Supplementary tables

Supplementary Table 1. The scenarios considered in the projections. σ_R , ρ_R , σ_B, and ρ_B (see Table 2 for definitions). The values in this table are based on the operating model that assumed that CPUE is proportional to selected abundance.

Scenario	σ_R	ρ_R	σ_C	h	σ_B	ρ_B	σ_N	ρ_N
1	0.274	0.455	0.039	0.729	0.214	0.700	0.216	0.700
2	0.100	0.455	0.039	0.729	0.214	0.700	0.216	0.700
3	0.800	0.455	0.039	0.729	0.214	0.700	0.216	0.700
4	0.274	0.000	0.039	0.729	0.214	0.700	0.216	0.700
5	0.274	0.900	0.039	0.729	0.214	0.700	0.216	0.700
6	0.274	0.455	0.000	0.729	0.214	0.700	0.216	0.700
7	0.274	0.455	0.100	0.729	0.214	0.700	0.216	0.700
8	0.274	0.455	0.039	0.600	0.214	0.700	0.216	0.700
9	0.274	0.455	0.039	1.200	0.214	0.700	0.216	0.700
10	0.274	0.455	0.039	0.729	0.000	0.700	0.216	0.700
11	0.274	0.455	0.039	0.729	0.300	0.700	0.216	0.700
12	0.274	0.455	0.039	0.729	0.214	0.000	0.216	0.700
13	0.274	0.455	0.039	0.729	0.214	0.900	0.216	0.700
14	0.274	0.455	0.039	0.729	0.214	0.700	0.000	0.700
15	0.274	0.455	0.039	0.729	0.214	0.700	0.300	0.700
16	0.274	0.455	0.039	0.729	0.214	0.700	0.216	0.000
17	0.274	0.455	0.039	0.729	0.214	0.700	0.216	0.900
18	0.100	0.455	0.039	0.729	0.000	0.700	0.216	0.700
19	0.100	0.455	0.039	0.729	0.300	0.700	0.216	0.700
20	0.800	0.455	0.039	0.729	0.000	0.700	0.216	0.700
21	0.800	0.455	0.039	0.729	0.300	0.700	0.216	0.700
22	0.100	0.000	0.039	0.729	0.214	0.700	0.216	0.700
23	0.100	0.000	0.039	0.729	0.000	0.700	0.216	0.700
24	0.100	0.000	0.039	0.729	0.300	0.700	0.216	0.700
25	0.274	0.000	0.039	0.729	0.000	0.700	0.216	0.700
26	0.274	0.000	0.039	0.729	0.300	0.700	0.216	0.700
27	0.800	0.000	0.039	0.729	0.214	0.700	0.216	0.700
28	0.800	0.000	0.039	0.729	0.000	0.700	0.216	0.700
29	0.800	0.000	0.039	0.729	0.300	0.700	0.216	0.700
30	0.100	0.900	0.039	0.729	0.214	0.700	0.216	0.700
31	0.100	0.900	0.039	0.729	0.000	0.700	0.216	0.700
32	0.100	0.900	0.039	0.729	0.300	0.700	0.216	0.700
33	0.274	0.900	0.039	0.729	0.000	0.700	0.216	0.700
34	0.274	0.900	0.039	0.729	0.300	0.700	0.216	0.700

Scenario	σ_R	ρ_R	σ_C	h	σ_B	ρ_B	σ_N	ρ_N
35	0.800	0.900	0.039	0.729	0.214	0.700	0.216	0.700
36	0.800	0.900	0.039	0.729	0.000	0.700	0.216	0.700
37	0.800	0.900	0.039	0.729	0.300	0.700	0.216	0.700
38	0.100	0.455	0.039	0.729	0.214	0.000	0.216	0.700
39	0.100	0.455	0.039	0.729	0.214	0.900	0.216	0.700
40	0.800	0.455	0.039	0.729	0.214	0.000	0.216	0.700
41	0.800	0.455	0.039	0.729	0.214	0.900	0.216	0.700
42	0.100	0.000	0.039	0.729	0.214	0.000	0.216	0.700
43	0.100	0.000	0.039	0.729	0.214	0.900	0.216	0.700
44	0.274	0.000	0.039	0.729	0.214	0.000	0.216	0.700
45	0.274	0.000	0.039	0.729	0.214	0.900	0.216	0.700
46	0.800	0.000	0.039	0.729	0.214	0.000	0.216	0.700
47	0.800	0.000	0.039	0.729	0.214	0.900	0.216	0.700
48	0.100	0.900	0.039	0.729	0.214	0.000	0.216	0.700
49	0.100	0.900	0.039	0.729	0.214	0.900	0.216	0.700
50	0.274	0.900	0.039	0.729	0.214	0.000	0.216	0.700
51	0.274	0.900	0.039	0.729	0.214	0.900	0.216	0.700
52	0.800	0.900	0.039	0.729	0.214	0.000	0.216	0.700
53	0.800	0.900	0.039	0.729	0.214	0.900	0.216	0.700

Supplementary Table 2. Factors not varied from the 2018 assessment for the harvest control rule evaluation simulations. The values in this table are based on the operating model that assumed that CPUE is proportional to selected abundance.

Factor	Values
Extent of log initial abundance estimation error by size-class j, $\sigma_{1,j}$	0.484, 0.466, 0.351, 0.302, 0.306, 0.247, 0.204, 0.196, 0.182, 0.171, 0.176, 0.188, 0.203, 0.221, 0.239, 0.257, 0.287

Supplementary Table 3. The scenarios considered in the projections. σ_R , ρ_R , σ_B, and ρ_B (see Table 2 for definitions). The values in this table are based on the operating model that assumed that CPUE is proportional to the square root of selected abundance.

Scenario	σ_R	ρ_R	σ_C	h	σ_B	ρ_B	σ_N	ρ_N
1	0.486	0.528	0.039	0.732	0.292	0.700	0.282	0.700
2	0.100	0.528	0.039	0.732	0.292	0.700	0.282	0.700
3	0.800	0.528	0.039	0.732	0.292	0.700	0.282	0.700
4	0.486	0.000	0.039	0.732	0.292	0.700	0.282	0.700
5	0.486	0.900	0.039	0.732	0.292	0.700	0.282	0.700
6	0.486	0.528	0.000	0.732	0.292	0.700	0.282	0.700
7	0.486	0.528	0.100	0.732	0.292	0.700	0.282	0.700
8	0.486	0.528	0.039	0.600	0.292	0.700	0.282	0.700
9	0.486	0.528	0.039	1.200	0.292	0.700	0.282	0.700
10	0.486	0.528	0.039	0.732	0.000	0.700	0.282	0.700
11	0.486	0.528	0.039	0.732	0.300	0.700	0.282	0.700
12	0.486	0.528	0.039	0.732	0.292	0.000	0.282	0.700
13	0.486	0.528	0.039	0.732	0.292	0.900	0.282	0.700
14	0.486	0.528	0.039	0.732	0.292	0.700	0.000	0.700
15	0.486	0.528	0.039	0.732	0.292	0.700	0.300	0.700
16	0.486	0.528	0.039	0.732	0.292	0.700	0.282	0.000
17	0.486	0.528	0.039	0.732	0.292	0.700	0.282	0.900
18	0.100	0.528	0.039	0.732	0.000	0.700	0.282	0.700
19	0.100	0.528	0.039	0.732	0.300	0.700	0.282	0.700
20	0.800	0.528	0.039	0.732	0.000	0.700	0.282	0.700
21	0.800	0.528	0.039	0.732	0.300	0.700	0.282	0.700
22	0.100	0.000	0.039	0.732	0.292	0.700	0.282	0.700
23	0.100	0.000	0.039	0.732	0.000	0.700	0.282	0.700
24	0.100	0.000	0.039	0.732	0.300	0.700	0.282	0.700
25	0.486	0.000	0.039	0.732	0.000	0.700	0.282	0.700
26	0.486	0.000	0.039	0.732	0.300	0.700	0.282	0.700
27	0.800	0.000	0.039	0.732	0.292	0.700	0.282	0.700
28	0.800	0.000	0.039	0.732	0.000	0.700	0.282	0.700
29	0.800	0.000	0.039	0.732	0.300	0.700	0.282	0.700
30	0.100	0.900	0.039	0.732	0.292	0.700	0.282	0.700
31	0.100	0.900	0.039	0.732	0.000	0.700	0.282	0.700
32	0.100	0.900	0.039	0.732	0.300	0.700	0.282	0.700
33	0.486	0.900	0.039	0.732	0.000	0.700	0.282	0.700
34	0.486	0.900	0.039	0.732	0.300	0.700	0.282	0.700
35	0.800	0.900	0.039	0.732	0.292	0.700	0.282	0.700
36	0.800	0.900	0.039	0.732	0.000	0.700	0.282	0.700

Scenario	σ_R	ρ_R	σ_C	h	σ_B	ρ_B	σ_N	ρ_N
37	0.800	0.900	0.039	0.732	0.300	0.700	0.282	0.700
38	0.100	0.528	0.039	0.732	0.292	0.000	0.282	0.700
39	0.100	0.528	0.039	0.732	0.292	0.900	0.282	0.700
40	0.800	0.528	0.039	0.732	0.292	0.000	0.282	0.700
41	0.800	0.528	0.039	0.732	0.292	0.900	0.282	0.700
42	0.100	0.000	0.039	0.732	0.292	0.000	0.282	0.700
43	0.100	0.000	0.039	0.732	0.292	0.900	0.282	0.700
44	0.486	0.000	0.039	0.732	0.292	0.000	0.282	0.700
45	0.486	0.000	0.039	0.732	0.292	0.900	0.282	0.700
46	0.800	0.000	0.039	0.732	0.292	0.000	0.282	0.700
47	0.800	0.000	0.039	0.732	0.292	0.900	0.282	0.700
48	0.100	0.900	0.039	0.732	0.292	0.000	0.282	0.700
49	0.100	0.900	0.039	0.732	0.292	0.900	0.282	0.700
50	0.486	0.900	0.039	0.732	0.292	0.000	0.282	0.700
51	0.486	0.900	0.039	0.732	0.292	0.900	0.282	0.700
52	0.800	0.900	0.039	0.732	0.292	0.000	0.282	0.700
53	0.800	0.900	0.039	0.732	0.292	0.900	0.282	0.700

Supplementary Table 4. Factors not varied from the 2018 assessment for the harvest control rule evaluation simulations. The values in this table are based on the operating model that assumed that CPUE is proportional to the square root of selected abundance.

Factor	Values
Extent of log initial abundance estimation error by size-class j, $\sigma_{1,j}$	0.484, 0.468, 0.362, 0.325, 0.343, 0.306, 0.279, 0.275, 0.260, 0.247, 0.251, 0.264, 0.279, 0.296, 0.312, 0.327, 0.349

Supplementary Table 5. The factors considered during the evaluation of the performance of harvest control rules for golden king crab (*Lithodes aequispinus*) in the eastern portion of the Aleutian Islands. The 3 values are lower limits, the estimates for 2018 [marked by asterisks (*)], and upper limits considered in the evaluation of the performance of harvest control rules. The values are based on the operating model in which a linear relationship between catch per unit of effort and square root of selected abundance is assumed. Data used in the model are for golden king crab in 1981–2018. MMB=mature male biomass; MMA=mature male abundance

Factors:	Values
Steepness, h	0.600, 0.732*, 1.200
Recruitment variation, σ_R	0.100, 0.486*, 0.800
Autocorrelation in recruitment, ρ_R	0.000, 0.528*, 0.900
Extent of annual harvest implementation error, σ_C	0.000, 0.039*, 0.100
Extent of mature male biomass estimation error, σ_B	0.000, 0.292*, 0.300
Autocorrelation in mature male biomass estimation error, ρ_B	0.000, 0.700, 0.900
Extent of mature male abundance estimation error, σ_N	0.000, 0.282*, 0.300
Autocorrelation in mature male abundance estimation error, ρ_N	0.000, 0.700, 0.900

Supplementary Table 6. The reference points used in the evaluation of candidate harvest control rules for golden king crab (*Lithodes aequispinus*) from the eastern portion of the Aleutian Islands: a proxy for biomass corresponding to maximum sustainable yield (35% of the unfished level of mature male biomass [MMB_{35}]), the fishing mortality rate corresponding to 35% of the unfished spawning biomass-per-recruit (F_{35}), mean catch, average mature male abundance (MMA_{ave}), and mean catch per unit of effort (CPUE). The estimates are based on the operating model in which a linear relationship between CPUE and square root of selected abundance is assumed. Data used in the model are for golden king crab in 1981–2018.

Reference Point	Estimate	Remarks
MMB_{35}	6654.32t	From the assessment model
F_{35}	0.64 yr^{-1}	
Mean catch	1492.82t	from the 2005–2006 fishing season through the 2018–2019 fishing season (post rationalization period)
Mean *MMA*, MMA_{ave}	5.47 million crab	from the 1985–1986 fishing season through the 2018–2019 fishing season (estimation period)
Mean CPUE	31.70 (number of crab / pot lift)	from the 2005–2006 fishing season through the 2018–2019 fishing season (post rationalization period)

Supplementary Table 7. Conservation performance metrics for golden king crab (*Lithodes aequispinus*) in the Aleutian Islands, with the initial state of the stock set at healthy or overfished, for scenario 1 (based on best parameter estimates) of the operating model in which a linear relationship between catch per unit of effort and square root of selected abundance is assumed. Values for the 5 harvest control rules (HR0, HR10, HR15, HR15U, and HR30) are probabilities that the estimated quantity (*MMB* or total catch) is above or below the associated reference point (MSST, OFL, ABC, MMB_{35}) calculated for the last 10 years of the 30-year projection period, which begins with 2018. For example, values for *MMB*<*MSST* are the probabilities that MMB is below MSST. Harvest control rules were ranked among each other for each performance metric (ranks are given in parentheses). Total catch is the catch retained in the directed pot fishery plus the discard mortality in the directed fishery and the bycatch mortality in the groundfish fishery. The stock is projected from 2 initial levels of abundance, measured in mature male biomass (MMB): a healthy state (i.e., MMB_{2018}/MMB_{35}=1.55) and an overfished state (i.e., MMB_{2018}/MMB_{35}=0.50). MSST=minimum stock size threshold; OFL=overfishing level; ABC=allowable biological catch; and B_{MSY}=the biomass corresponding to maximum sustainable yield.

Conservation metric	Description	HR0	HR10	HR15	HR15U	HR30
Healthy						
Overfished	MMB<MSST	0.000 (1)	0.000 (1)	0.000 (1)	0.000 (1)	0.000 (1)
Severely Overfished	MMB<0.5MSST	0.000 (1)	0.000 (1)	0.000 (1)	0.000 (1)	0.000 (1)
Overfishing (OFL)	TOTC>OFL	0.000 (1)	0.000 (1)	0.000 (1)	0.000 (1)	0.001 (1)
Overfishing (ABC)	TOTC>ABC	0.000 (1)	0.000 (1)	0.000 (1)	0.000 (1)	0.001 (1)
Below B_{MSY}	MMB<$MMB_{35\%}$	0.000 (1)	0.000 (1)	0.037 (3)	0.040 (4)	0.151 (5)
Overfished						
Overfished	MMB<MSST	0.000 (1)	0.000 (1)	0.000 (1)	0.000 (1)	0.000 (1)
Severely Overfished	MMB<0.5MSST	0.000 (1)	0.000 (1)	0.000 (1)	0.000 (1)	0.000 (1)
Overfishing (OFL)	TOTC>OFL	0.000 (1)	0.000 (1)	0.001 (3)	0.001 (3)	0.001 (5)
Overfishing (ABC)	TOTC>ABC	0.000 (1)	0.000 (1)	0.001 (3)	0.001 (3)	0.001 (5)
Below B_{MSY}	MMB<$MMB_{35\%}$	0.000 (1)	0.013 (2)	0.168 (3)	0.171 (4)	0.324 (5)

Supplementary Table 8. Economic performance metrics for golden king crab (*Lithodes aequispinus*) in the Aleutian Islands, with the initial state of the stock set at healthy or overfished, for scenario 1 (based on best parameter estimates) of the operating model in which a linear relationship between catch per unit of effort and square root of selected abundance is assumed. Values for 4 harvest control rules evaluated (HR10, HR15, HR15U, and HR30) are probabilities that the estimated quantity is above or below the associated reference point (e.g., $MMA<0.25MMA_{ave}$ indicates the probability that MMA is below 25% of MMA_{ave}) calculated for the last 10 years of the 30-year projection period, which begins with 2018. The exceptions are for values of catch (mean in metric tons), $CPUE_1$ (given as the number of crab per pot lift), and effort (given as the number of pot lifts). Harvest control rules were ranked among each other for each performance metric (ranks are given in parentheses). Catch is the catch retained in the directed port fishery. The stock is projected from 2 initial levels of abundance, measured in mature male biomass (MMB): a healthy state (i.e., $MMB_{2018}/MMB_{35}=1.55$) and an overfished state (i.e., $MMB_{2018}/MMB_{35}=0.50$). MMA=mature male abundance; MMA_{ave}=average MMA; $Catch_{AveHist}$=historical average catch; and $MMA_{AveHist}$=historical average MMA.

Economic metric	Unit/Description	HR10	HR15	HR15U	HR30
Healthy					
Fishery closure	$MMA<0.25MMA_{ave}$	0.000 (1)	0.000 (1)	0.000 (1)	0.000 (1)
Catch	Ave (t)	1465 (4)	1680 (3)	1681 (2)	1739 (1)
Catch Variability	Annual proportional change in catch	0.095 (1)	0.097 (3)	0.103 (4)	0.095 (2)
Relative Catch	$Catch<Catch_{AveHist}$	1.000 (4)	0.350 (3)	0.347 (2)	0.316 (1)
$CPUE_1$	Ave (no.)	47.9 (1)	41.3 (2)	41.0 (3)	37.9 (4)
$CPUE_2$	$CPUE<CPUE_{AveHist}$	0.000 (1)	0.004 (2)	0.004 (3)	0.025 (4)
Effort	Pot lifts	15684 (1)	20860 (2)	21026 (3)	23530 (4)
Stock Status	$MMA<MMA_{AveHist}$	0.000 (1)	0.214 (2)	0.221 (3)	0.375 (4)
Overfished					
Fishery closure	$MMA<0.25MMA_{ave}$	0.000 (1)	0.000 (1)	0.000 (1)	0.000 (1)
Catch	Ave (t)	1331 (4)	1480 (3)	1483 (2)	1499 (1)
Catch Variability	Annual proportional change in catch	0.092 (1)	0.095 (3)	0.099 (4)	0.092 (2)
Relative Catch	$Catch<Catch_{AveHist}$	0.720 (4)	0.549 (2)	0.545 (1)	0.555 (3)
$CPUE_1$	Ave (no.)	149.5 (1)	115.9 (2)	115.1 (3)	102.8 (4)
$CPUE_2$	$CPUE<CPUE_{AveHist}$	0.000 (1)	0.001 (2)	0.001 (2)	0.001 (4)

Economic metric	Unit/Description	HR10	HR15	HR15U	HR30
Effort	Pot lifts	4566 (1)	6549 (2)	6607 (3)	7478 (4)
Stock Status	$MMA<MMA_{AveHist}$	0.173 (1)	0.426 (2)	0.431 (3)	0.572 (4)

Supplementary Table 9. Decision matrix based on average policy ranks within each metric used to evaluate harvest control rules (HR0, HR10, HR15, HR15U, and HR30) for golden king crab (*Lithodes aequispinus*) in the Aleutian Islands, when a linear relationship between catch per unit of effort and square root of selected abundance is assumed in the operating model. Values are based on the last 10 years of the 30-year projection period, which begins with 2018. The stock is projected from 2 initial levels of abundance, measured in mature male biomass (MMB): a healthy state (i.e., MMB_{2018}/MMB_{35}=1.55) and an overfished state (i.e., MMB_{2018}/MMB_{35}=0.50). Values are average ranks within each metric, with ranks of the average metric ranks given in parentheses. The ranks of the catch metric correspond only to the long-term averages of retained catch; therefore, no average ranks were computed.

	Conservation	Catch	Catch Stability
Healthy			
HR0	1.00 (1)		
HR10	1.00 (1)	4	1.43 (1)
HR15	1.40 (3)	3	2.14 (2)
HR15U	1.60 (4)	2	2.71 (3)
HR30	1.80 (5)	1	2.86 (4)
Overfished			
HR0	1.00 (1)		
HR10	1.20 (2)	4	1.43 (1)
HR15	2.20 (3)	3	2.00 (2)
HR15U	2.40 (4)	2	2.43 (3)
HR30	3.40 (5)	1	3.14 (4)