3600	-1619.3500	-2158.3000	-1826.6200	-1859.3100
Totallencomp	-1387.6600	-1385.3000	-1053.5200	-1054.7500	-1387.2400	-1328.9800	-1353.8900
Observer cpue	-30.7872	-32.0923	-50.1416	-58.9974	-29.1853	-375.2010	-335.4950
Fishery cpue	-15.0060	-14.8956	-15.9309	-15.7905	-14.9586	-203.3850	-203.1740
RetdcatchB	4.3596	4.2725	4.3490	4.2937	4.3446	13.4847	12.9743
TotalcatchB	15.8541	15.7777	18.2634	18.0723	15.8344	23.1981	23.1523
GdiscdcatchB	0.0003	0.0003	0.0003	0.0003	0.0003	0.0015	0.0013
Rec_dev	22.2110	22.1588	21.3453	23.3081	22.0225	36.8985	30.7957
Pot F_dev	0.0135	0.0133	0.0142	0.0137	0.0136	0.0121	0.0121
Gbyc_F_dev	0.0229	0.0229	0.0213	0.0219	0.0229	0.0242	0.0236
Tag	2693.2100	2693.2800	2692.2300	2692.2000	2693.2500	2693.6300	2691.9900
RetcatchN	0.0016	0.0017	0.0015	0.0012	0.0015	0.0013	0.0017
Total	-853.7190	-847.3470	7.2694	-10.9848	-854.2010	-966.9320	-992.9190

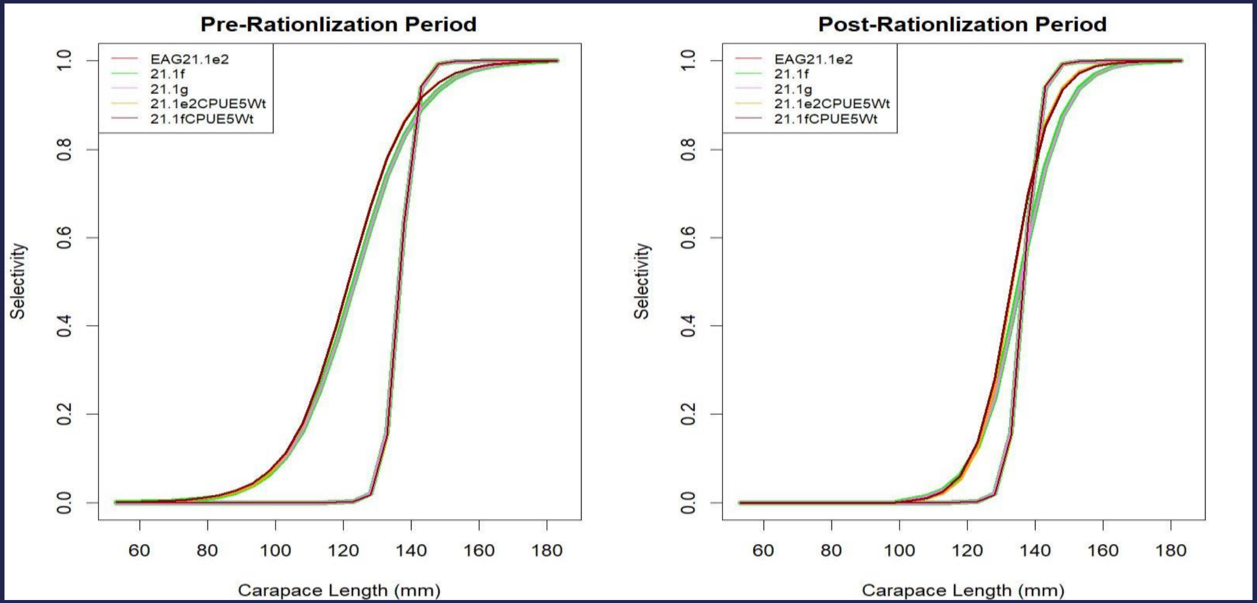
Table 13. Negative log-likelihood values of the fits for models 21.1e2 (base), 21.1f, 21.1e2 LF14, 21.1f LF14, 21.1e2CPUE5Wt, and 21.1fCPUE5Wt for golden king crab in the WAG. Likelihood components with zero entry in the entire rows are omitted.

Likelihood Component	21.1e2	21.1f	21.1e2 LF14	21.1f LF14	21.1e2CPUE5Wt	21.1fCPUE5Wt
Number of free parameters	157	157	157	157	157	157
Retlencomp	-2109.4400	-2096.5100	-1655.7900	-1666.5400	-1954.5800	-1984.9000
Totallencomp	-1530.8700	-1541.1100	-1187.2600	-1196.1600	-1427.7200	-1411.4200
Observer cpue	-48.0187	-44.0497	-55.0027	-46.2519	-461.6480	-330.7060
Fishery cpue	-19.4746	-19.2602	-20.6578	-19.8670	-180.4980	-216.2270
RetdcatchB	5.2842	5.0540	5.0378	4.8667	11.4356	10.4203
TotalcatchB	52.7969	52.3098	50.8439	50.8401	52.0413	52.0603
GdiscdcatchB	0.0011	0.0010	0.0012	0.0008	0.0056	0.0047
Rec_dev	20.8360	20.8027	22.3745	21.2696	33.6752	32.8384
Pot F_dev	0.0256	0.0257	0.0258	0.0262	0.0249	0.0246
Gbyc_F_dev	0.0431	0.0427	0.0424	0.0415	0.0461	0.0450
Tag	2694.4000	2694.0100	2692.4400	2692.5600	2696.0400	2697.0700
RetcatchN	0.00052	0.0005	0.00021	0.000345	0.000087	0.00027
Total	-934.4120	-928.6830	-147.9500	-159.2100	-1231.1800	-1150.7800

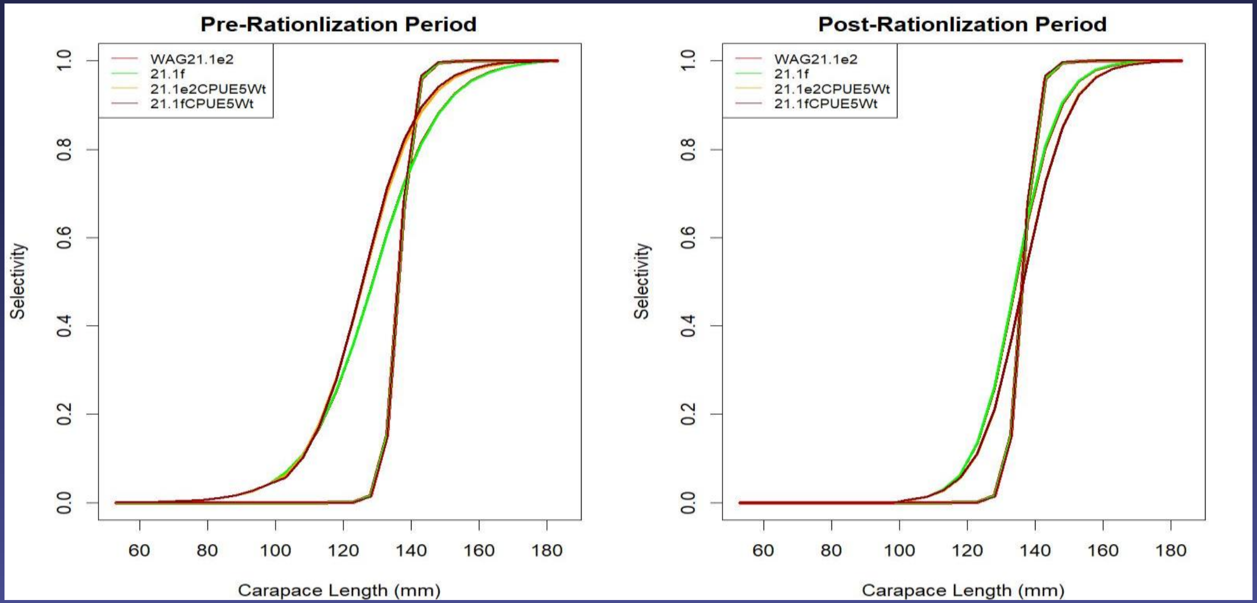
Results

Selectivity

EAG
Fig. 6



WAG
Fig. 16



CPUE

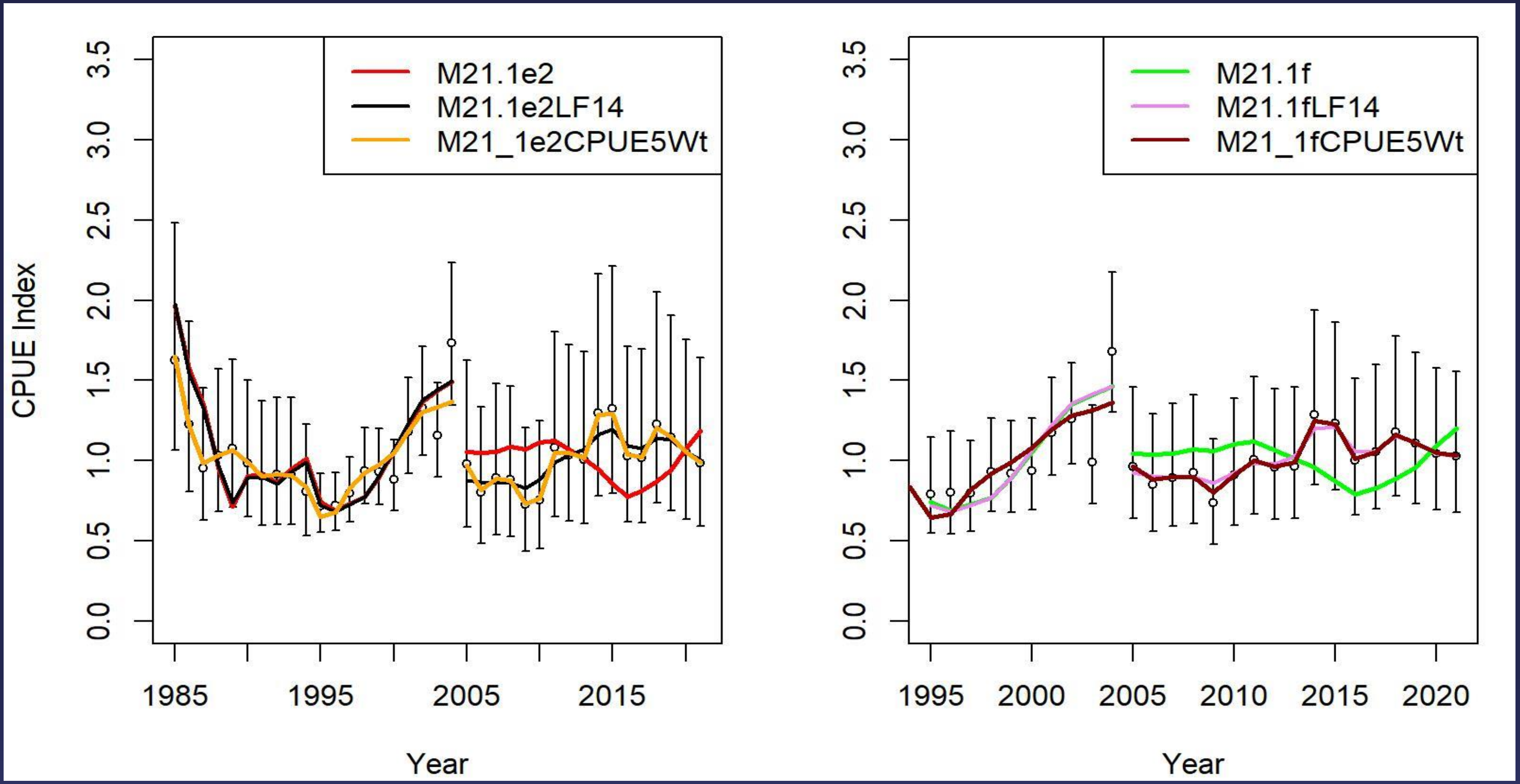


Figure 7. Comparison of input CPUE indices [black open circles with +/- 2 SE for model 21.1e2 (left) and model 21.1f (right)] with predicted CPUE indices (colored solid lines) by models 21.1e2, 21.1e2LF14, and 21.1e2CPUE5Wt (left); 21.1f, 21.1fLF14, and 21.1fCPUE5Wt (right) fits to EAG golden king crab data, 1985/86–2021/22. Model estimated additional standard error was added to each input standard error.

CPUE

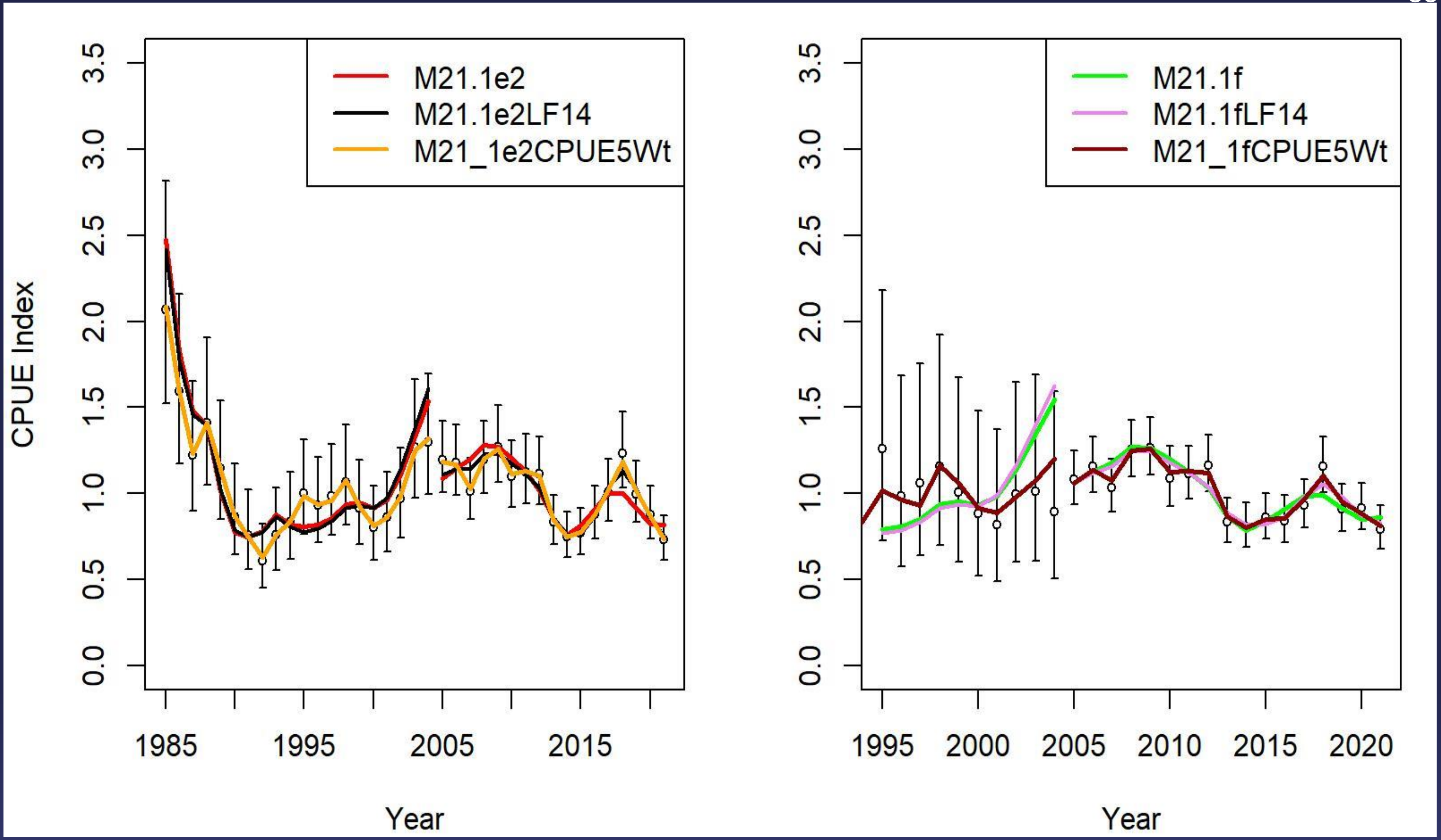
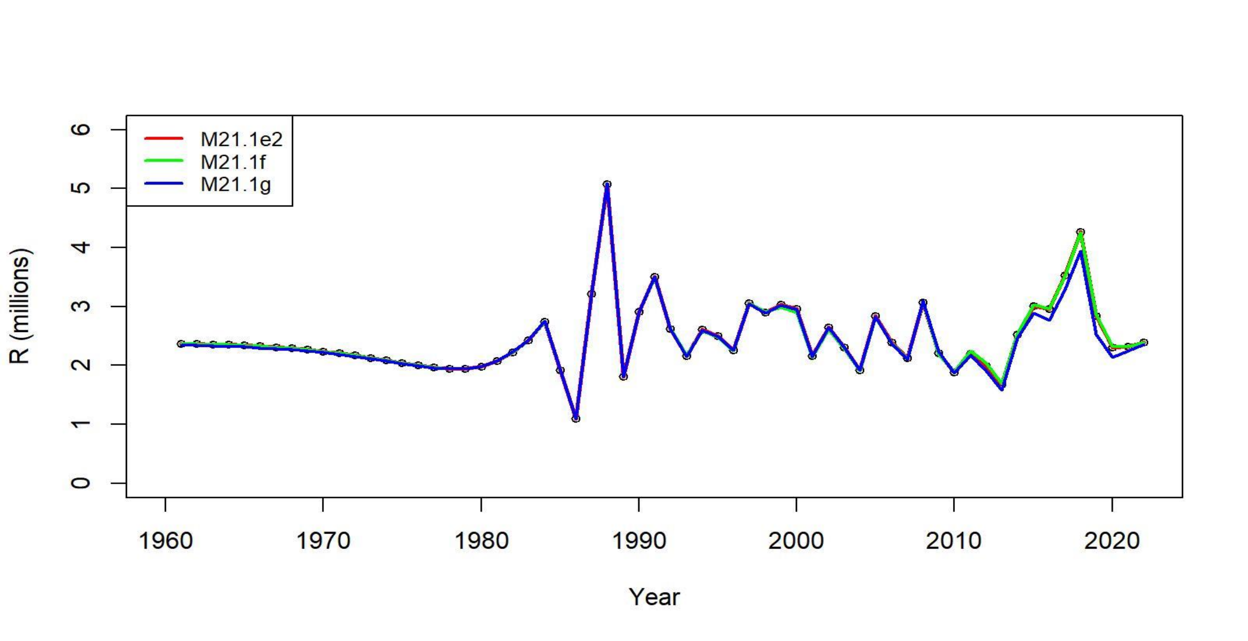


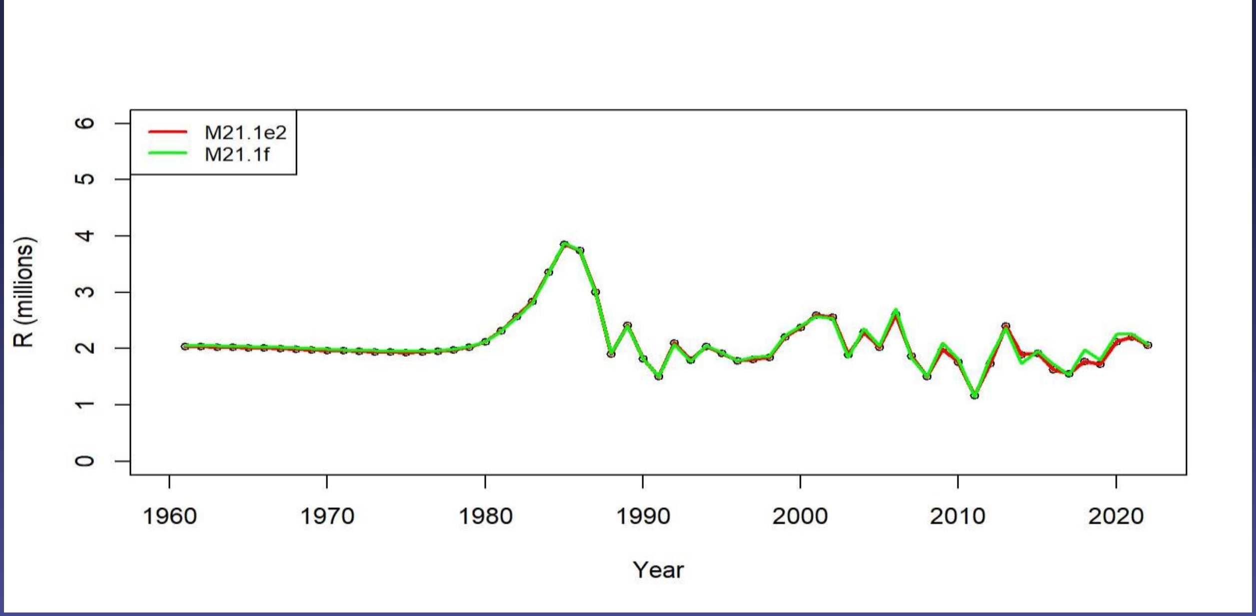
Figure 17. Comparison of input CPUE indices [black open circles with +/- 2 SE for model 21.1e2 (left) and model 21.1f (right)] with predicted CPUE indices (colored solid lines) for models 21.1e2, 21.1e2LF14, 21.1e2CPUE5Wt, 21.1f, 21.1fLF14, and 21.1f CPUE5Wt fits to WAG golden king crab data, 1985/86–2021/22. Model estimated additional standard error was added to each input standard error.

Recruitment

EAG Fig. 8



WAG Fig. 18



Catch & Bycath

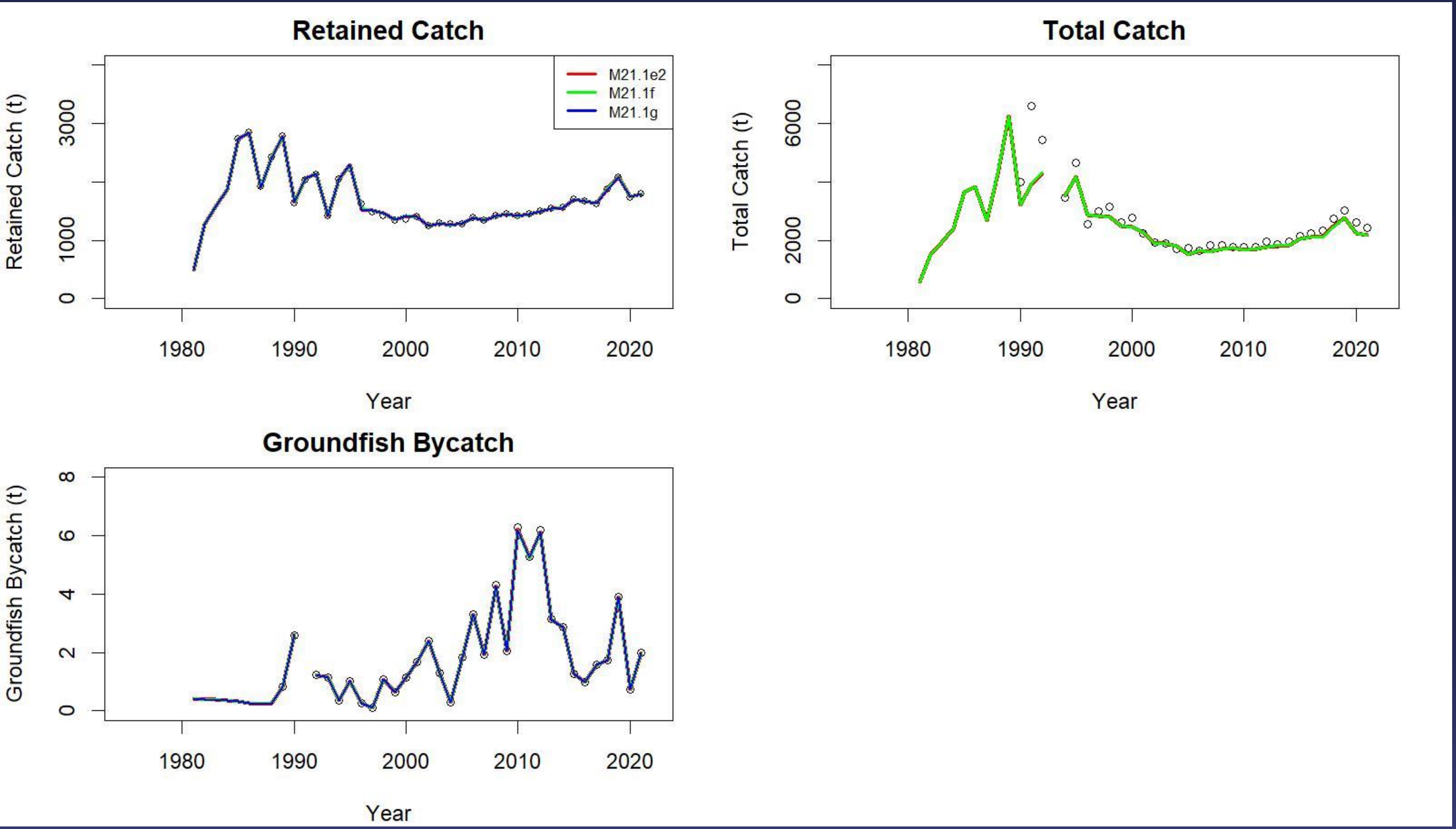


Figure 9. Observed (open circle) vs. predicted (solid line) retained catch (top left), total catch (top right), and groundfish bycatch (bottom left) of golden king crab for models 21.1e2, 21.1f, and 21.1g fits to EAG data, 1981/82–2021/22.

Catch & Bycath

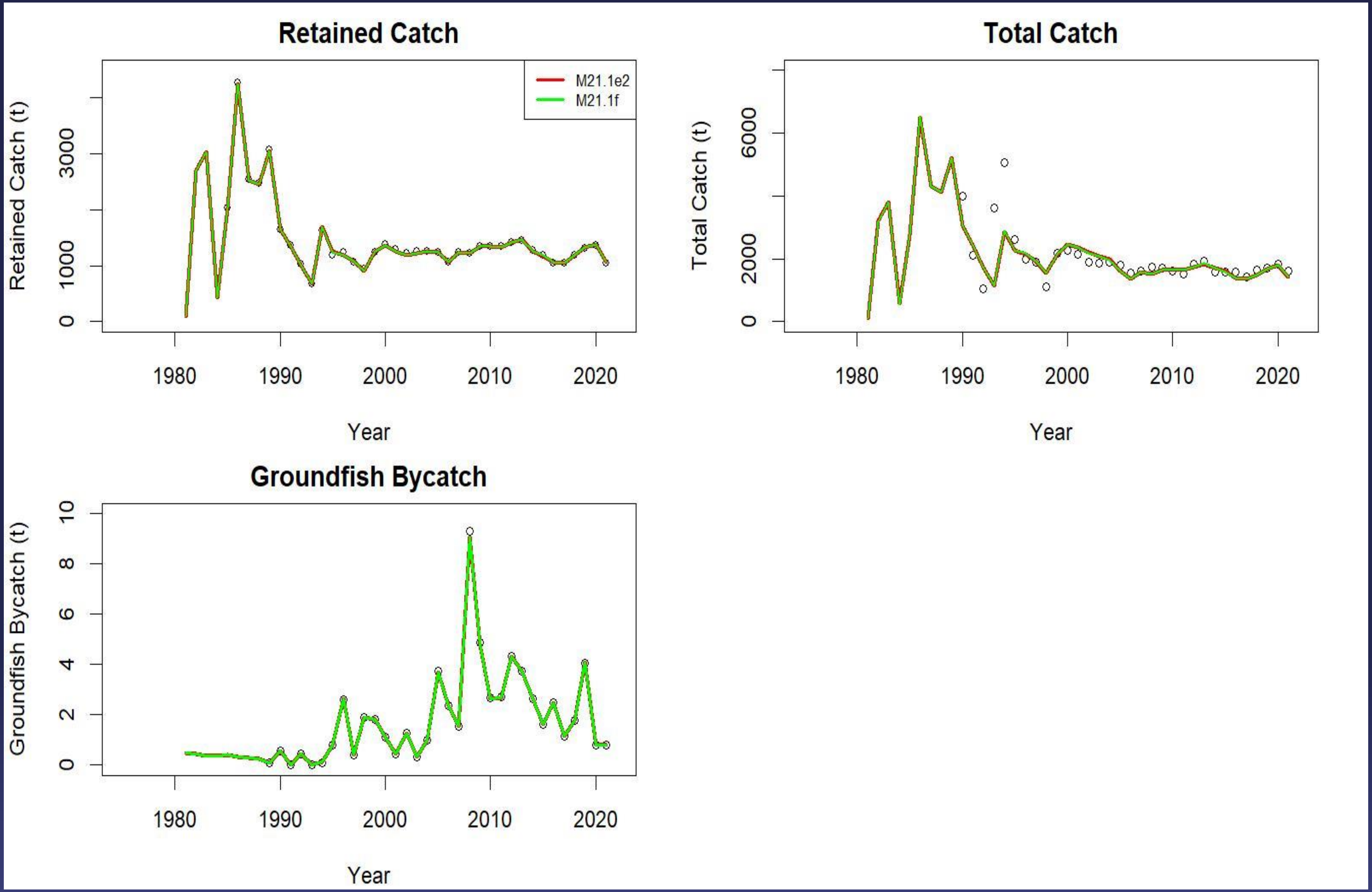


Figure 19. Observed (open circle) vs. predicted (solid line) retained catch (top left), total catch (top right), and groundfish bycatch (bottom left) of golden king crab for models 21.1e2 and 21.1f fits to WAG data, 1981/82–2021/22.

Fishing mortality

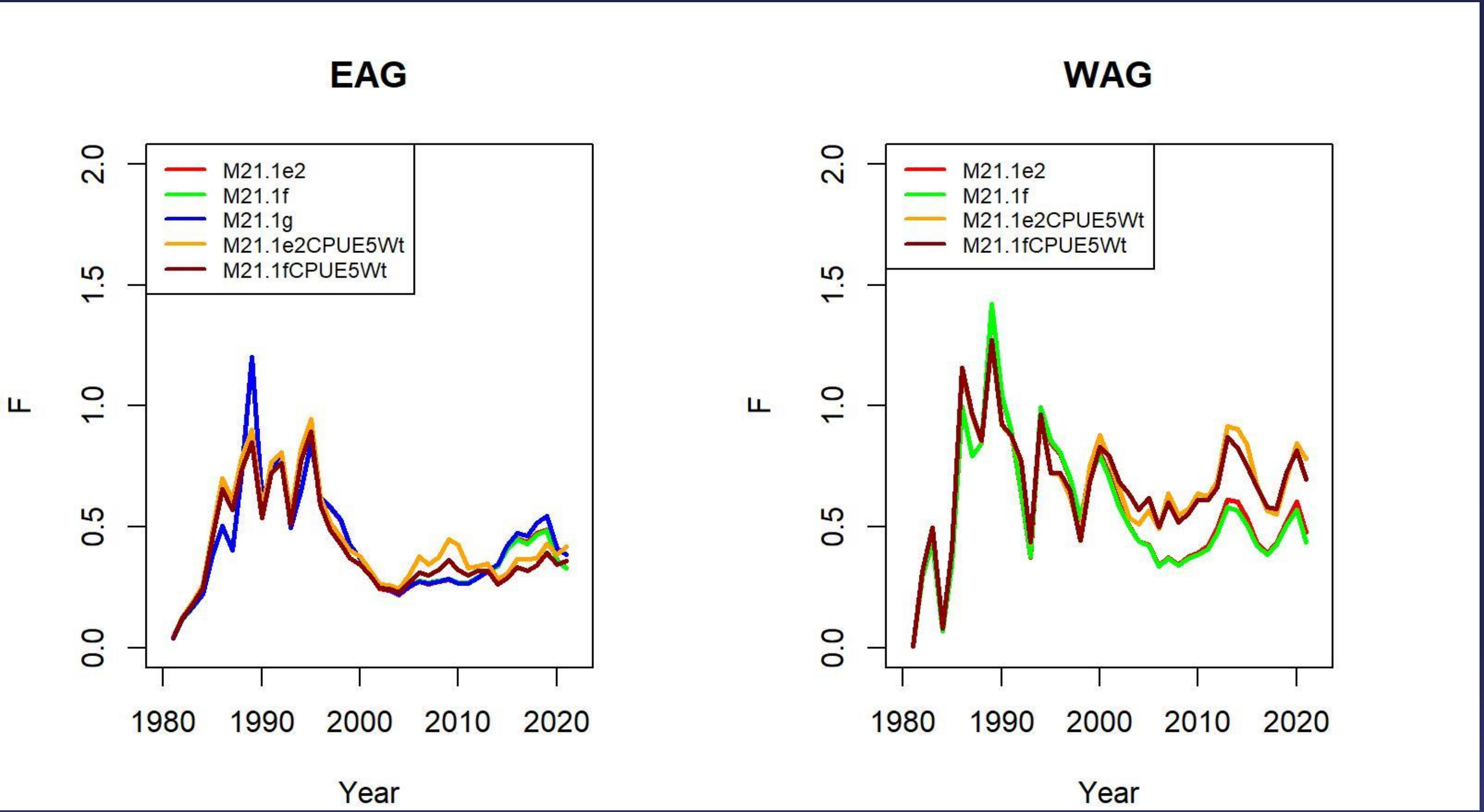


Figure 11. Trends in pot fishery full selection total fishing mortality of golden king crab for models 21.1e2, 21.1f, , 21.1g, 21.1e2CPUE5Wt, and 21.1fCPUE5Wt fits to EAG (left) and for models 21.1e2, 21.1f, 21.1e2CPUE5Wt, and 21.1fCPUE5Wt fits to WAG (right) data, 1981/82–2021/22.

MMB

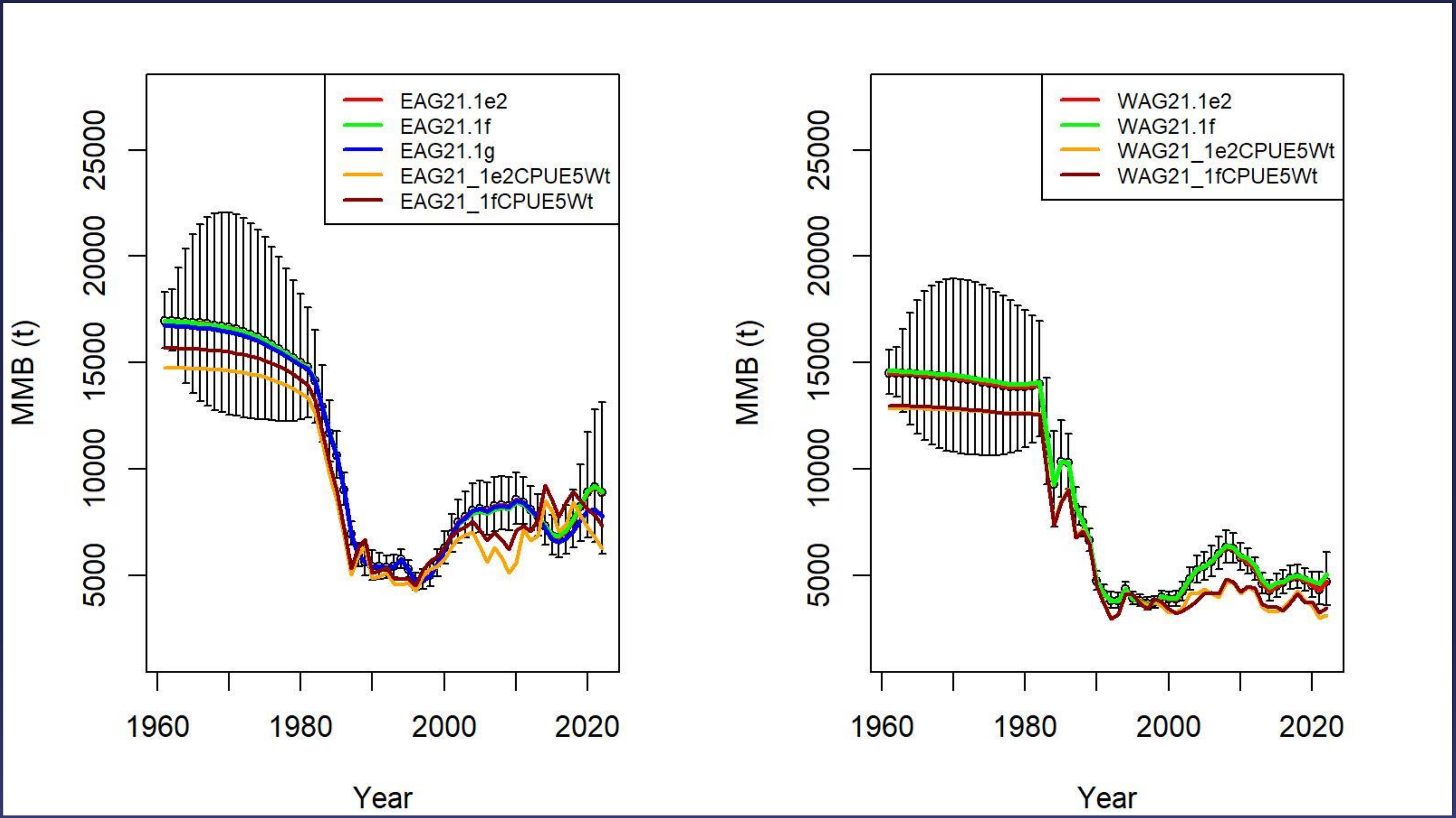


Figure 12. Trends in golden king crab mature male biomass for models 21.1e2, 21.1f, 21.1g, 21.1e2CPUE5Wt, and 21.1fCPUE5Wt fits to EAG (left) and for models 21.1e2, 21.1f, 21.1e2CPUE5Wt, and 21.1fCPUE5Wt fits to WAG (right) data, 1960/61–2021/22. Model21.1e2 estimate has two standard error confidence limits.

EAG

Model	Tier	$MMB_{35\%}$	Current MMB	MMB/ $MMB_{35\%}$	F_{OFL}	$F_{35\%}$	M(yr^{-1})	OFL	MaxABC (P*=0.49)	ABC (0.75*OFL)
21.1e2	3a	6,524	7,545	1.16	0.56	0.56	0.22	2,898	2,884	2,174
21.1f	3a	6,523	7,591	1.16	0.56	0.56	0.22	2,918	2,904	2,188
21.1g	3a	6,471	6,824	1.05	0.56	0.56	0.22	2,506	2,490	1,880
21.1e2Q	3b	6,462	6,442	0.997	0.55	0.56	0.22	2,311	2,286	1,733
21.1e2 LF14	3a	6,903	7,699	1.12	0.58	0.58	0.22	3,052	3,039	2,289
21.1f LF14	3a	6,758	7,532	1.11	0.57	0.57	0.22	2,897	2,886	2,173
21.1e2CPUE5Wt	3b	6,166	5,806	0.942	0.47	0.50	0.22	1,888	1,879	1,416
21.1fCPUE5Wt	3a	6,340	6,446	1.017	0.51	0.51	0.22	2,369	2,364	1,777

WAG

Model	Tier	$MMB_{35\%}$	Current MMB	MMB/ $MMB_{35\%}$	F_{OFL}	$F_{35\%}$	M(yr^{-1})	OFL	MaxABC (P*=0.49)	ABC (0.75*OFL)
21.1e2	3a	4,905	4,911	1.00	0.54	0.54	0.22	1,340	1,335	1,005
21.1f	3a	4,911	5,175	1.05	0.54	0.54	0.22	1,452	1,447	1,089
21.1e2 LF14	3b	4,976	4,817	0.97	0.50	0.52	0.22	1,288	1,279	966
21.1f LF14	3a	5,009	5,195	1.04	0.52	0.52	0.22	1,519	1,514	1,139
21.1e2CPUE5Wt	3b	4,558	3,792	0.832	0.45	0.55	0.22	730	726	547
21.1fCPUE5Wt	3b	4,549	4,036	0.887	0.48	0.55	0.22	875	870	656

AI

Model	OFL	MaxABC (P*=0.49)	ABC (0.75*OFL)
21.1e2	4,238	4,219	3,179
21.1f	4,370	4,351	3,277
21.1e2 LF14	4,340	4,318	3,255
21.1f LF14	4,416	4,400	3,312
21.1e2CPUE5Wt	2,618	2,605	1,963
21.1fCPUE5Wt	3,244	3,234	2,433

Thank you