

# Economic Status Report Summary: BSAI Crab Fisheries, 2013

The BSAI crab fisheries managed under the North Pacific Fishery Management Council's Fishery Management Plan (FMP) for Bering Sea/ Aleutian Islands crab are currently prosecuted by an active fleet of 110 catcher vessels and three catcher processors, and landed and processed at 21 processing facilities throughout the region. Of the 10 crab stocks managed under the FMP, seven<sup>1</sup> are currently open to targeted fishing. Pribilof Islands red- and blue king, and Western Aleutian red king crab stocks are currently designated overfished, as detailed in the assessments for these stocks, and the Eastern Bering Sea Tanner (EBT) crab fishery remained closed to targeted fishing for the 2012/13 season under the State of Alaska's management strategy. This report provides a brief summary of key indicators of economic status and performance of BSAI crab fisheries for 2013.<sup>2</sup>

## ***Fishery production and economic value – 2008-2012***

Harvest- and processing sector production statistics by crab fishery, including ex-vessel and 1<sup>st</sup> wholesale output, estimated revenue, and average prices are shown in Table 1 for calendar years 2008-2012 and summarized in Figure 1. Across all fisheries managed under the BSAI Crab FMP, the total volume of ex-vessel landings during 2012 was 104 million pounds, a 48 percent increase from the previous year. Processing sector finished production volume during 2012 was 67 million pounds aggregated over all FMP crab species and product forms, a 39 percent increase over the previous year. After reaching the highest levels observed since 2004, average prices reported in both sectors declined toward 2010 levels for most BSAI crab produced in 2012, with the result of total gross revenues over all fisheries remaining nearly constant from 2011 levels despite substantial increases in physical output: \$253<sup>3</sup> million ex-vessel for the year, decreased from \$258 million for 2011 (-2%), and \$392 million first wholesale revenues (+8% from the previous year).

As of 2012, allowable catch quantities in all BSAI crab fisheries currently open to targeted fishing are fully exploited (> 98% of total allocation landed), and recent inter-annual variation in commercial landings largely reflects stock assessment results and catch limits rather than changes in fishing capacity or exploitation rate. Notably,

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<sup>1</sup> Individual statistics where indicated in Tables 1 and 2 are suppressed in this report due to confidentiality restrictions and the small number of reporting entities; this includes most values for the Pribilof Island golden king (PIG) crab fishery and processing sector results for the Norton Sound red king (NSR) crab fishery; values that are indicated as suppressed in Tables 1 and 2 are also excluded from values reported in aggregate over multiple crab fisheries. Except where noted, the suppressed values are sufficiently small that they have minimal effect on the accuracy of aggregate information at the level of precision reported here.

<sup>2</sup> The Economic Status Report for BSAI Crab provides a comprehensive presentation of statistical information and analysis regarding economic dimensions of the fishery evaluation; update of the report for 2013 is in preparation and will include information on operating and quota lease costs for 2012 provided by revised EDR data collection.

<sup>3</sup> All prices are inflation-adjusted to 2012 dollars.

however, 2012 represented the first season that landings in the Saint Matthew blue king (SMB) crab fishery approached 100% of the combined target allocation, from less than 50% in 2009 when the fishery re-opened. The increase in aggregate production during 2012 was driven largely by the 88.9 million pounds of Bering Sea snow crab (BSS) landed, a 63 percent increase in volume over the previous year. Norton Sound red king crab (NSR) landings increased to 500 thousand pounds landed (+28%), and landings of 5.8 million pounds in Aleutian Islands golden king (AIG) and 7.8 million pounds in Bristol Bay red king (BBR) crab fisheries changed only slightly from the previous year, with the latter remaining at approximately half the level of the previous 5-year average.

Similar to ex-vessel production, the proportional increase in processing sector output aggregated over all active crab fisheries was driven by the 56.9 million pounds of BSS fishery production, increased by 50 percent in volume over the previous year. Finished volume in the BBR fishery of 5.2 million pounds (2.4 mt) was unchanged from 2011, where both years were near historical lows for the period since 1998. AIG and SMB fisheries produced 3.8 million and 1.13 million pounds of finished volume, respectively, the latter decreasing by 15 percent from 2011 output.

Ex-vessel and wholesale Alaska crab prices in 2012 reversed the upward trend of 2009-2011 in four of the five fisheries. BBR fishery average ex-vessel price dropped by 30 percent for 2012, to \$7.27 per pound, reversing the 34 percent price increase from 2010-2011; the average 2012 BBR wholesale price reported by processors declined by 20 percent, to \$15.09 per pound for 2012. AIG prices in both sectors similarly offset 2011 increases, falling to \$3.51 ex-vessel (-24%) and \$8.37 first wholesale (-13%) per-pound averages. The SMB average first wholesale price of \$12.45 fell by 12%, and the \$3.77 average ex-vessel price fell 28% from 2011. The exception to the general result of falling prices for 2012, NSR crab sales continued a gradual four-year trend of increasing average ex-vessel price, reaching \$5.48 per pound, 5.6% over the 2011 average<sup>4</sup>.

The estimated gross revenue value of production in the 2012 BSS fishery increased from 2011 levels to \$167 million ex-vessel (+21% over 2011), and \$268 million first wholesale (+28%), compared to much larger proportional increases in physical output of 68 percent and 50 percent, respectively. With physical output of both sectors in BBR and AIG fisheries largely held constant, estimated gross revenues for BBR fell to \$56.8 million ex-vessel (-30%) and \$78.7 million first wholesale (-36%), and AIG estimated revenues fell to \$20.5 million ex-vessel (-26%) and \$31.6 million wholesale (-10%). Declines in both physical output and prices in the SMB fishery combined to reduce ex-vessel gross revenue to an estimated \$5.97 million (-39%), and estimated first wholesale revenue fell to \$14.1 million (-25%). The NSR fishery exhibited the opposite, with increases in both price and output combining to increase gross ex-vessel revenue an to an estimated \$2.72 million (+30%). The 20-35% proportional inter-annual variation in gross revenue from 2011-2012 for these fisheries is approximately consistent with the average degree of variation over the last 15 years; longer time series for these and other

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<sup>4</sup> Processing sector results for the Norton Sound red king crab fishery are not available.

measures of crab fishery performance are available in the full BSAI Crab Economic Status Report, currently being updated for release in November, 2013.

### ***Price and revenue forecasts for 2013***

As noted above, calendar year 2012 data is the most current information available from primary economic data sources for Alaska fisheries. To provide more current information for this report, preliminary estimates of 2013 production and price variables are produced using forecasts of wholesale price for AIG, BBR, and BSS fisheries, extending the econometric model framework developed previously for the Council's analysis for Amendment 38 (NMFS, 2011). The forecast analysis uses vector autoregression (VAR) time-series methods to model historical data series (1991-2012) of wholesale prices for Alaska red- and golden king crab and snow crab from Commercial Operators Annual Report (COAR), and U.S. import- and export- volume and price series for king and snow crab from the U.S. Merchandise Trade Statistics to estimate median and 90% confidence intervals for Alaska crab wholesale market prices. To improve the precision of near-term forecasts, i.e., estimation of Alaska crab wholesale prices established during early 2013 for which COAR data are not yet available, the analysis leverages import/export trade data published up to a year in advance of Alaska-specific data sources.

A detailed description of the analytical methodology and model development is provided in Dalton (2008), and documentation of model selection and estimation results for price forecasts used in this report are provided in Appendix A. Price forecast intervals for 2013 AIG, BBR, and BSS fisheries are shown in Table 2, with estimates of ex-vessel and finished wholesale volume and revenue to-date for 2012/13 season AIG and BSS landings after January 1 of this year. Ex-vessel price estimates were derived using the wholesale price forecasts and conversion factors based on the average ratio of ex-vessel price to first-wholesale price observed over the 2007-2011 period. In-season commercial landings data for AIG and BSS fisheries to-date, combined with price forecasts and average product recovery rates observed over 2007-2011 were used to estimate production volume and revenue to-date in the ex-vessel and processing sectors for these fisheries. All data used in these estimations reflect final ex-vessel settlement prices, such that the price and revenue estimates shown in Table 2 represent final settlement values.

Wholesale price for golden king crab produced and sold in the AIG fishery during 2013 is estimated at \$10.24, with a 90% confidence forecast interval of \$9.17-\$11.34, substantially higher than the average price of \$8.37 observed for 2012. Wholesale price for snow crab produced and sold in the BSS fishery during 2013 is estimated at \$5.48, with a 90% confidence interval of \$5.18-\$5.78. The Bristol Bay red king crab price for 2013 is forecast with a median of \$18.38 (\$15.90-\$20.96 confidence interval). Forecasts for both red- and golden king crab indicate an increase of approximately 22% above 2012 averages, and snow crab price is forecast to increase 16% over the 2011 average. All three forecast medians approximate the 2011 average wholesale prices for the respective fisheries, which established high points for the post-rationalization period.

With 1.36 million pounds of golden king crab landed in the western and eastern AIG fishery during January-May, 2013 year-to-date finished production is estimated at 0.86 million pounds, and gross wholesale revenue is estimated at \$8.86 million; this does not represent the full calendar year total for 2013 as these figures will increase when updated to include 2013/14 season catch landed during August-December of 2013. No additional landings in the BSS fishery are expected, and estimated values shown in Table 2 for this fishery represent preliminary totals for the full 2013 calendar year. With 65 million pounds landed and sold during 2013 (>98% of the 2012/13 66.35 million pound catch limit), final ex-vessel revenue for the fishery is estimated at \$154 million ( $\pm$  \$8 million), based on an estimated ex-vessel price of \$2.36 ( $\pm$  0.13) per pound. At an estimated 42.7 million pounds finished volume, forecasted BSS wholesale revenue for 2013 is \$234.22 ( $\pm$ \$12.82) million. For the BBR fishery, Table 2 displays price information only; no landings have occurred to date as the fishery does not open until October.

### ***Employment and Income***

A summary of selected indicators from the most recent employment data available for Crab Rationalization (CR) program fisheries is provided in Table 3. Crab EDR data for calendar year 2012 are reported where available<sup>5</sup>, but results are preliminary pending completion of data validation and additional analyses. Due to a change in EDR crew and processing labor employment and pay reporting for catcher-processors, 2012 EDR data for AIG, BBR, and BSS fisheries are suppressed pending determination of appropriate aggregation protocols to maintain confidentiality for these data; full 2012 results are presented for the SMB fishery only.

The number of vessels operating in CR fisheries in 2012 increased from 77 to 83, and from 102 to 113 across all BSAI crab fisheries. Based on the average (mean) number of crew onboard (as reported in eLandings catch accounting records for crab vessels), there were an estimated 1037 crew positions across all 83 vessels in CR fisheries in 2012. Over the last 5 years, both the aggregate number of vessels and total crew positions have varied contemporaneously with the total size of crab catch allocations, declining in 2010 and 2011 and increasing in 2012 as BSS allocations were substantially increased. However, neither the number of vessels operating in individual fisheries or the number of crew positions has varied proportionally with catch, with vessel and crew participation rates varying to a lesser degree than catch. For example, changes in crew positions have varied from year-to-year by -14% to +19% in the BSS fishery, compared to much larger annual variations in catch.

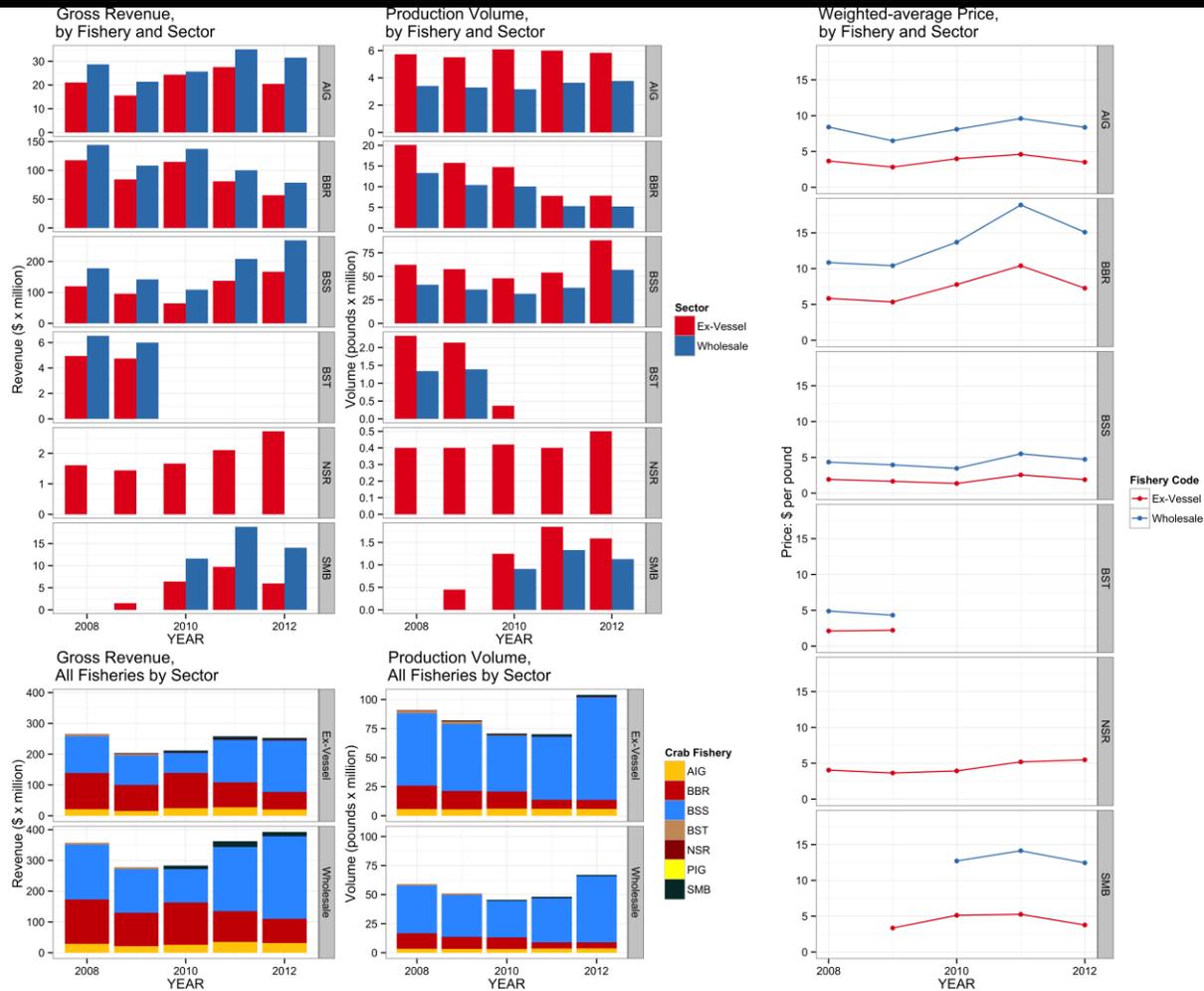
Crew compensation and processing sector employment and pay for 2008-2011 are shown in Table 3; these results will be updated for 2012 upon completion of validation and analysis of crab EDR data submitted by crab industry participants in July of this year, and will be released with the full Economic Status Report for BSAI Crab for 2013. Revenue-share payments to crab vessel crew members as a group totaled approximately \$34.7

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million in 2011, with \$16.1 million of that total going to vessel captains. For both groups, incomes rose in 2011, reflecting the overall increase in ex-vessel revenue described above. However, crew and captain revenue-share earnings increased by 31 and 27 percent over 2010 levels, somewhat greater proportionally than the corresponding increase in aggregate ex-vessel revenue. In addition to revenue-share payments, income is derived by some crew and many captains from royalties for harvesting quota shares held by either the captain or crew. While this may become an increasingly important source of income as opportunities for investment in QS ownership are advanced, there is no evidence to-date that the proportion of CR fishery quota share pools held by crab crew members has changed in recent years, following some limited consolidation that occurred during the initial years of the program (see NMFS Alaska Region, Restricted Access Management Program, Bering Sea and Aleutian Islands Crab Rationalization Program Report, Fishing Year 2011/12 for information on quota allocation and transfer activity, and other current CR program administration details).

Crab processing labor input associated with the IFQ and CDQ fisheries is estimated at nearly 681 thousand hours of processing labor expended on crab production in 2011, generating slightly greater than \$8 million in labor income. Most processing facilities that receive crab landings do not exclusively process crab, however, and it may be difficult to attribute crab processing labor to specific employment effects. The high degree of variance in the measure of crab processing labor hours likely reflects variation in processors' ability to track labor input by species for reporting compliance. The trend in processing labor input as reported in the BSAI Crab Economic Data Report (EDR) indicates general consistency with catch and production volume fluctuations. However, total processing labor hours declined across all CR fisheries, and by approximately 14% from 2010 overall, despite aggregate production volume remaining approximately constant from 2010 to 2011.

Figure 1: BSAI Crab Ex-vessel and First Wholesale Production, 2008-2012



(a) Revenue, (b) Volume, and (c) Weighted Average Price, 2008-2012; gross revenue and production volume by sector are presented in the upper pair of panels by individual crab fishery for comparison of within-fishery variation over time, and summarized over all fisheries in the lower panels to illustrate the variation in aggregate values and relative contribution of each fishery over time. See Table 1 footnotes for details.

Table 1: BSAI crab harvest and processing sector output - production volume, gross revenue, and average price, 2008-2012

Harvest Sector: Ex-Vessel Statistics <sup>a</sup>						Processing Sector: First Wholesale Statistics <sup>b</sup>						
Fishery: Year	Vessels	CFEC permits	Landed volume 1000 <i>mt</i>	million lbs	Gross revenue \$million	Average price \$/lb	Plants	Buyers	Finished volume 1000 <i>mt</i>	million lbs	Gross revenue \$million	Average price \$/lb
<b>Total - All BSAI crab fisheries <sup>d</sup></b>												
2008	116	261	41.2	90.82	\$264.93		21	23	26.8	59.07	\$357.65	
2009	112	242	37.18	81.96	\$203.35		22	26	23.16	51.06	\$277.69	
2010	102	232	32.08	70.72	\$211.95		19	24	20.65	45.53	\$283.30	
2011	102	235	31.79	70.09	\$258.04		18	27	21.85	48.17	\$362.50	
2012	113	284	47.15	103.95	\$252.76		20	26	30.39	67.01	\$392.61	
<b>Aleutian Islands golden king - Eastern and Western (AIG)</b>												
2008	5	12	2.6	5.73	\$21.03	\$3.67	7	7	1.55	3.41	\$28.71	\$8.41
2009	5	13	2.5	5.51	\$15.56	\$2.82	6	9	1.5	3.3	\$21.39	\$6.49
2010	5	13	2.76	6.09	\$24.32	\$3.99	5	9	1.44	3.17	\$25.67	\$8.10
2011	5	13	2.72	6	\$27.58	\$4.60	7	14	1.65	3.64	\$35.00	\$9.60
2012	6	14	2.65	5.84	\$20.49	\$3.51	8	14	1.71	3.77	\$31.56	\$8.37
<b>Bristol Bay red king (BBR)</b>												
2008	79	97	9.13	20.13	\$117.54	\$5.84	15	17	6.04	13.31	\$144.35	\$10.85
2009	70	86	7.16	15.78	\$84.22	\$5.34	13	16	4.72	10.4	\$108.27	\$10.41
2010	65	79	6.68	14.73	\$114.68	\$7.78	14	17	4.55	10.03	\$137.29	\$13.69
2011	62	71	3.53	7.79	\$80.95	\$10.40	14	18	2.41	5.3	\$100.18	\$18.89
2012	64	74	3.54	7.8	\$56.77	\$7.27	12	17	2.36	5.21	\$78.65	\$15.09
<b>Eastern Bering Sea snow (BSS)</b>												
2008	78	108	28.23	62.23	\$119.81	\$1.93	16	17	18.61	41.02	\$178.06	\$4.34
2009	77	103	26.17	57.69	\$95.87	\$1.66	15	17	16.31	35.97	\$142.04	\$3.95
2010	68	87	21.7	47.84	\$64.88	\$1.36	11	13	14.25	31.41	\$108.71	\$3.46
2011	68	88	24.52	54.05	\$137.68	\$2.55	14	16	17.18	37.89	\$208.48	\$5.50
2012	72	109	40.02	88.23	\$166.81	\$1.89	13	16	25.81	56.9	\$268.32	\$4.72

Source: ADF&G fish tickets, eLandings, CFEC pricing, ADF&G Commercial Operator's Annual Report, NMFS AFSC BSAI Crab Economic Data Report (EDR) database. Data shown for all BSAI crab fisheries by calendar year. All dollar values are adjusted for inflation to 2012-equivalent value. Information suppressed for confidentiality where indicated by "--"

<sup>a</sup> Except where noted, ex-vessel results reflect total commercial sales volume and value across all management programs (LLP/open access, IFQ, CDQ, ACA), inclusive of all harvest sector production (CV, CP, and catcher-sellers); ex-vessel value of CP and catcher-seller landings incorporated in revenue total by approximation using average CV ex-vessel sale price; ex-vessel average price results are sourced from CV sector EDR data where available (2008-2011 for CR program fisheries) and secondarily from CFEC gross earnings estimates (2012 for CR fisheries; all years for non-CR fisheries).

Table 1 (continued)

		Harvest Sector: Ex-Vessel Statistics <sup>a</sup>					Processing Sector: First Wholesale Statistics <sup>b</sup>					
Fishery: Year	Vessels	CFEC permits	Landed volume		Gross revenue \$million	Average price \$/lb	Plants	Buyers <sup>c</sup>	Finished volume		Gross revenue \$million	Average price \$/lb
			1000 <i>mt</i>	million lbs					1000 <i>mt</i>	million lbs		
<b>Eastern Bering Sea Tanner (BST)<sup>d</sup></b>												
2008	30	38	1.06	2.33	\$4.94	\$2.12	11	11	0.61	1.34	\$6.53	\$4.89
2009	18	24	0.97	2.14	\$4.75	\$2.22	10	11	0.63	1.39	\$5.99	\$4.32
2010	4	5	0.17	0.37	--	--	7	7	--	--	--	--
2011-2012							CLOSED					
<b>Norton Sound red king (NSR)<sup>e</sup></b>												
2008	22	34	0.18	0.4	\$1.61	\$4.04	2	2	--	--	--	--
2009	23	29	0.18	0.4	\$1.44	\$3.64	3	3	--	--	--	--
2010	23	37	0.19	0.42	\$1.66	\$3.93	2	3	--	--	--	--
2011	25	38	0.18	0.4	\$2.10	\$5.19	2	2	--	--	--	--
2012	30	64	0.23	0.5	\$2.72	\$5.48	3	3	--	--	--	--
<b>Pribilof Island golden king (PIG)</b>												
2008-2009							CLOSED					
2010	1	1	--	--	--	--	2	2	--	--	--	--
2011	2	2	--	--	--	--	1	1	--	--	--	--
2012	1	1	--	--	--	--	1	1	--	--	--	--
<b>Saint Matthew blue king (SMB)</b>												
2008							CLOSED					
2009	7	7	0.2	0.45	\$1.51	\$3.35	2	6	--	--	--	--
2010	11	14	0.57	1.25	\$6.41	\$5.12	5	9	0.41	0.91	\$11.63	\$12.71
2011	18	23	0.84	1.85	\$9.73	\$5.26	6	11	0.6	1.33	\$18.83	\$14.14
2012	17	22	0.72	1.59	\$5.97	\$3.77	6	11	0.51	1.13	\$14.08	\$12.45

<sup>b</sup> Counts of buyers include CPs landing and processing their own crab, but exclude catcher sellers (NSR fishery only); processing sector results inclusive of all CP and shoreside processor output; finished volume sourced from crab processor EDR production reports where available (2008-2011), or eLandings ex-vessel sales volume adjusted by average product recovery rate (PRR) by fishery (2012). Wholesale price results are sourced from crab processor EDR gross earnings reports where available (2008-2011) and secondarily from COAR gross earnings estimates (2012); gross wholesale revenue estimates are derived from price and volume sourced or estimated as described.

<sup>c</sup> Statistics reported for "All BSAI Fisheries" reflect information aggregated over all FMP crab fisheries, excluding fishery-level confidential information suppressed where indicated by "--".

<sup>d</sup> Landings and ex-vessel revenue suppressed in years where CDQ fishery landings are confidential.

<sup>e</sup> Data for Norton Sound red king crab are aggregated over the summer and winter commercial fisheries.

Table 2: 2013 Wholesale price forecasts and estimated year-to-date production - AIG, BBR, and BSS fisheries

Fishery	WS Price Forecast ±90%CI <sup>a</sup> \$/lb	Price Ratio <sup>b</sup>	PRR <sup>c</sup>	Landed volume <sup>e</sup> 2013 YTD <sup>d</sup>		Estimated Production Values, 2013 To-Date				
						Ex-vessel		Wholesale		
						Price ±90%CI \$/lb	Gross Revenue ±90%CI \$million	Finished volume		Gross Revenue ±90%CI \$million
				1000 <i>mt</i>	million lbs			1000 <i>mt</i>	million lbs	
AIG	\$10.24 ±1.07	0.46	0.63	0.62	1.36	\$4.72 ±0.49	\$6.43 ±0.67	0.39	0.86	\$8.86 ±0.93
BSS	\$5.48 ±0.3	0.43	0.66	29.60	65.25	\$2.36 ±0.13	\$153.98 ±8.48	19.39	42.74	\$234.22 ±12.82
BBR	\$18.38 ±2.48	0.54	0.68			\$9.97 ±1.35				

Source: ADF&G Commercial Operator's Annual Report, eLandings, NMFS AFSC BSAI Crab Economic Data Report (EDR) database.

<sup>a</sup> See Appendix A for forecast methods and model estimation results.

<sup>b</sup> Calculated as arithmetic mean of  $(p_e/p_w)_{t=2007-2011}$ , where  $p_e$  is average ex-vessel price and  $p_w$  is average wholesale price calculated from 2007-2011 crab EDR data.

<sup>c</sup> Calculated as arithmetic mean of  $(v_e/v_w)_{t=2007-2011}$ , where  $v_e$  is total volume of commercial ex-vessel landings and  $v_w$  total finished crab product volume calculated from 2007-2011 crab EDR data.

<sup>d</sup> Landings to-date for AIG and BSS represent catch of 2012-2013 season allocations for these fisheries landed between 1/1/13 and 5/31/13; does not include catch of 2013/14 season allocations; BSS landings represent the total expected volume for 2013.

<sup>e</sup> Confidence intervals for derived price and revenue estimates are propagated solely on the basis of wholesale price forecast model standard errors and do not reflect distributional information for other variables used in the calculation of estimated values.

Table 3: CR program fisheries crew and processing sector employment and earnings, 2008-2012

Crab Crew Employment and Earnings								Crab Processing Employment and Earnings					
Fishery: Year <sup>b</sup>	Crew positions			Crew share		Captain share		Processing labor hours			Processing labor payment		
	Obs	Total	Vessel mean	Total \$million	Vessel median \$1000	Total \$million	Vessel median \$1000	Obs	Total 1000 hrs <sup>d</sup>	Plant median 1000 hrs	Total \$1million	Plant median \$1000	Median \$/hour <sup>e</sup>
<b>All CR Program Fisheries<sup>e,g</sup></b>													
2008	96	1045		\$32.4		\$15.1		18	1022		\$13.5		
2009	89	1072		\$26.9		\$12.6		17	917		\$11.1		
2010	79	918		\$26.5		\$12.7		15	796		\$8.3		
2011	77	967		\$34.7		\$16.1		16	751		\$8.4		
2012	83	1037	--	--	--	--	--		--		--		
<b>Aleutian Islands golden king - Eastern and Western (AIG)<sup>f,g</sup></b>													
2008	4	--	--	--	--	--	--	6	38	2.8	\$0.6	\$101	\$12.38
2009	5	31	6.2	\$2.0	\$409	\$1.2	\$221	5	48	3.7	\$0.9	\$147	--
2010	5	31	6.2	\$3.2	\$642	\$1.8	\$277	4	--	--	--	--	--
2011	5	33	6.6	\$3.9	\$652	\$2.1	\$347	7	52	3.3	\$1.1	\$74	\$9.89
2012	6	46	7.67	--	--	--	--		--	--	--	--	--
<b>Bristol Bay red king (BBR)<sup>g</sup></b>													
2008	76	452	5.95	\$14.9	\$170	\$6.7	\$82	11	245	12.6	\$3.0	\$301	\$11.89
2009	70	424	6.06	\$10.2	\$130	\$4.8	\$68	12	205	9.7	\$2.4	\$139	\$11.46
2010	65	401	6.16	\$13.1	\$194	\$6.2	\$100	13	222	15.5	\$2.4	\$194	\$10.10
2011	62	385	6.21	\$10.3	\$150	\$4.8	\$82	14	107	4.7	\$1.2	\$73	\$10.14
2012	64	413	6.45	--	--	--	--		--	--	--	--	--
<b>Eastern Bering Sea snow (BSS)<sup>g</sup></b>													
2008	74	447	6.03	\$16.9	\$210	\$8.1	\$107	12	712	30.5	\$9.4	\$540	\$11.56
2009	77	491	6.38	\$13.9	\$159	\$6.2	\$78	14	633	24.7	\$7.4	\$339	\$11.38
2010	67	418	6.24	\$9.2	\$124	\$4.1	\$58	11	548	39.6	\$5.6	\$373	\$10.19
2011	68	437	6.43	\$19.3	\$272	\$8.6	\$126	14	575	31.2	\$6.0	\$345	\$10.25
2012	72	473	6.56	--	--	--	--		--	--	--	--	--

Table 3: continued

Crab Crew Employment and Earnings								Crab Processing Employment and Earnings					
Fishery: Year <sup>b</sup>	Crew positions <sup>a</sup>			Crew share payment <sup>b</sup>		Captain share payment <sup>b</sup>		Processing labor hours <sup>c</sup>			Processing labor payment		
	Obs	Total	Vessel mean	Total \$million	Vessel median \$1000	Total \$million	Vessel median \$1000	Obs	Total 1000 hrs <sup>d</sup>	Plant median 1000 hrs	Total \$million	Plant median \$1000	Median \$/hour <sup>d</sup>
<b>Eastern Bering Sea Tanner (BST)</b>													
2008	26	146	5.62	\$0.6	\$15	\$0.3	\$8	8	27	2.9	\$0.5	\$49	\$11.62
2009	14	87	6.21	\$0.6	\$30	\$0.4	\$17	8	31	3.3	\$0.3	\$36	\$10.88
2010	4	--	--	--	--	--	--	5	6	0.7	\$0.1	\$7	\$10.16
<b>Saint Matthew blue king (SMB)</b>													
2009	7	39	5.57	\$0.2	\$19	\$0.1	\$8	2	--	--	--	--	--
2010	12	68	5.67	\$1.0	\$78	\$0.6	\$45	5	19	0.4	\$0.2	\$4	\$9.90
2011	18	112	6.56	\$1.2	\$57	\$0.6	\$31	6	17	0.8	\$0.2	\$8	\$9.11
2012	17	106	6.24	\$0.8	\$43	\$0.4	\$22	6	21.12	0.76	\$0.2	\$7	\$9.59

Source: NMFS AFSC BSAI Crab Economic Data. Crew positions from eLandings. Data shown for all BSAI crab fisheries by calendar year. All dollar values are adjusted for inflation to 2012-equivalent value. Information suppressed for confidentiality where indicated by "--".

<sup>a</sup> For catcher processors, EDR reporting may be used to adjust eLandings crew size reporting in order to estimate the number of fishing crew and processing positions.

<sup>b</sup> Crew and captain payments reflect amounts paid for labor during the crab fishery and include all post-season adjustments, bonuses, and deductions for shared expenses such as fuel, bait, and food and provisions; payments for IFQ royalties, labor outside of crab fishery, health/retirement or other benefits are excluded.

<sup>c</sup> Processing labor hours for catcher processors are estimated by multiplying processing positions, number of days processing, and an assumed shift length of 12 hours per day.

<sup>d</sup> For all years, pay per hour statistics reflect only the shoreside and floating processing sectors.

<sup>e</sup> Statistics reported for "All BSAI Fisheries" reflect information aggregated over all rationalized crab fisheries, excluding fishery-level confidential information suppressed where indicated by "--". Values that are discontinuous with the rest of the series for a given variable due to data suppression are italicized.

<sup>f</sup> Due to confidentiality restrictions, Aleutian Islands Eastern and Western golden king crab fisheries are reported in aggregate. Where an entity reported labor information for both the Eastern and Western fisheries, counts of crew positions are averaged over both fisheries under the assumption that the same individuals are employed in both fisheries.

<sup>g</sup> Aggregate 2008 statistics for AIG, BBR, BSS, and BST are not directly comparable to results for later years; 2008 results exclude catcher processor data to preserve confidentiality, while sector-level results for 2009 and later reflect combined catcher processor data and catcher vessel/shoreside processor data. Due to change in CP EDR labor reporting, 2012 EDR data for AIG, BBR, BSS fisheries are suppressed pending determination of aggregation protocol for these data.

## **References**

**Dalton, M.** 2008. "A Time-Series Analysis of U.S. Import Prices and Alaska Processors' Wholesale Prices for King Crab (Draft)," Seattle, WA: NOAA Fisheries, Alaska Fisheries Science Center, 26p.

**National Marine Fisheries Service (NMFS).** 2011. "Environmental Assessment for Proposed Amendment 38 (Annual Catch Limits) and Amendment 39 (Snow Crab Rebuilding Plan) to the Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs," Juneau, Alaska: National Marine Fisheries Service, Alaska Regional Office. 401p, additional appendices.

## **Appendix to Economic Status Report Summary: BSAI Crab Fisheries, 2013**

### **PROBABILITY FORECASTS FOR ALASKA KING CRAB AND SNOW CRAB WHOLESALE PRICES: VAR(3) ANALYSIS**

#### **INTRODUCTION**

This document briefly summarizes model development and data updates and extensions to documentation of price forecast methods and results developed to support analysis of Proposed Amendments 38 and 39 of the BSAI Crab FMP (NMFS, 2011; pp 417-439). That report described a time series model that was used to estimate probabilistic forecast trajectories of crab wholesale prices for use in economic analysis of long-term simulations of crab population scenarios under management alternatives for implementation of Annual Catch Limits (ACLs). This appendix updates the VAR(3) model documentation from July, 2011. Specifically, it employs models for gold king crab and red king crab based on time series for king crab import and export prices, and COAR price indices for gold king crab and red king crab, respectively, and replaces the model for snow crab with one based on time series for snow crab COAR price, snow crab import price, and snow crab export price. The selected models are used to estimate short-term price forecasts of COAR price indices to estimate current-year (2013) Alaska crab wholesale prices based on 1991-2012 time series, updated with import/export price series current to July 2013.

#### **DATA**

Time series data for the period 1991-2012 were derived from COAR reports and U.S. Census Bureau Merchandise Trade Statistics, the latter were accessed via the U.S. Trade Policy Information System (TPIS). The COAR time series represent the i) physical quantity of production in each year and ii) an index of real first-wholesale prices (i.e., economic value per physical unit) for (all) types of frozen crab products. Separate series were derived from COAR for gold king crab, red king crab, and snow crab. Similarly, quantities and price indices for exports and imports were retrieved from the TPIS. However, the trade data do not distinguish among the three king crab species, and thus, are most comparable to the aggregate COAR series. In forming the real price indices, all nominal economic values were converted into 2012-equivalent real economic values using a price deflator based on a producer price index (PPI) available from the U.S. Bureau of Labor Statistics (BLS), WPU0223= Processed and unprocessed fish, a general category that includes frozen shellfish commodities.

#### **MODEL**

Vector autoregression (VAR) models with (alternatively) lags of 1-2-3 years were considered. Model specification tests based on the Akaike Information Criterion (AIC) and the Bayesian-Schwarz Information Criterion (BIC) were conducted using the 1991-2008 dataset. These, and a battery of bivariate, trivariate, quadrivariate Granger causality tests, had the strongest support for the VAR(3) model specification. The number of parameters to estimate grows with each lag and the VAR(4) model exhausted the time series. Likewise, the number of parameters grows for each series that is added to the system, and the statistical software (S+Finmetrics) had severe problems with bad results,

for example, with a VAR(3) and 4 series. In terms of the backtesting results, the VAR(2) model with 4 series was outperformed by the best VAR(3) with 3 series. Therefore, model selection here is limited to the VAR(3) specification, each with three time series for prices. The software that was used is S+8 with the module Finmetrics 3. All tests, estimation, and forecasting procedures are described in Chapter 11 ("Vector autoregressive models for multivariate time series") of Zivot and Wang (2003). The final set of models that were used to forecast prices are each represented by three time series (x1, x2, x3):

1. Gold king crab: COAR gold king crab price index (x1), TPIS king crab export price index (x2), TPIS king crab import price index (x3);
2. Red king crab: COAR red king crab price index (x1), TPIS king crab export price index (x2), TPIS king crab import price index (x3);
3. Snow crab: COAR snow crab price index (x1); TPIS snow crab export price index (x2), TPIS snow crab import price index (x3).

**DATA and SOURCES:**

Alaska 1<sup>st</sup> Wholesale price:

ADFG Commercial Operators Annual Report (COAR)

Series for golden king crab, red king crab, snow crab, all product forms, processors with 4 or 5 active years in 2008-2012: COAR\_GKC, COAR\_RKC, COAR\_SNOW

Trade data source: US Census Bureau Merchandise Trade Statistics

Retrieved September 2013: US International Trade Administration Trade Policy Information System (TPIS),

Group: Processed foods and feeds

Item: Unprocessed and packaged fish

HS Series for Exports and Imports, All US customs districts and trade partners:

0306144010--KING CRABS, FROZEN, EXCEPT CRABMEAT

0306144020--SNOW CRABS, FROZEN, EXCEPT CRABMEAT

EX\_KING, EX\_SNOW, IM\_KING, IM\_SNOW

Data for all years adjusted to real 2012 dollars using BLS PPI for commodities WPU0223

**Table A1: COAR and Import/Export Price Data, 1991 – 2012 (\$/lb)**

YEAR	COAR_GKC	COAR_RKC	COAR_SNOW	EX_KING	EX_SNOW	IM_KING	IM_SNOW
1991	12.98223	14.36648	3.41510	12.14609	4.15738	11.16507	6.29570
1992	10.74099	14.84132	3.42922	13.46351	4.07182	8.46008	4.42860
1993	8.37371	13.97920	4.10292	12.07161	4.88861	9.60061	5.34092
1994	12.79516	21.15540	6.37853	10.62373	6.63825	10.60611	6.06463
1995	10.01360	15.87560	9.03913	9.38057	7.70603	8.58858	6.26093
1996	8.89815	14.97745	5.83919	9.96496	5.77208	8.04923	5.13870
1997	7.41687	9.99136	3.38848	7.37067	3.86481	8.26375	3.82689
1998	6.65579	8.70834	3.16661	5.23578	3.18347	7.32151	3.62520
1999	10.27565	16.81486	4.38953	6.39187	4.04600	8.10128	4.60276
2000	10.59610	13.33107	6.13693	9.80251	5.72646	9.50330	5.49610
2001	10.58051	14.40638	5.56687	12.33516	5.52188	10.15675	4.72700
2002	11.16835	17.92830	5.47993	9.98210	5.34943	12.13933	4.79191
2003	11.36093	14.41550	6.48630	8.49169	6.42167	10.82452	5.62810
2004	9.38381	12.84945	6.67197	7.54108	6.09675	8.94444	5.40048
2005	7.70076	10.99487	5.03481	8.04401	5.10287	7.91203	4.11737
2006	5.47028	9.02126	3.46218	7.29848	4.62483	6.51205	3.58240
2007	6.71228	10.01576	4.62054	7.89444	3.82110	6.42673	4.49657
2008	7.44145	10.77325	4.52042	8.12229	4.07862	8.44604	4.46656
2009	6.19374	9.87337	3.91481	10.19693	4.25341	7.99778	3.82768
2010	7.92843	14.06370	3.44703	10.72556	3.99238	8.47409	4.10541
2011	10.45640	17.45717	5.35147	10.80889	4.84520	9.11247	5.54826
2012	9.13707	15.04263	4.75031	11.56523	4.58220	7.91697	4.71944



## BACKTESTING and CURRENT-YEAR FORECAST (NOWCAST) RESULTS

Fig. 1a: Gold king crab VAR(3) model and data 1991-2012 with three price series based on COAR wholesale values for gold king crab (plot), TPIS king crab import price index, and TPIS king crab export price index. The regression runs through 2013 with 90% 1-step forecasts for 2011 and 2012, where the latter is conditioned on Jan-July 2013 average values for TPIS series. The expected values of each forecast are represented by squares in the forecast intervals for each year. All values are in 2012 dollars per pound.

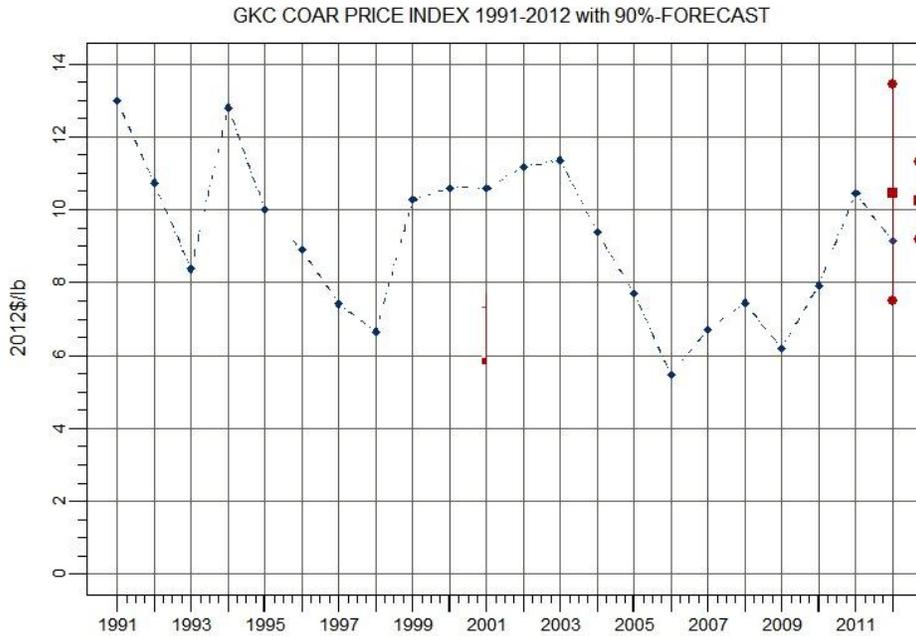


Fig. 1b: Red king crab VAR(3) model and data 1991-2012 with three price series based on COAR wholesale values for red king crab (plot), TPIS king crab import price index, and TPIS king crab export price index. The regression runs through 2013 with 90% 1-step forecasts for 2011 and 2012 where the latter is conditioned on Jan-July 2013 average values for TPIS series. The expected values of each forecast are represented by squares in the forecast intervals for each year. All values are in 2012 dollars per pound.

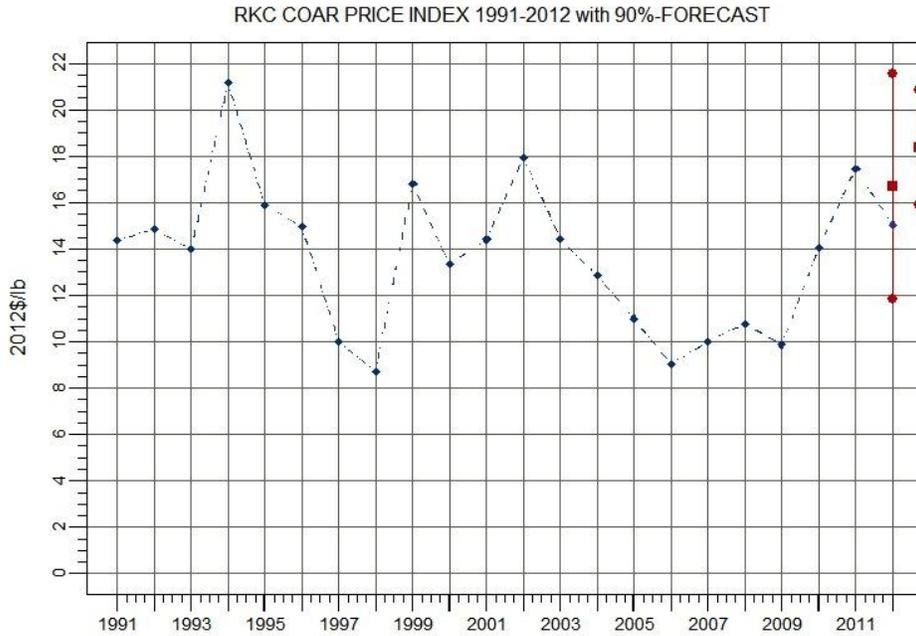


Fig. 1c: Snow crab VAR(3) model and data 1991-2008 with three price series based on COAR wholesale values for snow crab (plot) TPIS snow crab import price index, and TPIS snow crab export price index. The regression runs through 2013 with 90% 1-step forecasts for 2011 and 2012 where the latter is conditioned on Jan-July 2013 average values for TPIS series. The expected values of each forecast are represented by squares in the forecast intervals for each year. All values are in 2012 dollars per pound.

