



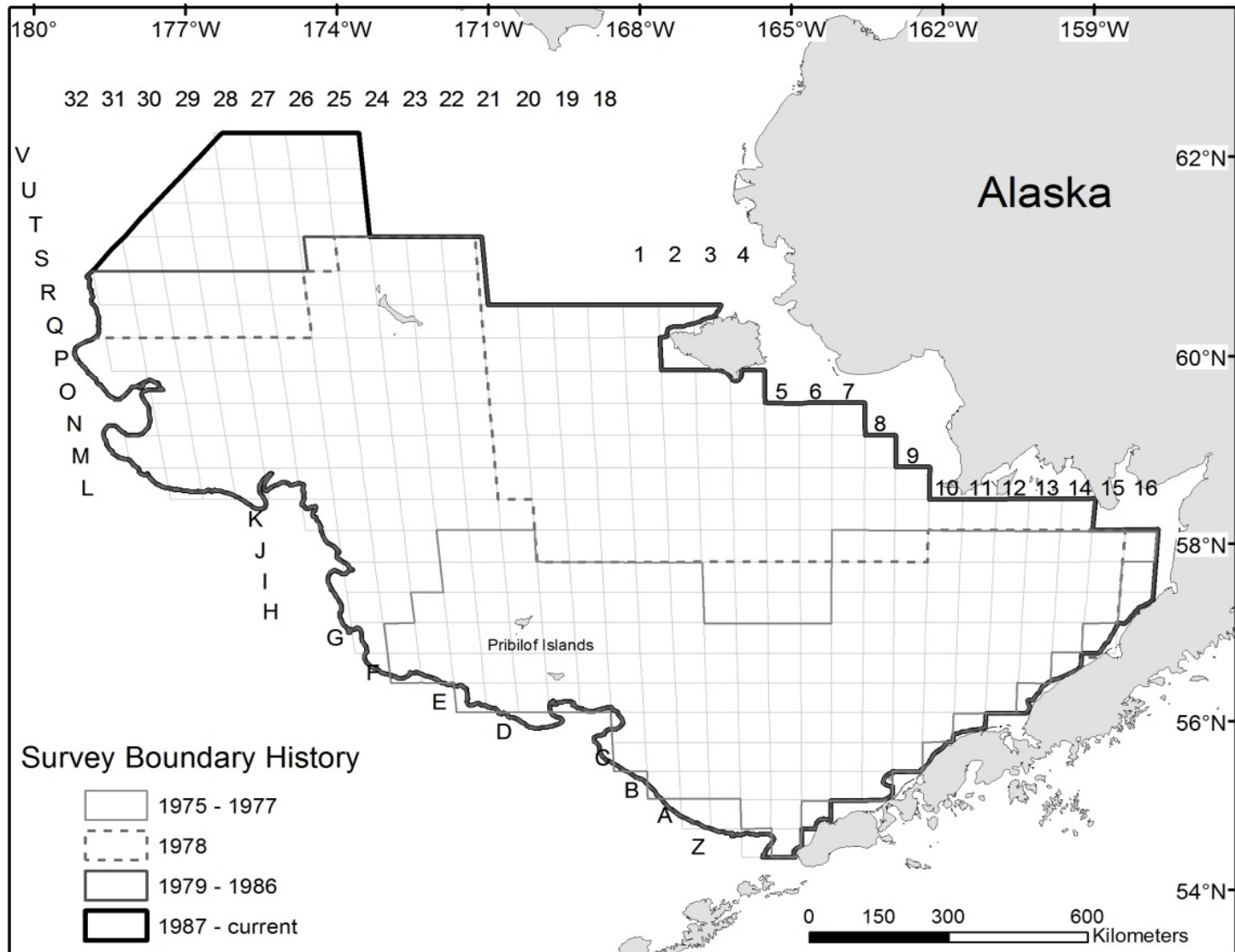
NOAA
FISHERIES
AFSC

EBS Bottom Trawl Survey Time Series

Crab Plan Team

May 2015

Survey Boundary History



Survey Year	Vessels	Start date	End date	# stations	# tows	# BB retows	Tow duration (min)	Haul types	Gear/Accessories
1975	14	1-Jun	7-Aug	140	140		60	3	20/3
1976	14, 17, 19	19-May	9-Aug	150	214		25 - 60	0, 3	20/3, 30/4,30/359
1977	14	26-May	5-Aug	159	161		18 - 30	0, 3	20/34
1978	14, 28	20-May	15-Aug	239	239		18 - 30	3	20/34
1979	12, 14, 28	22-May	24-Aug	321	464		12 - 30	3	20/34
1980	14, 31	12-May	30-Jul	324	364		30 - 36	3, 4	20/34
1981	1, 37	22-May	28-Jul	312	355		24 - 30	3, 4	25/34, 26/34, 35/2
1982	1, 19	29-May	1-Aug	347	347		18 - 30	3, 4	33/15, 34/15
1983	1, 37	7-Jun	1-Aug	354	354		12 - 30	3, 15	37/15, 38/15
1984	1, 37	9-Jun	19-Aug	356	434		18 - 36	0, 3, 4	26/34, 35/2, 37/15, 38/15
1985	37, 60	8-Jun	9-Sep	355	355		12 - 42	3	38/15, 39/15
1986	37, 57	3-Jun	1-Aug	354	354		18 - 30	3	38/15, 40/15
1987	19, 37	27-May	30-Jul	361	362		12 - 36	3	38/15, 42/15, 43/15
1988	37, 78	4-Jun	30-Jul	370	373		18 - 36	3	44/15
1989	37, 78	4-Jun	14-Aug	386	437		12 - 30	3, 4, 5, 18, 21	44/15
1990	37, 78	4-Jun	6-Aug	371	384		12 - 36	0, 3	44/15
1991	37, 78	7-Jun	13-Aug	372	378		12 - 36	0, 3	44/15
1992	37, 87	5-Jun	3-Aug	356	356		12 - 30	3	44/15
1993	88, 89	4-Jun	26-Jul	375	378		12 - 36	0, 3	44/15
1994	88, 89	3-Jun	26-Jul	374	376		6 - 36	3, 19	44/15
1995	88, 89	4-Jun	22-Jul	375	380		12 - 36	3, 19	44/15
1996	88, 89	8-Jun	28-Jul	374	375		12 - 42	3	44/15
1997	88, 89	7-Jun	26-Jul	375	376		12 - 36	3	44/15
1998	88, 89	9-Jun	29-Jul	374	375		18 - 36	3	44/15
1999	88, 89	23-May	20-Jul	372	404	31	12 - 42	3, 17	44/15
2000	88, 89	23-May	23-Jul	372	395	23	12 - 36	3, 17	44/15
2001	88, 89	29-May	19-Jul	374	375		18 - 36	3	44/15
2002	88, 89	2-Jun	24-Jul	374	375		12 - 36	3	44/15
2003	88, 89	2-Jun	22-Jul	375	380		6 - 36	3, 19	44/15
2004	88, 89	5-Jun	25-Jul	374	383		6 - 30	3, 19	44/15
2005	88, 89	3-Jun	22-Jul	372	373		12 - 36	3	44/15
2006	88, 134	2-Jun	25-Jul	375	410	30	12 - 30	3, 17, 19, 20	44/15
2007	88, 89	11-Jun	30-Jul	375	412	32	12 - 30	3, 17, 19	44/15
2008	88, 89	4-Jun	25-Jul	374	410	32	12 - 36	3, 17, 19	44/15
2009	88, 89	2-Jun	30-Jul	375	408	32	18 - 36	3, 17	44/15
2010	89, 162	7-Jun	4-Aug	375	403	23	12 - 42	3, 17, 19	44/15
2011	89, 162	5-Jun	31-Jul	375	396	20	12 - 36	3, 17	44/15
2012	89, 162	4-Jun	2-Aug	375	396	20	18 - 36	3, 17	44/15
2013	89, 162	9-Jun	1-Aug	375	376		18 - 36	3	44/15

Tows 1 hr
Tows 1 hr

Pribilof Corners Added
Net change 400-mesh to 83-112
St Matthew Corners Added

20 stations added in north

Station F06 data deleted
18 stations dropped

Survey Year	Standard Stations	Hot Spot	Bristol Bay Retow	Extra Tows (non-standard)	OCSEAP/ Synoptic	Triennial or North.Ext.	Winter Survey
1975	X ⁹			X	X		
1976	X ⁹			X	X ⁸		
1977	X			X			
1978	X			X			
1979	X			X (all std haul type)		X	
1980	X			X			
1981	X ¹			X			
1982	X ²			X		X	
1983	X ³			X			X
1984	X			X			
1985	X			X		X	X
1986	X			X			
1987	X			X			
1988	X ⁴			X		X	
1989	X			X			
1990	X	X		X			
1991	X ⁵			X		X	
1992	X ⁶						
1993	X	X		X			
1994	X	X		X		X	
1995	X	X		X			
1996	X			X			
1997	X			X			
1998	X			X			
1999	X		X ⁷	X			
2000	X		X ⁷	X			
2001	X			X		X	
2002	X			X			
2003	X	X		X			
2004	X	X		X		X	
2005	X			X		X	
2006	X	X	X ⁷	X		X	
2007	X	X	X ⁷	X			
2008	X	X	X ⁷				
2009	X		X ⁷	X			
2010	X	X ¹⁰	X ⁷	X		X	
2011	X		X ⁷	X			
2012	X		X ⁷	X			
2013	X			X			

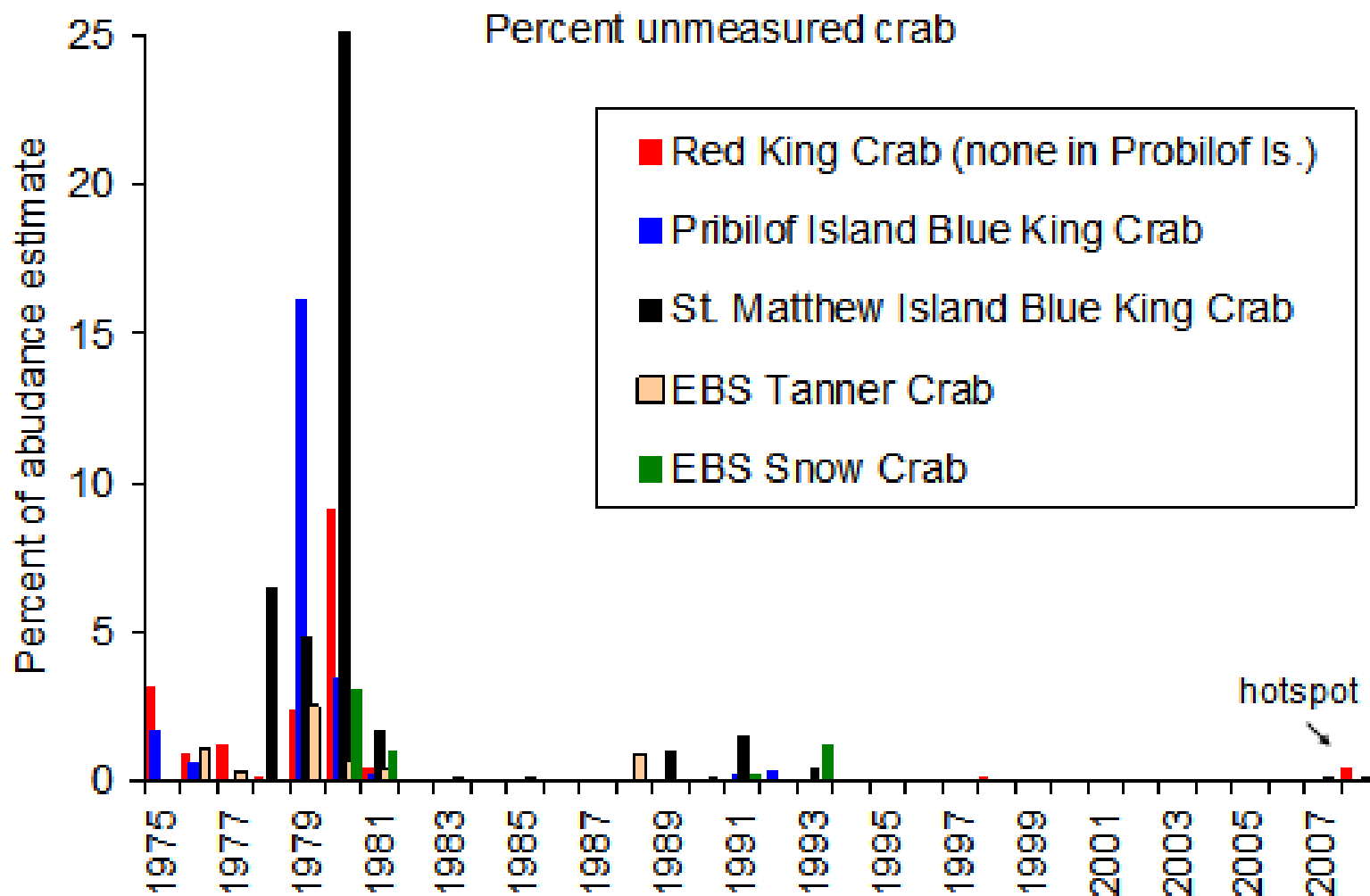
Time series revisions 2008-current

- 2008: Reproduce abundance estimate calculations for entire time series.
 - Early time series data to estimate abundance only available on paper.
- 2009: New time series with error fixes ($<1\% \Delta$)
- 2009: New time series with unmeasured crab ($1-25\% \Delta$)
- 2010: New time series with appropriate net width ($<10\% \Delta$)
- 2010: Recalculate time series with NEW length-wt regressions.
- 2014: New time series (cleaned data)
- Current: Reconsider female mature biomass.
- Current: Reconsider length-wt regression.

Jan 2014 Modeling Workshop

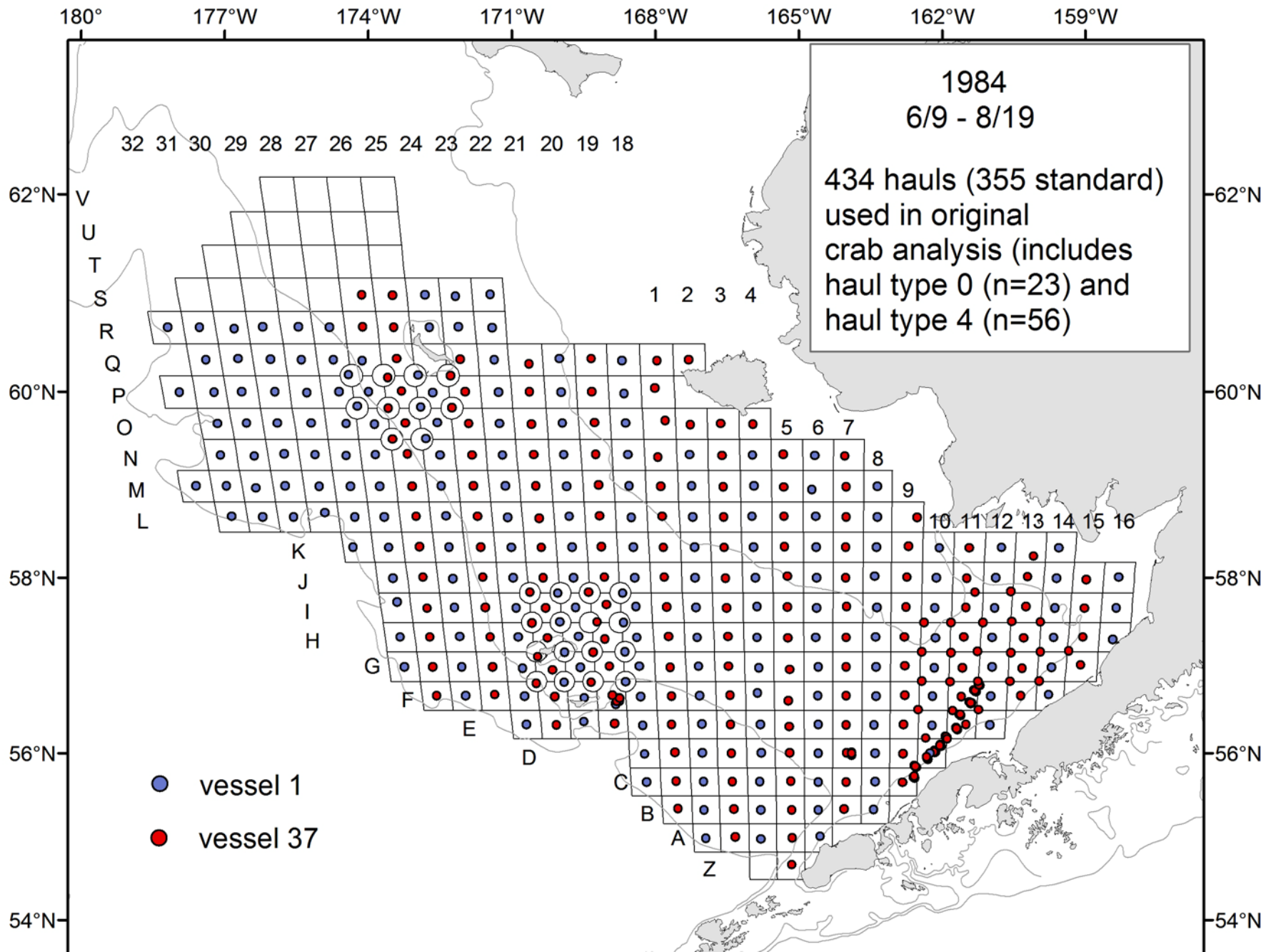
Unmeasured (“crushed”) crabs have been encountered in the survey in some years. Available biological sample information should be used to characterize these catches, preferably from the same tow. If no crabs were measured in a tow, adjacent similar tows can be used. The file of data supplied to assessment authors should clearly indicate which crab were actually measured and which ones were ‘inferred’.

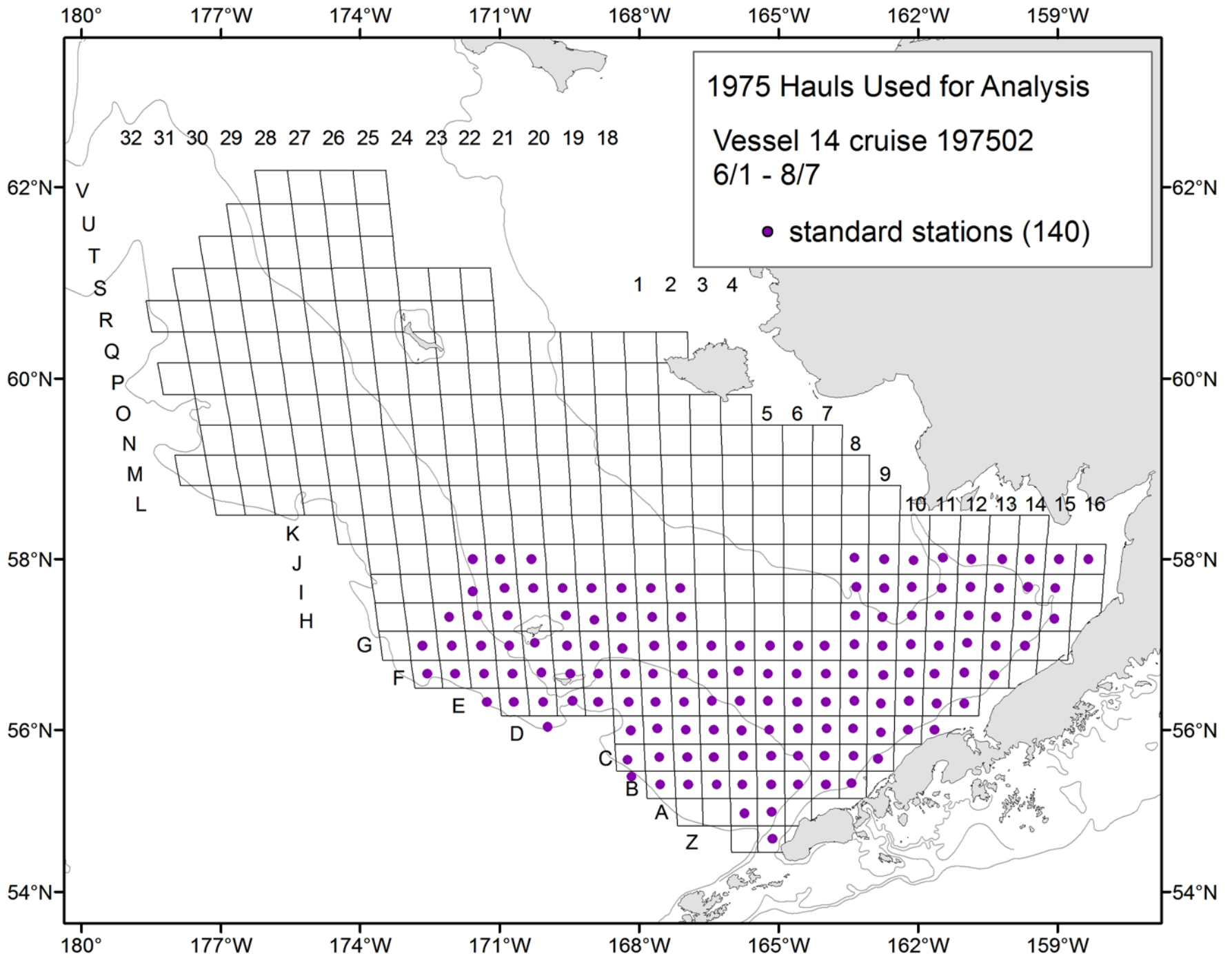
Unmeasured crab (999s)

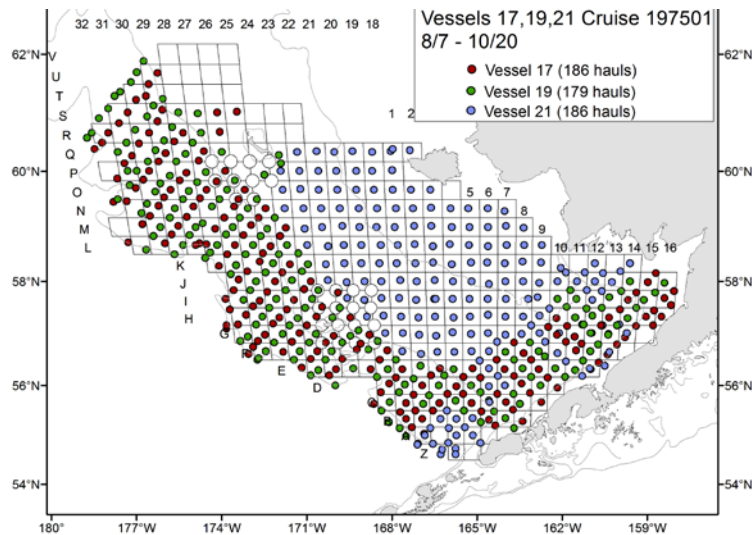
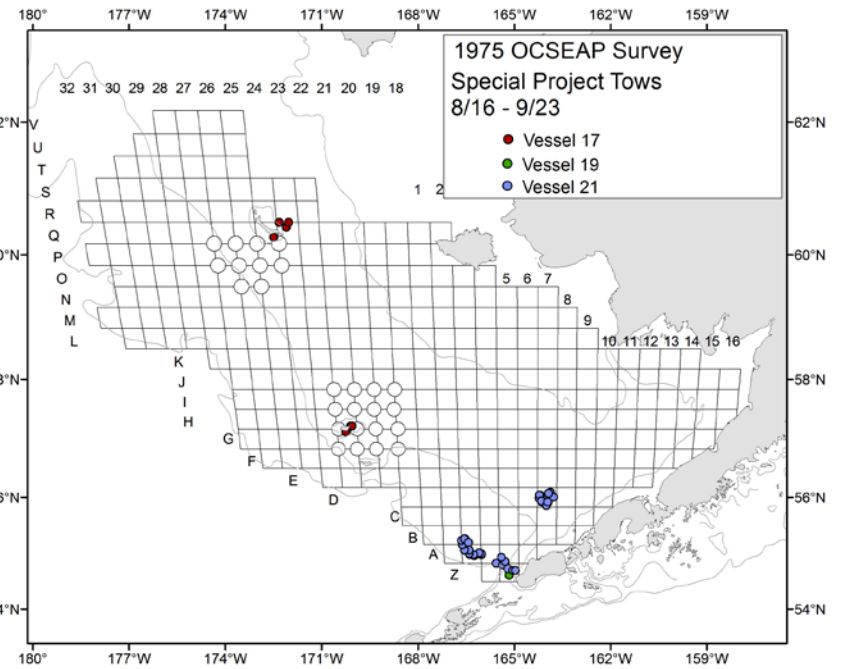
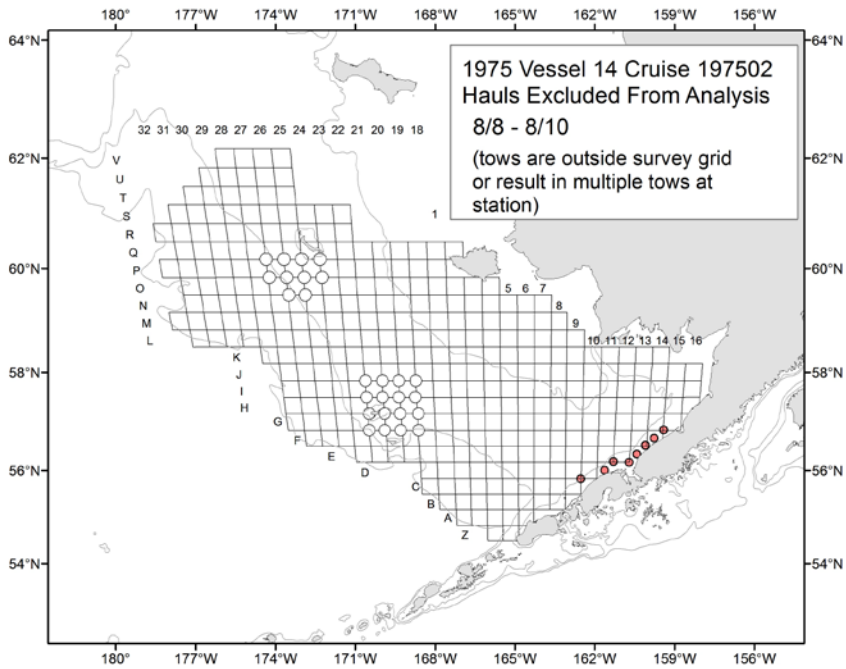


Jan 2014 Modeling Workshop

1. select one "standard haul" (HAUL_TYPE=3) per station for each station at which standard hauls were conducted,
2. assign stations to the same standard strata for all years (Prib's MTCA, St. Matt's MTCA, rest of west 166W, east 166W),
3. calculate average CPUE (numbers and weight) and standard errors by year over all sampled stations for each stratum,
4. report the area in each valid stratum by year (i.e., the sum of grids associated with sampled stations),
5. provide results (average CPUE in numbers and weight) by year, stratum, and sex, as well as by year, stratum, sex, shell condition, maturity state (for females) and size (1mm bins).







New Time Series

Considerations

- Spatial coverage
- Avoid bias associated with multiple tows at station
- Tow duration (avoid 1-hour tows)
- Increase coverage where possible using available data, while maintaining consistency with survey timeframe, gear, tow duration, standard density (one tow per station)

“The CPT agreed that the rationale behind the new time series was an improvement over the current time series, as long as standard Pribilof and St. Matthew corner stations are included. The CPT recommends that assessment authors should investigate the effects of the new time series on size frequencies. ”

“The CPT discussed the use of hotspot tows in the time series and concluded that the variance associated with a high density tow which would invoke a post-hoc sampling method should be addressed within stock assessments, rather than adding tows to the survey.”

“The CPT agreed that only abundance estimates for female red king crab should be based on leg 3 retows, and the leg 1 data should be used for male red king crab abundance estimates.”

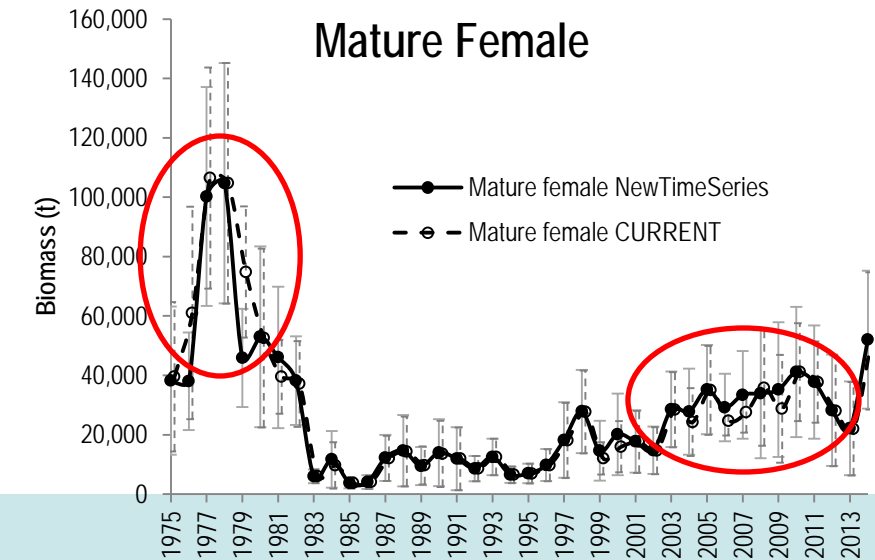
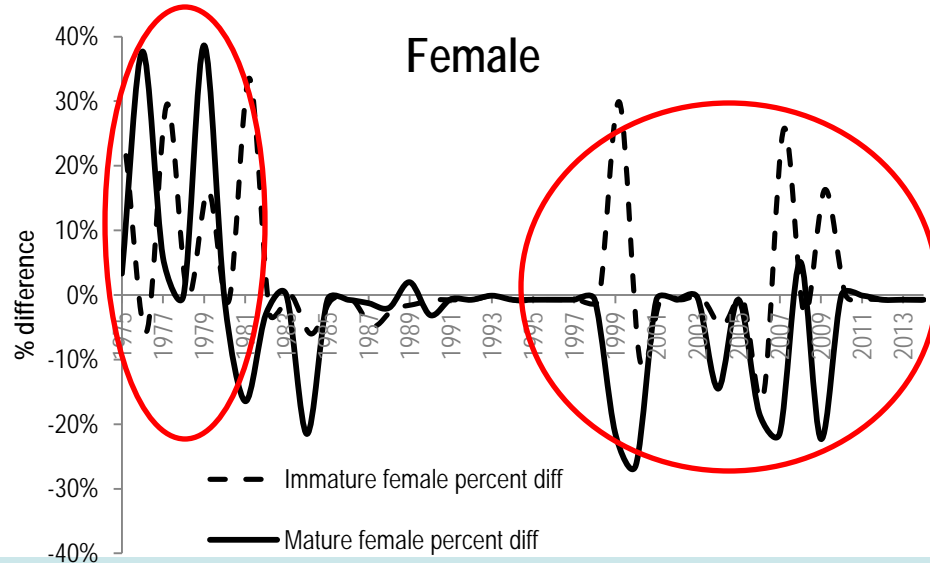
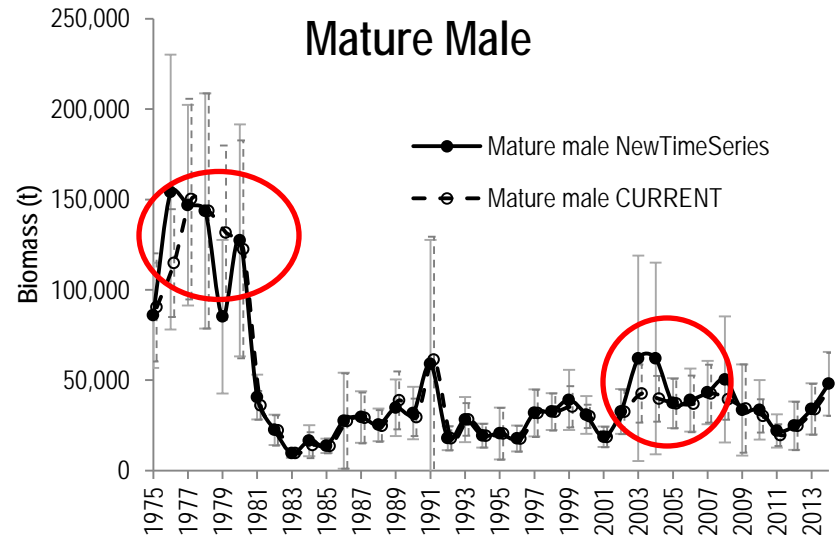
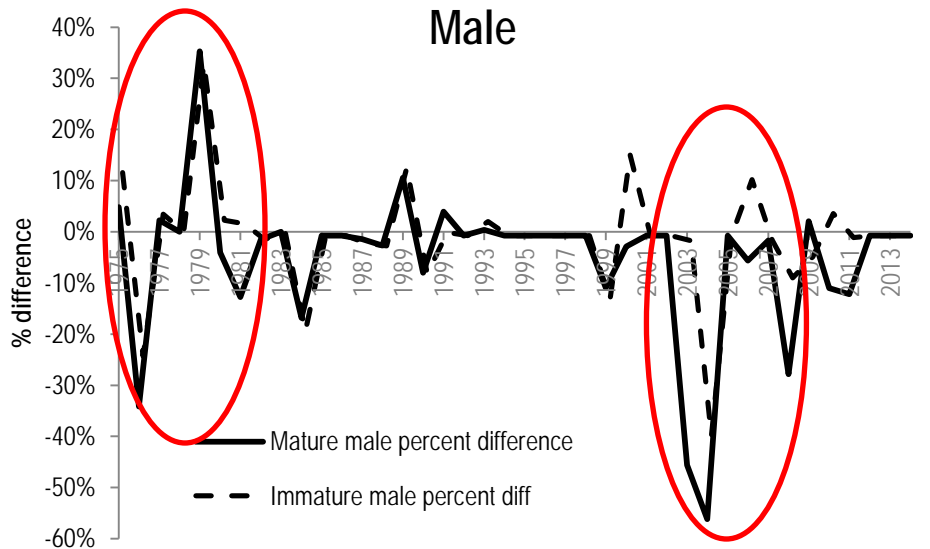
“The CPT concluded that the corner stations are useful because they increase the area surveyed, provide lower confidence intervals for most stocks, and are a long-term consistent protocol.”

“The CPT recommends that the new time series use standard corner stations, no hotspots or other extra tows, increased coverage following standard protocol where possible, and include an estimate for unmeasured crab.”

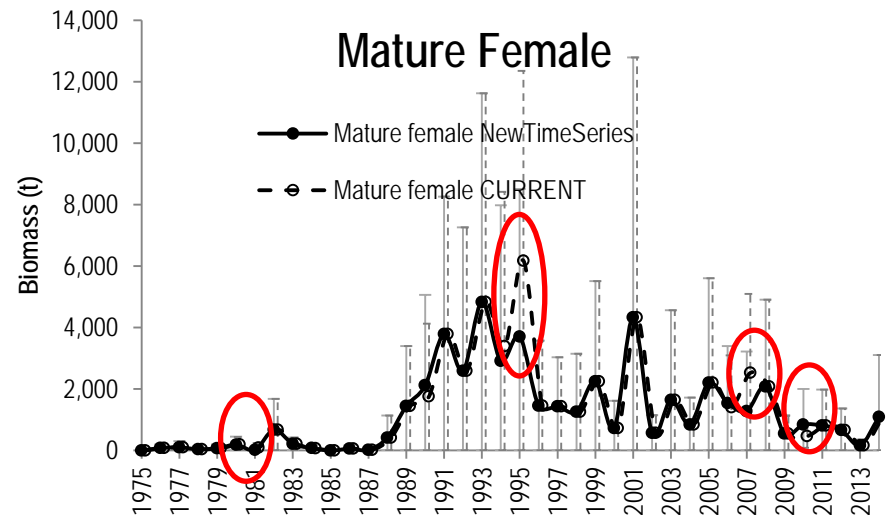
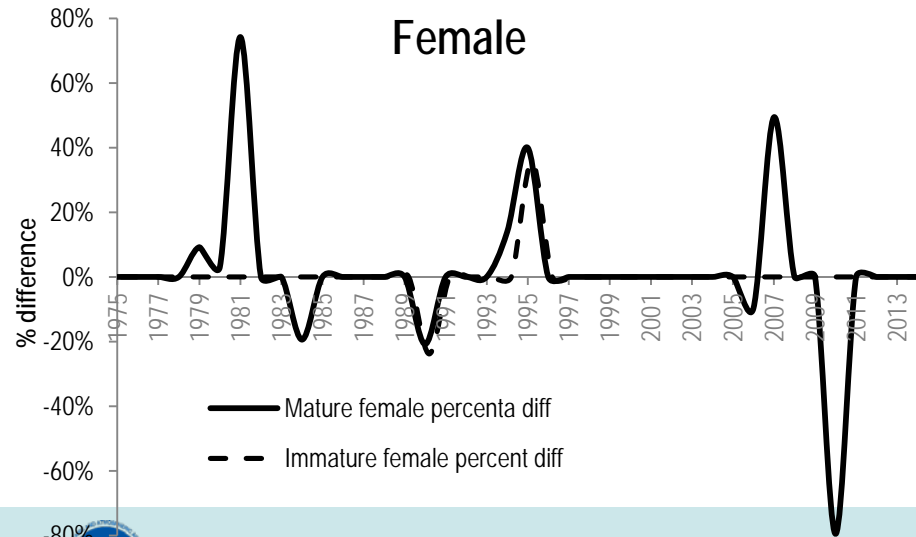
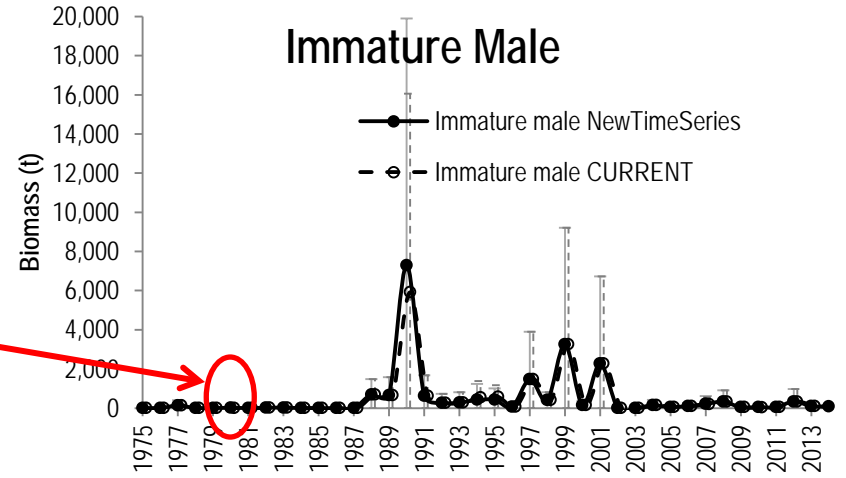
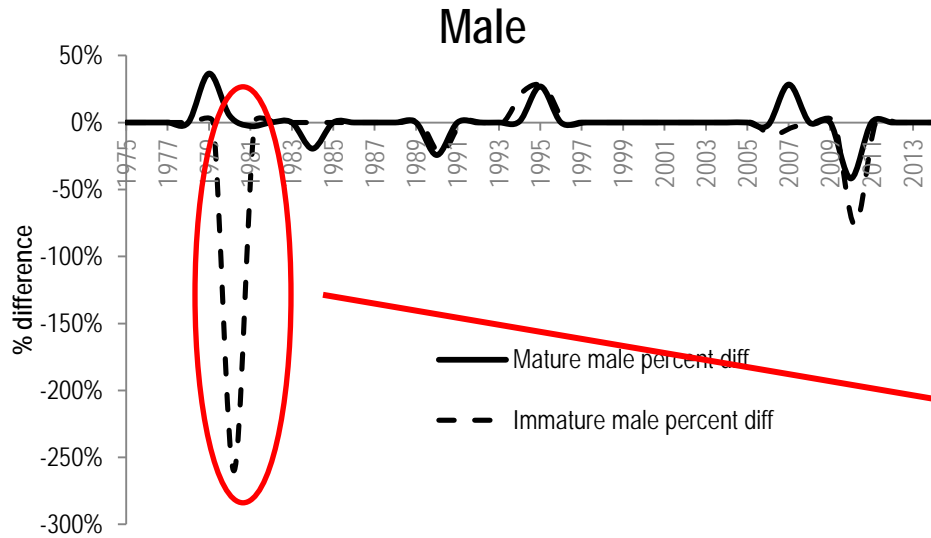
Stock	Sex	Difference between old and new timeseries biomass					
		Average		Minimum		Maximum	
		%	t	%	t	%	t
Bristol Bay red king crab	Immature male	-1.1%	(-573 t)	-40.0%	(-7,758 t)	32.9%	(8,051 t)
	Mature male	-5.2%	(-1,552 t)	-56.2%	(-22,281 t)	35.3%	(46,449 t)
	Immature female	2.6%	(185 t)	-15.6%	(-666 t)	33.6%	(2,574 t)
	Mature female	-2.3%	(-527 t)	-26.4%	(-4,198 t)	38.6%	(28,904 t)
Pribilof Islands red king crab	Immature male	-8.0%	(-29 t)	-260.0%	(-13 t)	27.0%	(152 t)
	Mature male	0.2%	(183 t)	-41.8%	(-1,298 t)	36.6%	(314 t)
	Immature female	0.3%	(0 t)	-23.8%	(-5 t)	35.7%	(10 t)
	Mature female	1.5%	(85 t)	-79.5%	(-372 t)	74.2%	(72 t)
Pribilof Islands blue king crab	Immature male	2.4%	(48 t)	-19.2%	(-19 t)	95.7%	(1,246 t)
	Mature male	-1.9%	(-380 t)	-50.3%	(-9,680 t)	23.2%	(344 t)
	Immature female	1.1%	(57 t)	-66.7%	(-2 t)	91.7%	(1,196 t)
	Mature female	-3.2%	(-3,598 t)	-235.4%	(-148,498 t)	61.3%	(1,712 t)
St. Matthew Is. blue king crab	Immature male	0.5%	(9 t)	-2.4%	(-61 t)	9.4%	(256 t)
	Mature male	0.9%	(54 t)	0.0%	(0 t)	11.4%	(670 t)
	Immature female	0.4%	(1 t)	-1.0%	(-2 t)	10.5%	(31 t)
	Mature female	-0.3%	(-1 t)	-17.9%	(-25 t)	2.7%	(8 t)
Tanner crab east of 166° W	Immature male	1.5%	(352 t)	-24.8%	(-496 t)	41.7%	(1,625 t)
	Mature male	2.4%	(1,300 t)	-17.4%	(-4,063 t)	41.8%	(11,614 t)
	Immature female	0.6%	(278 t)	-39.3%	(-509 t)	55.7%	(1,824 t)
	Mature female	1.5%	(860 t)	-13.0%	(-638 t)	42.3%	(23,481 t)
Tanner crab west of 166° W	Immature male	0.4%	(127 t)	-17.6%	(-2,423 t)	14.9%	(5,163 t)
	Mature male	0.8%	(234 t)	-28.2%	(-5,792 t)	19.6%	(3,877 t)
	Immature female	-0.2%	(-10 t)	-22.7%	(-3,629 t)	7.5%	(947 t)
	Mature female	0.8%	(95 t)	-12.9%	(-3,039 t)	13.9%	(1,309 t)
snow crab	Immature male	0.1%	(477 t)	-2.8%	(-3,171 t)	9.2%	(17,820 t)
	Mature male	0.5%	(723 t)	-7.3%	(-8,149 t)	10.9%	(12,205 t)
	Immature female	-0.2%	(-157 t)	-14.9%	(-10,233 t)	6.5%	(5,443 t)
	Mature female	-0.1%	(-554 t)	-11.8%	(-30,935 t)	7.2%	(11,138 t)



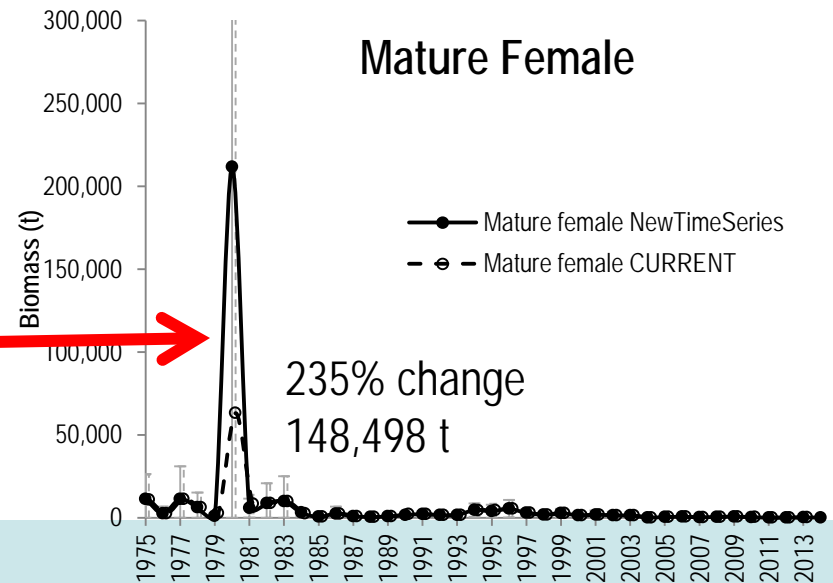
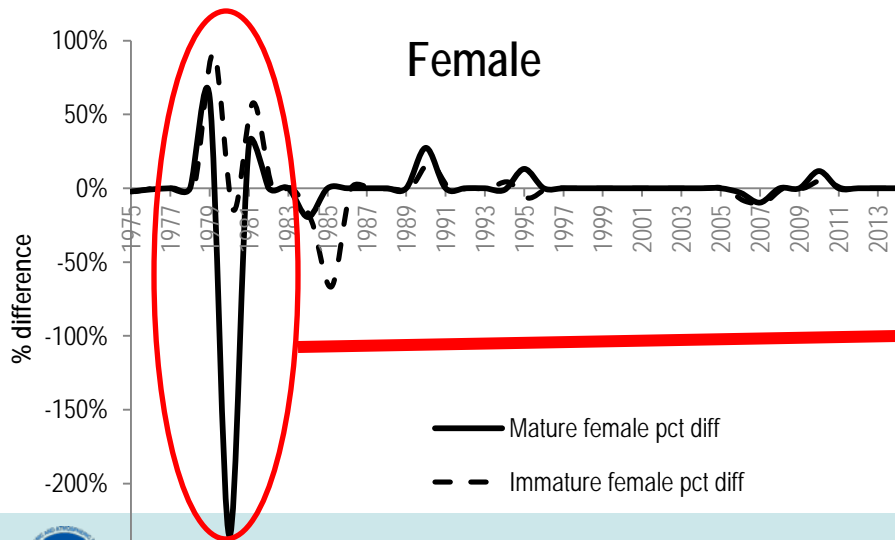
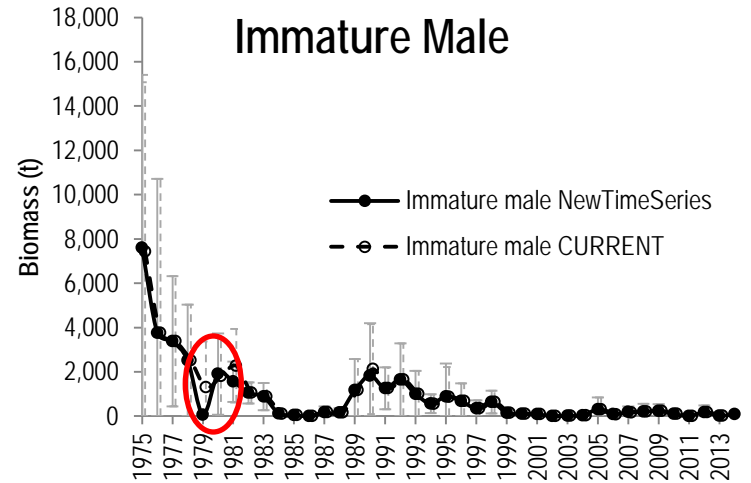
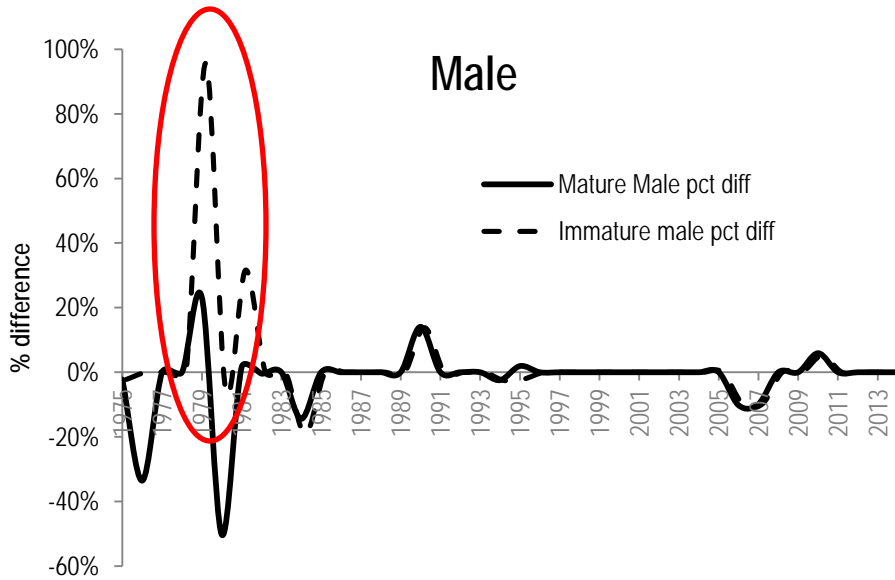
Bristol Bay red king crab



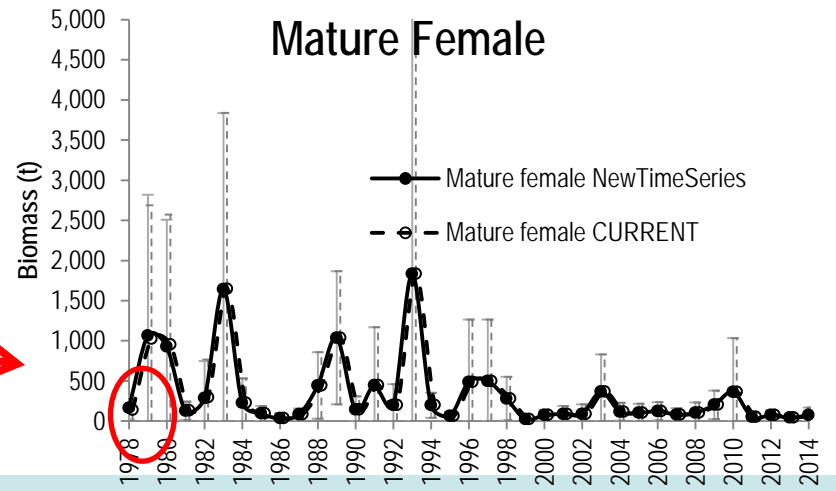
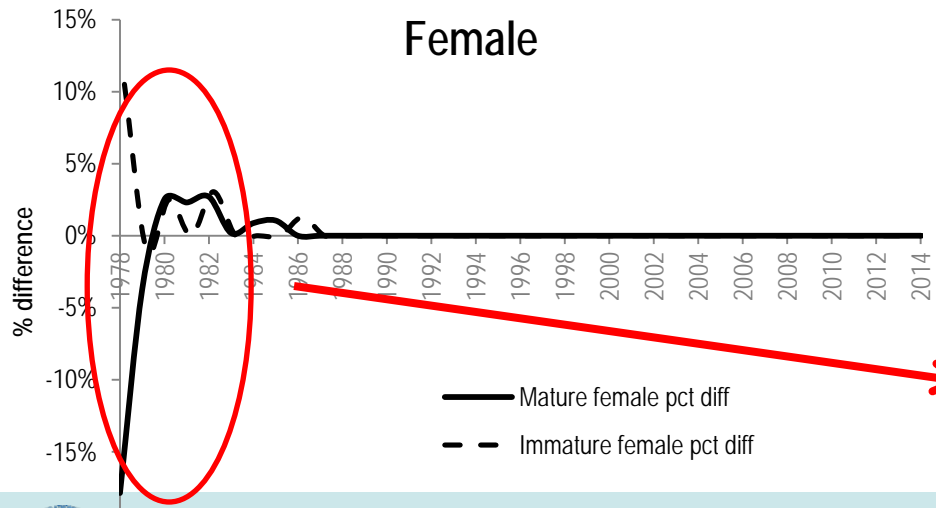
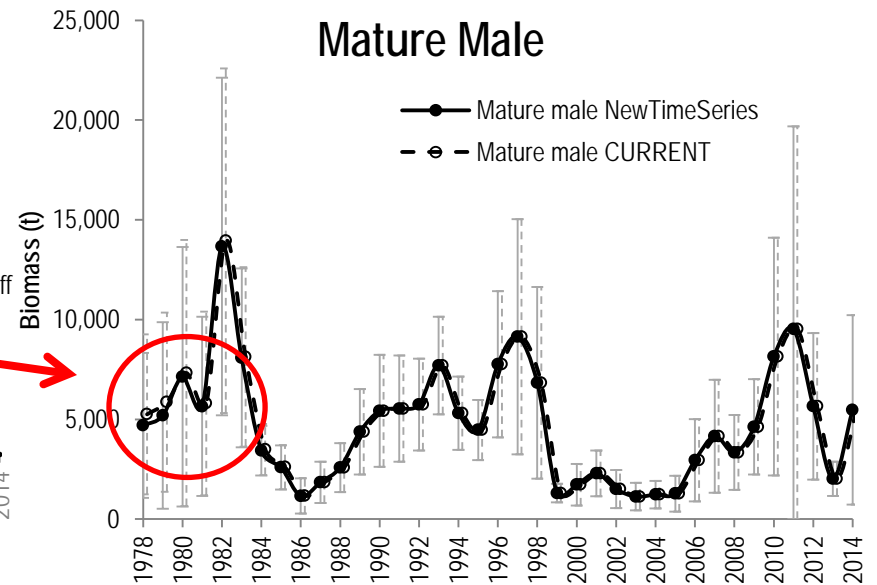
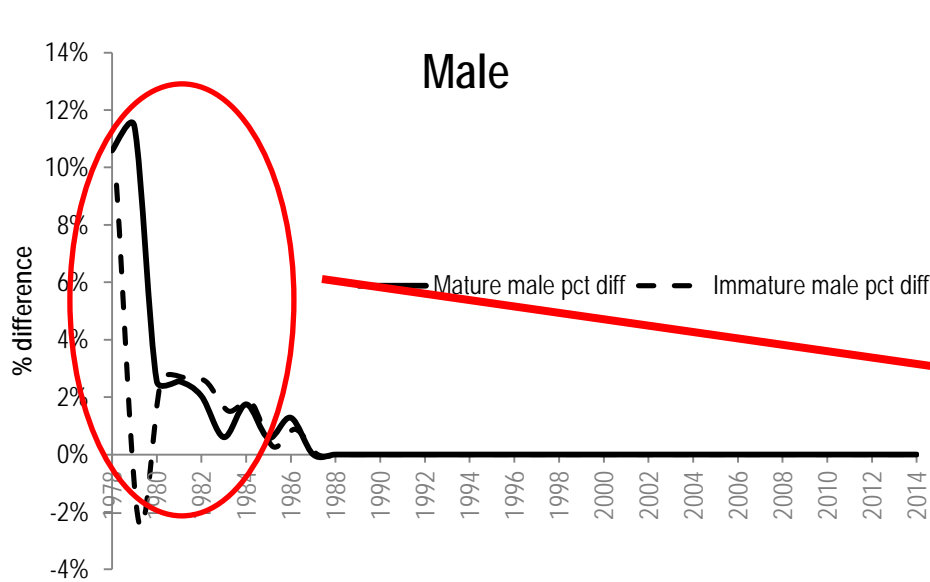
Pribilof Islands red king crab



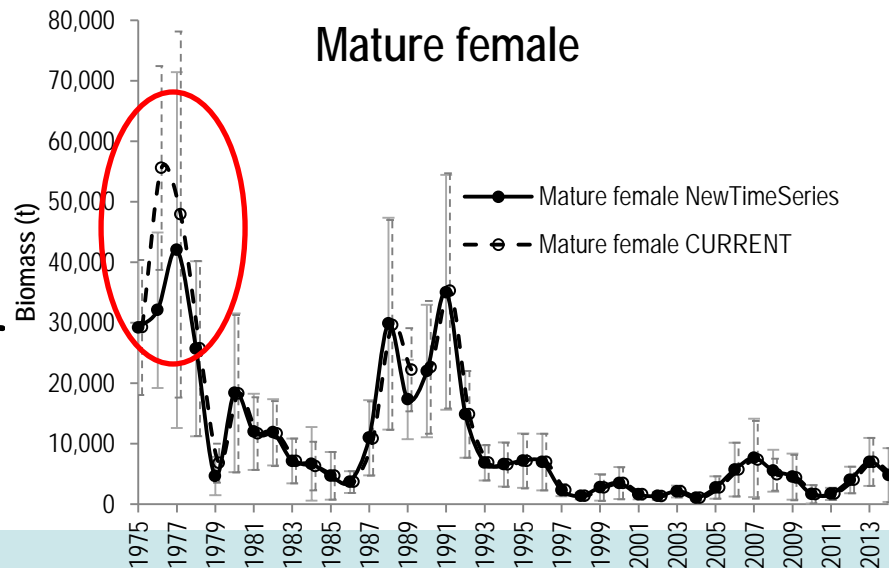
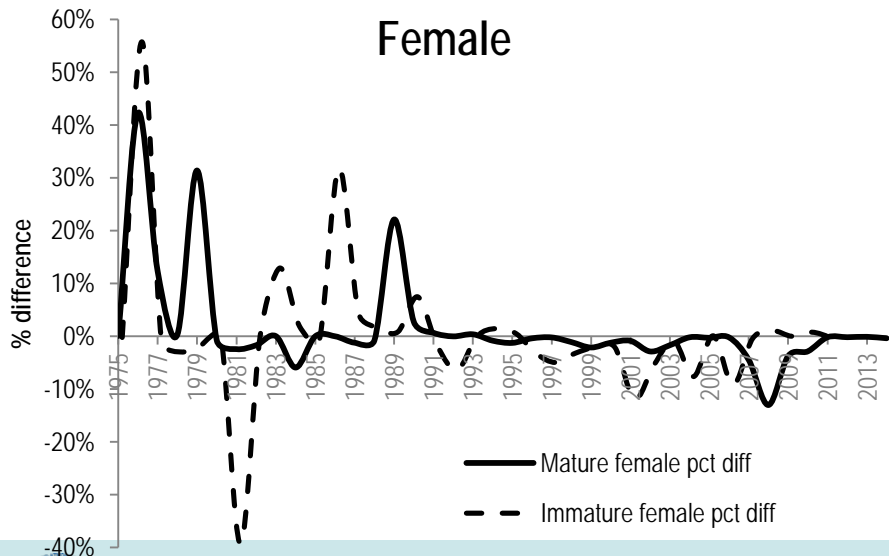
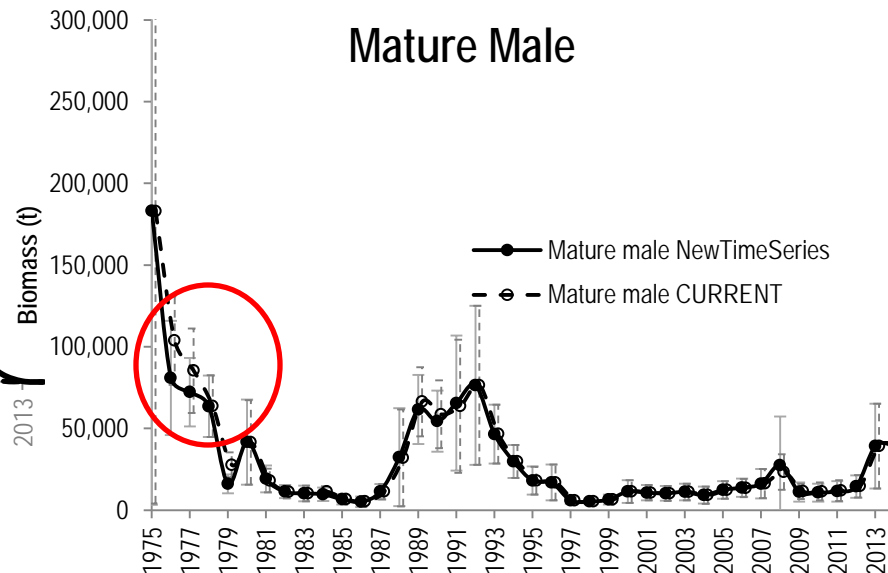
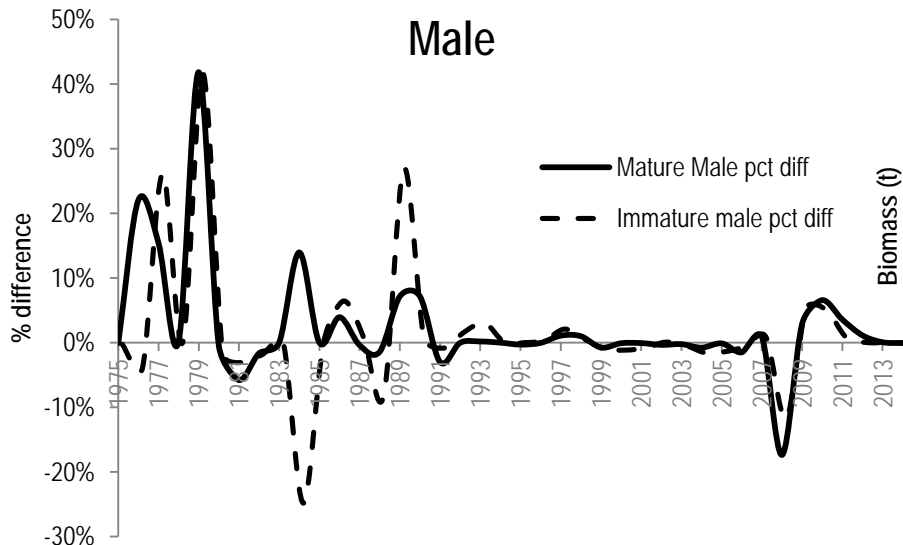
Pribilof Islands blue king crab



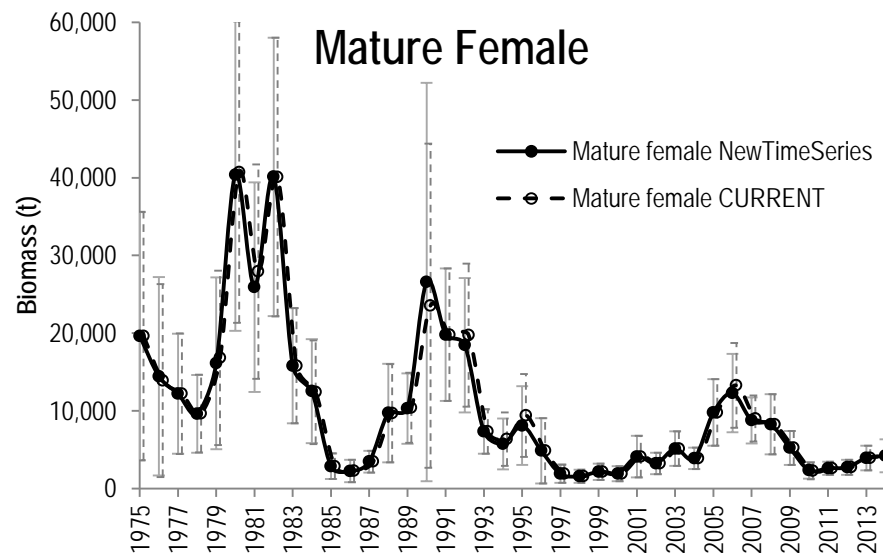
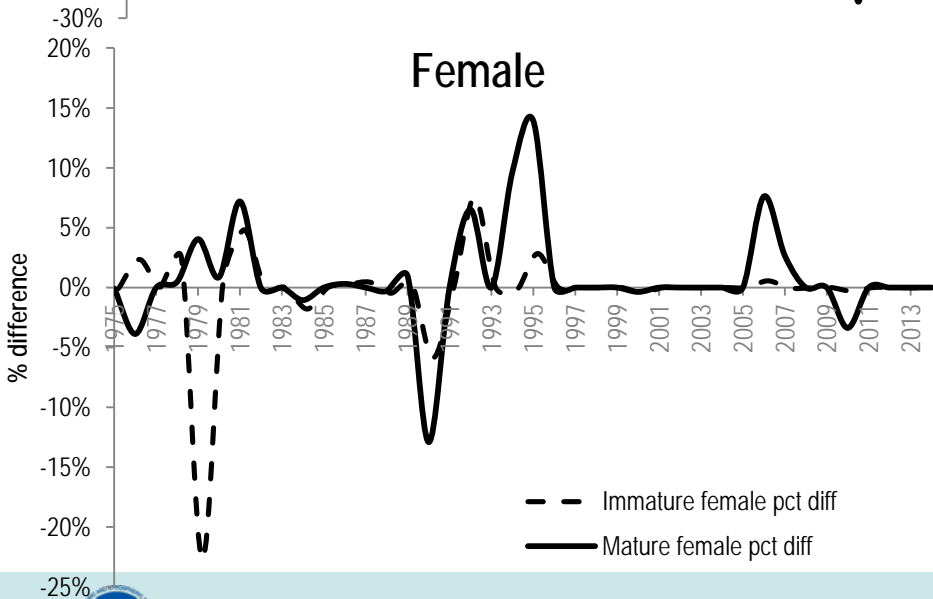
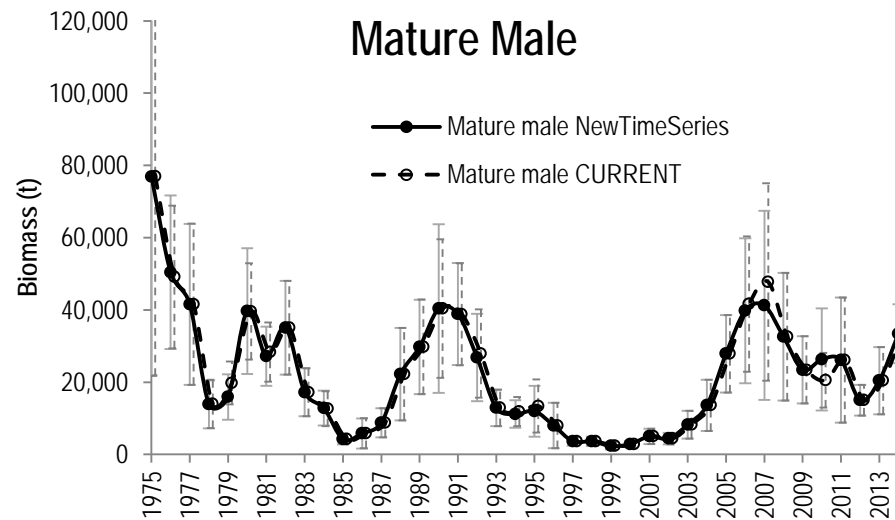
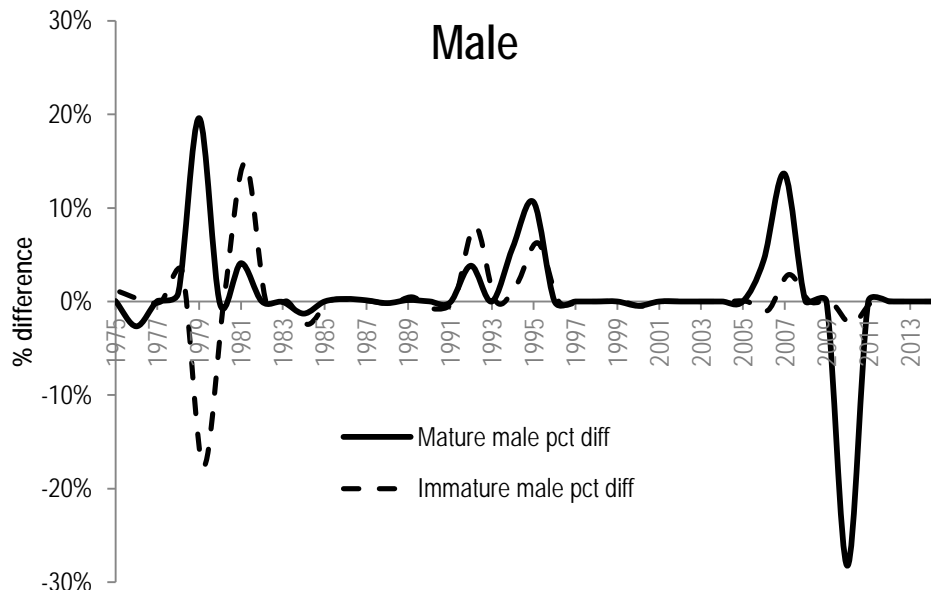
St. Matthew Island blue king crab



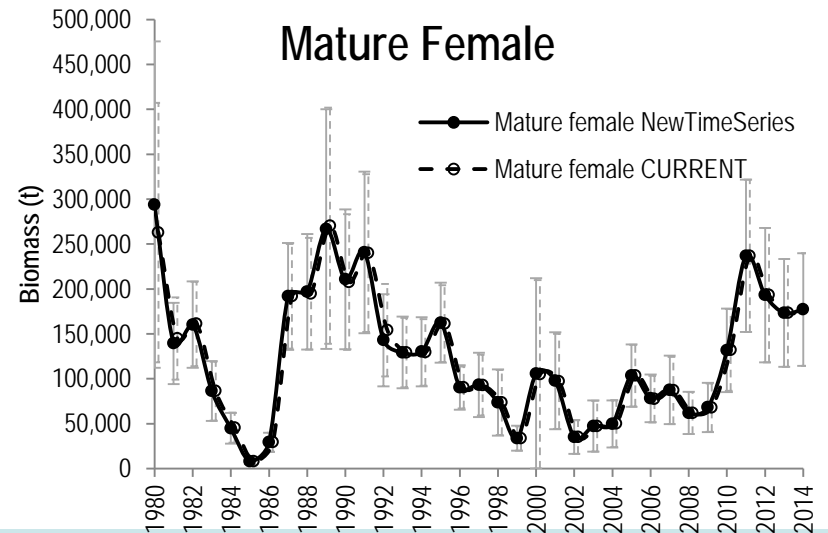
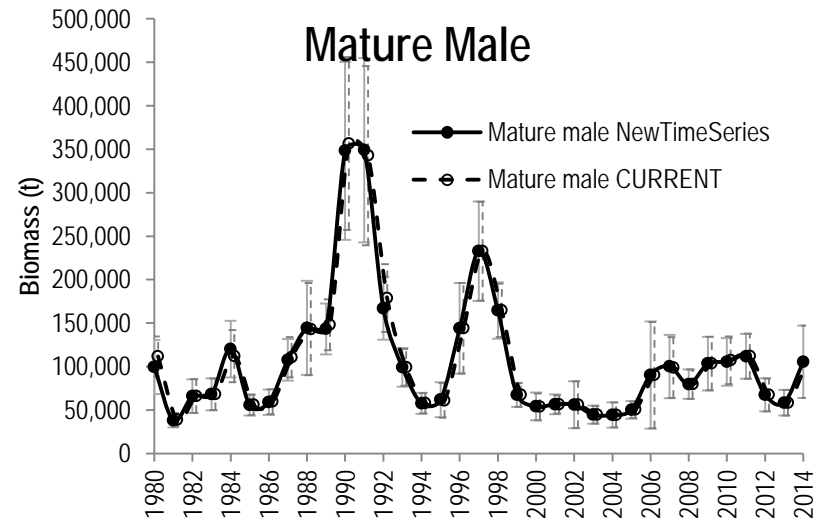
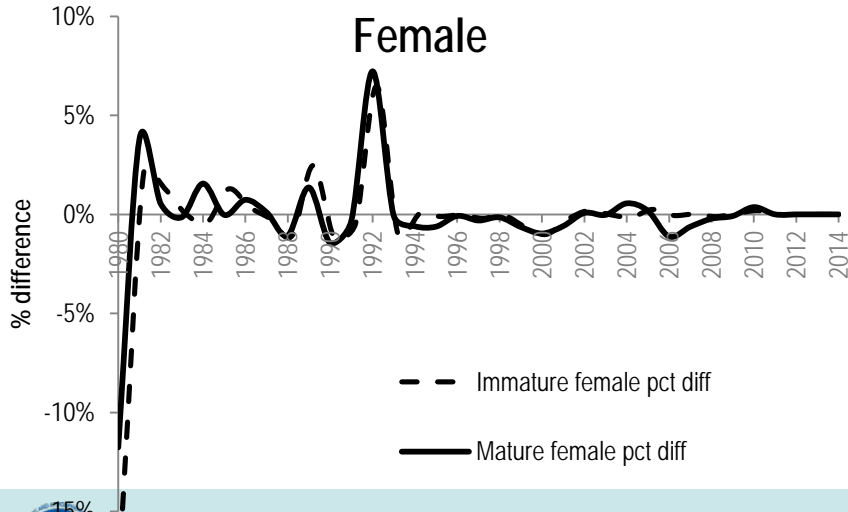
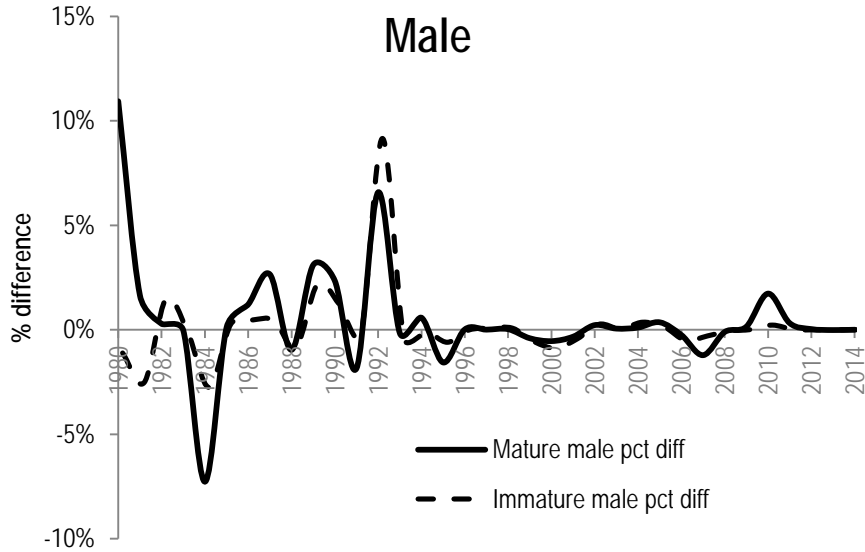
Tanner crab east of 166° W



Tanner crab west of 166° W



Snow crab



Mature biomass definition

- Currently use ADFG cut line for both females and males
- Females: data available
 - Size at maturity
 - Mature abundance
- Males: data not available
 - Chela height data for Chionoecetes
 - Not feasible to measure all.
- The following compares mature female biomass in the new time-series as calculated by carapace size and clutch size (scored by egg presence and/or shape of abdominal flap).

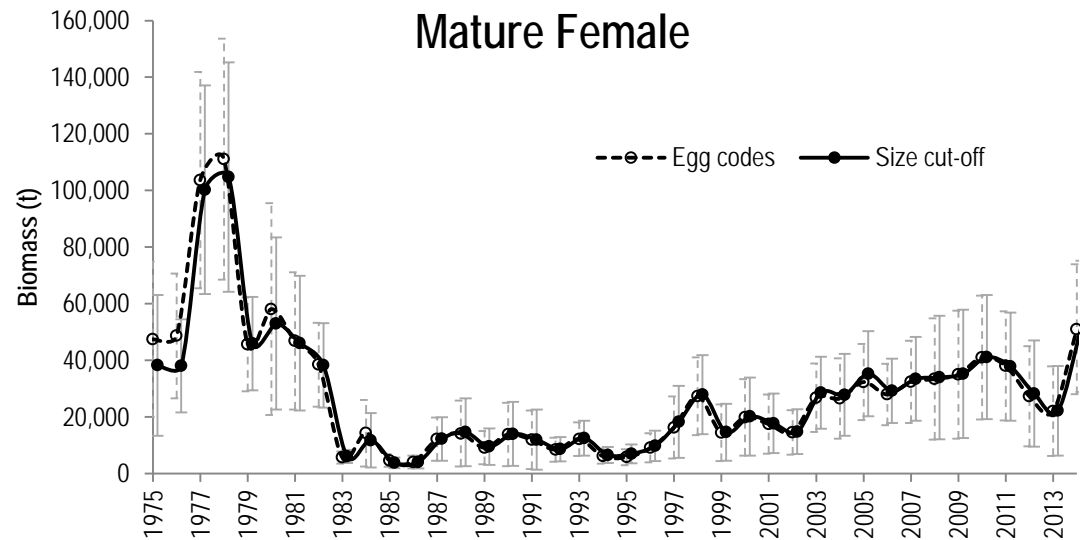
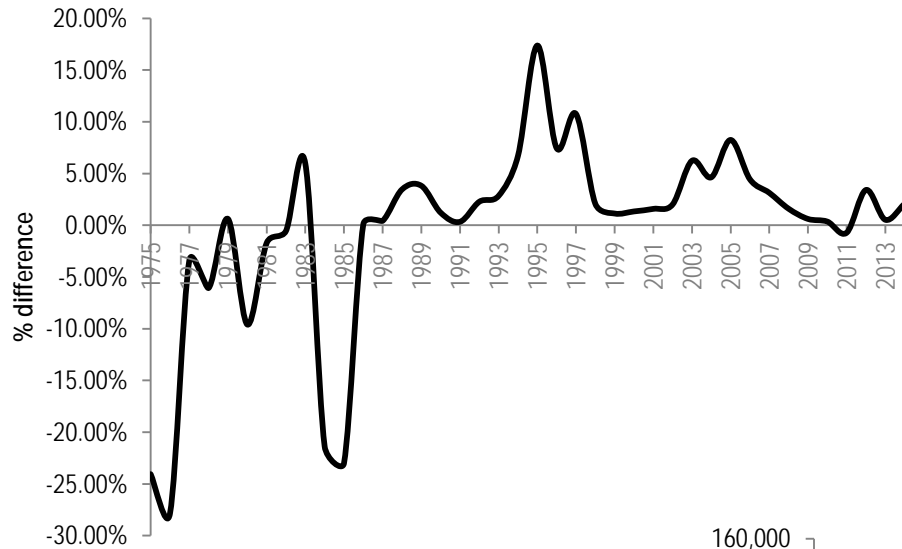


Mature females: Size cut-off vs. egg presence

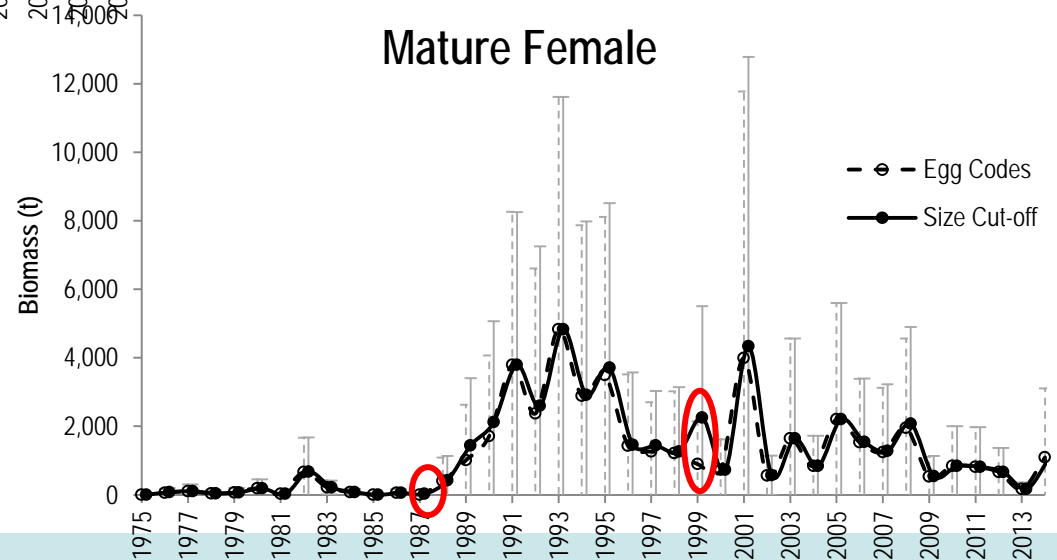
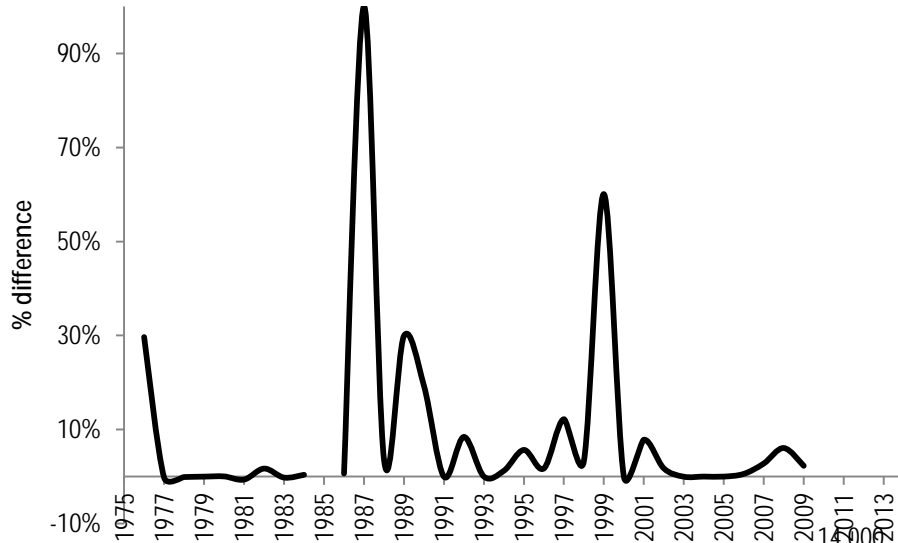
	Percent Difference		
	Average	Min	Max
Bristol Bay red king crab	-0.3%	-27.9%	17.4%
Pribilof Islands red king crab	9.0%	-0.6%	100.0%
Pribilof Islands blue king crab	-5.8%	-115.8%	68.5%
St. Matthew Island blue king crab	35.3%	-25.9%	100.0%
Tanner crab <u>east</u> of 166° W	-33.3%	-119.7%	51.7%
Tanner crab <u>west</u> of 166° W	-50.9%	-153.6%	-3.8%
snow crab	-5.3%	-43.1%	36.1%



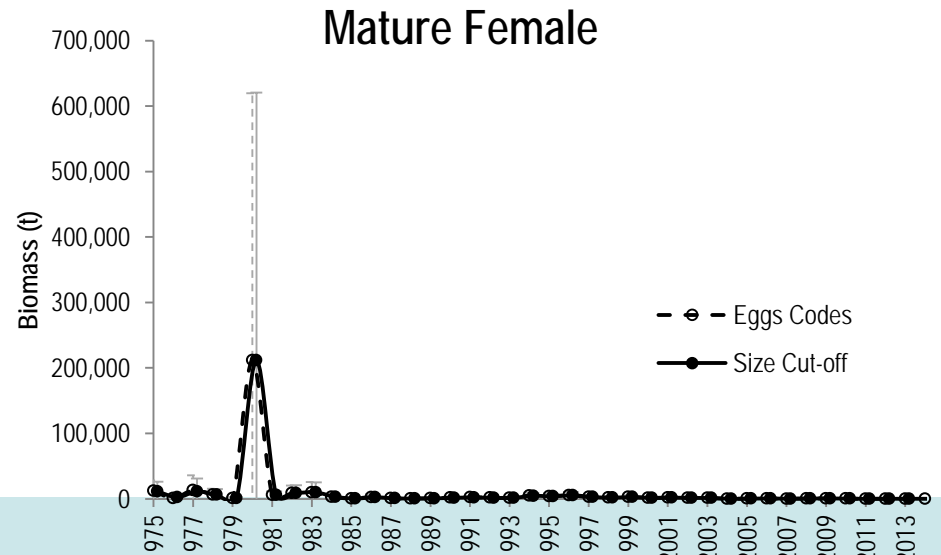
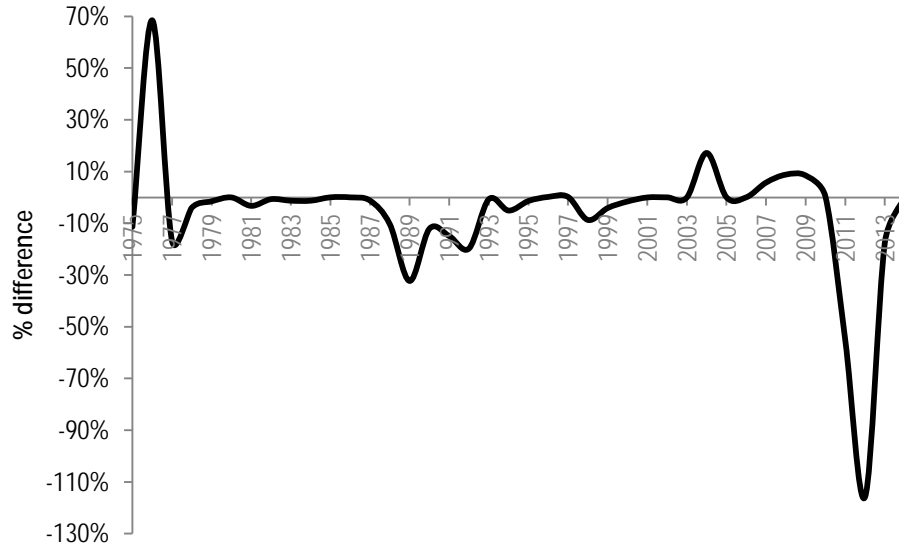
Bristol Bay red king crab



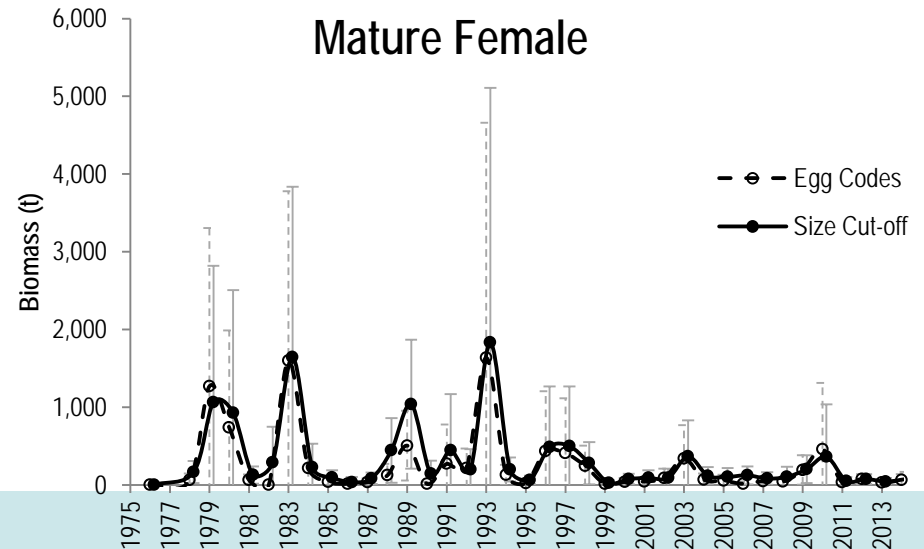
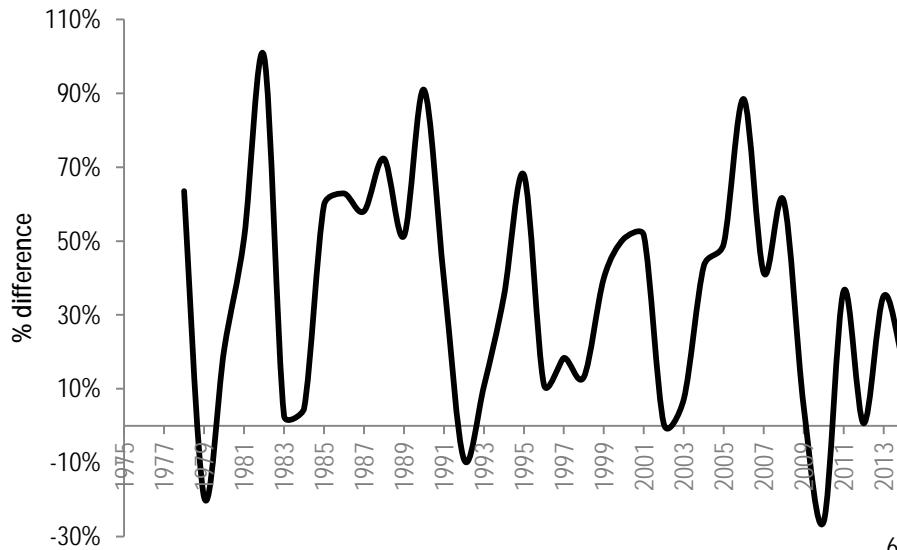
Pribilof Islands red king crab



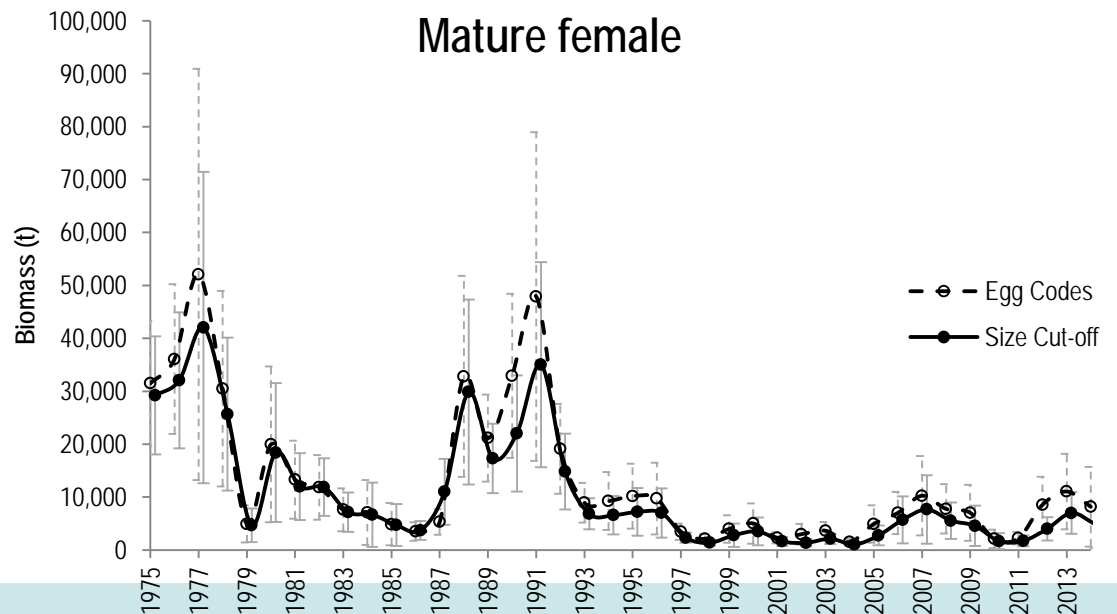
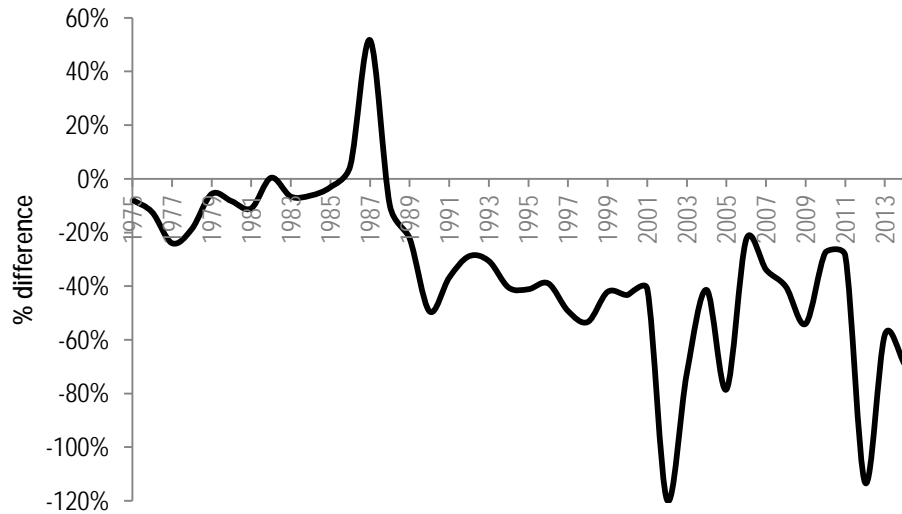
Pribilof Islands blue king crab



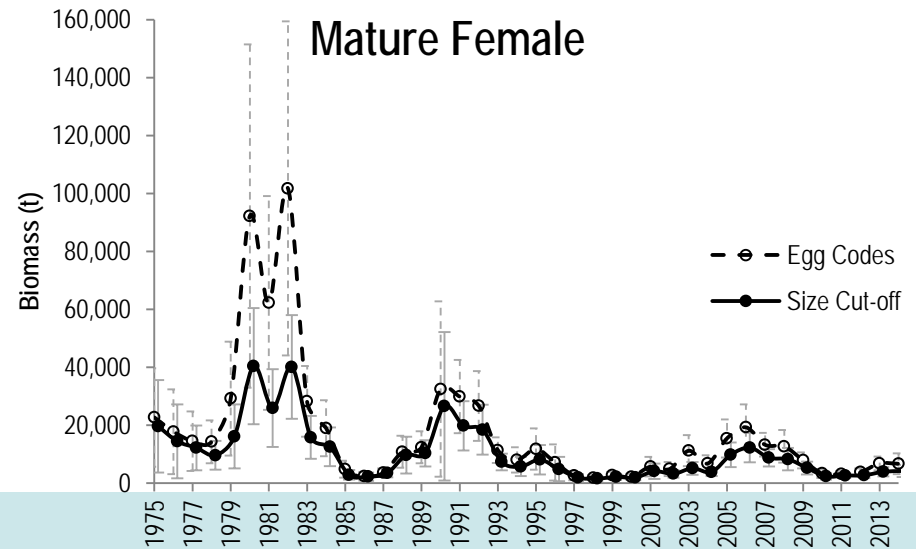
St. Matthew Island blue king crab



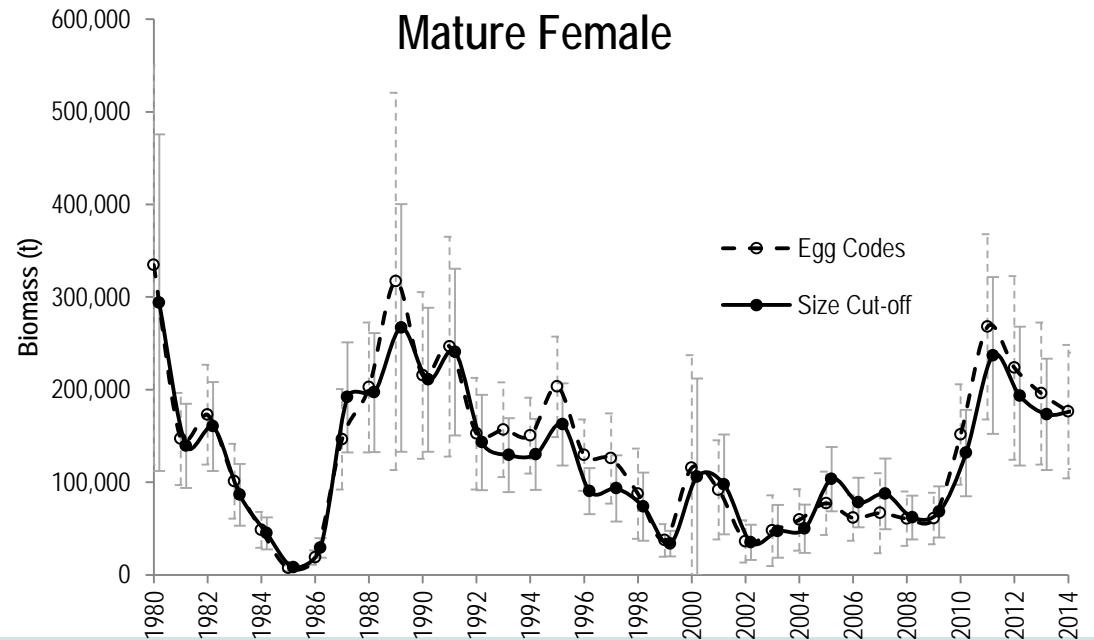
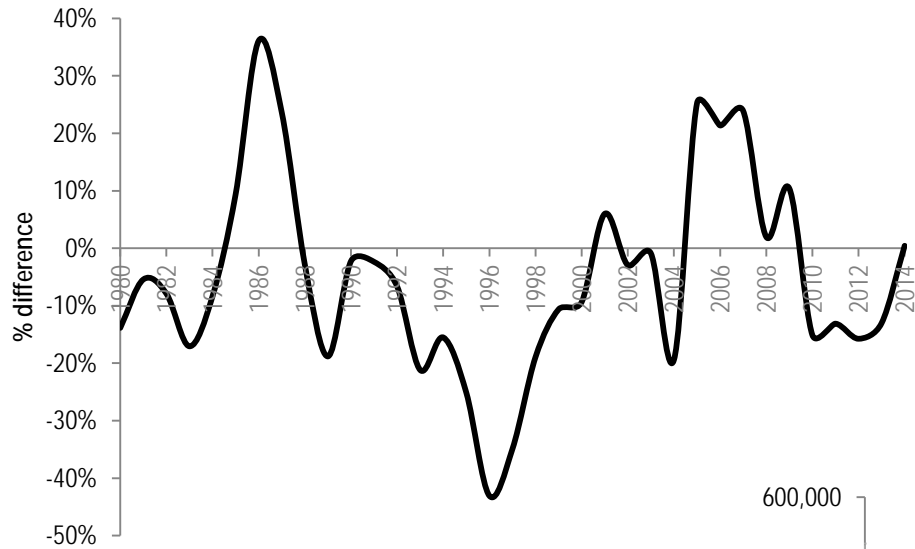
Tanner crab east of 166° W



Tanner crab west of 166° W



Snow crab



New time-series: 1 Regression factor vs. 2 regression factors

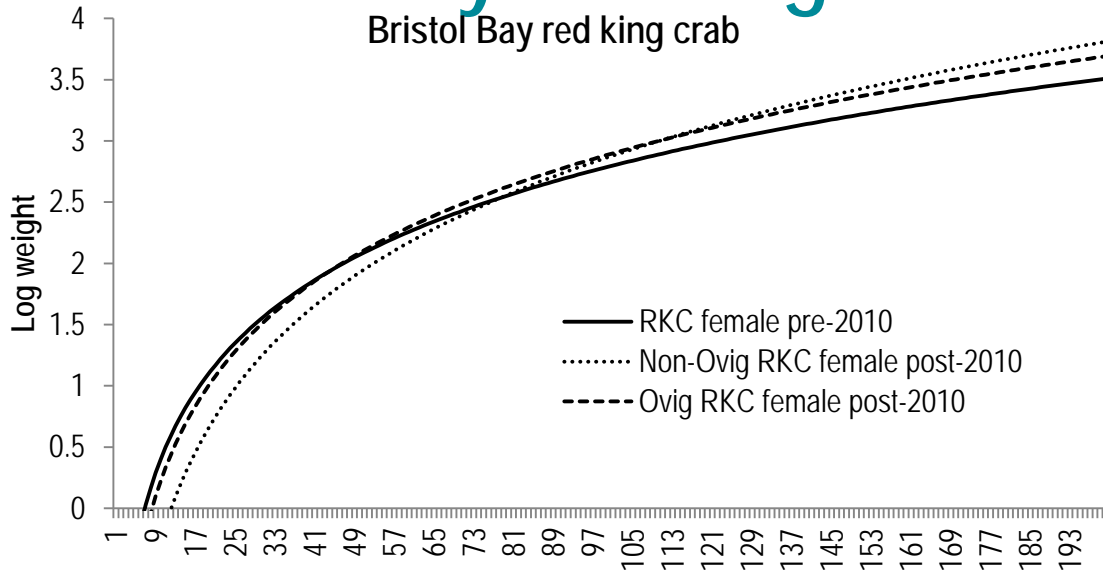
- The following compares mature male and female biomass calculations in the new time-series using the standard regression factors (2 sets: old 1975-2009 and new 2010-2014) and the new regression factors only (1975-2014).
- New regression factors include separate calculations for ovigerous and non-ovigerous females.

1 Regression factor vs. 2 regression factors

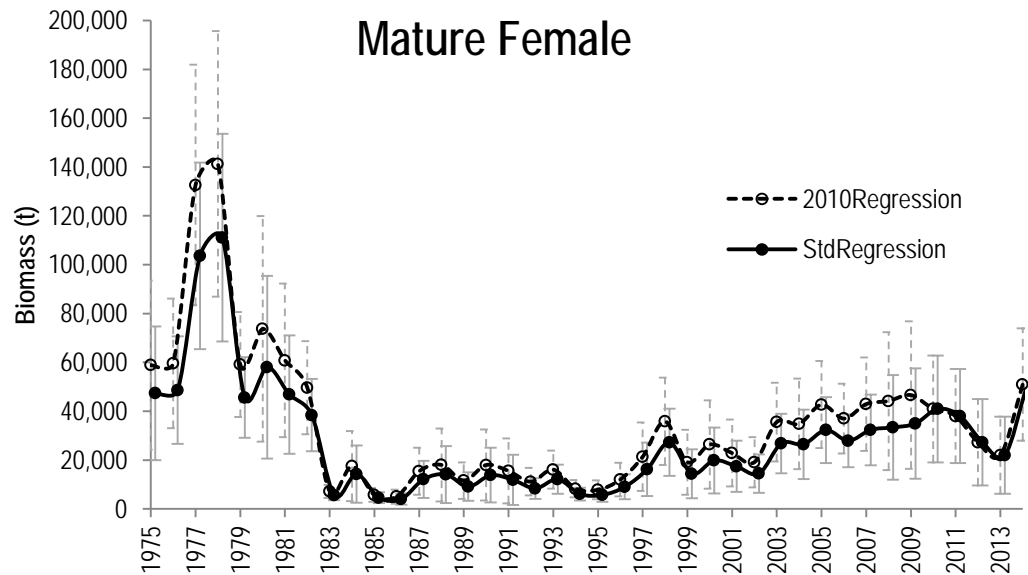
Stock	Sex	Percent Difference		
		Average	Min	Max
Bristol Bay	Mature male	-2.04%	-2.23%	-1.94%
red king crab	Mature female	-30.00%	-36.64%	-22.58%
Pribilof Islands	Mature male	-1.86%	-2.53%	-1.10%
red king crab	Mature female	-37.26%	-51.99%	-24.20%
Pribilof Islands	Mature male	n/a	n/a	n/a
blue king crab	Mature female	n/a	n/a	n/a
St. Matthew Island	Mature male	n/a	n/a	n/a
blue king crab	Mature female	n/a	n/a	n/a
Tanner crab	Mature male	2.56%	2.22%	3.10%
east of 166° W	Mature female	42.39%	41.54%	44.06%
Tanner crab	Mature male	1.83%	1.22%	2.98%
west of 166° W	Mature female	43.26%	42.19%	44.13%
snow crab	Mature male	0.17%	0.03%	0.28%
	Mature female	-27.75%	-32.52%	-19.56%

Mostly impacts females.

Bristol Bay red king crab

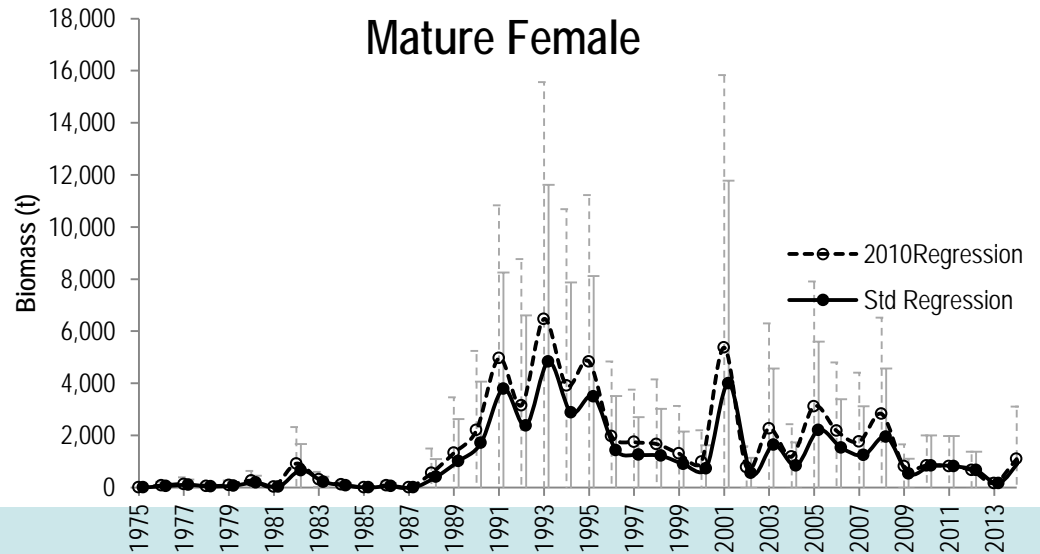
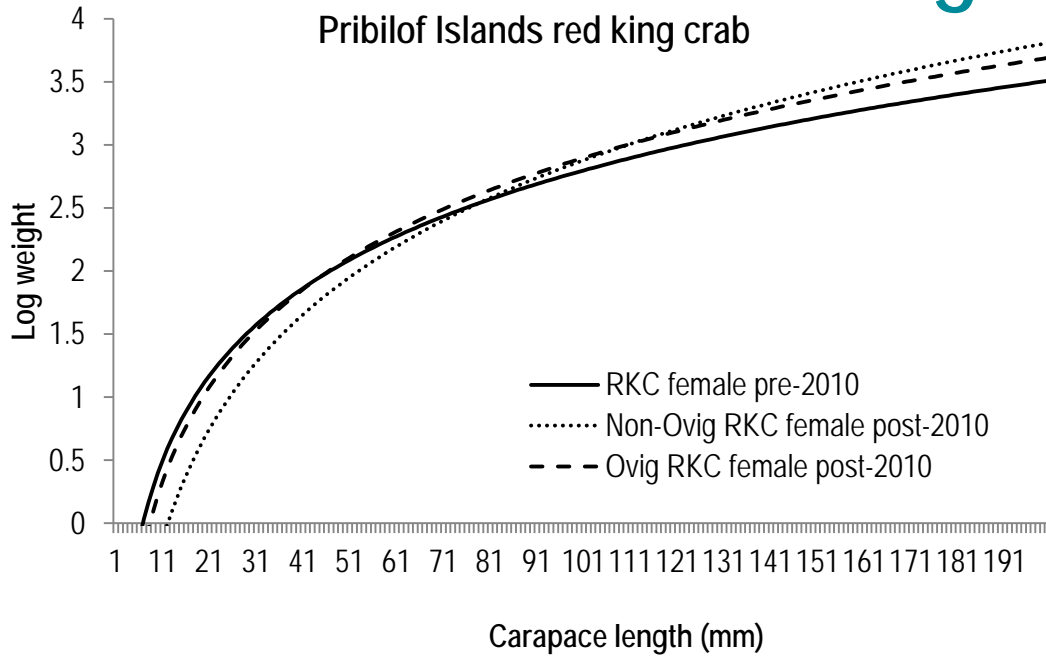


Carapace length (mm)



Pribilof District red king crab

Pribilof Islands red king crab



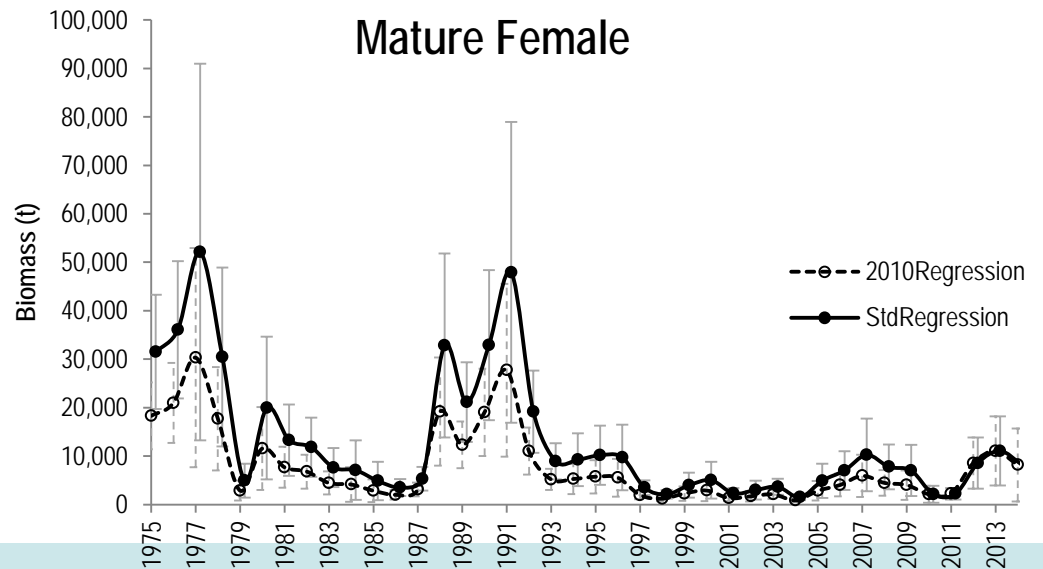
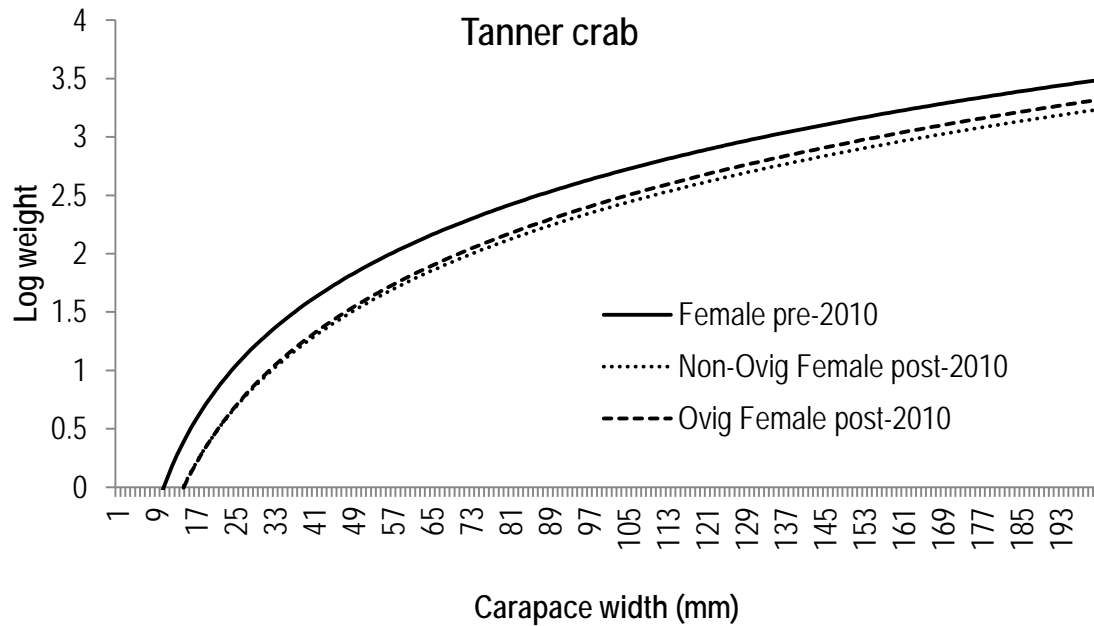
Pribilof District blue king crab

- Not enough samples have been collected between 2007-2014 to update regression factors.

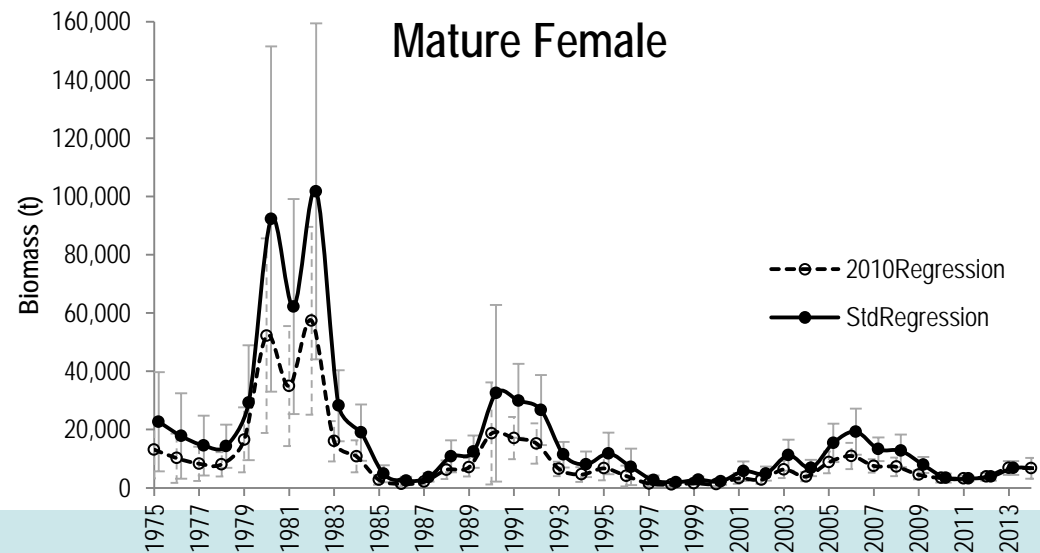
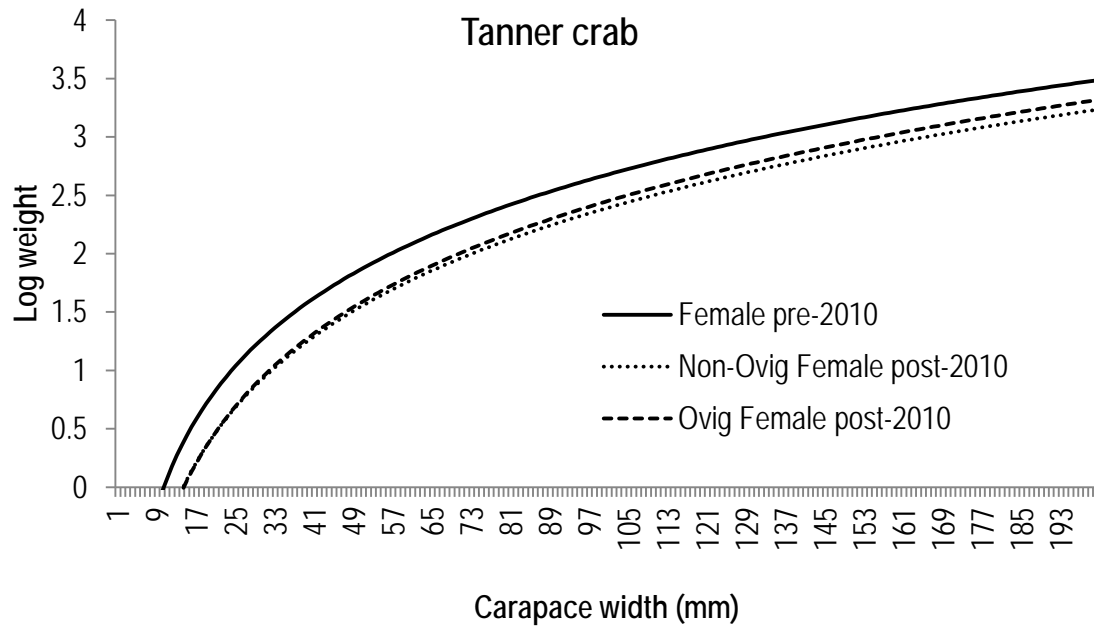
St. Matthews Island blue king crab

- Not enough samples have been collected between 2007-2014 to update regression factors.

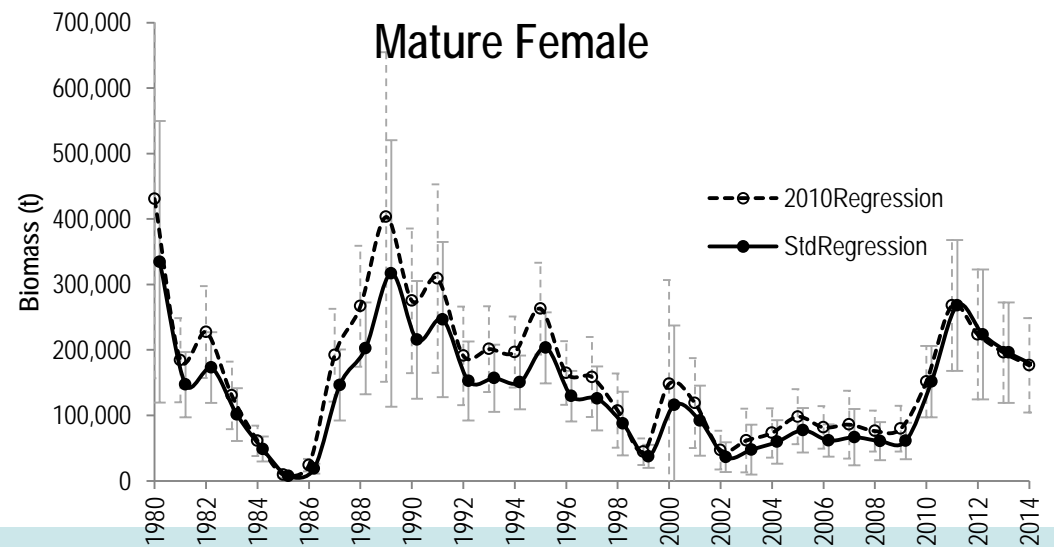
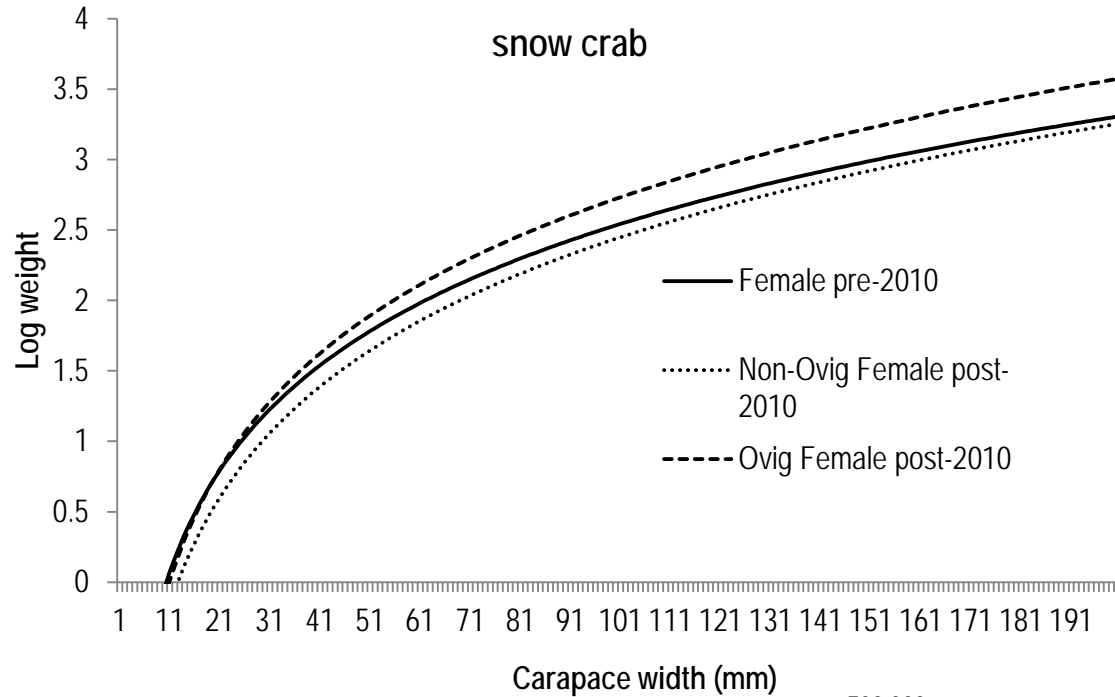
Tanner crab east of 166° W



Tanner crab west of 166° W



Snow crab



Jan 2014 Modeling Workshop

Biological information should be included in the file provided to assessment authors with sufficient information that the sum of the measured crabs, after accounting for the sampling fraction, would match the observed haul weight for the species. The information provided in the past did not always satisfy this specification: for example, when the haul was not completely sampled, there were “crushed” crabs in the tow, or the length-weight regression differed from that assumed.