

MEMORANDUM State of Alaska

DEPARTMENT OF FISH AND GAME

TO:	Lowell Fair, Regional Supervisor –R1 Andrew Olson, F&G Coordinator –R1 Division of Commercial Fisheries	DATE:	November 25, 2020
THRU:	Joe Stratman, Lead Crab Biologist –R1	FILE NO.:	S:\Shellfish\Research\Tanner\Mn gmt anlyss\2020-2021\...
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FROM:	Katie Palof, Biometrician Division of Commercial Fisheries	SUBJECT	2020/21 Southeast Alaska TC stock status, <i>non-confidential</i> version

Summary

The estimated 2020/2021 Southeast Region mature male Tanner crab biomass is 4.95 million pounds: down approximately 0.5 million pounds from the 2019/2020 estimate of 5.44 million pounds. This estimate exceeds the 2.3 million-pound threshold of mature male biomass in regulation [5 AAC 35.113(a)] required to open the commercial fishery. Once the threshold is met, season length is determined using a regulatory harvest strategy based on effort and mature male biomass. No guideline harvest level (GHL) is set or targeted through inseason management. Despite the lack of a GHL-based harvest strategy, harvestable surplus (GHL) of legal male Tanner crab is estimated to provide a basis for evaluating fishery performance and removals from the stock. Applying the stock health status recommended (11.9%) and maximum (20%) exploitation rates to mature male biomass results in a range of GHLs between 0.58 and 0.97 million pounds, respectively (Tables 1 and 2). Harvesting at higher levels, when stock health is poor or moderate, may increase the probability of population declines. Since 2010, the stock status of Southeast Alaska Tanner crab has generally improved, although mature male biomass is down for the second consecutive year after generally increasing the last few years.

The 2020/2021 Southeast Alaska Tanner crab stock is summarized as follows:

- Generally regional biomass has been steady or increasing under the current effort-based management framework, allowing for a stable population and a consistent annual harvest (Figures 1, 2, and A1).
- The trends in legal and mature male biomasses have been generally increasing since 2010, however this is the second consecutive year that projected mature biomass decreased from the previous year (Figure 1 and A1).
- Overall stock health is mixed with some areas improving and others declining from last year. Stock health is “Poor” in two areas, “Below Average” in two areas, “Moderate” in two areas, “Above Average” in four areas, and “Healthy” in two areas (Tables 2 and 3).

Tanner crab survey and analysis

Methods to estimate mature male biomass and assess stock health are similar to those used since 2013; changes to the sampling areas, sampling methods, and catch per unit effort (CPUE) calculations are described below. Background and details of historic methods can be found in Bishop et al. 2013. In general, a three-stage Catch Survey Analysis (CSA) model is used to estimate biomass and the Alaska Department of Fish and Game (ADF&G) survey data are used to assess stock health (Seber 2002, Zheng and Kruse 1999).

No Updates or Changes (2016–2020)

2015 Updates and Changes

Due to budget constraints, Port Camden and Port Frederick were removed as surveyed areas in 2015 and are now considered part of the non-surveyed area for biomass calculations. To estimate regional Tanner crab biomass, the survey area biomass is extrapolated to the non-surveyed areas using an expansion factor. The expansion factor was adjusted in 2015 by removing the average contribution of commercial catch from the two areas removed from the survey during the years used for expansion factor estimation (1980–2000). From 1980 to 2000, an average of 1% of the commercial harvest was from Port Frederick and 4% of the commercial harvest was from Port Camden. Therefore, the previous expansion factor of 71% was reduced to 66%. The current analysis calculates biomass assuming 66% of the biomass is found in the survey areas and 34% in the non-surveyed areas. All graphs and figures reflect these changes.

Additionally, in 2015 the Stephens Passage area was removed from the October Tanner crab survey. In the past, data from the summer red king/Tanner crab survey and the October Tanner crab survey were combined to assess stock health and estimate biomass in this area. Retrospective analysis of these data showed that the summer red king crab survey adequately allowed for an estimation of biomass in Stephens Passage and that the October survey data could be removed. Long- and short-term trends of stock health were recalculated using ONLY summer red king/Tanner crab survey data during the baseline years (1997–2006) and the biomass estimates were also adjusted by a correction factor. This correction factor was calculated by comparing a retrospective analysis from 1997 (when the survey began for Tanner crab) to 2014 (the last year Stephens Passage was surveyed in October). Biomass estimates using only the red king crab survey data were compared to those using both data sets. The difference between these estimates was used to adjust ONLY the red king crab survey data biomass estimates to be comparable to previous years. On average the biomass estimates using ONLY the red king crab survey data were 7% higher than those with both data sets. For 2015 and beyond, the biomass estimate was adjusted down 7% to compare to previous years reported biomass estimates using data from both surveys.

2014 – No Updates or changes

2013 Updates and Changes

In preparation for the 2013 Tanner crab survey the survey areas were stratified based on crab density and depth, modeled on the density stratification currently in place for red king crab survey areas (Clark 2008). Prior to this stratification, simple random sampling had occurred to determine pot placement in the survey areas. The goal of density stratified sampling is to provide more statistically robust estimates of CPUE for use in the CSA model, which in turn will provide additional confidence in our biomass forecasts. Survey sampling from 2013 forward will be performed using these density strata to guide our randomized pot placement. All of the previous year's CPUE calculations and biomass estimates were also re-estimated to accommodate the changes in sampling methods.

A CSA model is performed for each of the survey areas, accurate harvest data in each area is vital to biomass estimation. Harvest, in numbers of crab, is used in the model to scale the survey CPUE to estimate biomass in each area. Inaccurate accounting of harvest can lead to over or under estimation of the biomass. To better match spatial harvest with survey areas, the statistical areas included in harvest calculations for each survey area were reevaluated. The CSA model requires that the harvest input accounts for all harvest on the stock being modeled, prior to this reevaluation some statistical areas adjacent to our survey areas were not included when they should have been. Historic harvests from fish tickets were recalculated using these improved statistical area divisions and used in the 2013 CSA models. The recalculated harvest in these areas changed the magnitude of the biomass estimates in some of the surveyed areas.

The final change in 2013 and future analyses was the graphical representation of legal biomass from the CSA in the area figures. In the past the forecasted biomass for each year was represented here, however this led to inaccuracies in the actual trend in legal biomass (forecasted biomass estimates in each year only include data up to that year). In this document

the estimated biomass for each year is based on the current year's model, which includes all data available for each area. Displaying the biomass estimates from the current year's model allows for a more accurate representation of the trends in biomass over time, which more closely follows the historic harvest in most areas.

Harvestable Surplus

Since the 2009/2010 fishing season the Southeast Alaska Tanner crab fishery has been managed using a minimum mature male biomass threshold with a variable season length, in days, determined by a regulatory harvest strategy reliant on fishing effort and mature male biomass. Even though the fishery is not managed using a GHL, the department continues to determine stock health, establish a biologically appropriate mature male harvest rate, and calculate GHLS to provide a biologically sound benchmark by which actual fishery performance can be evaluated. Based on the analysis of Tanner crab biology and harvest strategies adopted in other regions, region-wide exploitation rate (ER) should not exceed 20% of mature male or 38% of legal male estimated biomass.

Catch-survey modeling of the 2020 fishery and survey data yields a biomass estimate of 4.95 million pounds of mature (greater than 108 mm carapace width) and 3.06 million pounds of legal (greater than 140 mm carapace width) male Tanner crab (Table 1). This is a decrease of 0.48 million pounds of legal male Tanner crab (-8.9%) from the 2019 estimate (Figure A1), predominantly due to legal biomass decreases from the 2019 projections in Glacier Bay, Holkham Bay, Icy Strait, Seymour Canal, North Juneau, and Lynn Sisters, but balanced by legal biomass increases in Stephens Passage, Thomas Bay, Excursion Inlet, Pybus Bay, Gambier Bay, and Peril Strait. Harvesting at the maximum rate (20% of mature biomass) would equate to a GHL of approximately 0.97 million pounds (Table 1). Harvest above this level will increase the probability of population declines. Incorporating stock health information suggests a regional exploitation rate of 11.9% of the mature male biomass would reduce the likelihood of population decline and may provide higher probability of an increase in biomass (Table 1).

Stock Status

Stock health status is determined by a combination of long- and short-term trends in CPUE. Significance in long-term or short-term trends is defined as a p-value < 0.05. Long-term trends compare the current years mean to the long-term baseline value (generally 1997-2010, or the first ten years for which survey data are available); short-term trends regress the last four years of survey data to determine if a significant increasing or decreasing trend is present. Total score is the sum of scores (+1, 0, -1 for long-term; +.25, 0, -.25 for short-term) for each response variable. Stock health is defined by the total score: < -3.25 = Poor, -3.25 to -1.26 = Below Average, -1.25 to 1.25 = Moderate, 1.26 to 3.25 = Above Average, and > 3.25 = Healthy. Recommended exploitation rates based on stock health are zero percent for "Poor", 5% for "Below Average", 10% for "Moderate", 15% for "Above Average", and 20% for "Healthy".

Tanner crab survey areas

Icy Strait, Poor 0%

The Icy Strait stock score decreased since the 2019 survey from moderate to poor stock status (-3.50, Table 2). This change in the population status was due to a decrease in the CPUE of pre-recruit males but an increase in recruit males (Figures 3a and 3b). Recruit male CPUE is not significantly different from its long-term averages, while pre-recruit, post-recruit male and mature female CPUEs are significantly below their long-term averages. Recruit male CPUE has a significant increasing short-term trend, while pre-recruit male and mature female CPUE have significant decreasing short-term trends. The percent of females with poor clutch fullness is not significantly lower than 10% and has a significant short-term increasing trend. Harvest from this area provided an average of 12.0% of the commercial harvest over the baseline years and 7.1% of the harvest during the 2019/2020 fishery (Figure 3a).

Glacier Bay, Below Average 5%

The Glacier Bay stock score decreased from the 2019 survey to -2.50, moving the stock status to below average (Table 2). Decreased stock health score is primarily due to decrease in pre-recruit male, recruit male, and mature female CPUEs (Figures 4a and 4b). Pre-recruit male CPUE fell to be significantly below its long-term average, while recruit and post-recruit male CPUEs are not significantly different from their long-term averages. Pre-recruit male CPUE also has a significant decreasing short-term trend. The percent of females with poor clutch fullness is not significantly lower than 10%. The population is above baseline levels, but both legal and mature biomass is decreasing rapidly from the high levels

of the last few years. Harvest from this area provided an average of 9.2% of the commercial harvest over the baseline years and 17.5% of the harvest during the 2019/2020 fishery (Figure 4a).

Thomas Bay, Healthy 20%

The Thomas Bay stock score increased substantially from the 2019 survey to a stock status of healthy; up to 4.50 (Table 2). Pre-recruit and recruit male, along with mature female, CPUEs are significantly above their long-term baseline, while post-recruit male CPUE is at its long-term average (Figure 5a and 5b). Both pre-recruit and recruit CPUEs have significant short-term increasing trends. The percent of females with poor clutch fullness is significantly lower than 10%. Legal biomass projections for 2020 are above the long-term baseline values for the first time since 2006. Thomas Bay commercial harvest provided an average of 4.8% of the regional commercial harvest over the baseline years and 2.1% of the harvest during the 2019/2020 fishery (Figure 5a).

Holkham Bay, Above Average 15%

The Holkham Bay stock score remained above average, but the overall stock health score decreased to 1.50 from 2.00 in 2019 (Table 2). All recruit class CPUEs are at or above their long-term averages, with recruit male CPUE being significantly above its long-term average (Figures 6a and 6b). There is a significant short-term decreasing trend in recruit male and mature female CPUEs. The percentage of females with poor clutch fullness is significantly lower than the baseline 10% level. Biomass estimates are generally increasing and are well above their long-term averages. Harvest from this area provided an average of 7.1% of the commercial harvest over the baseline years and 5.7% of the harvest during the 2019/2020 fishery (Figure 6a).

Port Camden, Not surveyed since 2015

The Port Camden area was removed from the survey in 2015 due to budgetary constraints as well as the low contribution of this area to the overall Tanner crab commercial harvest. Port Camden is now included in the non-surveyed areas; the average contribution of the catch from Port Camden from 1980 to 2000 (catch years used for survey expansion value calculation) was removed from the survey expansion percentage. See comments at the beginning of this document for specific methods. The harvest from this area provided an average of 3.8% of the commercial harvest over the baseline years and the harvest is confidential during the 2019/2020 fishery.

Red king crab survey areas

Stephens Passage, Healthy 20%

The Stephens Passage stock score remained in healthy stock status and increased to a score of 5.50 from 3.50 in 2019 (Table 2). All recruit class CPUEs are significantly above their long-term averages (Figures 7a and 7b). Recruit and post-recruit male CPUE have significant short-term increasing short-term trends. The percentage of females with poor clutch fullness was significantly less than the 10% threshold. The legal biomass estimate is above the baseline value, with both legal and mature biomass reaching the high levels of the late 1990s. The harvest from this area provided an average of 9.5% of the commercial harvest over the baseline years and 10.7% of the harvest during the 2019/2020 fishery (Figure 7a). Starting in 2015, only survey data from the summer red king crab survey is used to assess the Stephens Passage area. Refer to the assessment updates and changes at the beginning of this document.

Seymour Canal, Below Average 5%

The Seymour Canal stock score fell to below average, down from moderate in 2019. The 2020 score is -2.00; down from 1.00 in 2019 (Table 3). This score decrease was driven by a decrease in pre-recruit and recruit male CPUE, with recruit male CPUE falling significantly below its long-term average, and by an increase in the percentage of females with poor clutches. Pre-recruit, post-recruit, and mature female CPUEs are still at or above their long-term averages, but not significantly above (Figures 8a and 8b). The percentage of females with poor clutch fullness is above the threshold of 10%, indicating an increased number of females with poor or low clutches. The legal biomass estimate, while down from 2019, is still at the baseline value but down from high values of the last few years. The harvest from this area provided an average of 6.3% of the commercial harvest over the baseline years and 11.1% of the harvest during the 2019/2020 fishery (Figure 8a).

North Juneau, Above Average 15%

The North Juneau stock score decreased since the 2019 survey but remained at a stock health status of above average (Table 3). This score decrease is driven by significant short-term decreasing trends in pre-recruit, recruit, and mature female CPUEs. All recruit class CPUEs are at or above their long-term averages, with only pre-recruit male CPUEs being significantly above (Figures 9a and 9b). The percentage of females with poor clutch fullness is significantly less than 10%. The legal biomass estimate is below the baseline value and slightly decreasing. The harvest from this area provided an average of 7.1% of the commercial harvest over the baseline years and 5.3% of the harvest during the 2019/2020 fishery (Figure 9a).

Excursion Inlet, Moderate 10%

The Excursion Inlet stock score decreased since the 2019 survey, from -0.25 to -0.50, but remained at a stock health of moderate (Table 3). This change is driven by a significant short-term decreasing trends in mature female CPUE. All recruit class CPUEs are not significantly different from their long-term values, and similar to 2019 levels. However, none are significantly above baseline levels. Recruit male CPUE has a significant short-term decreasing trend (Figures 10a and 10b). The percentage of females with poor clutches is at the 10% threshold. The legal biomass estimate is at the baseline value and has an increasing trend. The harvest from this area provided an average of 6.3% of the commercial harvest over the baseline years and 2.2% of the harvest during the 2019/2020 fishery (Figure 10a).

Pybus Bay, Above Average 15%

The Pybus Bay stock increased since the 2019 survey to a stock health status of above average. It is currently scored at 1.50; up from -2.75 in 2019 (Table 3). This change is a result of increases in all recruit class CPUEs, with both pre-recruit and recruit CPUEs being significantly above their baseline values. There are significant short-term decreasing trends in pre-recruit male and post-recruit CPUEs from historic high levels 4 years ago (Figures 11a and 11b). The percentage of females with poor clutches was not significantly different from the 10% threshold. The legal biomass estimate is above the baseline value and contradicts the decreasing trend of the past few years. The harvest from this area provided an average of 1.2% of the commercial harvest over the baseline years and the harvest is confidential during the 2019/2020 fishery (Figure 11a).

Gambier Bay, Poor 0%

The Gambier Bay stock score remained at a poor stock health status. It is currently scored at -4.75; up slightly from -5.00 in 2019 (Table 3). This increase is driven by increases in pre-recruit and recruit CPUEs, however all recruit classes are significantly below their baseline values. There are significant short-term decreasing trends in pre-recruit male, post-recruit male and mature female CPUEs (Figures 12a and 12b). The percentage females with poor clutches is not significantly different from the threshold of 10%. The legal biomass estimate is below the baseline value and has a decreasing trend over the last few years. The harvest from this area provided an average of 1.9% of the commercial harvest over the baseline years and the harvest is confidential during the 2019/2020 fishery (Figure 12a).

Peril Strait, Moderate 10%

The Peril Strait stock score remained moderate, increasing to 1.00 from 0.00 in 2019 (Table 3). This increased score is driven by an increase in recruit CPUE which is now significantly above its long-term baseline value. All other recruit class CPUEs are at or above their long-term averages, but not significantly so (Figures 13a and 13b). There is a significant short-term increasing trend in recruit male CPUE, but also a significant decreasing trend in mature female CPUE. The percentage of females with poor clutches is not significantly different from the 10% threshold. The legal biomass estimate is above its baseline value, with an increasing trend in the past few years. The harvest from this area contributed an average of 0.7% of the commercial harvest over the baseline years and 0.3% of the harvest during the 2019/2020 fishery (Figure 13a).

Lynn Sisters, Above Average 15%

The Lynn Sisters stock remained at above average stock health, with the score decreasing slightly to 2.00 from 2.25, from 2019 (Table 3). Both pre-recruit and recruit CPUEs are significantly above the long-term average, while post-recruit male and mature female CPUEs are at their long-term baseline values (Figures 14a and 14b). There are no significant short-term trends. The percentage of females with poor clutch fullness is not significantly lower than 10%. The legal biomass estimate is above the baseline value at historically high levels for the area and has remained high for the last three years.

The harvest from this area provided an average of 0.7% of the commercial harvest over the baseline years and 1.1% of the harvest during the 2019/2020 fishery (Figure 14a).

Port Frederick, Not surveyed since 2015

The Port Frederick survey area was removed from the survey in 2015 due to its low contribution to the overall Tanner crab catch and department budget constraints. Port Frederick is now included in the non-surveyed areas. The average contribution of catch in Port Frederick from 1980 to 2000 was removed from the survey expansion percentage. See comments at the beginning of this document for more detail. The harvest from this area provided an average of 0.5% of the commercial harvest over the baseline years and 0.81% of the harvest during the 2019/2020 fishery.

Literature Cited

Bishop, G., C. Siddon, and A. Olson. 2013. Southeast Alaska Tanner crab survey and stock health prior to the 2011/2012 season. Regional information report No. 1J13-03. Alaska Department of Fish and Game, Division of Commercial Fisheries.

Clark, J.E. 2008. Restratification of the red king crab stock assessment survey in Southeast Alaska (pp.96). Juneau: Alaska Department of Fish and Game, Division of Commercial Fisheries.

Seber, G. A. F. 2002. The estimation of animal abundance, 2 edition. Blackburn Press, Caldwell, New Jersey. 654 pp.

Zheng, J., and G. H. Kruse. 1999. Evaluation of harvest strategies for Tanner crab stocks that exhibit periodic recruitment. *Journal of Shellfish Research* 18:667-679.

Tables and Figures

Table 1. Results of 2020 catch-survey modeling estimation of legal and mature Tanner crab biomass and guideline harvest level (GHL) calculations using proposed maximum 20% region-wide mature exploitation rates and exploitation rates based upon the current stock health status for each of the 12 survey areas. See matrices below for a more detailed look at the basis of stock status determinations. The expansion factor of 66% (34% for non-surveyed areas) for the total legal and mature male crab biomass was based on the percent of commercial harvest taken from 1980–2000 in surveyed areas. The average harvest and biomass from the first ten years of survey data in each area represents a mean historical baseline (long-term average) of harvest. Both Tanner crab survey (TCS) and red king crab survey (RKCS) areas are presented.

	Survey area	Healthy stock status					Current stock status			1997-2006**	
		Biomass of legal crab	Biomass of mature crab	Mature harvest rate	Legal harvest rate	GHL ^a	Mature harvest rate	Legal harvest rate	GHL ^a	Average catch	Est. mature biomass
TCS	Icy Strait	151,016	199,719	20%	26%	39,944	0%	0%	0	160,673	375,023
	Glacier Bay	363,919	541,494	20%	30%	108,299	5%	7%	27,075	118,541	659,423
	Stephens Passage	437,161	651,612	20%	30%	130,322	20%	30%	130,322	128,405	370,280
	Thomas Bay	131,223	297,548	20%	45%	49,865*	20%	45%	49,865*	54,997	182,570
	Holkham Bay	244,930	354,245	20%	29%	70,849	15%	22%	53,137	103,853	204,314
RKCS	Seymour Canal	173,358	303,672	20%	35%	60,734	5%	9%	15,184	89,027	256,921
	North Juneau	129,556	191,424	20%	30%	38,285	15%	22%	28,714	91,575	271,604
	Excursion Inlet	179,469	314,294	20%	35%	62,859	10%	18%	31,429	80,896	279,146
	Pybus Bay	45,033	92,766	20%	41%	17,113*	15%	31%	13,915	15,011	55,938
	Gambier Bay	19,692	49,693	20%	50%	7,483*	0%	0%	0	27,005	89,805
	Peril Strait	99,381	211,880	20%	43%	37,765*	10%	21%	21,188	10,989	94,317
	Lynn Sisters	45,372	59,635	20%	26%	11,927	15%	20%	8,945	11,220	38,146
	Other Areas	1,040,663	1,683,505			336,701			200,609	459,614	1,482,342
	Total	3,060,773	4,951,487	20%	32%	972,145	11.9%	19%	580,383	1,351,806	4,359,829

^a Guideline harvest level (GHL) is 20% of the mature male biomass unless this scenario creates a legal harvest rate that is greater than 38%, if this is the case the GHL is adjusted to be 38% of legal male biomass.

*Adjusted GHL due to >38% of legal biomass.

** Means represent years 1997 to 2006 in most areas, otherwise they represent the first ten years of survey data in the area.

Table 2. Matrix of Tanner crab stock status determination from the 2020 Tanner crab survey. The long-term average is defined as the first 10 years of available data from 1997–2010. Short-term trends are based on individual regression analyses over the past 4 years (including the current year). Total score is the sum of scores (+1, 0, -1 for long-term; +.25, 0, -.25 for short-term) for each response variable. Stock health is defined by the total score: < -3.25 = Poor, -3.25 to -1.26 = Below Average, -1.25 to 1.25 = Moderate, 1.26 to 3.25 = Above Average, and > 3.25 = Healthy.

	Icy Strait		Glacier Bay		Stephens Passage		Thomas Bay		Holkham Bay	
	% of baseline	Score	% of baseline	Score	% of baseline	Score	% of baseline	Score	% of baseline	Score
Large/mature females Percent clutch fullness < 25% -vs. long-term average -short term trend	-37	0 -0.25	-30	0 0	-68	1 0	-48	1 0	-91	1 0
- CPUE vs. long-term average - CPUE vs. short-term trend	-81	-1 -0.25	-85	-1 -0.25	77	1 0	89	1 0	26	0 -0.25
Prerecruit males - CPUE vs. long-term average - CPUE short-term trend	-56	-1 -0.25	-51	-1 -0.25	143	1 0	165	1 0.25	65	0 0
Recruit males - CPUE vs. long-term average - CPUE short-term trend	-32	0 0.25	48	0 0	71	1 0.25	57	1 0.25	63	1 -0.25
Postrecruit males - CPUE vs. long-term average - CPUE short-term trend	-66	-1 0	-3	0 0	91	1 0.25	5	0 0	46	0 0
2019 Total score	-0.50		1.25		3.50		2.00		2.00	
2019 Stock status	Moderate		Above Average		Healthy		Above Average		Above Average	
2019 Mature harvest rate	10%		15%		20%		15%		15%	
2020 Total score	-3.50		-2.50		5.50		4.50		1.50	
2020 Stock status	Poor		Below Average		Healthy		Healthy		Above Average	
2020 Mature harvest rate	0%		5%		20%		20%		15%	

Table 3. Matrix of Tanner crab stock status determination from the 2020 red king crab survey. The long-term average is defined from 1997–2006. Short-term trends are based on individual regression analyses over the past 4 years (including the current year). Total score is the sum of scores (+1, 0, -1 for long-term; +.25, 0, -.25 for short-term) for each response variable. Stock health is defined by the total score: < -3.25 = Poor, -3.25 to -1.26 = Below Average, -1.25 to 1.25 = Moderate, 1.26 to 3.25 = Above Average, and > 3.25 = Healthy.

	Seymour Canal		North Juneau		Excursion Inlet		Pybus Bay	
	% of Baseline	Score	% of Baseline	Score	% of Baseline	Score	% of Baseline	Score
Large/Mature female percent clutch fullness < 25% - vs. long-term average - short term trend	60	0 -0.25	-87	1 0.25	-36	0 0	-11	0 0
- CPUE vs. long-term average - CPUE vs. short-term trend	111	0 -0.25	9	0 -0.25	-22	0 -0.25	326	0 0
Pre-recruit males - CPUE vs. long-term average - CPUE short-term trend	74	0 -0.25	58	1 -0.25	40	0 0	225	1 -0.25
Recruit males - CPUE vs. long-term average - CPUE short-term trend	-69	-1 -0.25	-13	0 -0.25	-15	0 -0.25	220	1 0
Post-recruit males - CPUE vs. long-term average - CPUE short-term trend	5	0 0	12	0 0	19	0 0	4	0 -0.25
2019 Total score	1.00		2.00		-0.25		-2.75	
2019 Stock status	Moderate		Above Average		Moderate		Below Average	
2019 Mature harvest rate	10%		15%		10%		5%	
2020 Total score	-2.00		1.50		-0.50		1.50	
2020 Stock status	Below Average		Above Average		Moderate		Above Average	
2020 Mature harvest rate	5%		15%		10%		15%	

Table 3.–Continued

	Gambier Bay		Peril Strait		Lynn Sisters	
	% of Baseline	Score	% of Baseline	Score	% of Baseline	Score
Large/Mature female percent clutch fullness < 25%						
- vs. long-term average	-22	0	-26	0	7	0
- short term trend		0		0		0
- CPUE vs. long-term average	-71	-1	27	0	-42	0
- CPUE vs. short-term trend		-0.25		-0.25		0
Pre-recruit males						
- CPUE vs. long-term average	-32	-1	73	0	91	1
- CPUE short-term trend		-0.25		0		0
Recruit males						
- CPUE vs. long-term average	-49	-1	240	1	54	1
- CPUE short-term trend		0		0.25		0
Post-recruit males						
- CPUE vs. long-term average	-66	-1	50	0	65	0
- CPUE short-term trend		-0.25		0		0
2019 Total score	-5.00		0.00		2.25	
2019 Stock status	Poor		Moderate		Above Average	
2019 Mature harvest rate	0%		10%		15%	
2020 Total score	-4.75		1.00		2.00	
2020 Stock status	Poor		Moderate		Above Average	
2020 Mature harvest rate	0%		10%		15%	

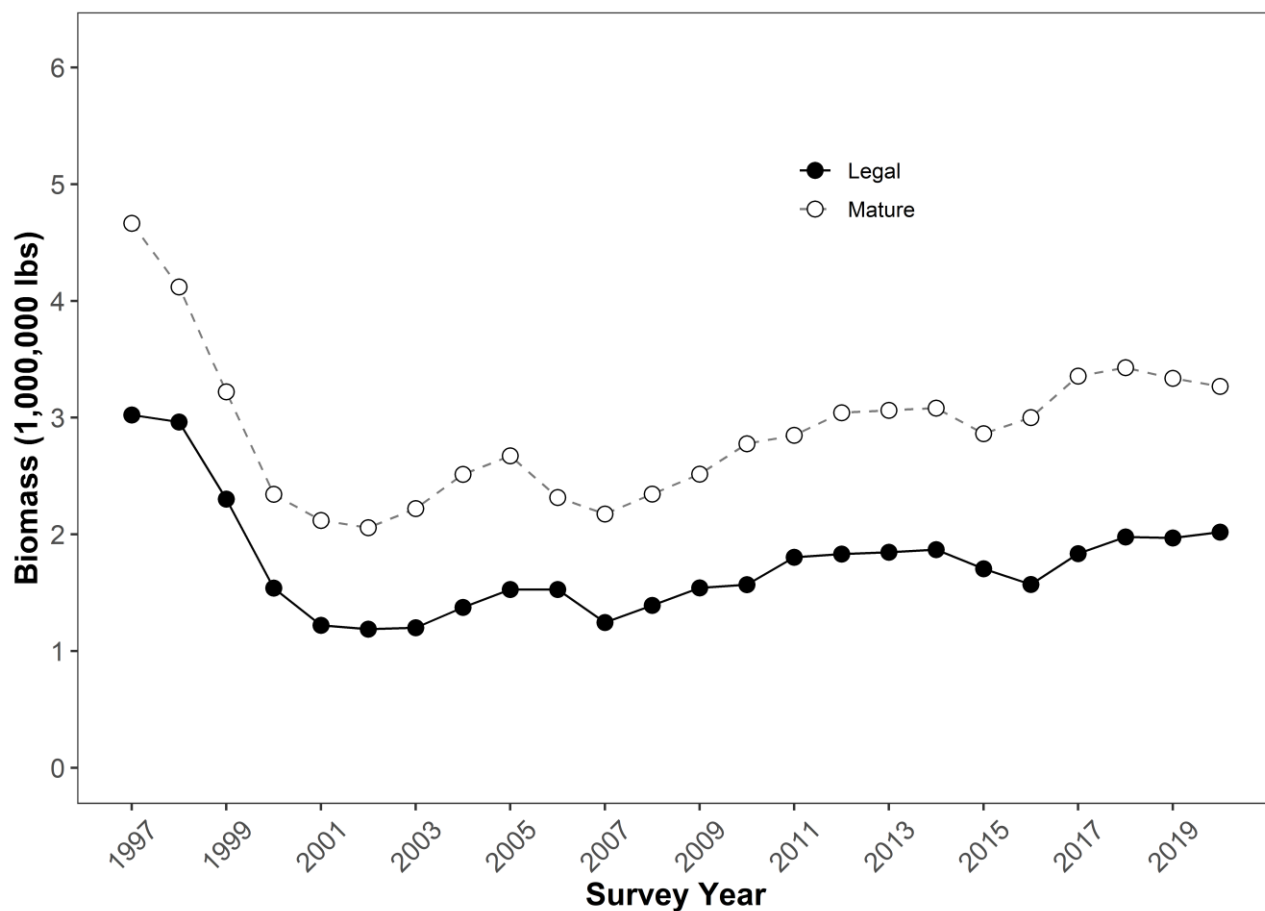


Figure 1. Trends in Tanner crab mature and legal biomass for the surveyed areas estimated from the 2020 catch-survey modeling using the pot survey data for Southeast Alaska. Biomass estimates do NOT include non-surveyed areas (starting in 2015 Port Camden and Port Frederick were removed from the survey areas, they are not included in any biomass estimates here). Prior to 2001 the biomass of areas initially not surveyed (Thomas Bay, Glacier Bay), but added in subsequent years, is as estimated as their average percent contribution to the total surveyed biomass in all subsequent years (first year surveyed to current year’s survey).

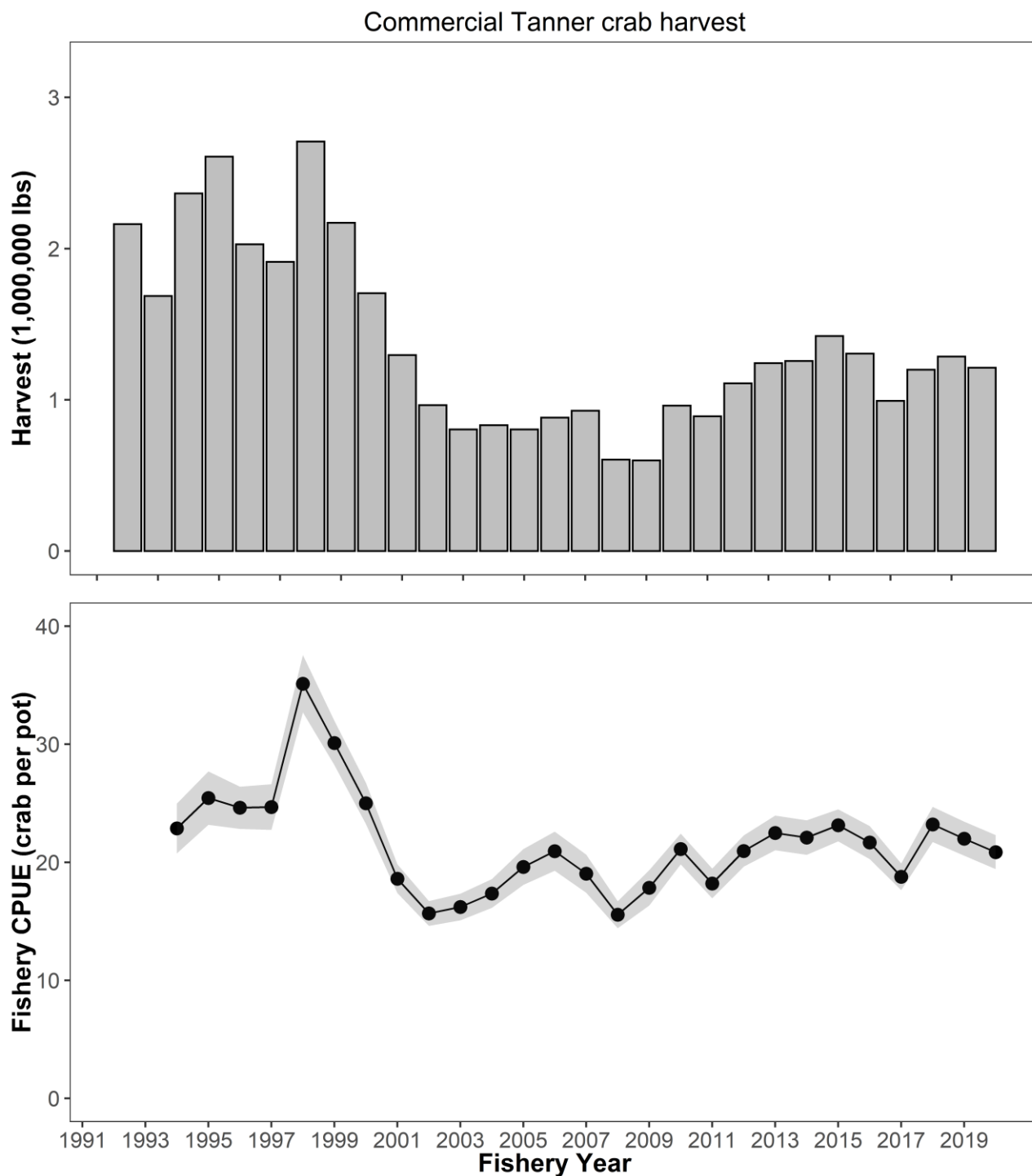


Figure 2. Southeast Alaska commercial Tanner crab harvest and standardized commercial catch-per-unit-effort (CPUE) for 1991/1992 through 2019/2020 seasons. The x axis is represented by fishery year, e.g. 2018/2019 season is 2019 fishery year. CPUE was calculated using logbook data, which began during the 1993/1994 season. Standardized CPUE was calculated by using a similar number of pot lifts for each year, based on the year (2008/2009) with the fewest number of pot lifts (12,521).

Icy Strait

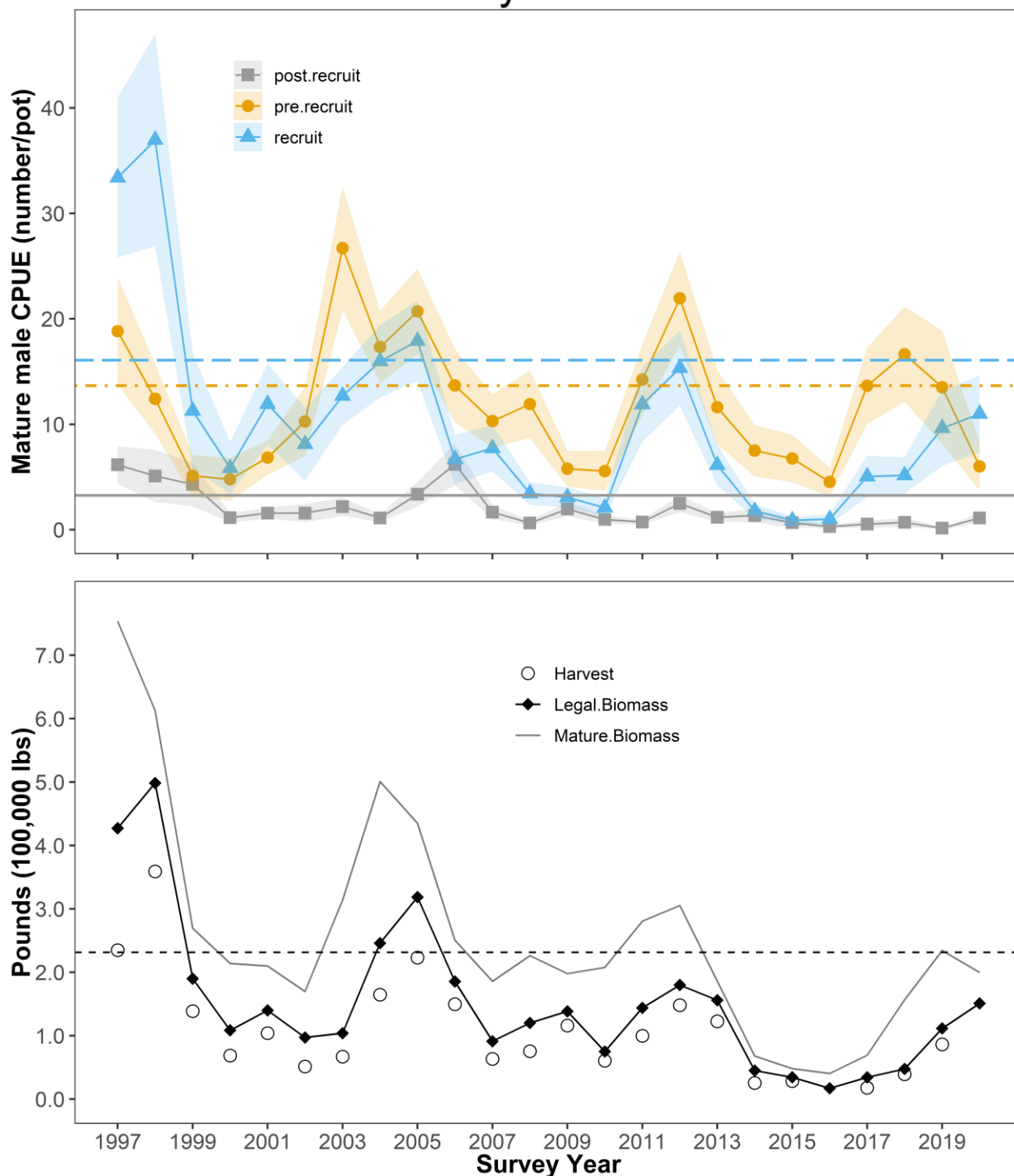


Figure 3a. Icy Strait Tanner crab survey area. Biomass estimates of legal and mature Tanner crab are based on catch-survey analysis methodologies. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997-2006) for pre-recruit male (orange), recruit (blue), and post-recruit (grey) crabs. Reference line for biomass (dashed line) represents the long-term average (1997-2006) for legal biomass (lb). There is a significant short-term *increasing* trend for pre-recruit and *decreasing* trend for recruit male CPUE ($p < 0.05$).

Icy Strait - Females

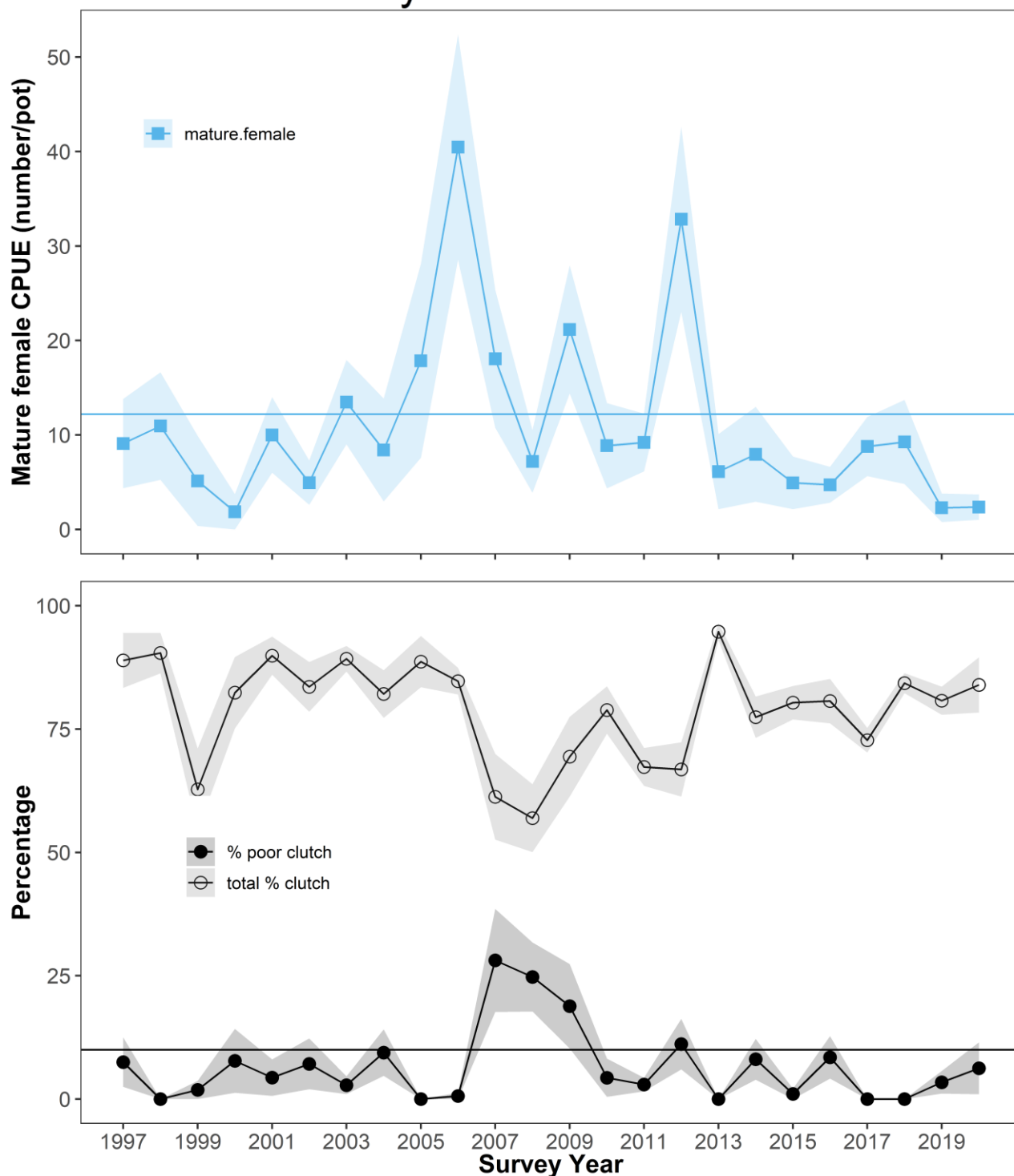


Figure 3b. Female information for Icy Strait Tanner crab survey area. Reference lines represent long-term benchmark (1997-2006) values. There is a significant *decreasing* short-term trend in mature female CPUE, and significant *increasing* trend in the proportion of poor clutches ($p < 0.05$).

Glacier Bay

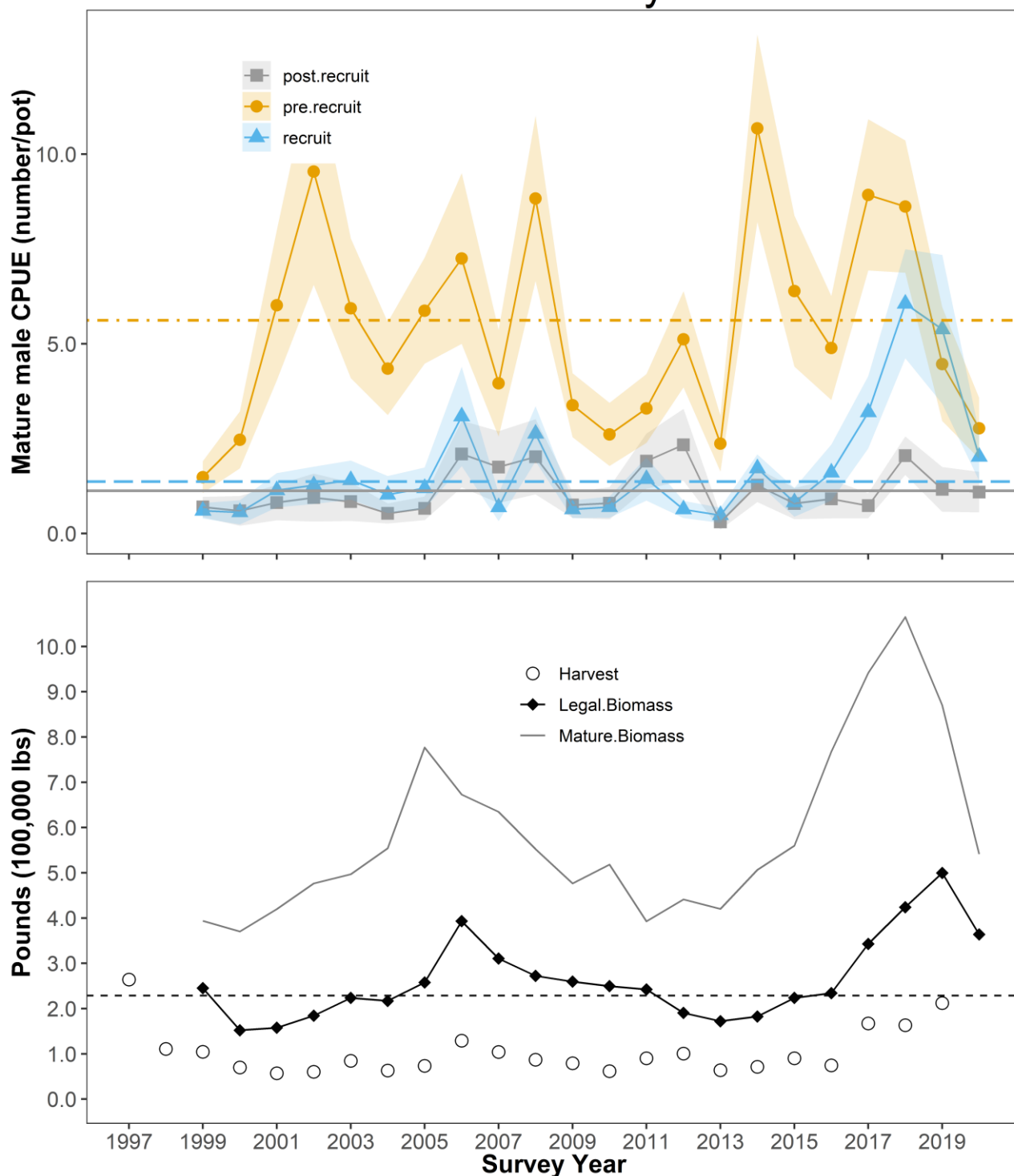


Figure 4a. Glacier Bay Tanner crab survey area. Biomass estimates of legal and mature Tanner crab are based on catch-survey analysis methodologies. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997-2006) pre-recruit male (orange), recruit (blue), and post-recruit (grey) crabs. Reference line for biomass (dashed line) represents the long-term average (1997-2006) for legal biomass (lb). There is a significant short-term decreasing trend for pre-recruit male CPUE ($p < 0.05$).

Glacier Bay - Females

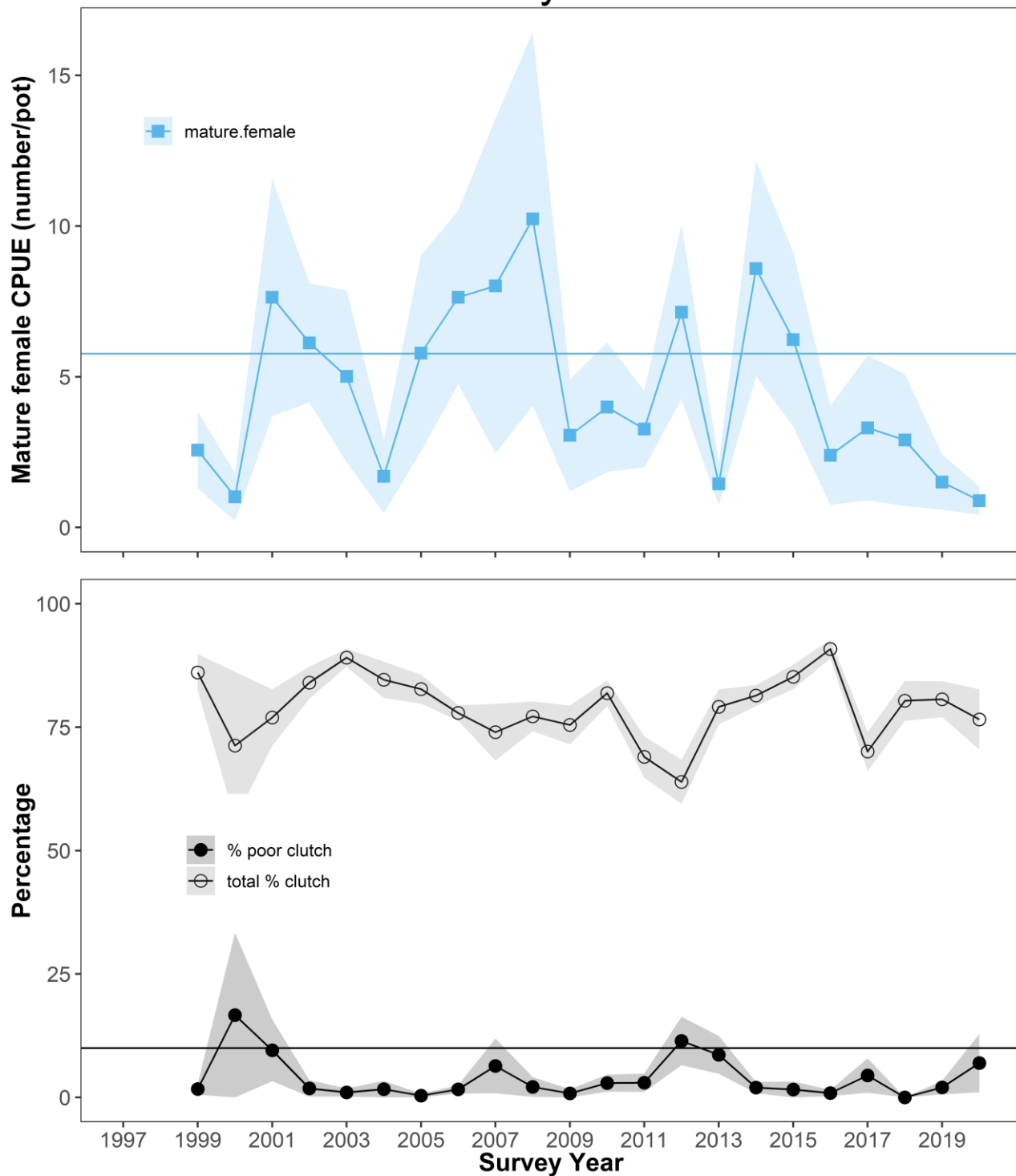


Figure 4b. Female information for Glacier Bay Tanner crab survey area. Reference lines represent long-term benchmark (1997-2006) values. There is a significant short-term decreasing trend in mature female CPUE ($p < 0.05$).

Thomas Bay

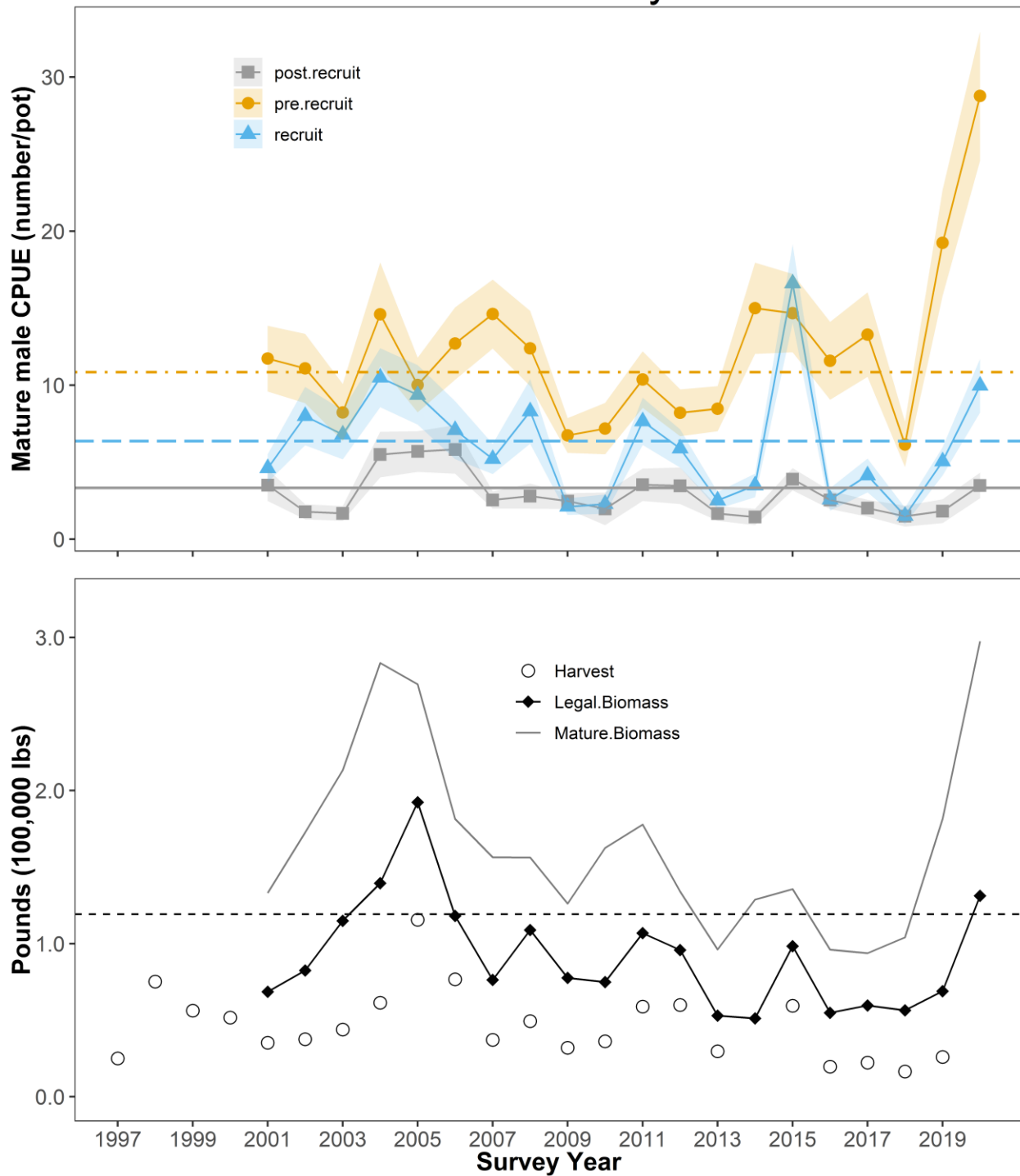


Figure 5a. Thomas Bay Tanner crab survey area. Biomass estimates of legal and mature Tanner crab are based on catch-survey analysis methodologies. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997-2006) for pre-recruit male (orange), recruit (blue), and post-recruit (grey) crabs. Reference line for biomass (dashed line) represents the long-term average (1997-2006) for legal biomass (lb). There are significant short-term *increasing* trends for pre-recruit and recruit male CPUEs ($p < 0.05$).

Thomas Bay - Females

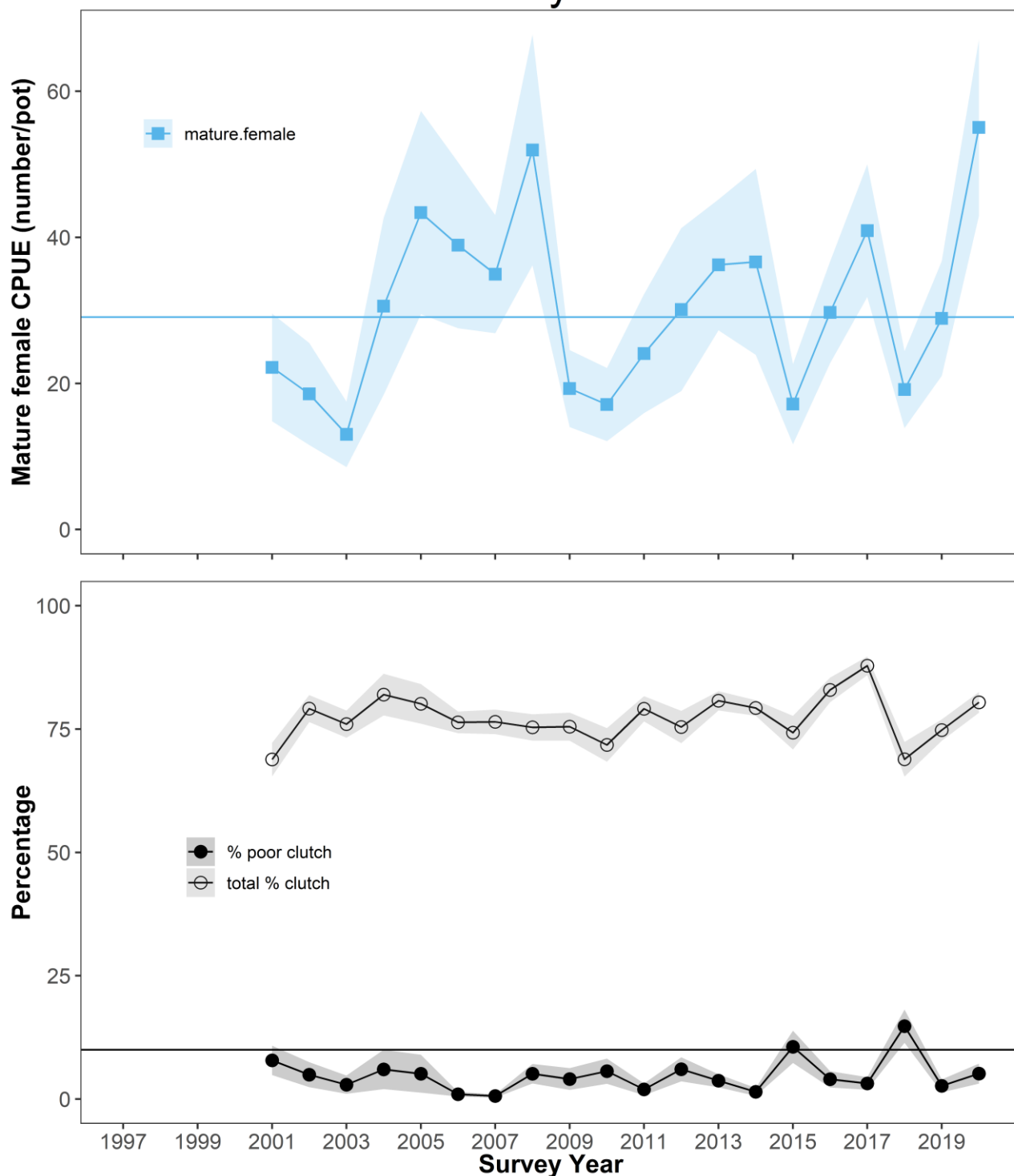


Figure 5b. Female information for Thomas Bay Tanner crab survey area. Reference lines represent long-term benchmark (1997-2006) values. There are NO significant short-term trends in either CPUE or the proportion of poor clutches ($p < 0.05$).

Holkham Bay

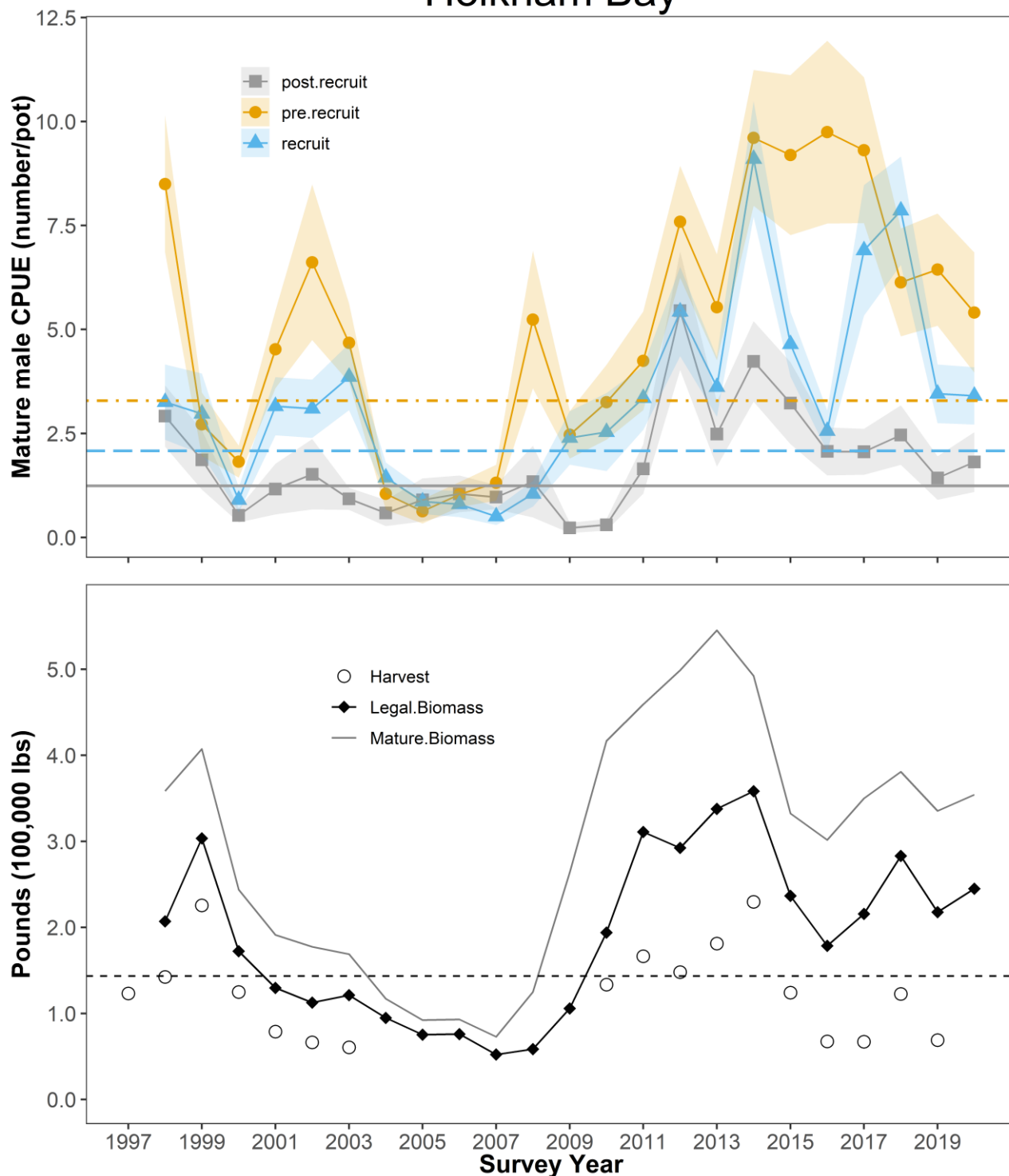


Figure 6a. Holkham Bay Tanner crab survey area. Biomass estimates of legal and mature Tanner crab are based on catch-survey analysis methodologies. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997-2006) for pre-recruit male (orange), recruit (blue), and post-recruit (grey) crabs. Reference line for biomass (dashed line) represents the long-term average (1997-2006) for legal biomass (lb). There is a significant short-term *decreasing* trend for recruit CPUE ($p < 0.05$).

Holkham Bay - Females

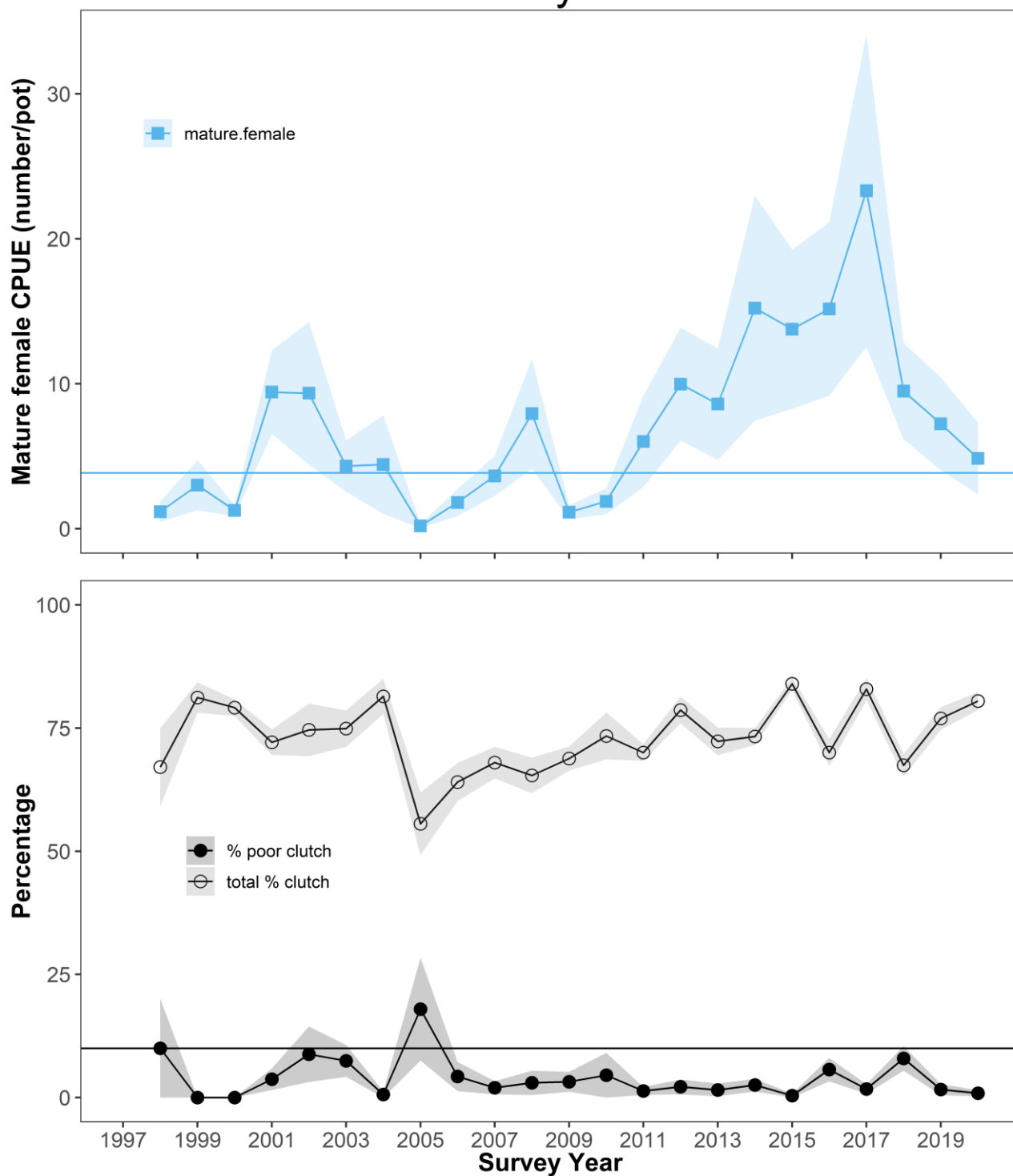


Figure 6b. Female information for Holkham Bay Tanner crab survey area. Reference lines represent long-term benchmark (1997-2006) values. There is a significant short-term decreasing trend in mature female CPUE ($p < 0.05$).

Stephens Passage

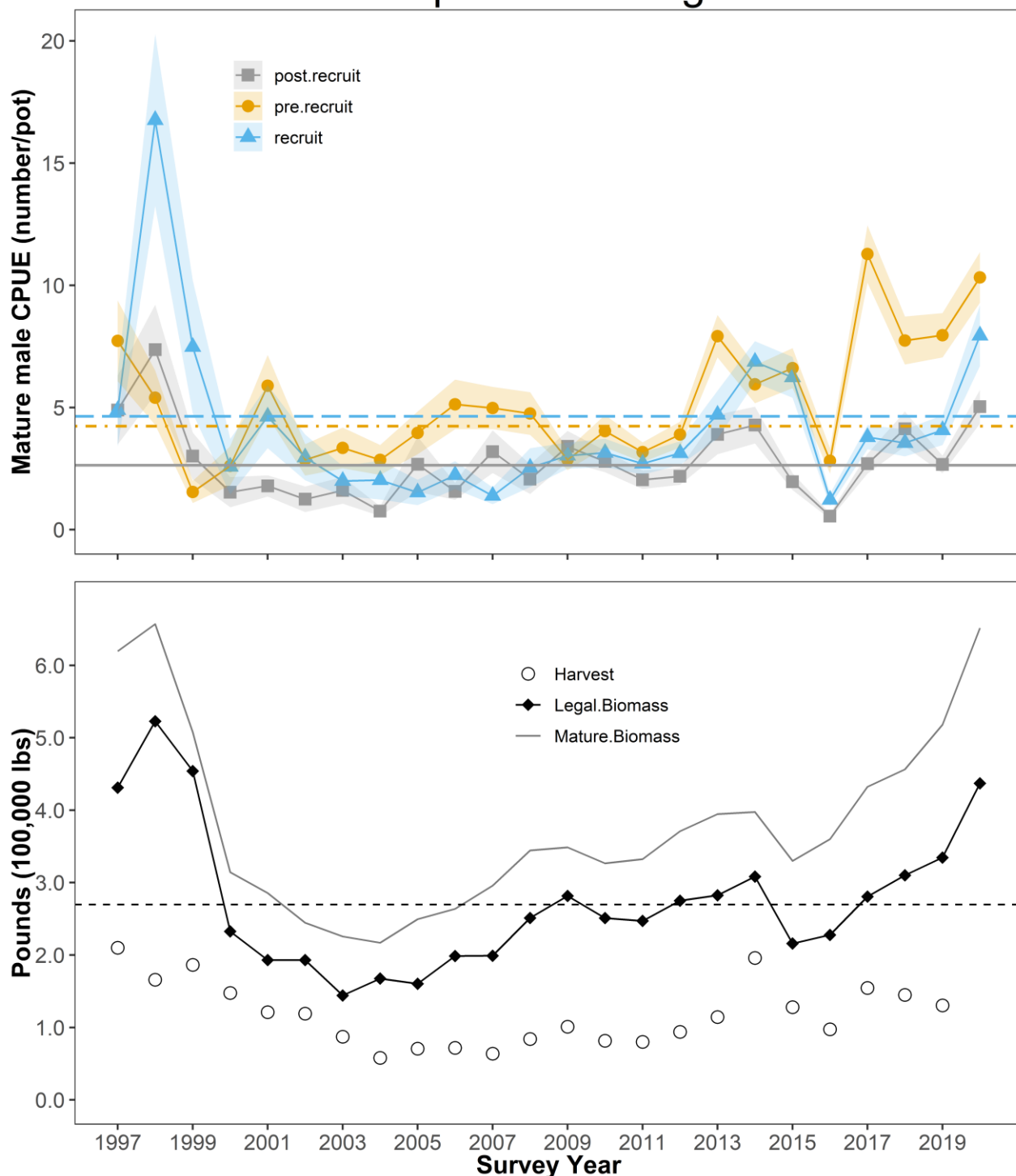


Figure 7a. Stephens Passage red king crab survey area. Biomass estimates of legal and mature Tanner crab are based on catch-survey analysis methodologies. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997-2006) for pre-recruit male (orange), recruit (blue), and post-recruit (grey) crabs. Reference line for biomass (dashed line) represents the long-term average (1997-2006) for legal biomass (lb). There is a significant short-term *increasing* trend for both recruit and post-recruit male CPUE ($p < 0.05$).

Stephens Passage - Females

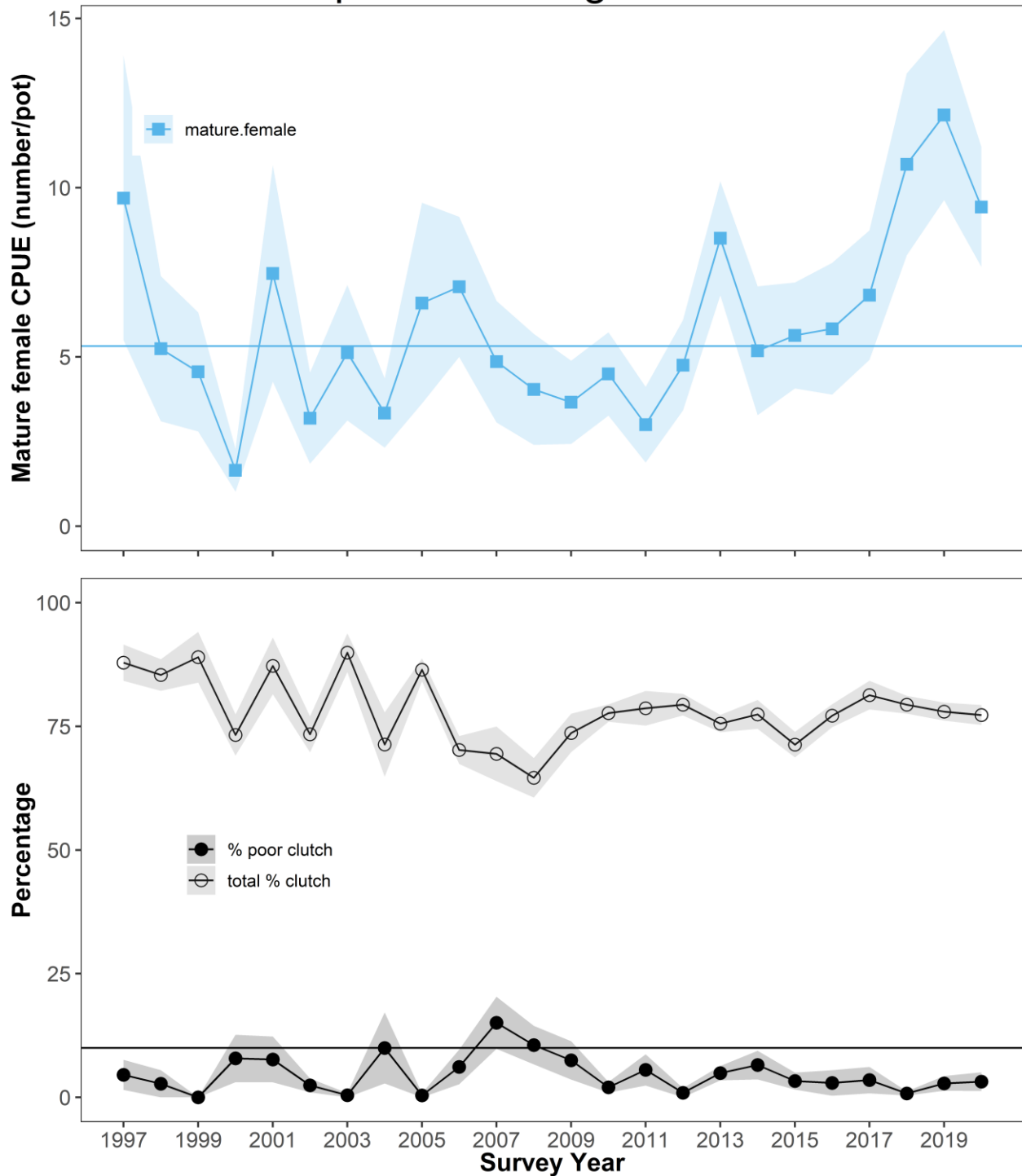


Figure 7b. Female information for Tanner crab in the Stephens Passage red king crab survey area. Reference lines represent long-term benchmark (1997-2006) values. There are NO significant short-term trends in either CPUE or the proportion of poor clutches ($p < 0.05$).

Seymour Canal

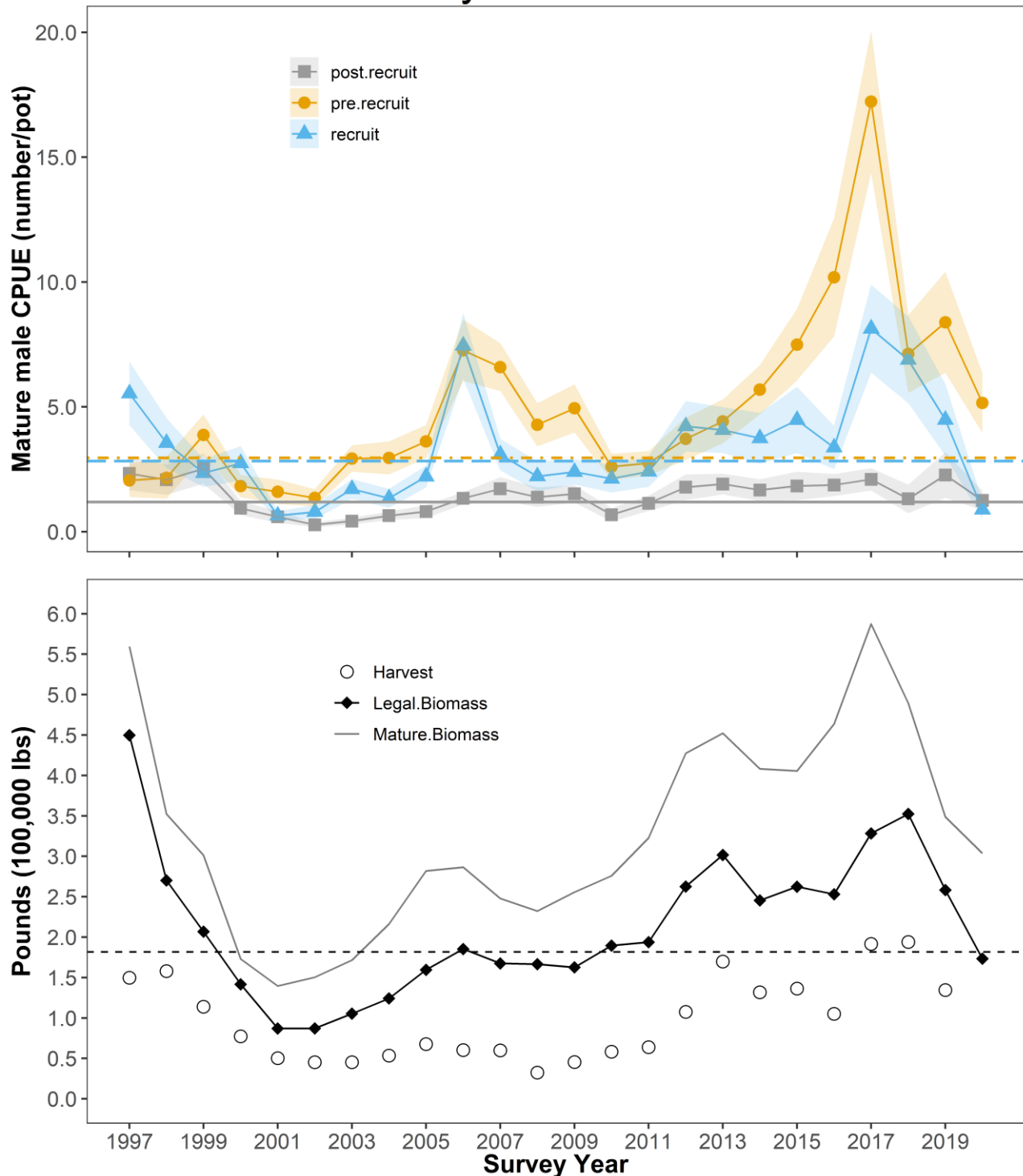


Figure 8a. Seymour Canal red king crab survey area. Biomass estimates of legal and mature Tanner crab are based on catch-survey analysis methodologies. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997-2006) for pre-recruit male (orange), recruit (blue), and post-recruit (grey) crabs. Reference line for biomass (dashed line) represents the long-term average for legal biomass (lb). There are significant short-term *decreasing* trends in pre-recruit and recruit male CPUEs ($p < 0.05$).

Seymour Canal - Females

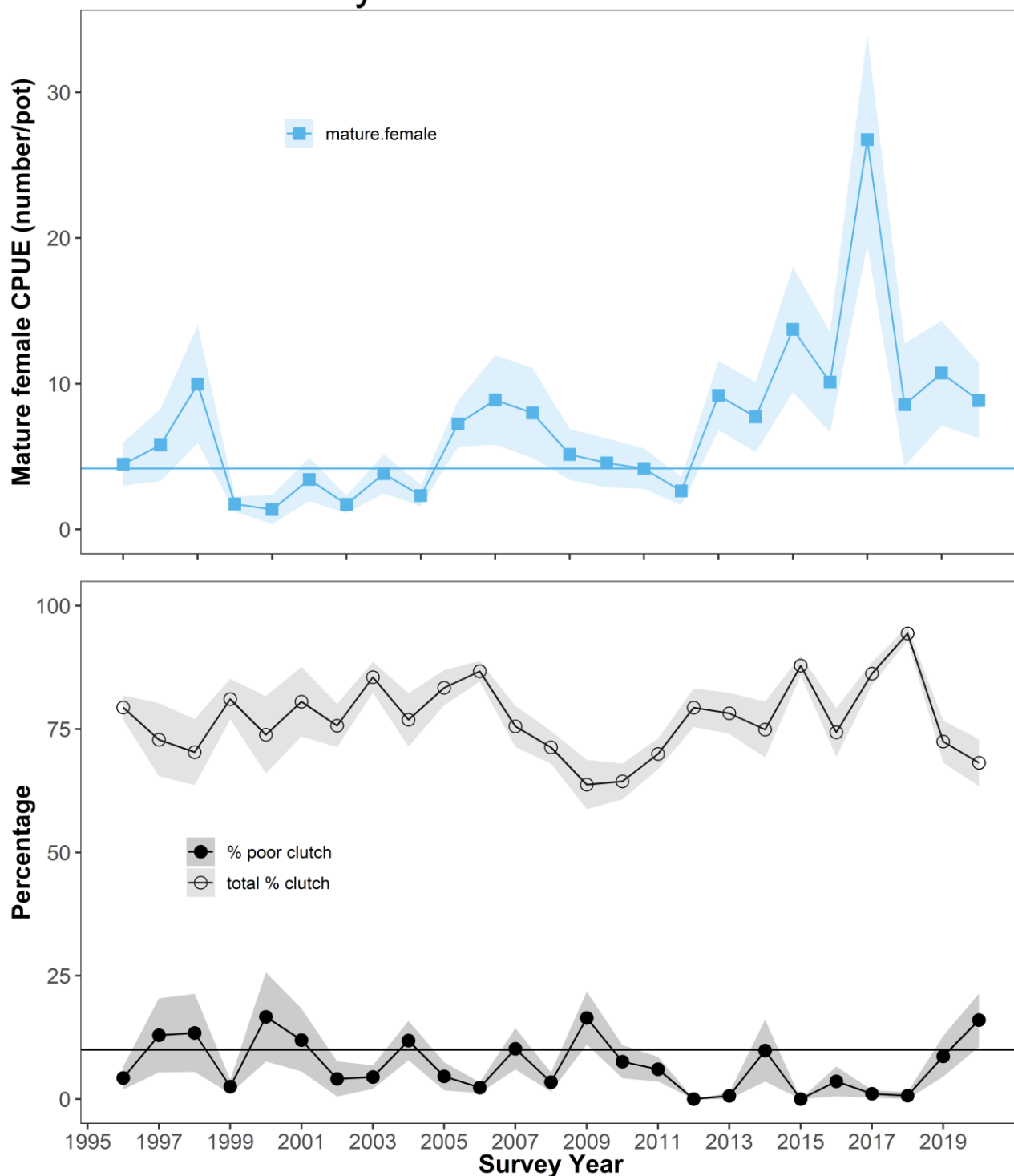


Figure 8b. Female information for Tanner crab in the Seymour Canal red king crab survey area. Reference lines represent long-term benchmark (1997-2006) values. There is a significant short-term *decreasing* trend in mature female CPUE and a significant short-term *increasing* trend in the proportion of poor clutches ($p < 0.05$).

North Juneau

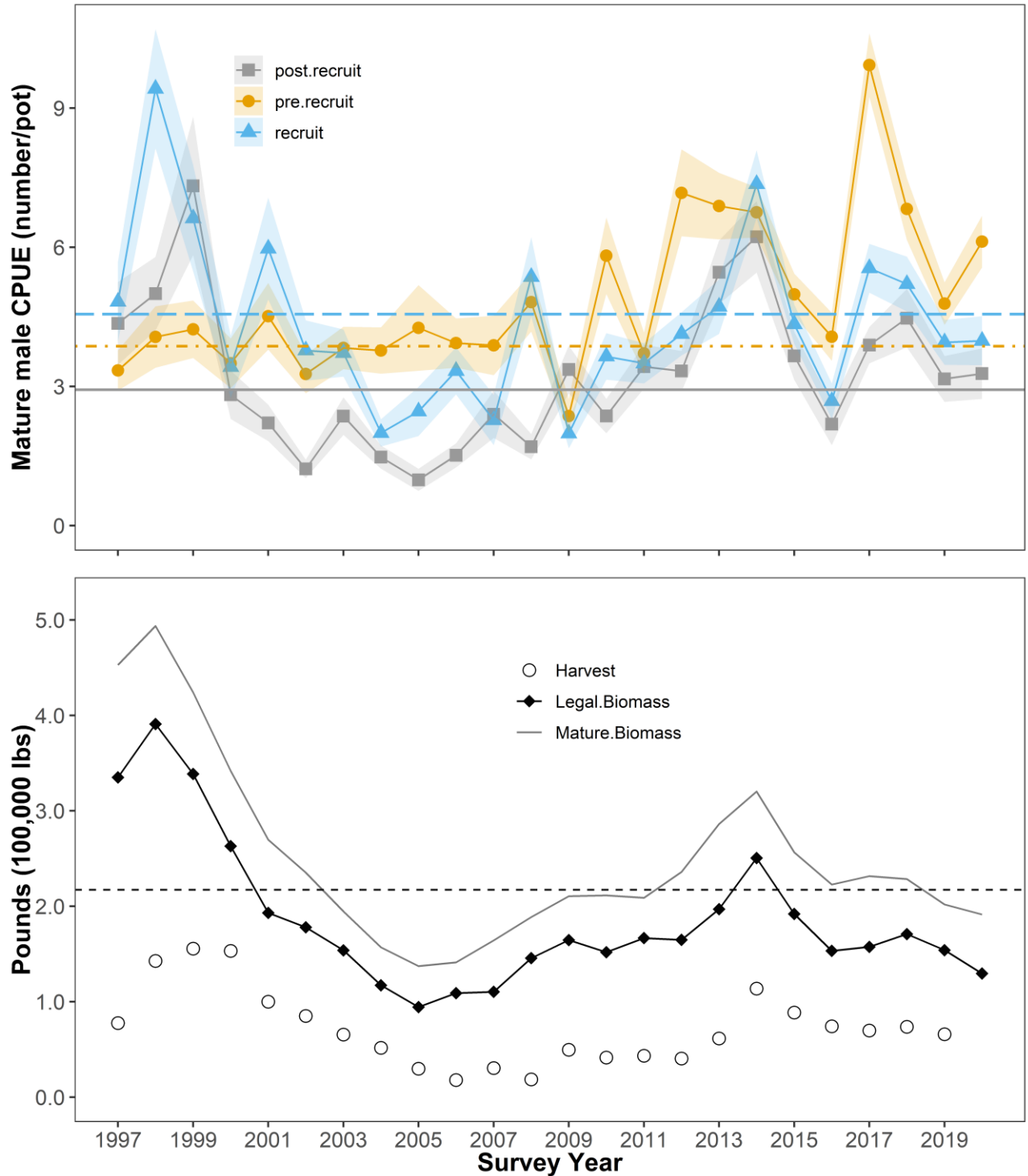


Figure 9a. North Juneau red king crab survey area. Biomass estimates of legal and mature Tanner crab based on catch-survey analysis methodologies. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997-2006) for pre-recruit male (orange), recruit (blue), and post-recruit (grey) crabs. Reference line for biomass (dashed line) represents the long-term average (1997-2006) for legal biomass (1b). There are significant short-term *decreasing* trends for pre-recruit and recruit male CPUEs ($p < 0.05$).

North Juneau - Females

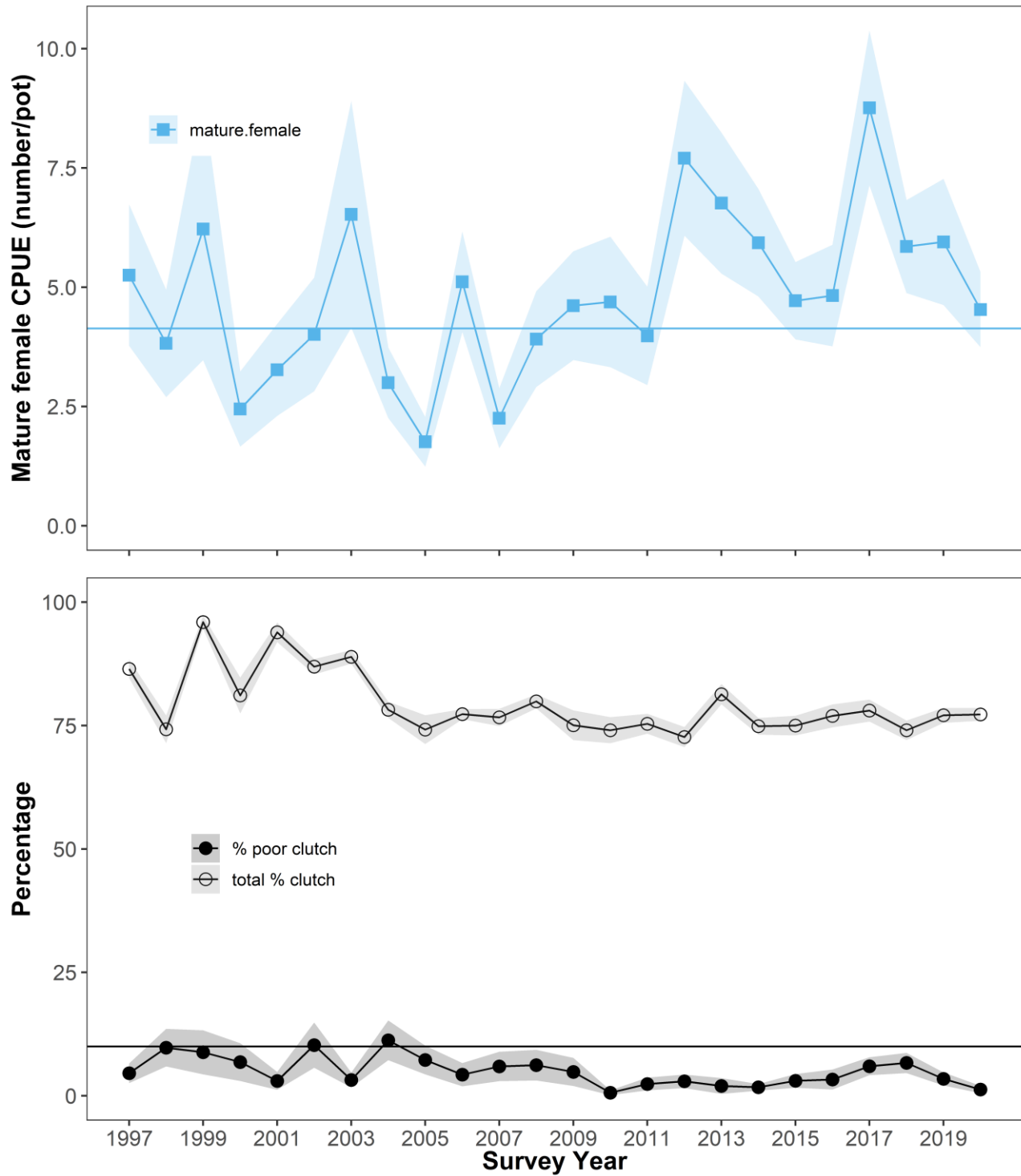


Figure 9b. Female information for Tanner crab in the North Juneau red king crab survey area. Reference lines represent long-term benchmark (1997-2006) values. There is a significant short-term *decreasing* trend in mature female CPUE and a significant *decreasing* trend in the proportion of poor clutches ($p < 0.05$).

Excursion Inlet

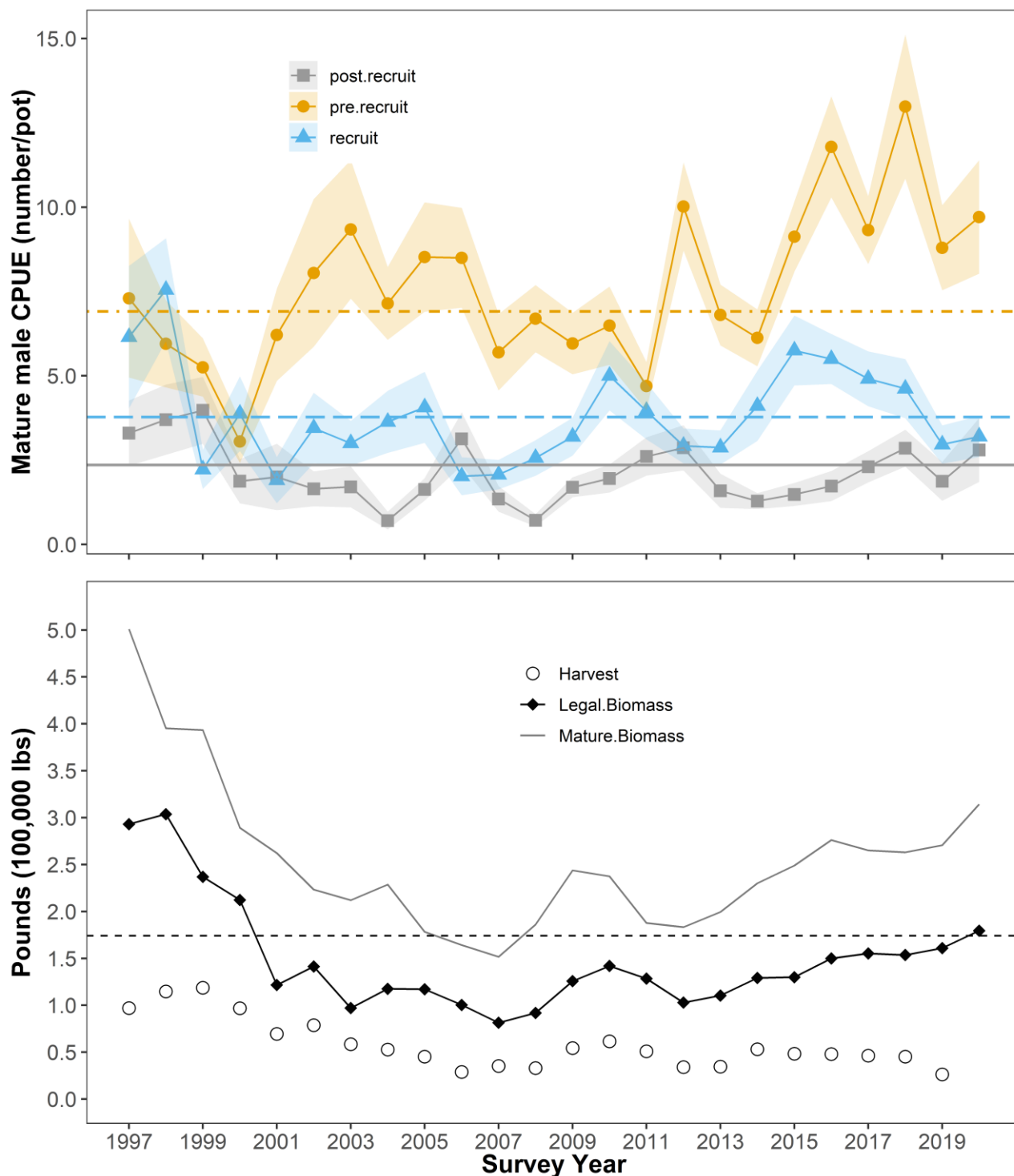


Figure 10a. Excursion Inlet red king crab survey area. Biomass estimates of legal and mature Tanner crab based on catch-survey analysis methodologies. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997-2006) for pre-recruit male (orange), recruit (blue), and post-recruit (grey) crabs. Reference line for biomass (dashed line) represents the long-term average for legal biomass (lb). There is a significant short-term *decreasing* trend for recruit male CPUE ($p < 0.05$).

Excursion Inlet - Females

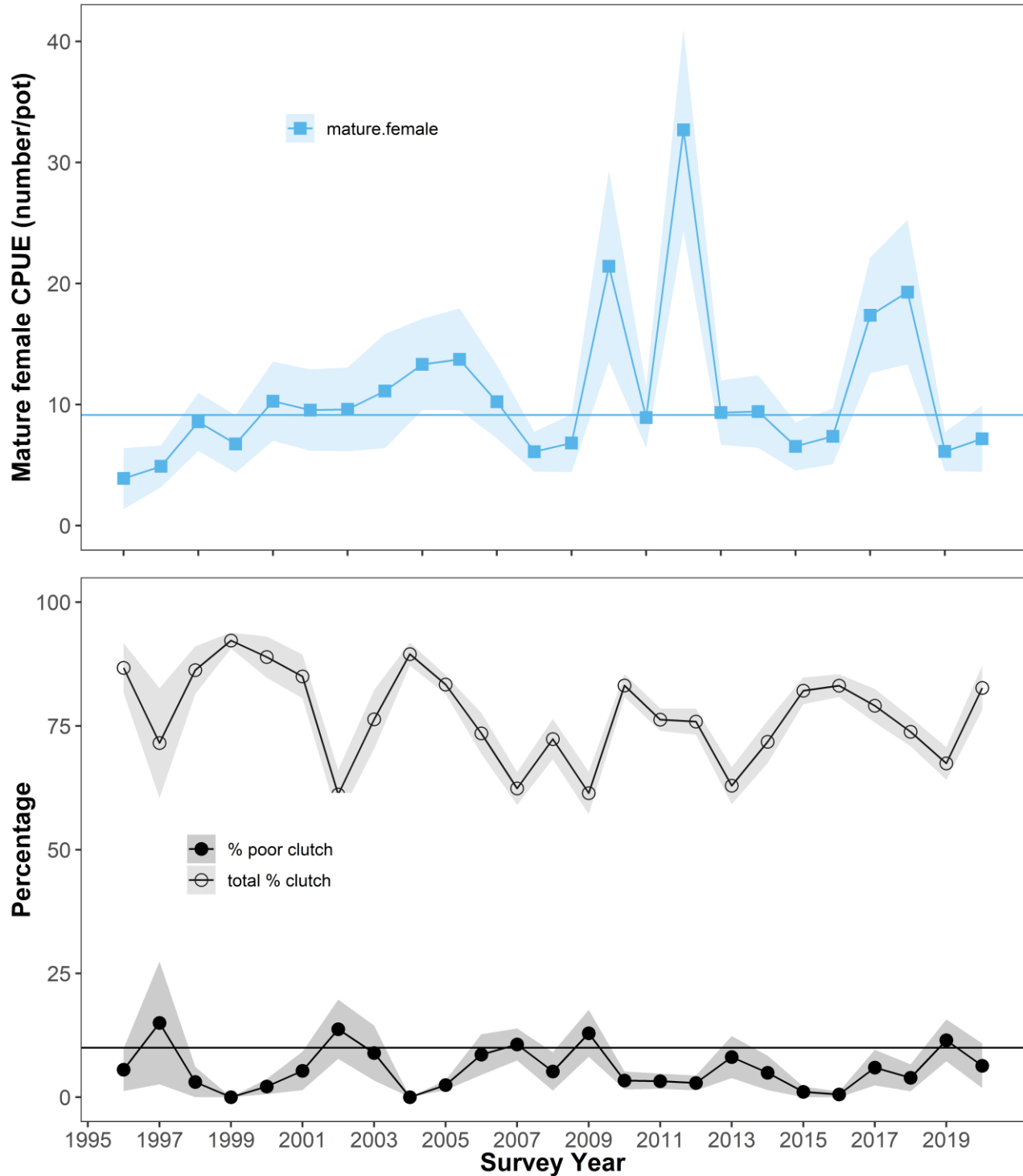


Figure 10b. Female information for Tanner crab in the Excursion Inlet red king crab survey area. Reference lines represent long-term benchmark (1997-2006) values. There is a significant short-term *decreasing* trend in mature female CPUE, but no trends for the proportion of poor clutches ($p < 0.05$).

Pybus Bay

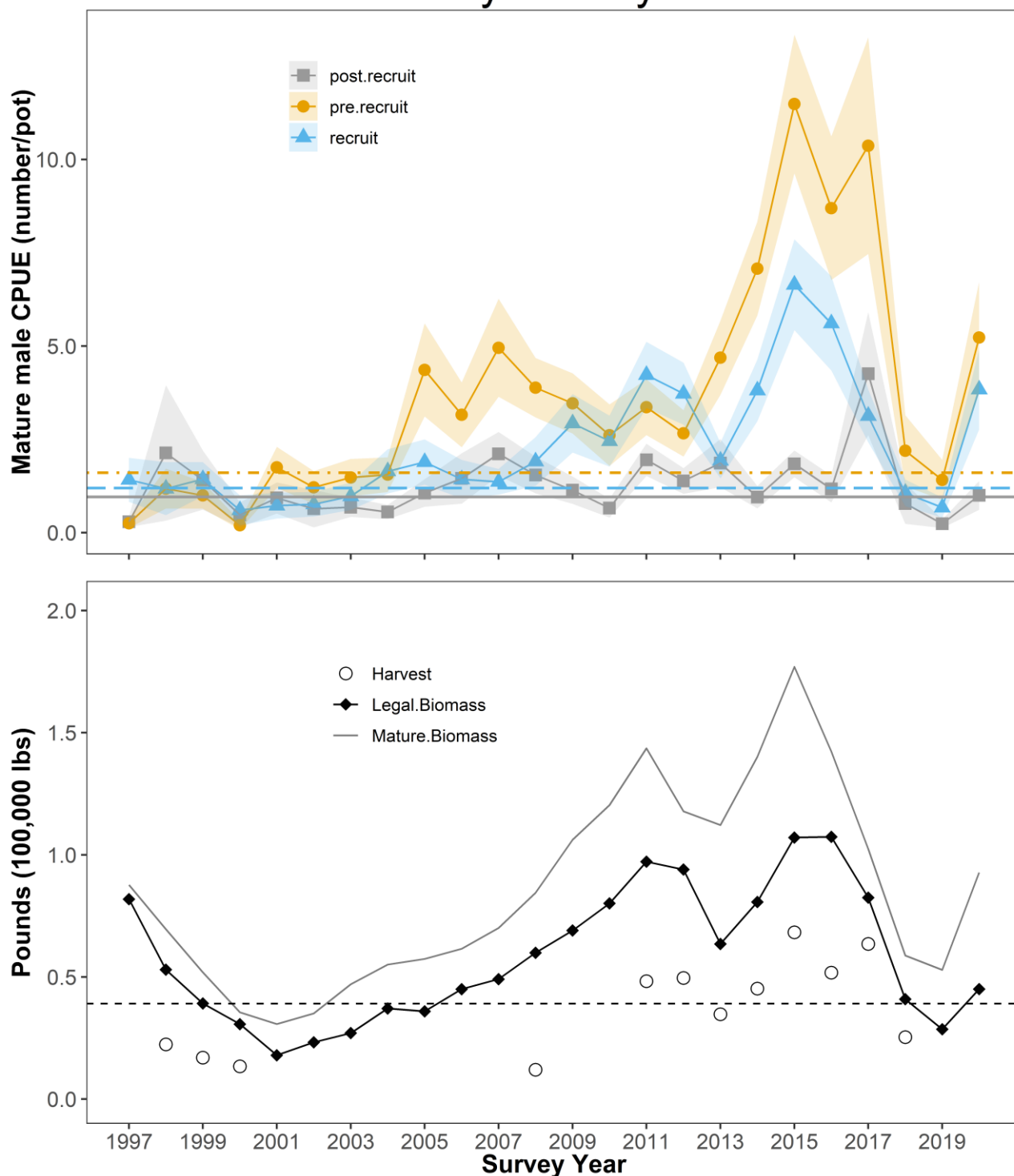


Figure 11a. Pybus Bay red king crab survey area. Biomass estimates of legal and mature Tanner crab are based on catch-survey analysis methodologies. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997-2006) for pre-recruit male (orange), recruit (blue), and post-recruit (grey) crabs. Reference line for biomass (dashed line) represents the long-term average for legal biomass (lb). There are significant short-term *decreasing* trends ($p < 0.05$) for pre-recruit and post-recruit male CPUEs.

Pybus Bay - Females

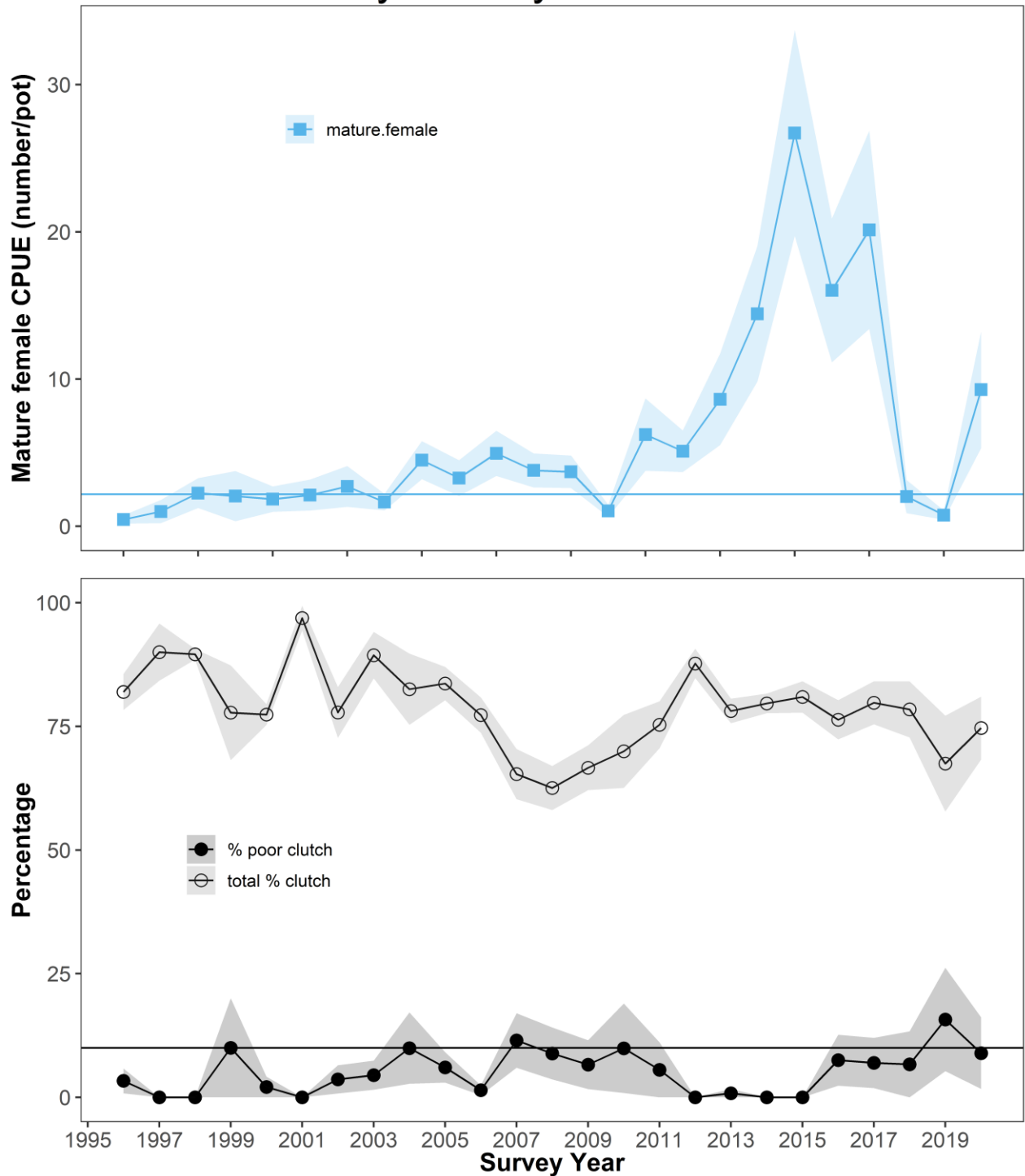


Figure 11b. Female information for Tanner crab in the Pybus Bay red king crab survey area. Reference lines represent long-term benchmark (1997-2006) values. There are NO significant short-term trend ($p < 0.05$) for either mature female CPUE or the proportion of poor clutches.

Gambier Bay

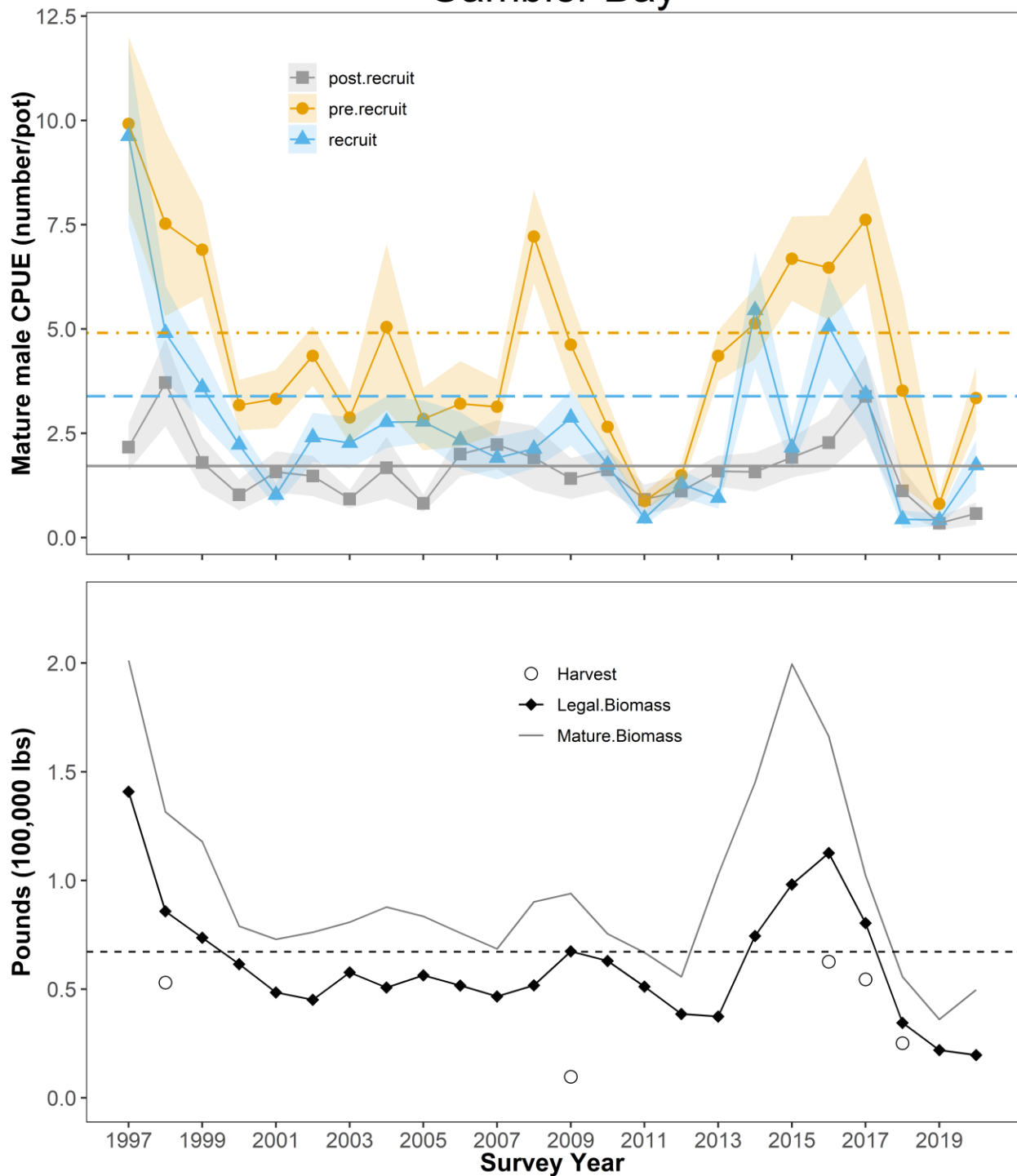


Figure 12a. Gambier Bay red king crab survey area. Biomass estimates of legal and mature Tanner crab are based on catch-survey analysis methodologies. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997-2006) for pre-recruit male (orange), recruit (blue), and post-recruit (grey) crabs. Reference line for biomass (dashed line) represents the long-term average for legal biomass (1b). There are significant short-term *decreasing* trends ($p < 0.05$) for pre-recruit and post-recruit male CPUE.

Gambier Bay - Females

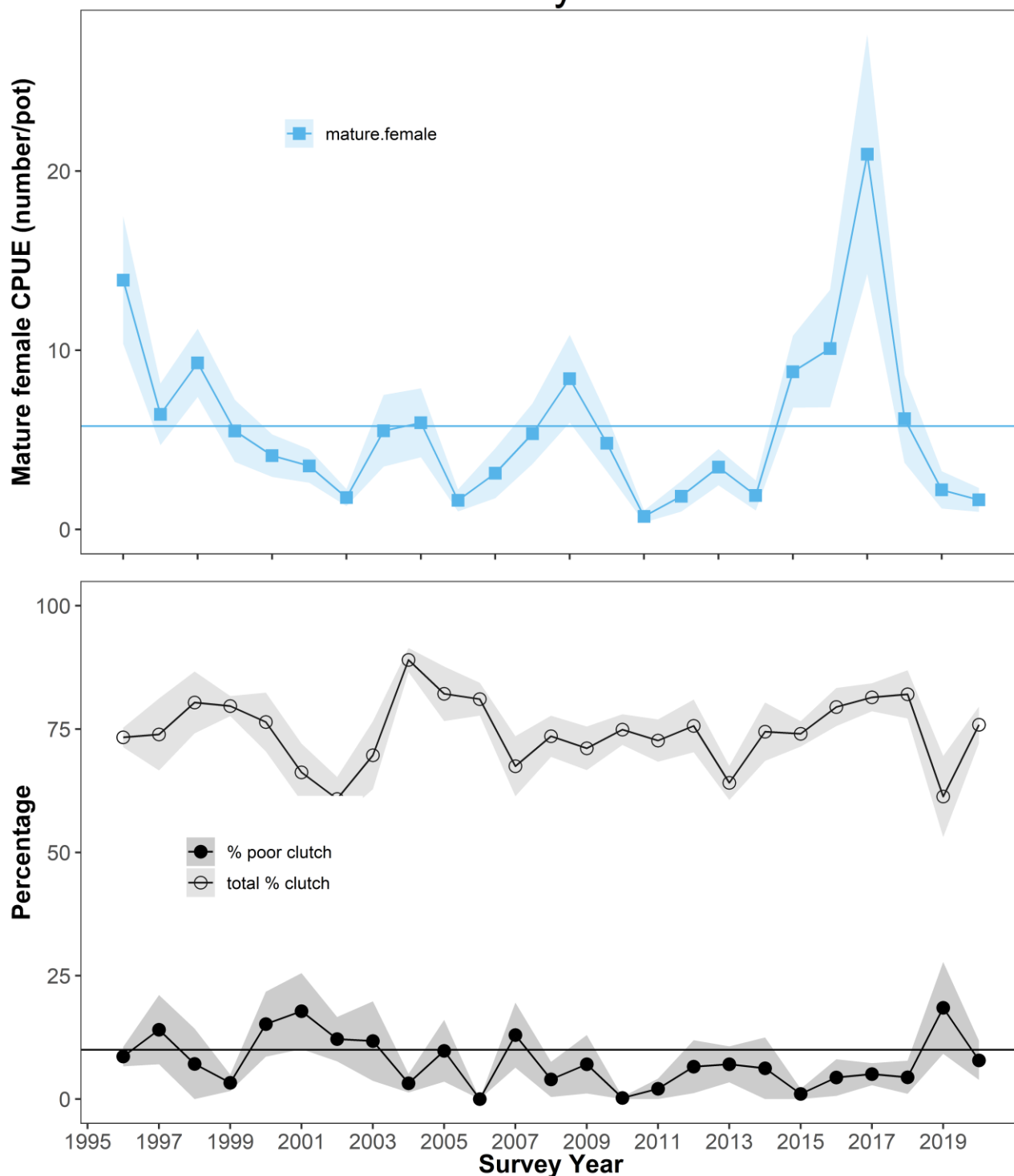


Figure 12b. Female information for Tanner crab in the Gambier Bay red king crab survey area. Reference lines represent long-term benchmark (1997-2006) values. There is a significant short-term *decreasing* trend in mature female CPUE ($p < 0.05$).

Peril Strait

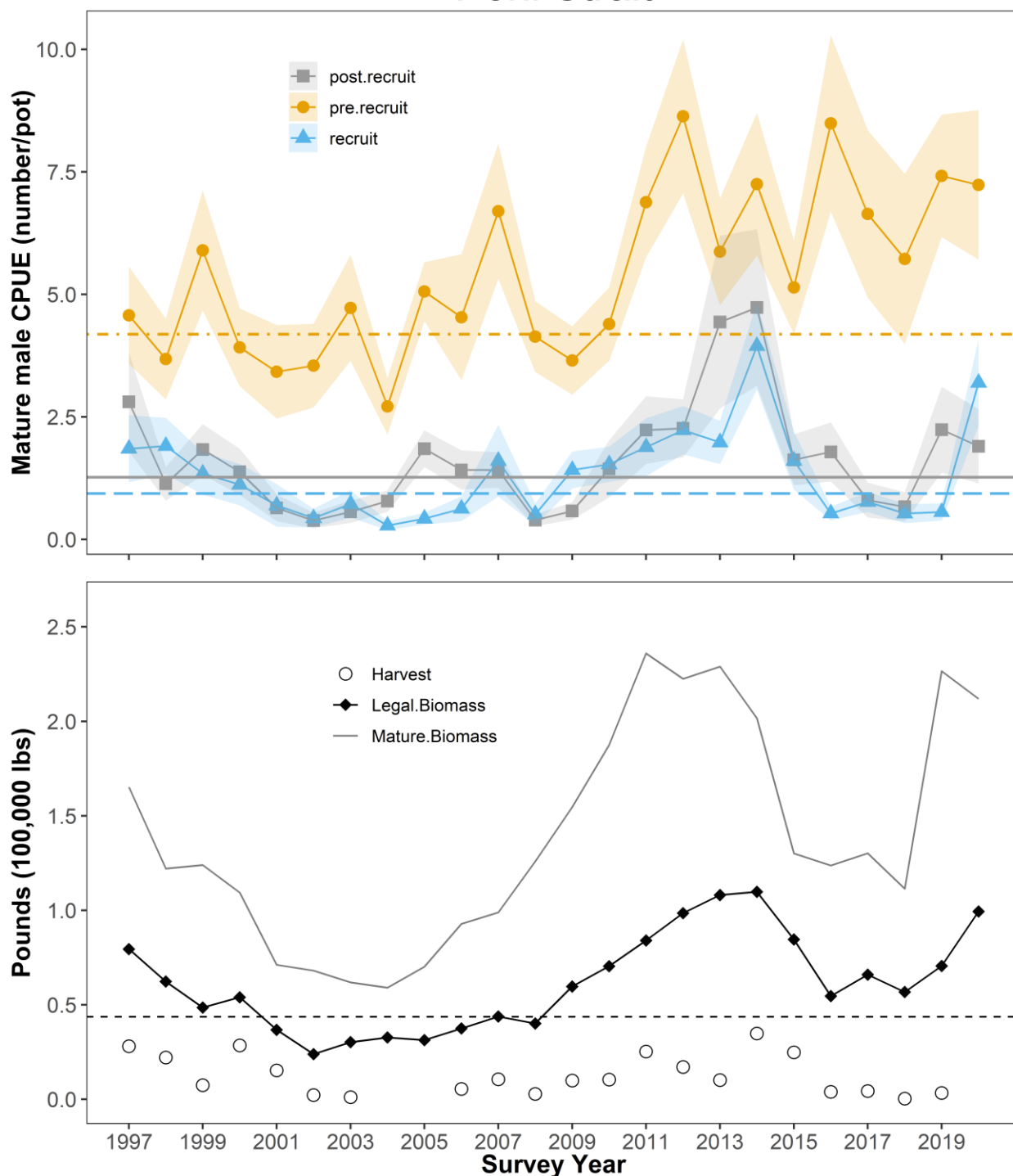


Figure 13a. Peril Strait red king crab survey area. Biomass estimates of legal and mature Tanner crab based on catch-survey analysis methodologies. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997-2006) for pre-recruit male (orange), recruit (blue), and post-recruit (grey) crabs. Reference line for biomass (dashed line) represents the long-term average for legal biomass (lb). There is a significant short-term increasing trend ($p < 0.05$) for recruit male CPUE.

Peril Strait - Females

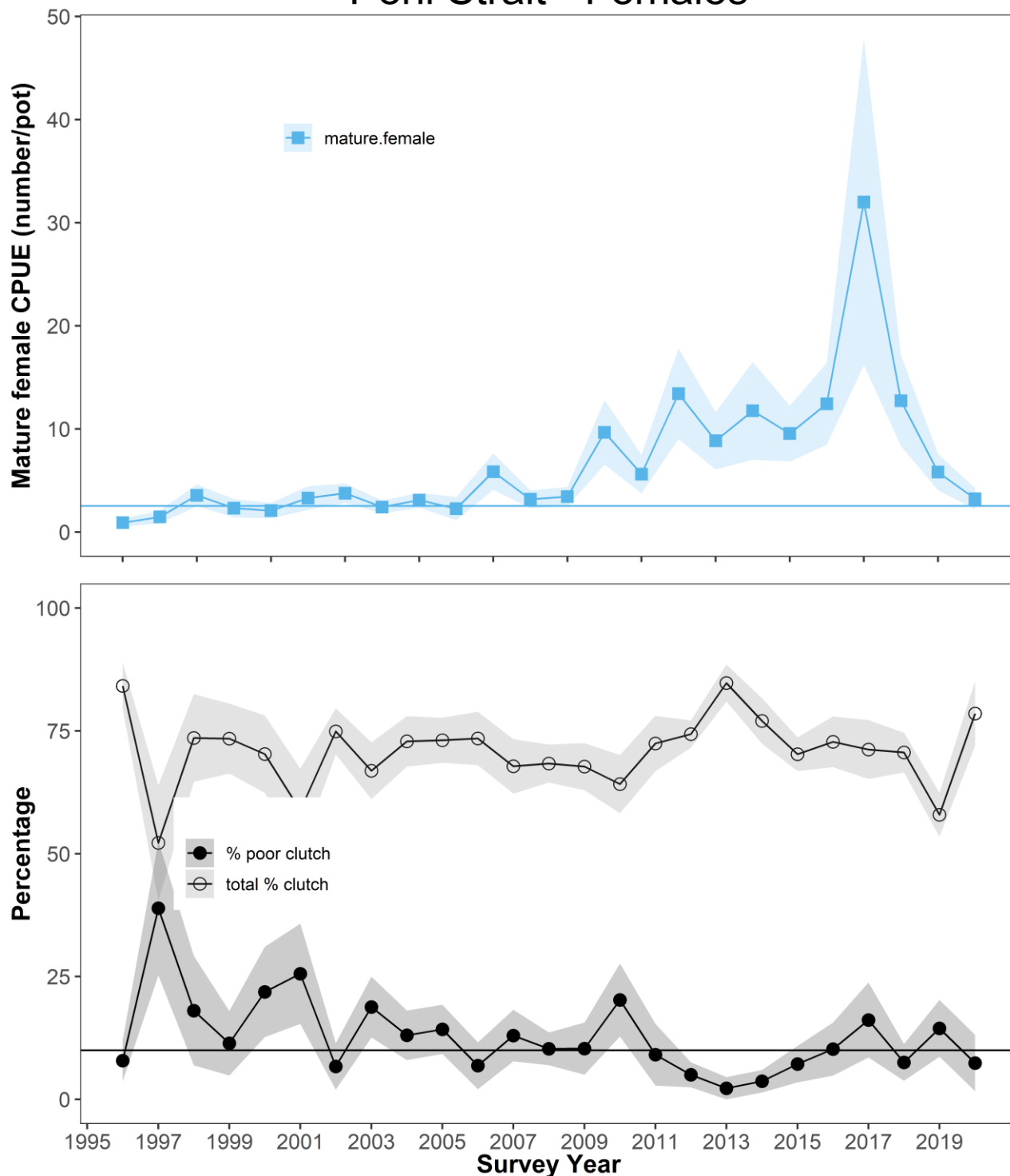


Figure 13b. Female information for Tanner crab in the Peril Strait red king crab survey area. Reference lines represent long-term benchmark (1997-2006) values. There is a significant short-term *decreasing* trend in mature female CPUE but no trend in the proportion of poor clutches ($p < 0.05$).

Lynn Sisters

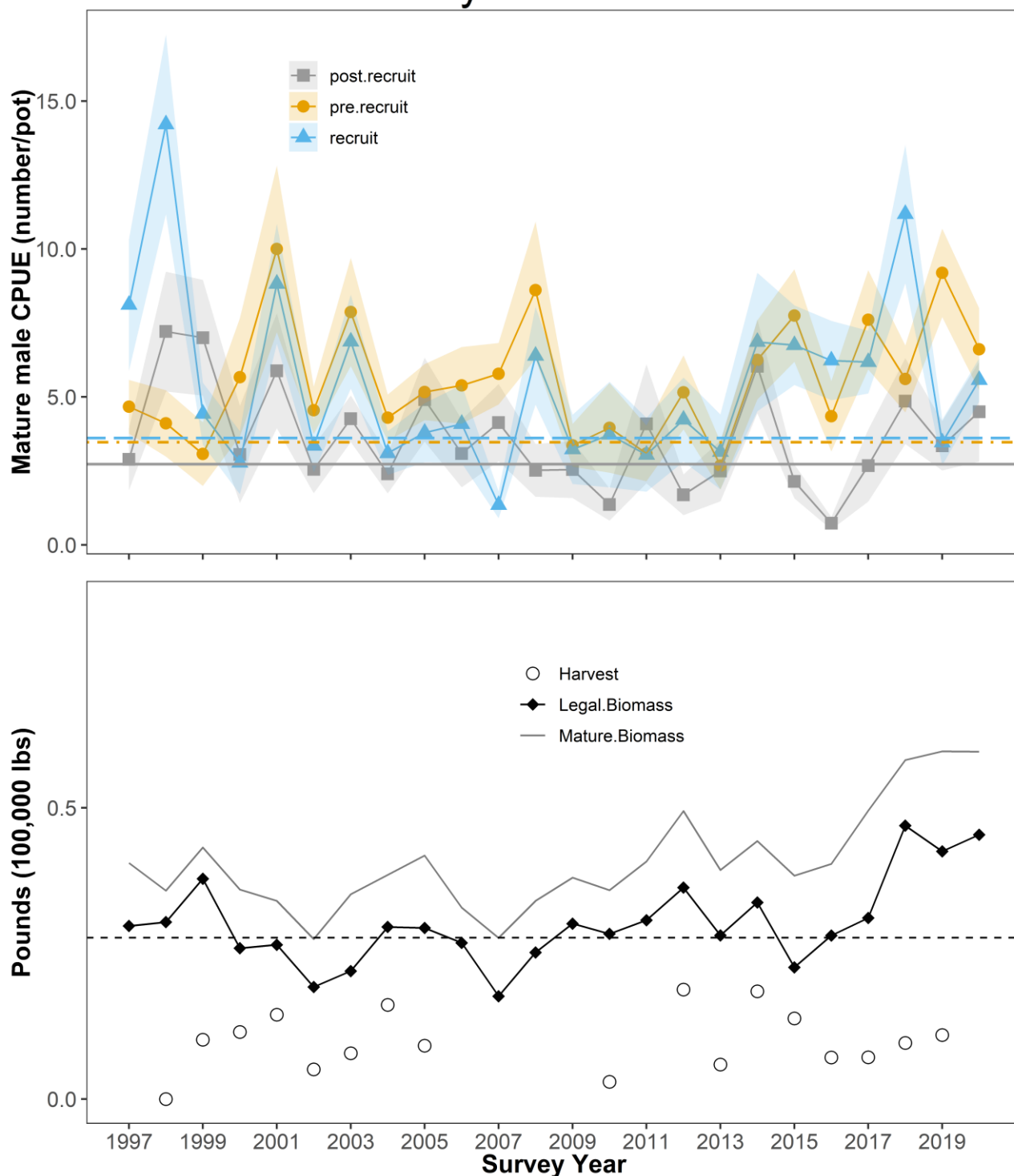


Figure 14a. Lynn Sisters red king crab survey area. Biomass estimates of legal and mature Tanner crab based on catch-survey analysis methodologies. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997-2006) for pre-recruit male (orange), recruit (blue), and post-recruit (grey) crabs. Reference line for biomass (dashed line) represents the long-term average for legal biomass (lb). There are NO significant short-term trend ($p < 0.05$) for male CPUEs.

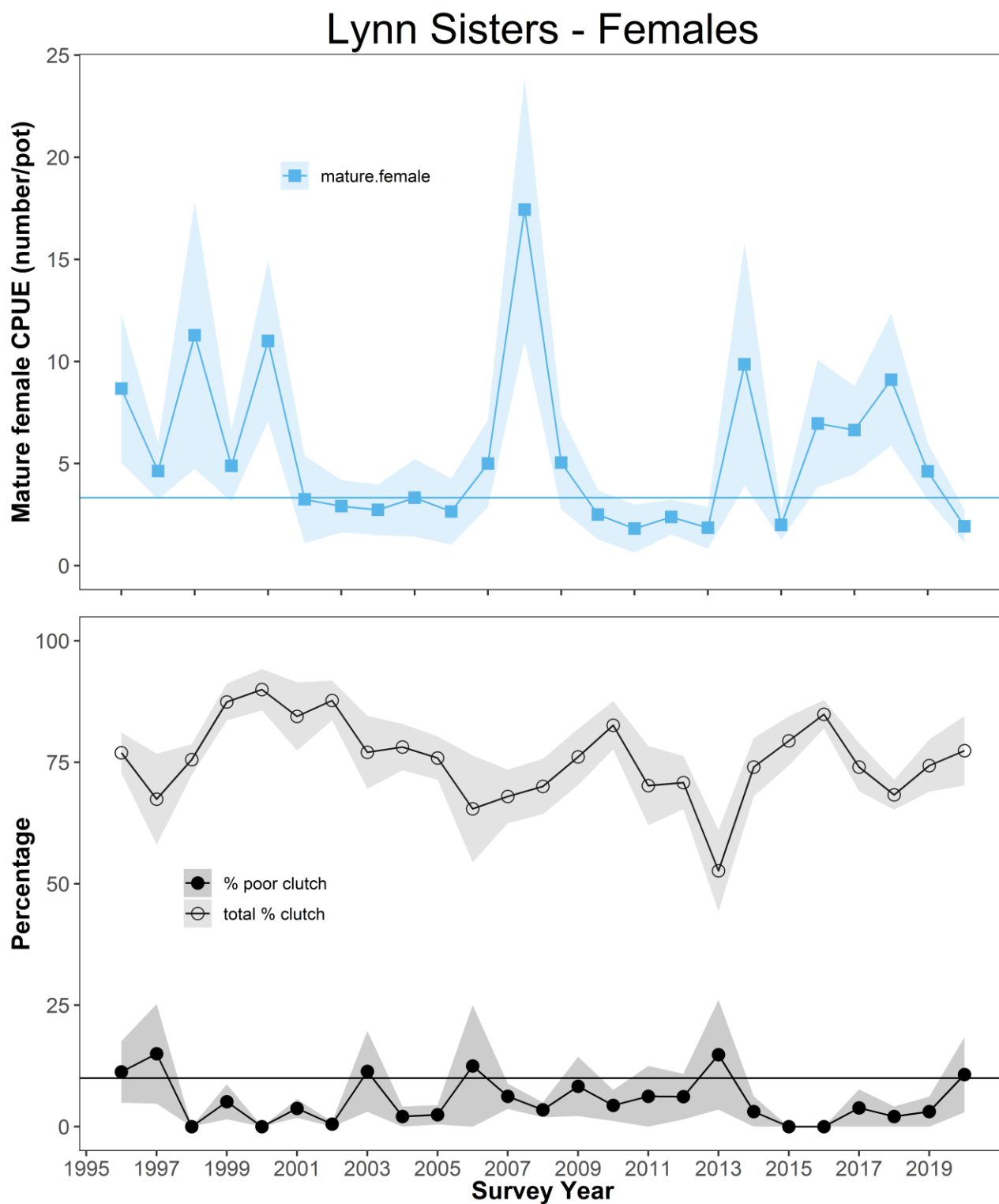


Figure 14b. Female information for Tanner crab in the Lynn Sisters red king crab survey area. Reference lines represent long-term benchmark (1997-2006) values. There are NO significant short-term trends in either CPUE or the proportion of poor clutches ($p < 0.05$).

Appendix A.

Table A1: Regional biomass estimates from surveyed areas ONLY. The “2020 model” reflects biomass estimates from the 2020 CSA models (displayed in Figure 1) and the “Annual Point Estimates” reflects the survey area biomass as a point estimate from each modeling year.

Year	2020 Model		Year	Annual Point Estimates	
	Legal	Mature		Legal	Mature
1997	3,023,009	4,664,010	1997	2,493,821	4,220,952
1998	2,963,559	4,120,349	1998	2,720,334	3,795,396
1999	2,302,847	3,222,317	1999	2,151,751	3,389,834
2000	1,540,723	2,343,159	2000	1,437,612	2,629,980
2001	1,220,435	2,120,117	2001	1,362,224	2,829,680
2002	1,187,657	2,056,763	2002	1,320,312	2,930,950
2003	1,201,183	2,221,700	2003	1,413,118	2,687,625
2004	1,373,916	2,514,326	2004	1,510,615	2,939,302
2005	1,528,524	2,673,726	2005	1,679,678	3,223,890
2006	1,527,295	2,316,656	2006	1,627,099	2,753,115
2007	1,245,917	2,174,497	2007	1,350,935	2,393,922
2008	1,392,061	2,345,475	2008	1,385,647	2,508,436
2009	1,542,494	2,516,070	2009	1,416,062	2,432,032
2010	1,569,819	2,775,740	2010	1,217,049	1,951,796
2011	1,803,275	2,849,324	2011	1,360,387	2,135,861
2012	1,831,428	3,042,683	2012	1,621,839	2,970,708
2013	1,847,239	3,063,341	2013	1,756,533	2,801,311
2014	1,869,091	3,082,605	2014	2,024,637	3,814,305
2015	1,705,667	2,862,369	2015	2,142,529	3,757,413
2016	1,571,528	3,000,978	2016	1,740,116	3,239,586
2017	1,834,309	3,355,324	2017	2,163,773	4,384,734
2018	1,977,302	3,428,205	2018	2,717,958	4,367,920
2019	1,969,555	3,336,227	2019	2,237,506	3,587,481
2020	2,020,110	3,267,982	2020	2,020,110	3,267,982

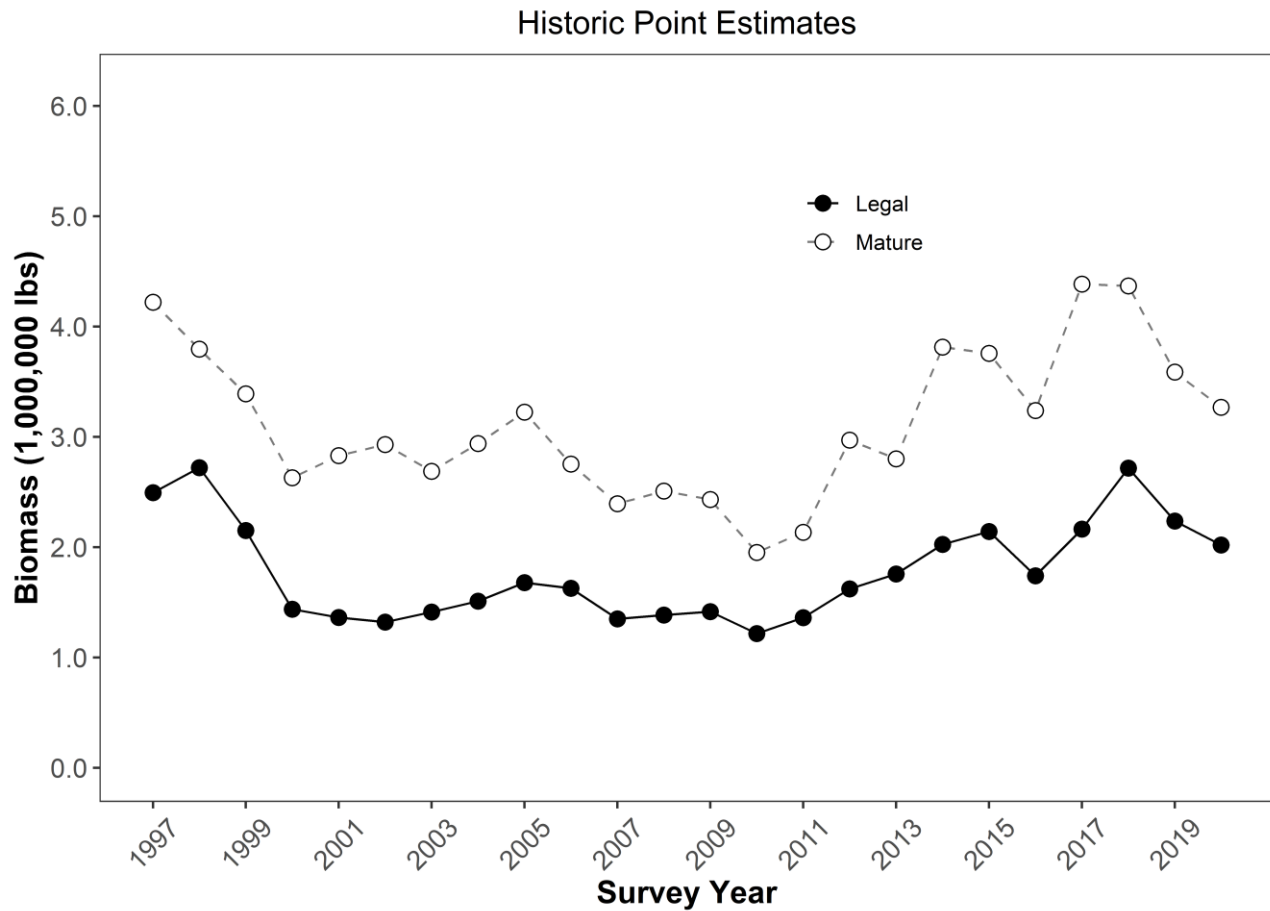


Figure A3. Trends in Tanner crab mature and legal biomass for the surveyed areas estimated from each year’s projection or point estimate using the pot survey data for Southeast Alaska. The points above reflect the survey area biomass as a point estimate from each modeling year, i.e. 2007 values are taken from the 2007 CSA model. Biomass estimates do NOT include non-surveyed areas (starting in 2015 Port Camden and Port Frederick were removed from the survey areas, they are not included in any biomass estimates here). Prior to 2001 the biomass of areas initially not surveyed (Thomas Bay, Glacier Bay), but added in subsequent years, is as estimated as their average percent contribution to the total surveyed biomass in all subsequent years (first year surveyed until current year’s survey).