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2020 Southeast Alaska Red King Crab Stock Health Assessment and Management Plan for the 2020/2021 Season

by

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and

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Alaska Department of Fish and Game **Division of Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	E
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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2020 SOUTHEAST ALASKA RED KING CRAB STOCK ASSESSMENT AND MANAGEMENT PLAN FOR THE 2020/2021 SEASON

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TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This report provides an overview of the stock assessment, harvest strategy, and regulations for the 2020/2021 season Southeast red (*Paralithodes camstchaticus*) and blue king crab (*Paralithodes platypus*) commercial and personal use fisheries. The personal use red and blue king crab fishery opened July 1 in Excursion Inlet and non-surveyed areas, while Section 11-A (Juneau Area) opened on August 21 for three and a half days. For the commercial fishery the guideline harvest level is 97,881 lb and is less than the 200,000 lb threshold; therefore, the commercial fishery did not open for the 2020/2021 season.

Key words: red king crab, *Paralithodes camtschaticus*, stock assessment, catch per unit effort, CPUE, Southeast

OVERVIEW

The Alaska Department of Fish and Game (ADF&G) annually evaluates stock status and establishes the guideline harvest levels (GHLs) for the Southeast red (RKC) and blue king crab (BKC) fishery using data from fishery independent surveys (pot gear), commercial fishery catch per unit of effort (CPUE), and biological data (length, weight, and shell condition) from the surveys and fishery. The Southeast Alaska management area (Registration Area A) consists of all waters defined in 5 AAC 34.100 (Figure 1).

Projected estimates of regional mature male biomass for the 2020/2021 season are 1.87 million lb, using the mark-recapture adjustments and the historical expansion factor applied to the non-surveyed areas. However, this value is substantially below the baseline level (defined as the average biomass from 1993–2007), suggesting the regional stock remains in a low or depressed state.

The 2020/2021 Southeast commercial RKC fishery season GHL is 97,881 lb and is less than the 200,000 lb minimum threshold [5 AAC 34.113]; therefore, the fishery did not open for the 2020/2021 season. The personal use RKC and BKC fishery opened July 1, 2020 in Excursion Inlet and non-surveyed areas with bag and possession limits of one RKC or BKC per person per day. Results from the annual stock assessment survey in the Juneau Area (Section 11-A) showed overall stock health to be at moderate levels, with legal biomass estimated to be above the long-term average and mature biomass estimated to be below the long-term average. The personal use summer fishery in Section 11-A opened on August 21, 2020 for three and a half days with a seasonal household limit of two crab and daily bag and possession limit of two crab (Table 2) to target 12,635 lb (1,527 crab) in the summer fishery.

The RKC and BKC commercial fishery and personal use fishery outside of Section 11-A are managed separately and there are no regulatory thresholds or allocations that combine estimated harvest for both user groups. Personal use harvest outside of Section 11-A is not considered when calculating the commercial GHLs for each area to determine whether the total commercial GHL meets the 200,000 lb threshold in regulation for a commercial fishery. A personal use permit requirement was implemented in 2018 for the outside Section 11-A personal use fishery and will improve catch accounting, future stock assessments, and management decisions.

2020 SOUTHEAST RED KING CRAB STOCK ASSESSMENT

SUMMARY OF STOCK STATUS

The Southeast RKC stock assessment regional biomass estimates for the 2020/2021 season are **1.62 million lb of legal crab and 1.87 million lb of mature crab**, using the historical expansion factor (Tables 2–4). The legal biomass estimate decreased 8.4% from the previous year using

the 2020 model estimates (Figure 3). The mature biomass estimate decreased 9.4% from 2019 using the 2020 model estimates.

Survey area biomass is estimated using a 3-stage catch survey analysis model (CSA) and adjusted using the mark-recapture expansions when available (Stratman et al. 2019). Port Frederick and Holkham Bay have not been surveyed since 2015 due to reductions in survey funding and therefore are no longer included in determining survey biomass estimates. The legal crab component is composed of both recruit and postrecruit crab and defined as those greater than 178 mm in carapace width, whereas mature crab are prerecruit, recruit and postrecruit crab, or those greater than 129 mm in carapace length. Biomass estimates from the survey areas (Table 2, Figure 2) are then expanded based on assumptions of how representative these areas are to the entire population in Southeast.

Both mature and legal survey biomasses declined an average of 7.0% annually from 2001–2013 (Figure 3). Legal and mature biomass showed regionwide increases for the first time in 2015 since 2008, however, this year only two of the seven survey areas (Lynn Sisters and Pybus Bay) had increases in either legal and mature biomass (Figures 4–17).

Compared to historical levels in most areas (with the exception of Juneau and Lynn Sisters), CPUE of juvenile and females size and sex classes are at below average levels, suggesting that either this portion of the population is declining or that the current year's survey did not adequately capture them. The CPUE of some portions of the mature male size and sex classes are still below average for all the survey areas except Lynn Sisters. Gambier had significantly low values in all mature male CPUEs, where Seymour, Peril, Juneau, and Excursion had two of three mature male recruit classes below their long-term averages. Overall, recruitment, in the form of prerecruit CPUE, is significantly below average levels for six of the seven surveys areas, with only Lynn Sisters being at the long-term average for prerecruit CPUE, suggesting that regionwide improvements to mature and legal male biomass are still underway and may take a few more years even with the absence of fishing in most of the survey areas. In most survey areas prerecruit biomass is still lacking compared to the 1990s and early 2000s and is visualized as the small difference between mature and legal biomass in the area figures (Figures 4–17). A matrix of stock health indicators provides an objective and repeatable evaluation of the survey data; a five-year summary of matrix results is therefore presented here (Table 5). Specific stock health by survey area (Table 6) is discussed below.

MARK-RECAPTURE ADJUSTMENTS

All survey areas (Excursion Inlet, Lynn Sisters, Peril Strait, Pybus Bay, Gambier Bay, and Seymour Canal; Figure 2), except Juneau due to its expansive area, have a biomass adjustment that is calculated from mark-recapture studies (Table 1). Two of the six survey areas have a single mark-recapture event, while the other four have two events; therefore, the estimate of biomass using this method does not take into account extensive inter-annual variability or variability in population size for all areas and should be applied with caution. The department has completed work on a second mark-recapture estimate for the four larger survey areas, and does not plan at this time, to continue with additional mark-recapture studies. Mark-recapture attempts in 2013 and 2014 (Lynn Sisters and Excursion Inlet) did not have sufficient sample sizes to produce usable biomass estimates (Robson and Regier 1964). Pybus Bay, Seymour Canal, Excursion Inlet, and Gambier Bay were successfully resampled in 2014, 2015, 2016, and

2017 respectively. In three of the cases, resampling efforts yielded an adjustment factor similar to the first estimate (Table 1).

Adjustments based on a weighted average of the two sampling events were used to determine the mark-recapture adjustment applied to this year's CSA (Table 1). The biomass estimates presented in this analysis are the 2020 CSA model estimates adjusted by these values.

EXPANSION OPTION FOR NON-SURVEYED AREAS

Regional biomass is estimated from the seven survey areas and extrapolated to the entire region using an expansion factor defined as the proportion of the population that lies within the non-surveyed areas (Tables 2–4, Figure 3). In 2015, the surveyed areas were adjusted since surveys in Port Frederick and Holkham Bay were discontinued due to funding. The removal of Port Fredrick from the survey is accounted for by placing it in the non-surveyed area designation. A biomass estimate has never been produced for Holkham Bay due to the inconsistency of the data and therefore, it has always been included as a non-surveyed area, thus no changes to the biomass estimation were needed in removing Holkham Bay from the survey.

The expansion factor, or an estimate of the percentage of the population found in the non-surveyed areas using historical harvest data, has not been consistent over time (Palof and Stratman 2020). In the past, we used two expansion factors that represented historical harvests from 1974–1984 (with 47.2% of the harvest coming from the non-surveyed areas), and harvests in a more modern time during the baseline years from 1993–2007 (with 36.1% of the harvest coming from the non-surveyed areas).

Both options involve assumptions about the spatial distribution of the RKC population and the spatial effort of the fleet. The baseline time frame represents both a high and low period in the RKC biomass and is used as a baseline time frame for other metrics in our assessment. However, this time frame is influenced by management actions, such as spatial closures, that greatly influenced the spatial effort of the fleet. The historical harvest time frame (1974–1984) was chosen to be the most appropriate for the 2020 assessment since it includes harvest years before management actions dictated spatial closure or influenced fleet behavior. However, this time frame assumes that the spatial distribution of the RKC in Southeast Alaska has remained consistent over time, specifically since 1974, and with varying population sizes.

Expanding to the non-surveyed areas using the historical harvest time frame results in a regional biomass of **1.62 million lb for legal crab and 1.87 million lb for mature crab** (Table 2).

HARVEST RATES

Determining an appropriate harvest rate for RKC in Southeast Alaska has been challenging due to inconsistent recruitment and varying levels of population health. As a result, in 2018, Palof and Stratman (2020) reviewed and implemented harvest rate strategies that yielded three options for appropriate harvest rates that can be applied to mature male biomass, each having its own associated risk.

Option 1, using the equilibrium harvest rates, is considered the most **risk neutral option** with an equal probability of the mature male biomass decreasing or increasing in the following year after applying this level of harvest pressure. This option uses a regression model and therefore incorporates both the variability in the harvest rates and their associated change in mature male biomass. In theory, these harvest levels will maintain the equilibrium population size when the population is at equilibrium. However, a disadvantage to this method as currently applied is that

it does not account for time-varying trends in survival or other factors such as environmental change, temperature, etc. that affect biomass. For our purposes, equilibrium could be defined as the average baseline population size (Figure 3) or a biomass that is sustainable over time. When the population is below equilibrium, harvesting at these rates will either maintain low population levels or, more likely, cause a decrease in population size. The resulting *GHL for option 1 is 134,297 lb* (Table 2).

Option 2, using the average harvest rate for years in which the mature male biomass increased, is considered the **lowest risk option** with a high probability of the mature male biomass increasing in the following year after applying this level of harvest pressure. This option only uses the average of the harvest rates that resulted in population increases, and therefore does not incorporate variability as well as option 1. In theory, these harvest levels will increase the population size regardless of health of the stocks. However, during depressed stock health conditions, where biomass levels are below baseline values, even small harvest levels may still result in a decrease in population size. The resulting *GHL for option 2 is 53,685 lb* (Table 3).

Option 3, using an alternative approach to an equilibrium harvest rate, which is the sum of the average harvest rate and the average change in mature male biomass, is considered the **highest risk option**. This option is most appropriate when there is not a significant relationship between the harvest rate and the change in the mature population. In theory this option should have an equal probability of the mature male biomass decreasing or increasing in the following year after applying this level of harvest pressure when the population is at equilibrium levels. However, this option only uses the averages of the harvest rates and the changes in mature male biomass over the entire time range, and therefore does not incorporate variability as well as the model output does in option 1. Similar to option 1 these harvest rates will maintain the equilibrium population size when the population is at equilibrium or baseline levels, but when the population is below equilibrium, harvesting at these rates will either maintain low population levels or, more likely, cause a decrease in population size. The resulting *GHL for option 3 is 175,181 lb* (Table 4).

STOCK ASSESSMENT CONCERNS AND RECOMMENDATIONS

Recovery in most of the survey areas, except for the Juneau area and Lynn Sisters area, appears to be slow. Most areas, except for Peril Strait, had increasing biomass estimates from 2015–2017, however, in 2018 a decrease in both legal and mature biomass occurred in all survey areas that experienced personal use and commercial harvest in the previous season (2017/2018). The impact of the commercial fishery opening in the 2017/2018 season is confounded by potential increased personal use harvest in the survey areas, but this is hard to quantify since we do not currently have an estimate of personal use harvest in any area except Section 11-A, although estimates of personal use harvest are currently being collected with the implementation of the regional king crab personal use harvest permit in 2018 with a database system to query and analyze harvest still in progress.Regional biomass levels have decreased from 2019 and are still below the baseline levels (Figure 3). The Juneau Area and Lynn Sisters area the only survey areas where legal and mature biomass are above their baseline levels.

Slow recovery since 2001, which may be due to poor or inconsistent recruitment, and declines in the survey areas after the last commercial fishery opening (2017/2018 fishing season), suggest that harvesting at the equilibrium harvest levels (those used in the 2017/2018 GHL calculations, option 1 here) from these areas would increase the probability of continued

population declines or stunt population growth. Thus, removals at the levels presented in options 1 and 3 (Tables 2 and 4) are not recommended for the upcoming season. Of the three harvest options presented none resulted in a GHL that is above the 200,000 lb threshold required for a fishery opening [5 AAC 34.113].

SURVEY AREA STOCK STATUS AND HARVEST RATE RECOMMENDATION

STOCK STATUS BY SURVEY AREA (TABLE 5, FIGS. 4–17)

Significance in long-term or short-term trends is defined as a p-value <0.05. Long-term trends compare the current year's mean to the long-term baseline value (1993–2007); short-term trends regress the last four years of survey data to determine if a significant increasing or decreasing trend is present. Estimates of legal and mature mark-recapture biomass (adj.legal / adj.mature) for the entire biomass time series for each area were added to the legal biomass graphs, along with their associated long-term baseline (1993–2007; solid black line for legal and grey dotted line for mature) estimates (Figures 4–17). Raw sample sizes for each area are reported in Table 5. Graphs for each area reflect biomass estimates from the 2020 CSA model.

Pybus Bay (below average)

Pybus Bay stock health increased but remained in below average status. Recruit, postrecruit, and mature female CPUEs are below their long-term averages, but not significantly so. Prerecruit, juvenile male and juvenile female CPUEs are significantly below their long-term averages. There is a significant short-term decrease in the juvenile females. Legal biomass increased 32% from the 2019 model and mature biomass increased 21%. Both are increasing but remain low compared to historical levels in this area. Egg percentage is at a normal level and the percentage of poor clutches is significantly below the baseline value. The mature biomass estimate is 57.4% below the baseline value.

The stock health rating in Pybus Bay remains below average. Though there were increases in mature and legal biomass, these estimates remain below long-term baselines. There are no short-term increases in any of the size/sex classes. Due to the aforementioned concerns and the low level of the stock biomass in Pybus Bay, no harvestable surplus is recommended for the 2020/2021 season.

Gambier Bay (poor)

Gambier Bay stock health decreased but remained in poor status. All size and sex class CPUEs, except for mature females, are significantly below their long-term averages. In the short-term (last four years), there is a significant decrease in juvenile female, juvenile male, prerecruit, and postrecruit male CPUE. Juvenile and female portions of this population are still low compared to the higher levels observed in 2017. The proportion of females with poor clutches is at the long-term baseline of 10% and the overall average clutch fullness was lower than typical but improved from 2019. Legal biomass decreased 17% and mature biomass decreased 21% from the 2019 model estimate. Additionally, the legal and mature biomass estimates are still low compared to historical levels for this area. The mature biomass estimate is 75.5% below the baseline value.

Stock health has declined in Gambier Bay the last three years and is categorized as poor. Nearly all sex/size classes remain significantly below their long-term averages. Short-term decreases

are evident in a majority of sex/size classes. Considering these negative trends in Gambier Bay, no harvestable surplus is recommended for the 2020/2021 season.

Seymour Canal (below average)

The overall stock health for Seymour Canal increased from poor to below average. Mature female, juvenile female, prerecruit male, and recruit male CPUEs were all significantly below their long-term averages, and only a small number of prerecruit crab were sampled in the survey pots in 2020. Juvenile male and postrecruit CPUEs were below their long-term averages but not significantly so. There is a significant short-term decreasing trend in both prerecruit and postrecruit CPUEs. The juvenile and female portions of this population were under sampled in both the 2019 and 2020 surveys (Table 5), and therefore caution should be taken in interpreting any of the indicators of female stock health. The estimate of legal biomass decreased 22% and the mature biomass decreased 21% from the 2019 model estimates. The mature biomass estimate is 83.8% below the baseline value.

Stock health in Seymour Canal has improved from poor to below average. Recruit and postrecruit CPUEs have increased somewhat from 2019 but remain below long-term averages. No short-term increases are evident and mature and legal biomass estimates have decreased since 2019. Due to the aforementioned concerns and the low level of the stock biomass in Seymour Canal, no harvestable surplus is recommended for the 2020/2021 season.

Peril Strait (below average)

The Peril Strait stock status improved to below average from poor. All recruit classes, except postrecruit males, are significantly below their long-term averages. There is a significant short-term decreasing trend in mature female CPUE. Female and juvenile portions of the population continue to decline. The proportion of females with poor clutches was significantly less than 10%, and the total egg clutch percentage was at typical levels for this area. The legal biomass estimate decreased 11% from the 2019 model estimate and the mature biomass estimate decreased 6%, both are the lowest they have been since the survey began. Reasons for lack of recovery in this area are unclear, but the survey CPUEs do not indicate any consistent signs of improvement. The mature biomass estimate is 88.9% below the baseline value.

Stock health in Peril Strait remains a concern. Nearly all size/sex classes are significantly below their long-term averages, and no short-term increasing trends are evident. Legal and mature biomass estimates have shown no improvement from 2019 and both estimates have decreased and remain below long-term averages; therefore, no harvestable surplus is recommended for the 2020/2021 season.

Juneau (moderate)

The stock status for the Juneau area increased to moderate from below average last year. Prerecruit and recruit CPUEs are still significantly below the long-term averages, while juveniles (both male and female), mature females, and postrecruit CPUE were at or above their long-term average. There is a significant short-term decreasing trend in both prerecruit and recruit CPUE. Estimates of legal biomass decreased 8.0% while mature biomass decreased by 4% since 2019 (based on the 2020 model output). When compared to the 2019 model estimate, legal biomass decreased 6%, while mature biomass increased 0.4% (essentially remaining stable). Indicators of female stock health remain good as indicated by the low proportion of

poor clutches and high clutch fullness. Legal biomass is still at its long-term baseline value, but mature biomass fell to 12% below the baseline.

The annual 11-A red king crab stock assessment survey found the estimated legal biomass decreased and mature biomass is stable compared to 2019 predicted values. The 2020 model shows a decrease in mature biomass for the last two years. The stock status for the Juneau area has increased to moderate from below average in 2020. Prerecruit, recruit, and post recruit catch per unit effort (CPUE) increased from 2019 to 2020. CPUEs of mature females, juvenile females, and juvenile males were at baseline levels. Post recruit male CPUE was significantly above its long-term average, while CPUEs of prerecruit and recruit male red king crab were significantly below their long-term averages. Due to stable trends in the mature size/sex classes, the decision was made in July to set the harvest rate at 7.0% for the 2020/2021 season.

Lynn Sisters (moderate)

Stock health in the Lynn Sister's area increased but remained at a moderate status in 2020. CPUEs for all size and sex classes are at their long-term averages. There are significant increasing short-term trends in mature female and postrecruit CPUE. Indicators of female stock health were good, as seen by the low proportion of poor clutches and high clutch fullness. Legal biomass increased 41%, while mature biomass decreased 8% from the 2019 model estimates. Both legal and mature biomass are above their long-term baseline values, with mature biomass 32% above the baseline value.

Positive trends in stock health are evident. Legal and mature biomass estimates are above long-term baselines for the second time in nine years. The majority of size/sex classes are at or above long-term averages. However, there are many indications that stock health remains a concern in Lynn Sisters. While legal and mature biomass increased from last season, recruit class CPUE dropped below its long-term average. Positive trends in stock health have become evident after an eight-year closure to all fishing, but the adjusted legal biomass estimate is smaller than seen in all other survey areas with the exception of Peril Strait (Table 2). A permit requirement for personal use fishing outside of Section 11-A was implemented in 2018. The first couple of years of harvest data should better inform on the potential effort in Lynn Sisters and what level of harvest rates would be appropriate. Given these concerns there is not a harvestable surplus of RKC in the Lynn Sisters area for the 2020/2021 season.

Excursion Inlet (poor)

The stock health of Excursion Inlet decreased to poor status. CPUEs of juvenile females, juvenile males, prerecruit males, and postrecruit males are all significantly below their long-term averages. CPUE of recruit males is below the long-term average but not significantly so; CPUE of mature females is at the long-term average. There are significant short-term decreasing trends in both juvenile male and prerecruit CPUE. The percentage of poor clutches increased from low levels observed the last three years and is above the long-term baseline of 10% but not significantly so. Overall clutch fullness is also low this year, which along with the high percentage of poor clutches, indicates concern for the female portion of this stock. Both legal and mature biomass estimates decreased 11% from the 2019 model estimates. The mature biomass estimate is 55% below the baseline value.

Stock health has declined in Excursion Inlet as evident from negative trends in stock health. CPUEs of all mature male sex/size classes have dropped below long-term baselines for the

second consecutive season. Mature and legal biomass estimates have decreased, and both are now below long-term baselines. There are no short-term increasing trends. Considering these trends in Excursion Inlet, there is not a harvestable surplus of RKC for the 2020/2021 season.

Port Frederick (unknown since 2014)

Port Frederick was removed as a survey area in 2015 due to budget constraints and is now considered part of the non-surveyed areas in Tables 2–4. From 1979 to 2004 (the years used to expand the survey biomass to the non-surveyed areas), Port Frederick contributed to 2.4% of the harvest. The previous percent expansion of 65.2% survey areas and 34.8 % non-surveyed areas was adjusted. Excluding Port Frederick, 62.8% of the harvest is from survey areas and 37.2% from non-surveyed areas. Adjusting the expansion factor allows for consistency between previous year estimates and the current year, all comparisons regionally were performed with a time series of estimates that were adjusted to not include Port Frederick. For the purposes of assessing the 2020/2021 commercial fishery, Port Frederick is considered part of the non-surveyed areas.

Holkham Bay (unknown since 2014)

Holkham Bay was removed as a survey area in 2015 due to budget constraints. The decision to drop Holkham Bay from the survey was based on difficulties in interpreting survey results from this location. Holkham Bay had consistently been surveyed since 2002, however, the data were not always adequate to use in the CSA to produce a biomass estimate; the area was only useful as an index of biomass and the estimates were never included in the regionwide biomass estimate and continues to be part of the non-surveyed areas.

Non-Surveyed Areas

Information used to assess non-surveyed areas for the 2020/2021 commercial fishery recommendation include the current CSA and historical harvest data, by statistical area, from fish tickets. The percentage of historical harvest that occurred within the surveyed areas from the 1974/1975 to 1984/1985 seasons was used to expand the harvestable surplus from the surveyed area to non-surveyed areas. Since 2015, when Port Frederick was removed from the survey, a historical harvest of 52.8% from surveyed areas is used, the remaining 47.2% of harvest is targeted from the non-surveyed areas. Summing up the mature biomass estimates for the surveyed areas, and using this 52.8%/47.2% ratio, yields an adjusted mature biomass estimate of 877,729 lb for non-surveyed areas. Applying a 10.0% harvest rate (a percentage which is close to the average equilibrium harvest rate for all surveyed areas in combination) to this estimate provides a harvestable surplus of 87,773 lb in the non-surveyed areas (Table 8).

2020/2021 RKC FISHERY MANAGEMENT ACTIONS

Stock health in Gambier Bay remained poor. All size and sex class CPUEs, except for mature females, are significantly below their long-term averages. Legal biomass decreased 17% and mature biomass decreased 21% from the 2019 model estimate. Short-term decreases are evident in a majority of sex/size classes. Gambier Bay will remain closed to fishing.

Stock health in Lynn Sisters has improved slightly but remains categorized as moderate with male recruitment and legal biomass concerns. The majority of size/sex classes are at or above long-term averages. However, there are many indications that stock health remains a concern in Lynn Sisters. While legal and mature biomass increased from last season, recruit class CPUE

dropped below its long-term average. Positive trends in stock health have become evident after an eight-year closure to all fishing, but the adjusted legal biomass estimate is smaller than seen in all other survey areas with the exception of Peril Strait. A permit requirement for personal use fishing outside of Section 11-A was implemented in 2018. The first couple of years of harvest data should better inform on the potential effort in Lynn Sisters and what level of harvest rates would be appropriate. The Lynn Sisters area will remain closed to fishing.

Stock health in Seymour Canal and Peril Strait improved to below average, but both showed a decrease in mature and legal biomass. In Seymour Canal, mature female, juvenile female, prerecruit male, and recruit male CPUEs were all significantly below their long-term averages, and only a small number of prerecruit crab were sampled in the 2020 survey. Mature and legal biomass estimates decreased and no short-term increasing trends were evident. In Peril Strait, all recruit classes, except postrecruit males, are significantly below their long-term averages. Legal and mature biomass estimates have shown no improvement from 2019 and both estimates have decreased and remain below long-term averages. Seymour Canal and Peril Strait will remain closed to fishing.

Stock health in Pybus Bay improved slightly but remains categorized as below average, with mature male biomass levels a concern. Though there were increases in mature and legal biomass, these estimates remain below long-term baselines; the mature biomass estimate is 57.4% below the baseline value. There are no short-term increases in any of the size/sex classes. Pybus Bay will remain closed to fishing.

Stock health in Excursion Inlet declined from below average to poor. CPUEs of juvenile females, juvenile males, prerecruit males, and postrecruit males are all significantly below their long-term averages. Mature and legal biomass estimates have decreased, and both are now below long-term baselines. There are no short-term increasing trends. Excursion Inlet has no harvestable surplus and was closed to personal use fishing on September 26, 2020.

Stock health in the Juneau area increased to moderate from below average in 2020. Prerecruit, recruit, and post recruit catch per unit effort (CPUE) increased from 2019 to 2020. CPUEs of mature females, juvenile females, and juvenile males were at baseline levels. Post recruit male CPUE was significantly above its long-term average, while CPUEs of prerecruit and recruit male red king crab were significantly below their long-term averages. In July 2020, the harvest rate was set at 7.0% for the 2020/2021 season and according to the allocation plan prescribed in 5 AAC 34.111, summer and winter personal use fisheries were structured to target 1,527 crab and 305 crab respectively.

Non-Surveyed areas have an estimated mature male biomass of 877,729 lb or 47.2% of the regionwide estimate (using historical harvest from the 1974/1975 to 1984/1985 seasons). Stock health in non-surveyed areas may be exhibiting the same trends in stock health seen in surveyed areas, such as decreasing mature and legal male biomass. Geographically, non-surveyed areas encompass a much larger area than surveyed areas and generally see less fishing effort than surveyed areas. Some fishermen have noted good catches of RKC in non-surveyed areas, while others have witnessed declines in areas they fish. The non-surveyed areas, which include Port Frederick and Holkham Bay, can likely withstand a low level of harvest in the near term and will remain open with a minimal bag and possession limit.

Beginning September 27, 2020, all areas open to personal use red and blue king crab fishing outside of Section 11-A will maintain the reduced daily bag and possession limit of one king crab per day as prescribed in regulation [5 AAC 77.664(b)].

FISHERY MANAGEMENT CONCERNS

The RKC and BKC commercial fishery and personal use fishery outside of Section 11-A are managed separately and there are no regulatory thresholds or allocations that combine estimated harvest for both user groups. Personal use harvest outside of Section 11-A is not considered when calculating the commercial GHLs for each area to determine whether the total commercial GHL meets the 200,000 lb threshold in regulation for a commercial fishery [5 AAC 34.113]. The newly implemented permit system for the personal use fishery will provide managers better information on the level of personal use harvest outside of Section 11-A, improve future CSA estimates, and inform potential Alaska Board of Fisheries decisions.

Information is lacking to expand surveyed area biomass out to non-surveyed areas to estimate regionwide RKC biomass. Historical harvest based on fish ticket data is the single information source presently available to make inferences about biomass in the non-surveyed areas. Management actions (e.g., area closures and short seasons) and regulatory changes (e.g., Section 11-A allocation plan) influence the distribution of commercial harvest. The commercial fishery was closed from 1985/1986 to 1992/1993. The 1993/1994 and 1994/1995 seasons featured area closures to protect stocks of concern and the current Section 11-A allocation plan went into effect in 1995/1996. Historical harvest for the period when these management actions were implemented affected spatial distribution of commercial effort. Therefore, the years prior to the 1985/1986 season represent the best historical harvest data by which to calculate regional biomass from survey area data. For the 1974/1975 to 1984/1985 seasons, the average commercial harvest taken from surveyed areas was 52.8% of the total harvest. The surveyed to non-surveyed area was split 52.8% to 47.2%, and that expansion was applied to the sum of the mature biomass estimates. To calculate the commercial GHL this season, management used an approach first used in 2017, and applied a 10.0% harvest rate to the Other Area adjusted mature biomass estimate, instead of applying the aforementioned 52.8%/47.2% split to the harvestable surplus from the surveyed areas. In future seasons when the 200,000 lb threshold is reached, this approach will likely relieve harvest pressure on surveyed areas and will allow permit holders to fish for RKC in areas that have never been surveyed and currently receive no fishing effort due to the short duration of recent seasons.

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Palof, K., and J. Stratman. 2020. 2019 Southeast Alaska red king crab stock assessment and management plan for the 2019/2020 season. Alaska Department of Fish and Game, Regional Information Report No. 1J20-09, Douglas.

Stratman, J., A. Messmer, K. Wood, T. Bergmann, and K. Palof. 2019. Operational plan: Southeast Alaska red king crab pot survey, 2018–2022. Alaska Department of Fish and Game, Regional Operational Plan ROP.CF.1J.2019.02, Douglas.

TABLES AND FIGURES

Table 1.–Biomass adjustments based on the ratio of Chapman mark/recapture estimates to catch-survey analysis (CSA) estimates of legal crab. The ratio of legal to mature crab from the current year is used to scale the adjustment from biomass of legal crabs to biomass of mature crabs.

	Mark/Recapture Study (lb)		
Survey area	**CSA**	**M/R**	**Adjustment**
Lynn Sisters [a]	39,886	69,674	1.75
Pybus Bay [b,d]	80,807	236,042	2.92
	17,635	67,220	3.81
	Weighted avg.		3.08
Gambier Bay [b,g]	42,104	180,433	4.29
	25,294	84,394	3.34
	Weighted avg.		3.93
Excursion Inlet [b,f]	20,066	97,232	4.85
	17,184	12,501	0.73
	Weighted avg.		2.95
Seymour Canal [c,e]	6,387	58,002	9.08
	29,062	267,233	9.20
	Weighted avg.		9.17
Peril Strait [c]	19,023	52,377	2.75
Port Frederick [c]	12,523	53,436	4.27

Adjustments were calculated using CSA estimates of the year the mark/recapture occurred: a = 2009, b = 2010, c = 2011, d = 2014, e = 2015, f = 2016, and g = 2017.

Table 2.–Option 1: risk neutral—model-based equilibrium exploitation rates. Summary of 2020 commercial red king crab fishery GHL calculations (lb) for the seven surveyed areas and non-surveyed areas. Risk neutral option based on 2018 calculated equilibrium exploitation rates (Appendix A). The harvest rate for the non-surveyed areas is a weighted average of the surveyed area's harvest rates (shown below) and the average mature male biomass for each area over the entire time series (1979–2019). Biomass estimates apply the adjustment in Table 1 to the CSA biomass presented here. Biomass of non-surveyed areas was expanded based on historical year range of 1974–1984. Personal use catch for non-surveyed areas is mean catch estimated from 2008–2012 statewide survey data. Blue king crab (BKC) is estimated as 1.06% of the surveyed areas based on historical catch, and its GHL contribution is an expansion of the surveyed area's GHL using the same percentage.

Survey area	CSA Biomass of legal crab	CSA Biomass of mature crab	Legal biomass	Mature biomass	Equilibrium HR	Total GHL	Personal use catch	2020 Commercial GHL (lb)
Pybus Bay	50,380	57,760	**155,200**	**177,938**	**12%**	21,353	n/a	21,353
Gambier Bay	14,900	16,363	**58,548**	**64,294**	**4%**	2,572	n/a	2,572
Seymour Canal	24,147	24,275	**221,546**	**222,717**	**1%**	2,227	n/a	2,227
Peril Strait	5,779	6,741	**15,912**	**18,561**	**4%**	742	n/a	742
Juneau Area [a]	301,219	361,007	301,219	361,007	**7%**	25,270	15,162	10,108
Lynn Sisters	22,435	34,022	**39,190**	**59,431**	**9%**	5,349	n/a	5,349
Excursion Inlet	20,775	26,450	**61,201**	**77,917**	**6%**	4,675	n/a	4,675
Blue King Crab	4,660	5,582	**9,040**	**10,408**	**–**	–	–	498
Expansion using historical years (1974–1984) – 47.2% of the population in the NON-survey areas								
Non-surveyed areas	393,008	470,765	**762,365**	**877,729**	**10%**	87,773	1,000	86,773
Total	837,303	1,002,966	**1,624,219**	**1,870,003**	–	–	–	**134,297**

[a] The Juneau area harvest rate in this option is 17%, but it was open to personal use harvest in summer 2020 at a harvest rate of 7%. "n/a" represents data that is not available or readily estimable from the other bays.

Table 3.–Option 2: lowest risk—high probability of mature male biomass increasing. Summary of 2020 commercial red king crab fishery GHL calculations (lb) for the seven surveyed areas and non-surveyed areas. Risk adverse option based on 2018 calculated average harvest rates when the mature male biomass was increasing (Appendix A). The exploitation rate for the non-surveyed areas is a weighted average of the surveyed areas harvest rates (shown below) and the average mature male biomass for each area over the entire time series (1979–2019). Biomass estimates apply the adjustment in Table 1 to the CSA biomass presented here. Biomass of non-surveyed areas was expanded based on the historical year range of – 1974–1984. Personal use catch for non-surveyed areas is mean catch estimated from 2008–2012 statewide survey data. Blue king crab (BKC) is estimated as 1.06% of the surveyed areas based on historical catch, and its GHL contribution is an expansion of the surveyed areas GHL using the same percentage.

Survey area	Biomass of legal crab	Biomass of mature crab	ADJUSTED legal biomass	ADJUSTED mature biomass	ADJUSTED avg inc HR	Total GHL	Personal use catch	2020 Commercial GHL (lb)
Pybus Bay	50,380	57,760	**155,200**	**177,938**	**2%**	3,559	n/a	3,559
Gambier Bay	14,900	16,363	**58,548**	**64,294**	**2%**	1,286	n/a	1,286
Seymour Canal	24,147	24,275	**221,546**	**222,717**	**0.5%**	1,114	n/a	1,114
Peril Strait	5,779	6,741	**15,912**	**18,561**	**4%**	742	n/a	742
Juneau Area [a]	301,219	361,007	301,219	361,007	**7%**	25,270	15,162	10,108
Lynn Sisters	22,435	34,022	**39,190**	**59,431**	**3%**	1,783	n/a	1,783
Excursion Inlet	20,775	26,450	**61,201**	**77,917**	**1%**	779	n/a	779
Blue King Crab	4,660	5,582	**9,040**	**10,408**	**–**	–	–	205
Expansion using historical years (1974–1984) – 47.2% of the population in the NON-survey areas								
Non-surveyed areas	393,008	470,765	**762,365**	**877,729**	**4%**	35,109	1,000	34,109
Total	837,303	1,002,966	**1,624,219**	**1,870,003**	–	–	–	**53,685**

[a] The Juneau area was open to personal use harvest in summer 2019 at a harvest rate of 7%. "n/a" represents data that is not available or readily estimable from the other bays.

Table 4.–Option 3: highest risk option – data based, using a sum of the average harvest rate and average change in mature male biomass. Summary of 2020 commercial red king crab fishery GHL calculations (lb) for the seven surveyed areas and non-surveyed areas. This exploitation rate option is based on 2018 calculated combination of average harvest rate and average change in mature male biomass for each area (Appendix A). The harvest rate for the non-surveyed areas is a weighted average of the surveyed areas harvest rates (shown below) and the average mature male biomass for each area over the entire time series (1979–2019). Biomass estimates apply the adjustment in Table 1 to the CSA biomass presented here. Biomass of non-surveyed areas was expanded based on the historical year range of 1974 to 1984. Personal use catch for non-surveyed areas is mean catch estimated from 2008–2012 statewide survey data. Blue king crab (BKC) is estimated as 1.06% of the surveyed areas based on historical catch, and its GHL contribution is an expansion of the surveyed areas GHL using the same percentage.

Survey area	Biomass of legal crab	Biomass of mature crab	ADJUSTED legal biomass	ADJUSTED mature biomass	ADJUSTED avg HR & avg change	Total GHL	Personal use catch	2020 Commercial GHL (lb)
Pybus Bay	50,380	57,760	**155,200**	**177,938**	**18%**	32,029	n/a	32,029
Gambier Bay	14,900	16,363	**58,548**	**64,294**	**5%**	3,215	n/a	3,215
Seymour Canal	24,147	24,275	**221,546**	**222,717**	**4%**	8,909	n/a	8,909
Peril Strait	5,779	6,741	**15,912**	**18,561**	**3%**	557	n/a	557
Juneau Area [a]	301,219	361,007	301,219	361,007	**7%**	25,270	15,162	10,108
Lynn Sisters	22,435	34,022	**39,190**	**59,431**	**10%**	5,943	n/a	5,943
Excursion Inlet	20,775	26,450	**61,201**	**77,917**	**12%**	9,350	n/a	9,350
Blue King Crab	4,660	5,582	**9,040**	**10,408**	**–**	–	–	743
Expansion using historical years (1974–1984) –47.2% of the population in the NON-survey areas								
Non-surveyed areas	393,008	470,765	**762,365**	**877,729**	**12%**	105,327	1,000	104,327
Total	837,303	1,002,966	**1,624,219**	**1,870,003**	–	–	–	**175,181**

[a] The Juneau area harvest rate in this option is 17%, but it was open to personal use harvest in summer 2019 at a harvest rate of 7%. "n/a" represents data that is not available or readily estimable from the other bays.

Table 5.–Total stock health designations and associated scores for 2016–2020 by survey area.

Survey Area	2016	2017	2018	2019	2020
Pybus Bay	Below Average (-2.0)	Moderate (0.50)	Below Average (-3.0)	Below Average (-3.75)	Below Average (-2.50)
Gambier Bay	Below Average (-2.0)	Moderate (0.00)	Poor (-5.25)	Poor (-6.00)	Poor (-6.25)
Seymour Canal	Below Average (-3.0)	Moderate (1.25)	Below Average (-3.0)	Poor (-5.0)	Below Average (-3.50)
Peril Strait	Poor (-5.5)	Poor (-6.0)	Poor (-5.0)	Poor (-6.25)	Below Average (-4.25)
Juneau Area	Moderate (-1.50)	Above Average (2.5)	Moderate (1.25)	Below Average (-3.50)	Moderate (-0.50)
Lynn Sisters	Poor (-5.0)	Moderate (-1.50)	Moderate (-0.75)	Moderate (0.50)	Moderate (1.50)
Excursion Inlet	Poor (-4.75)	Below Average (-4.25)	Moderate (1.00)	Below Average (-2.75)	Poor (-4.75)
Port Frederick	–	–	–	–	–

Table 6.–Stock health scores and their associated categories used for the previous (2006–2008) and current (since 2008) seasons. Scores are calculated in 0.25 increments.

Score	Previous Categories	Current Categories
-7.00 to -4.50	Poor	Poor
-4.25 to -1.75	Poor	Below Average
-1.50 to 1.50	Moderate	Moderate
1.75 to 4.25	Healthy	Above Average
4.5 to 7.00	Healthy	Healthy

Table 7.–Samples sizes for the 2020 survey by area.

	Pybus Bay	Gambier Bay	Seymour Canal	Peril Strait	Juneau	Lynn Sisters	Excursion Inlet
Prerecruit	24	11	1	8	387	94	33
Recruit	62	12	18	12	325	52	33
Postrecruit	100	51	106	38	1,057	79	36
Juvenile male	24	46	19	13	900	188	70
Juvenile female	25	51	0	18	691	208	96
Mature female	193	201	8	30	1,438	458	205
Effective No. of Pots	43	52	52	51	222	28	55

Table 8.– Summary of 2020 commercial red king crab fishery GHL calculations (in pounds) and harvest rate recommendations for the 7 surveyed areas and non-surveyed areas. Adjusted mature biomass from the mark-recapture study are shown in bold. Biomass of non-surveyed areas was expanded to be 47.2% of the region.

Survey area	CSA Biomass of Legal Crab	CSA Biomass of Mature Crab	Mature biomass	Mature harvest rate	Total GHL	Personal use catch	2020 Commercial GHL
Pybus Bay	50,380	57,760	**177,938**	0.0%	0	0	0
Gambier Bay	14,900	16,363	**64,294**	0.0%	0	0	0
Seymour Canal	24,147	24,275	**222,717**	0.0%	0	0	0
Peril Strait	5,779	6,741	**18,561**	0.0%	0	0	0
Juneau Area	301,219	361,007	361,007	7.0%	25,270	15,162	10,108
Lynn Sisters	22,435	34,022	**59,431**	0.0%	0	0	0
Excursion Inlet	20,775	26,450	**77,917**	0.0%	0	0	0
Non-surveyed areas	393,008	470,765	**877,729**	10.0%	–	–	87,773
Blue King Crab	4,660	5,582	**10,408**	NA	–	–	0
Total	837,303	1,002,966	1,870,003	–	–	–	97,881

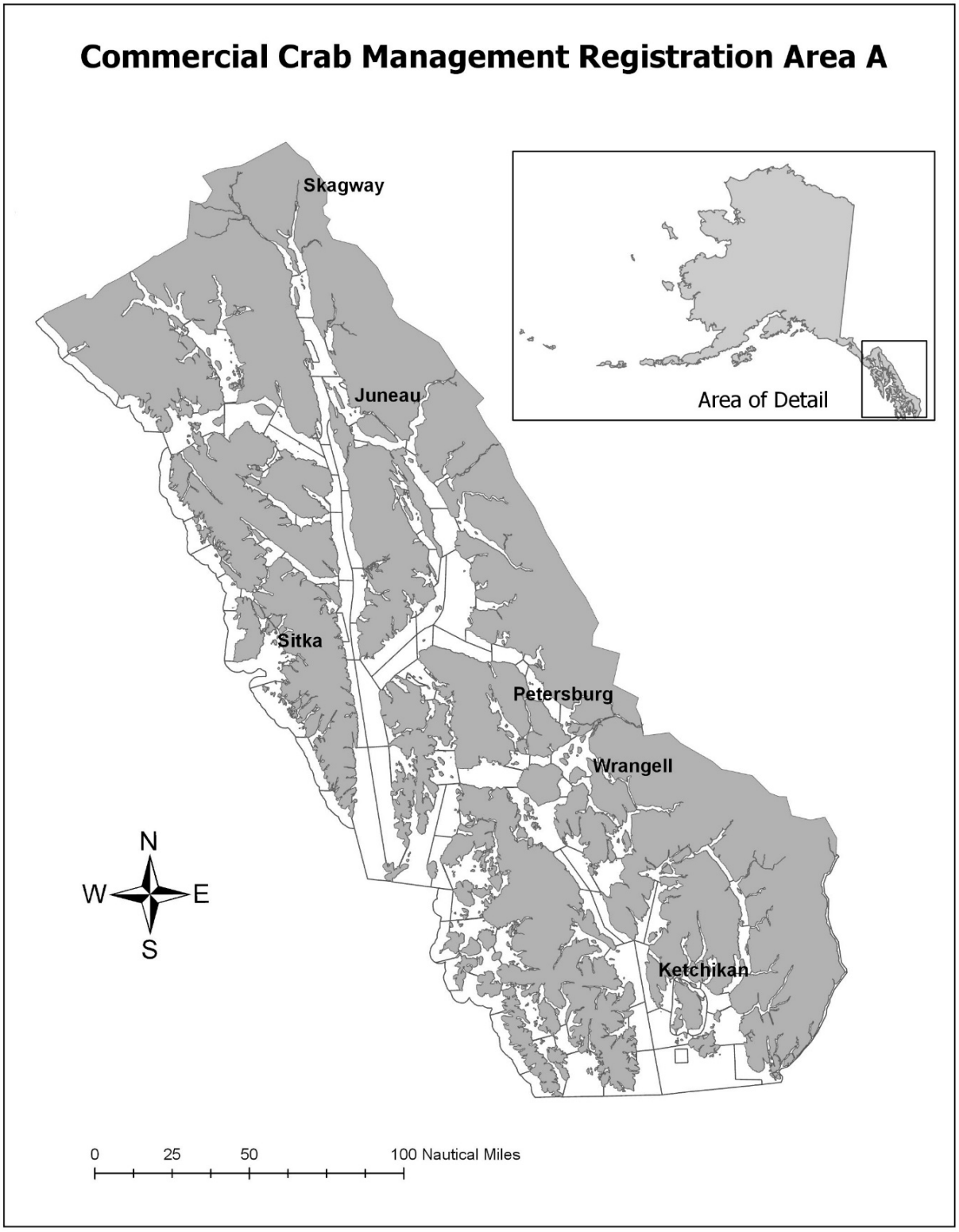

Figure 1.–Map of Southeast Alaska (Registration Area A).

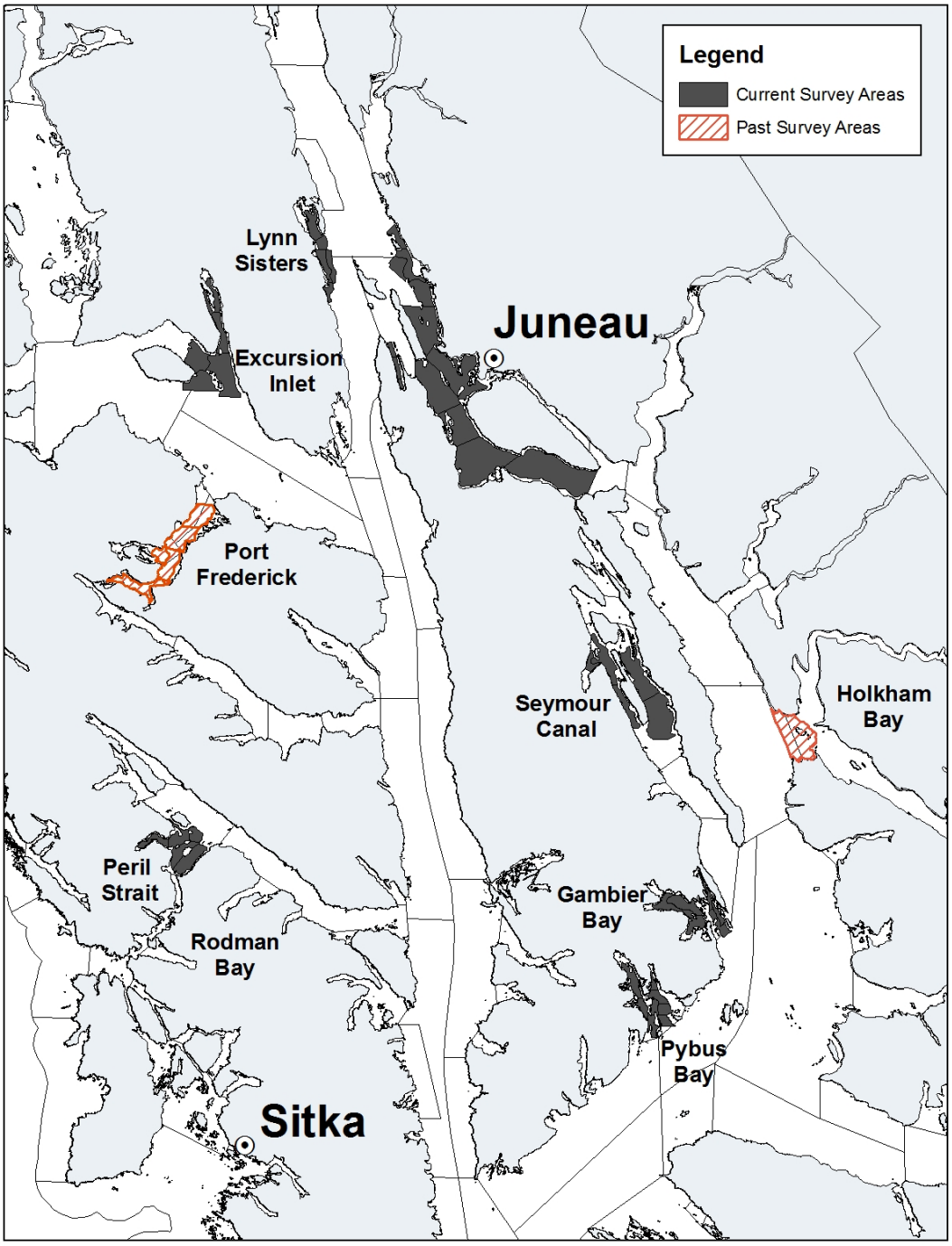

Figure 2.–2020 red king crab survey areas in Southeast Alaska. In 2015, Port Frederick and Holkham Bay were removed as survey areas but are shown here for reference.

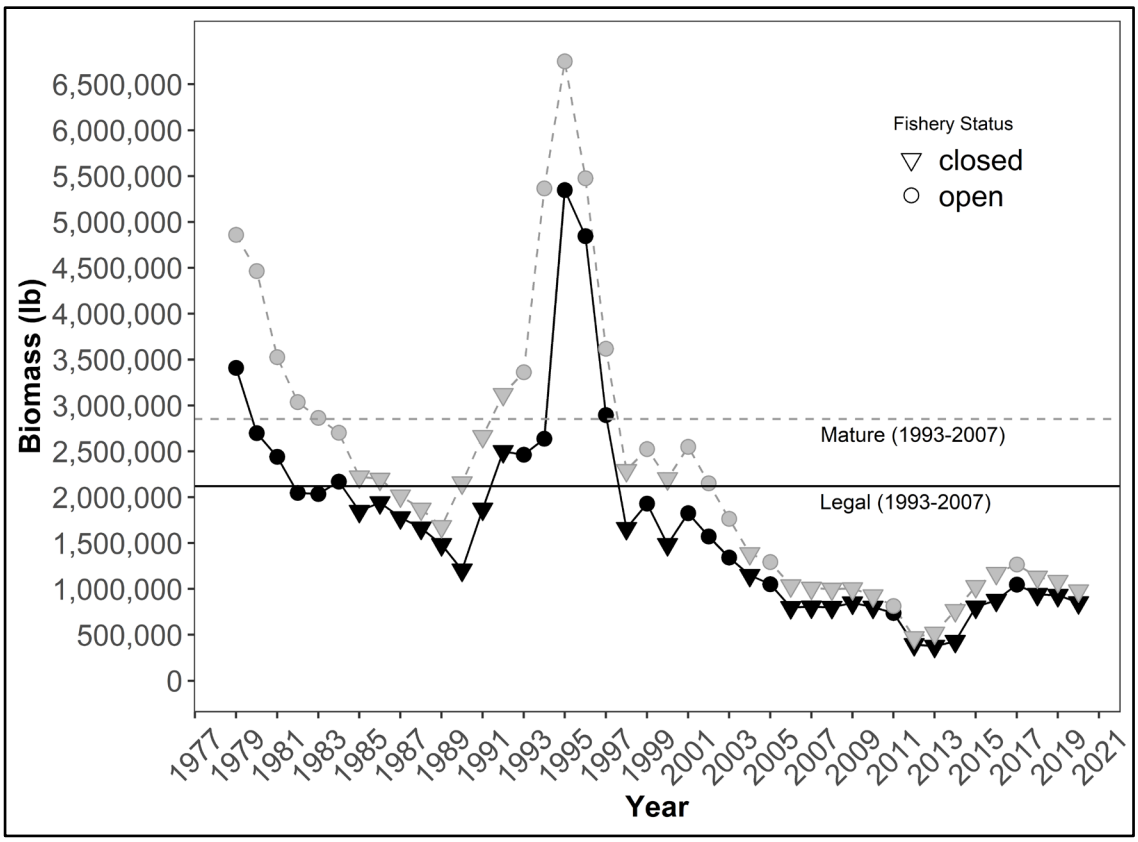

Figure 3.–Total biomass estimates of mature (gray points and line) and legal (black points and line) red king crab for surveyed areas in Southeast Alaska. Estimates based on Catch-Survey Analysis (CSA) methodologies adjusted using mark-recapture study results (Table 1). This does not include Holkham Bay, Port Frederick, or non-surveyed areas. Reference lines represent long-term (1993–2007) average of legal and mature biomass estimates. Triangles represent years without a commercial harvest.

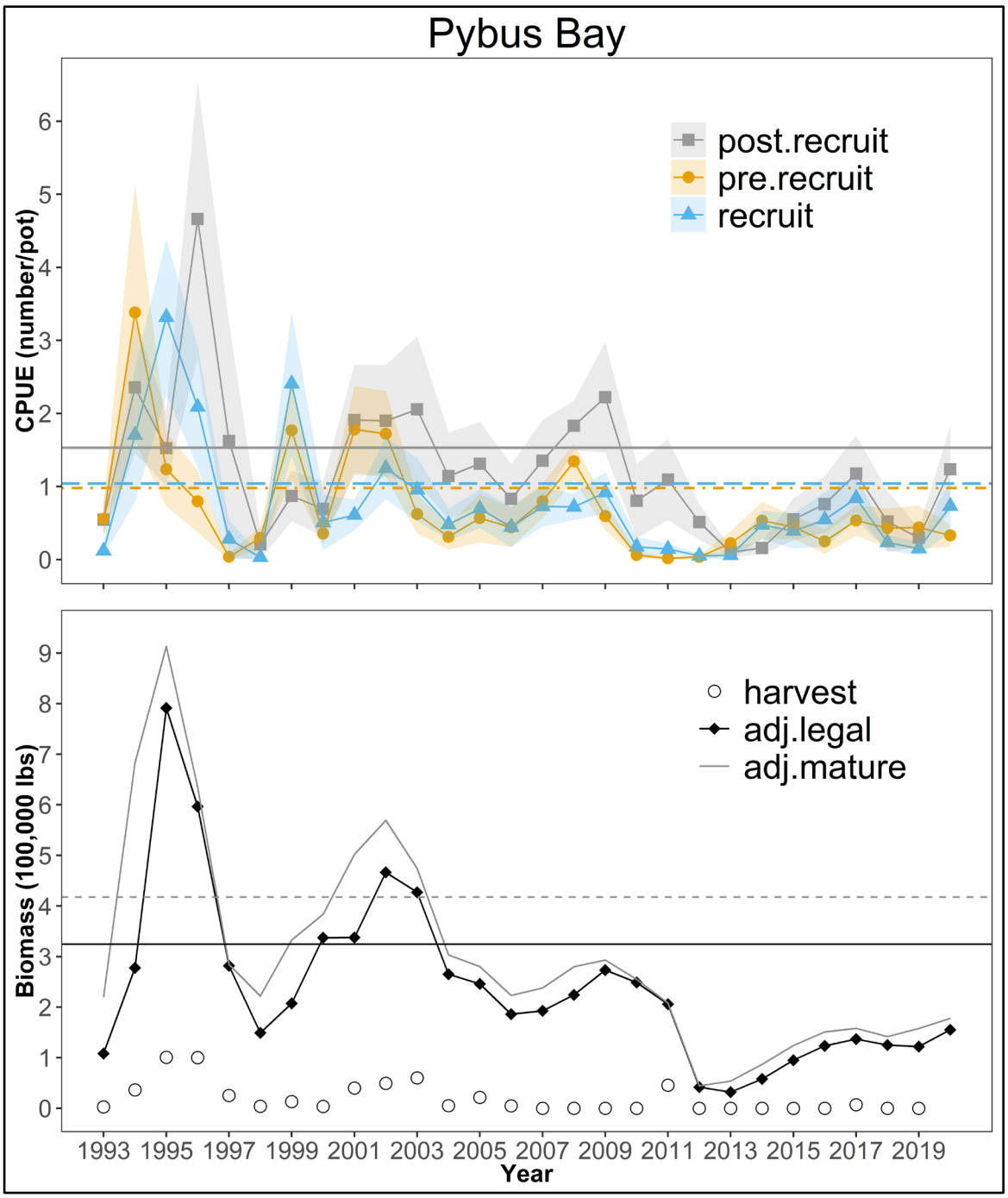

Figure 4.–Pybus Bay CPUEs for male size/sex classes of red king crab, biomass estimates from the current year's CSA model and harvest data. Reference lines represent long-term baselines for each parameter (1993–2007). Gray dotted reference line in the biomass figure represents the long-term baseline for mature biomass, while the solid black refers to the legal biomass. There are no significant short-term trends this year.

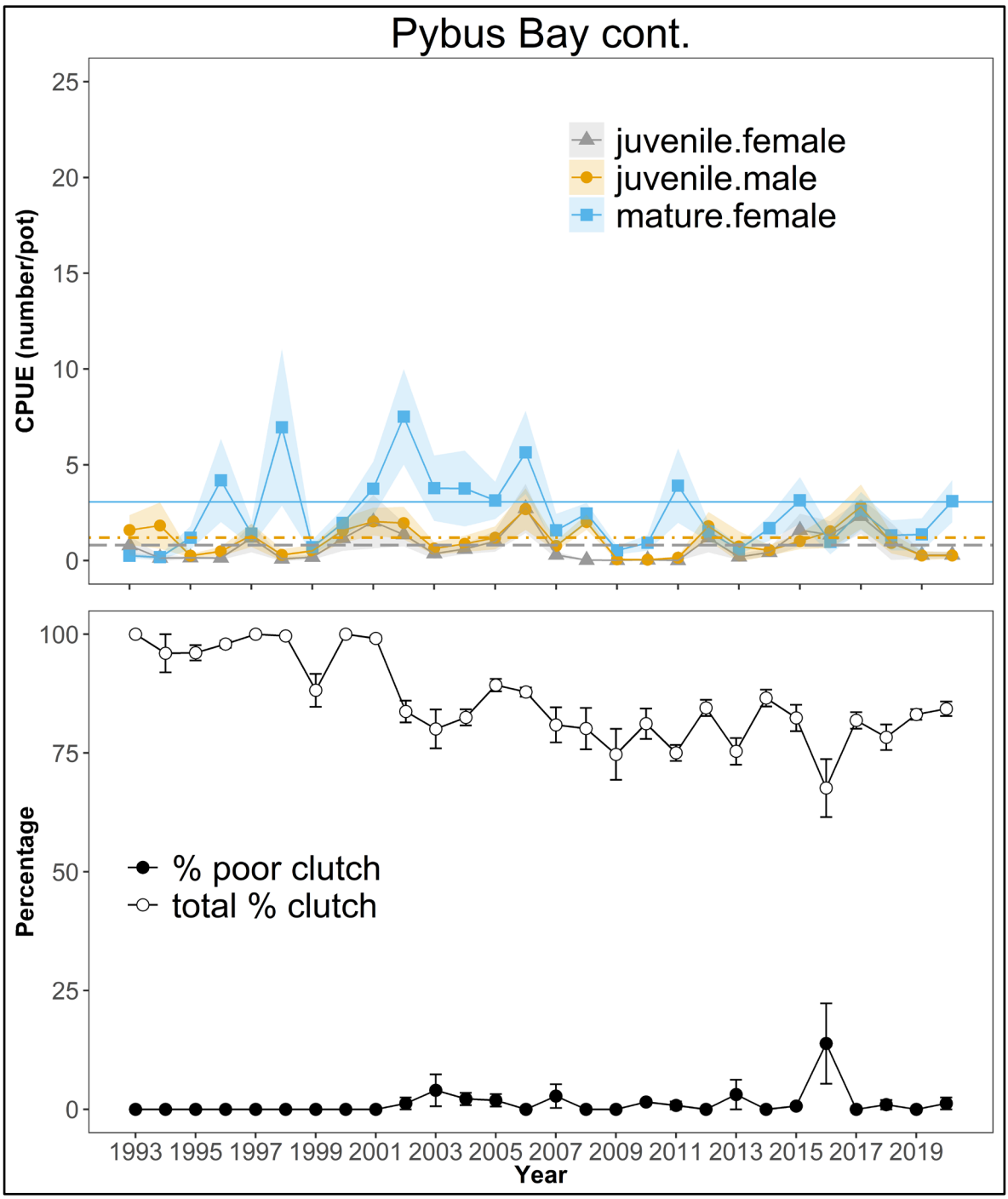

Figure 5.–Pybus Bay CPUEs for female and juvenile male size/sex classes of red king crab, clutch fullness and proportion of poor clutches. Reference lines represent long-term baselines for each parameter (1993–2007). There is a significant short-term decreasing trend in the juvenile male and females this year.

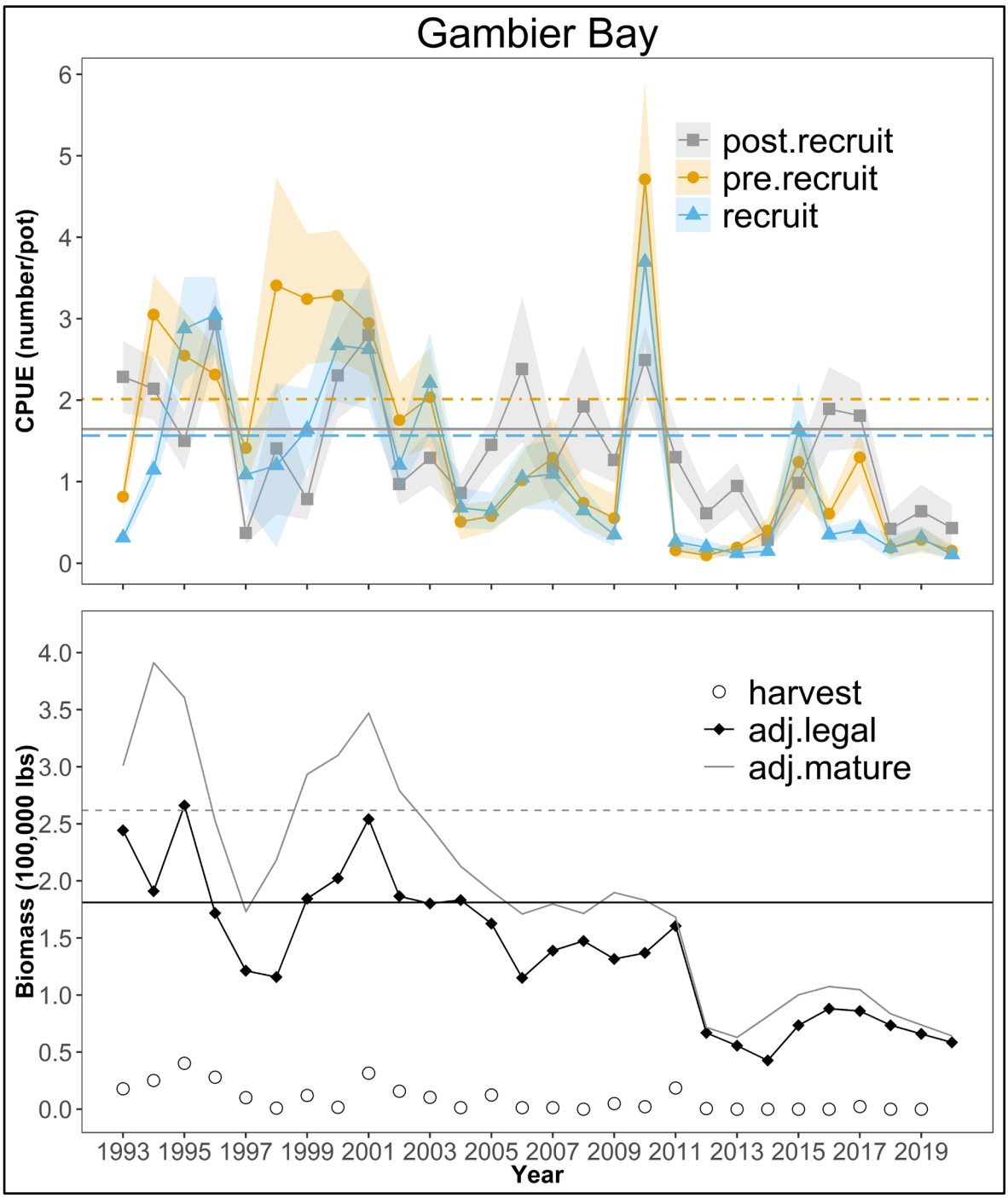

Figure 6.–Gambier Bay CPUEs for male size/sex classes of red king crab, biomass estimates from the current year's CSA model and harvest data. Reference lines represent long-term baselines for each parameter (1993–2007). Gray dotted reference line in the biomass figure represents the long-term baseline for mature biomass, while the solid black refers to the legal biomass. There are significant short-term decreasing trends in prerecruit and postrecruit male CPUEs.

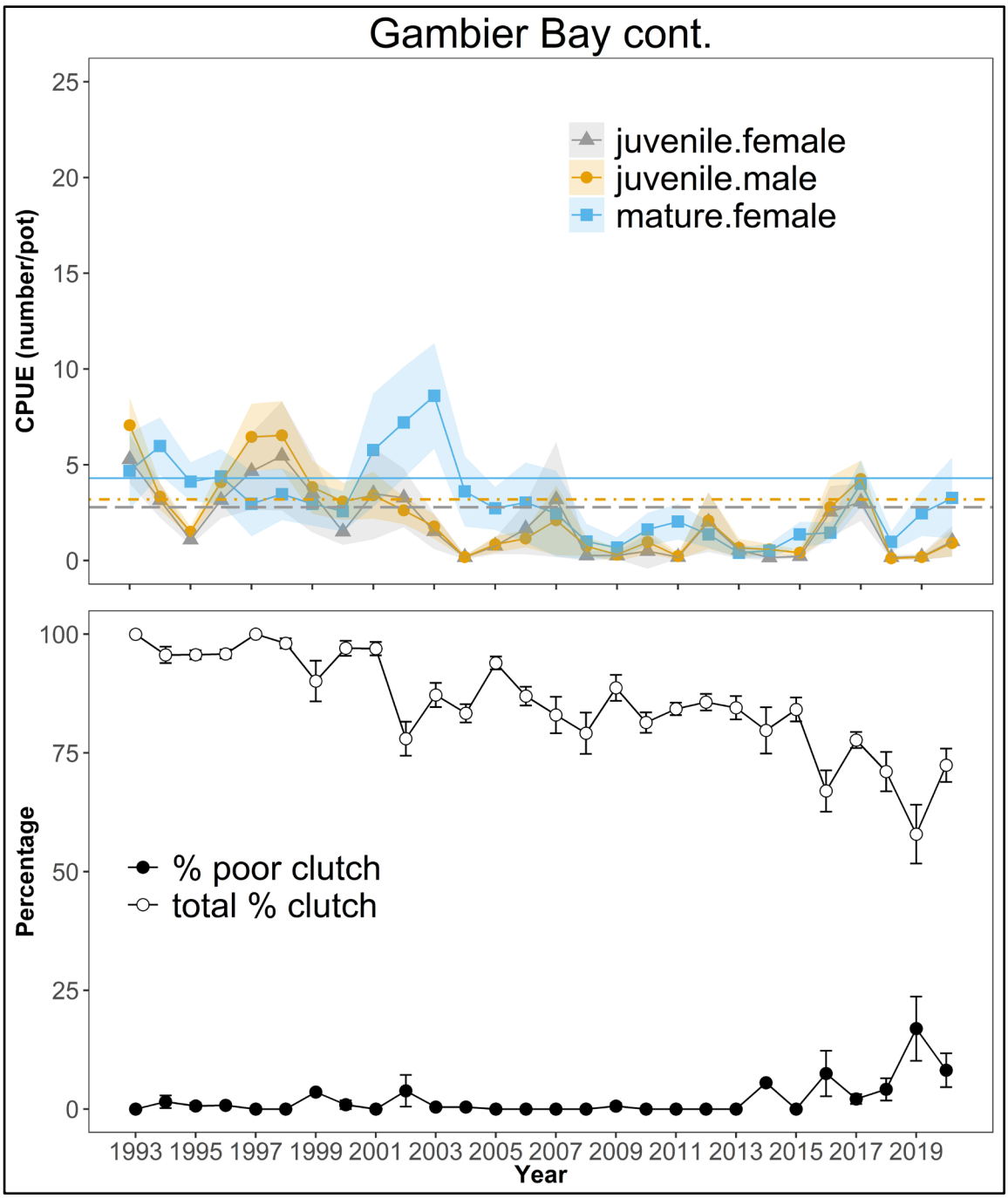

Figure 7.–Gambier Bay CPUEs for female and juvenile male size/sex classes of red king crab, clutch fullness and proportion of poor clutches. Reference lines represent long-term baselines for each parameter (1993–2007). There are significant decreasing short-term trends in juvenile male and female CPUEs, as well as significant increase in the percentages of females with poor clutches (<25% full).

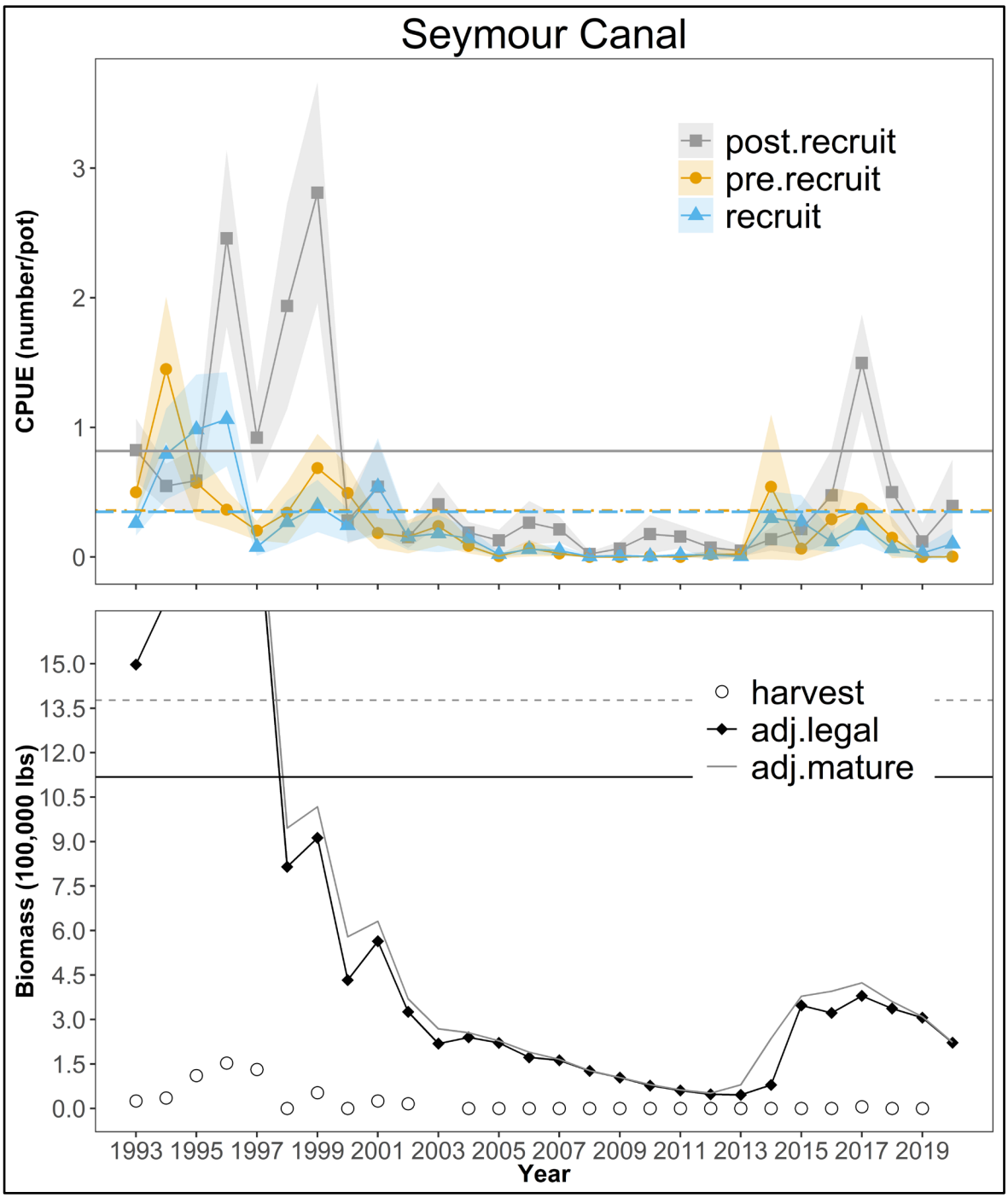

Figure 8.–Seymour Canal CPUEs for male size/sex classes of red king crab, biomass estimates from the current year's CSA model and harvest data. Reference lines represent long-term baselines for each parameter (1993–2007). Gray dotted reference line in the biomass figure represents the long-term baseline for mature biomass, while the solid black refers to the legal biomass. There are significant decreasing short-term trends in both prerecruit and postrecruit CPUEs.

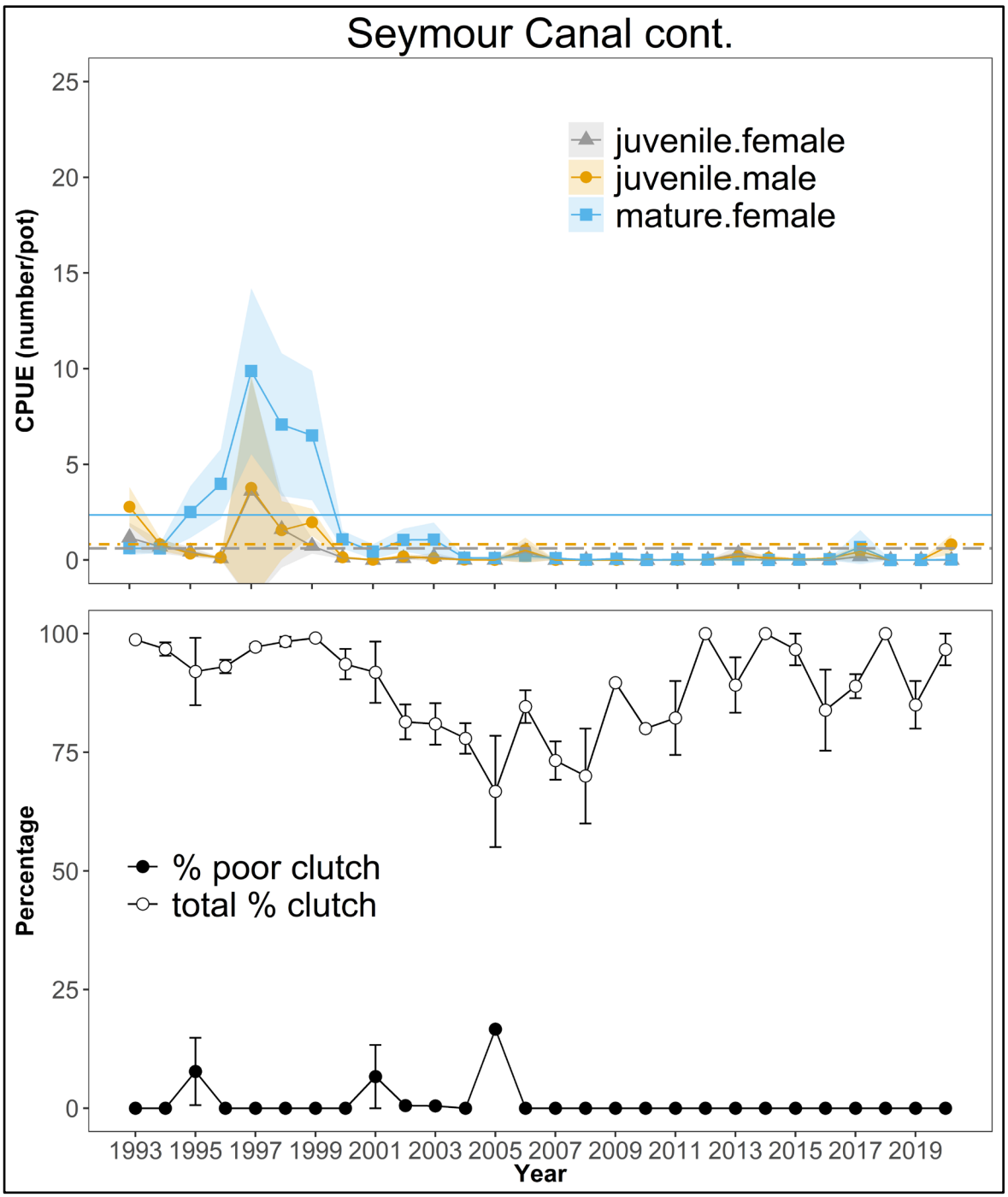

Figure 9.–Seymour Canal CPUEs for female and juvenile male size/sex classes of red king crab, clutch fullness and proportion of poor clutches. Reference lines represent long-term baselines for each parameter (1993–2007). There are no significant short-term trends this year.

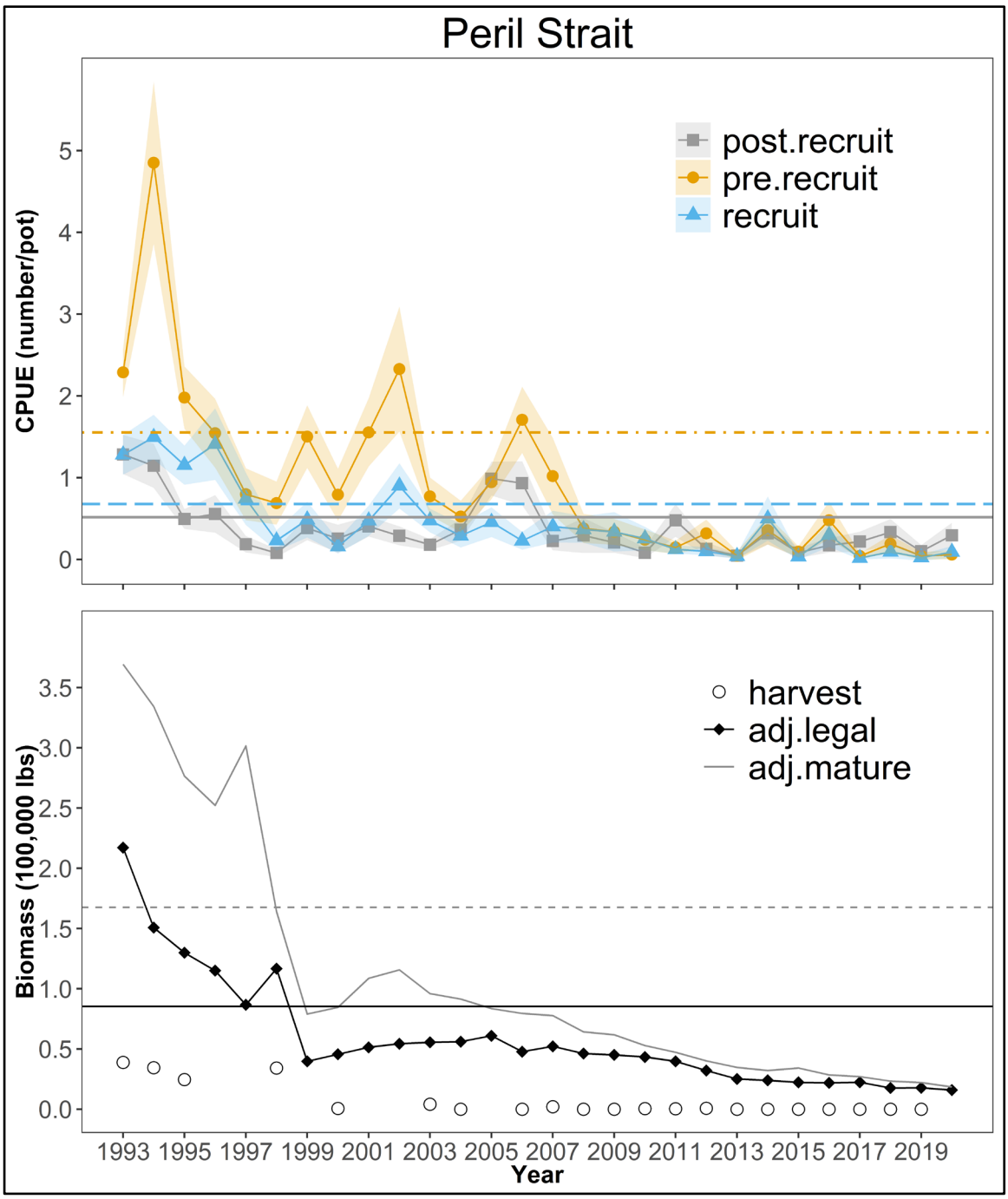

Figure 10.–Peril Strait CPUEs for male size/sex classes of red king crab, biomass estimates from the current year's CSA model and harvest data. Reference lines represent long-term baselines for each parameter (1993–2007). Gray dotted reference line in the biomass figure represents the long-term baseline for mature biomass, while the solid black refers to the legal biomass. There are no significant short-term trends in mature male CPUEs this year.

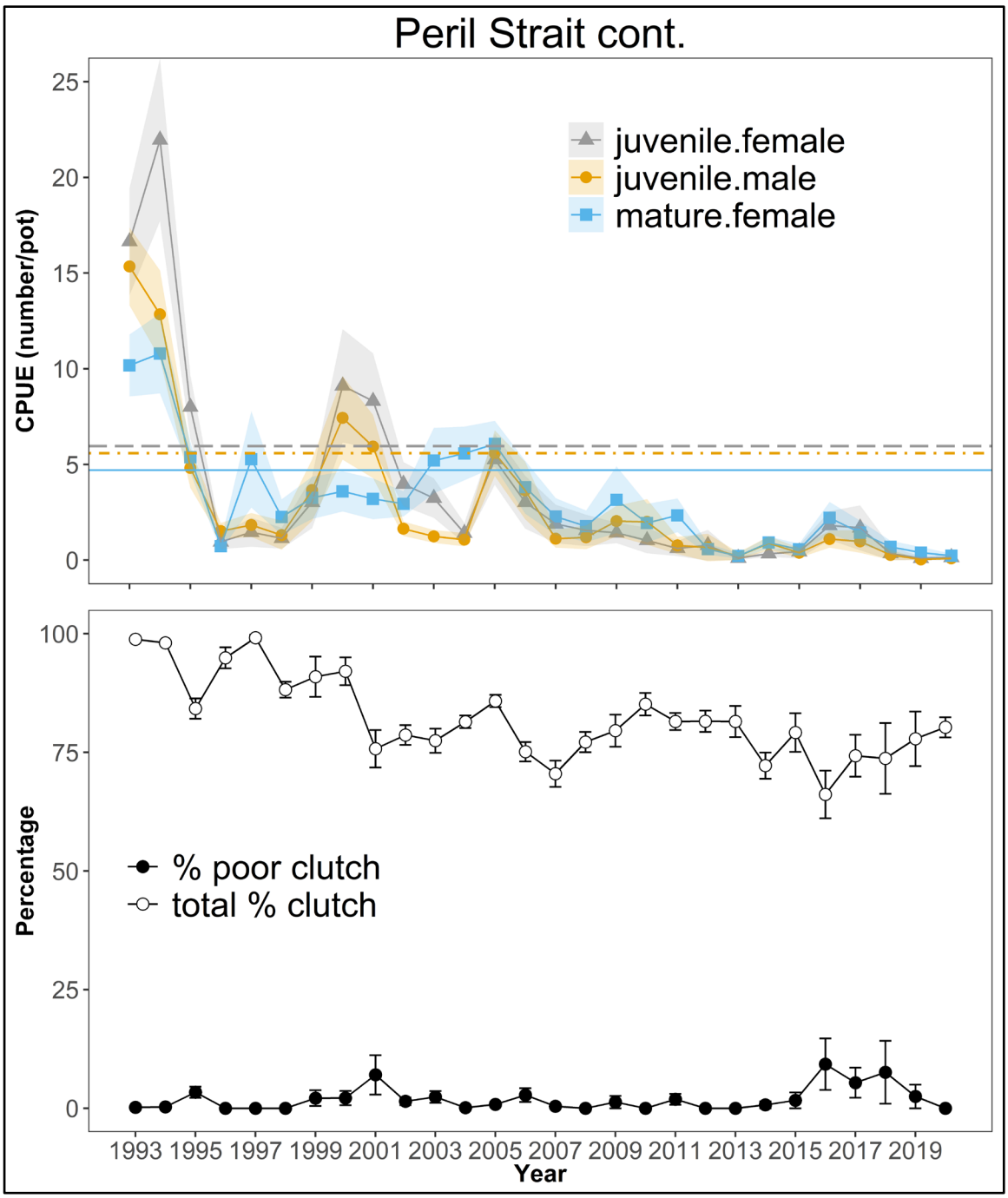

Figure 11.–Peril Strait CPUEs for female and juvenile male size/sex classes of red king crab, clutch fullness and proportion of poor clutches. Reference lines represent long-term baselines for each parameter (1993–2007). There is a significant short-term decreasing trend in mature female CPUEs this year.

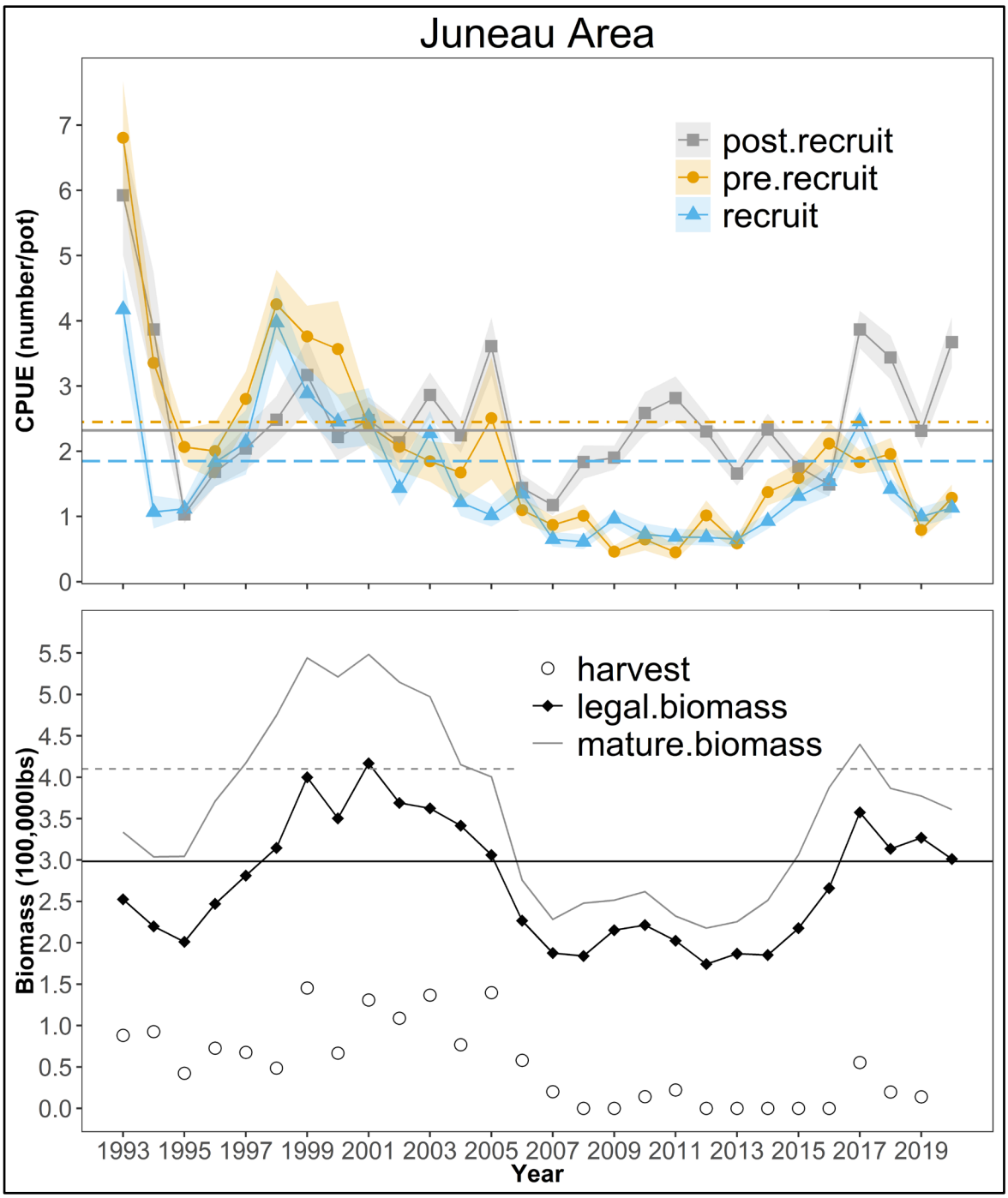

Figure 12.–Juneau area CPUEs for male size/sex classes of red king crab, biomass estimates from the current year's CSA model and harvest data. Reference lines represent long-term baselines for each parameter (1993–2007). Gray dotted reference line in the biomass figure represents the long-term baseline for mature biomass, while the solid black refers to the legal biomass. There are significant short-term decreasing trends in prerecruit and recruit male CPUEs.

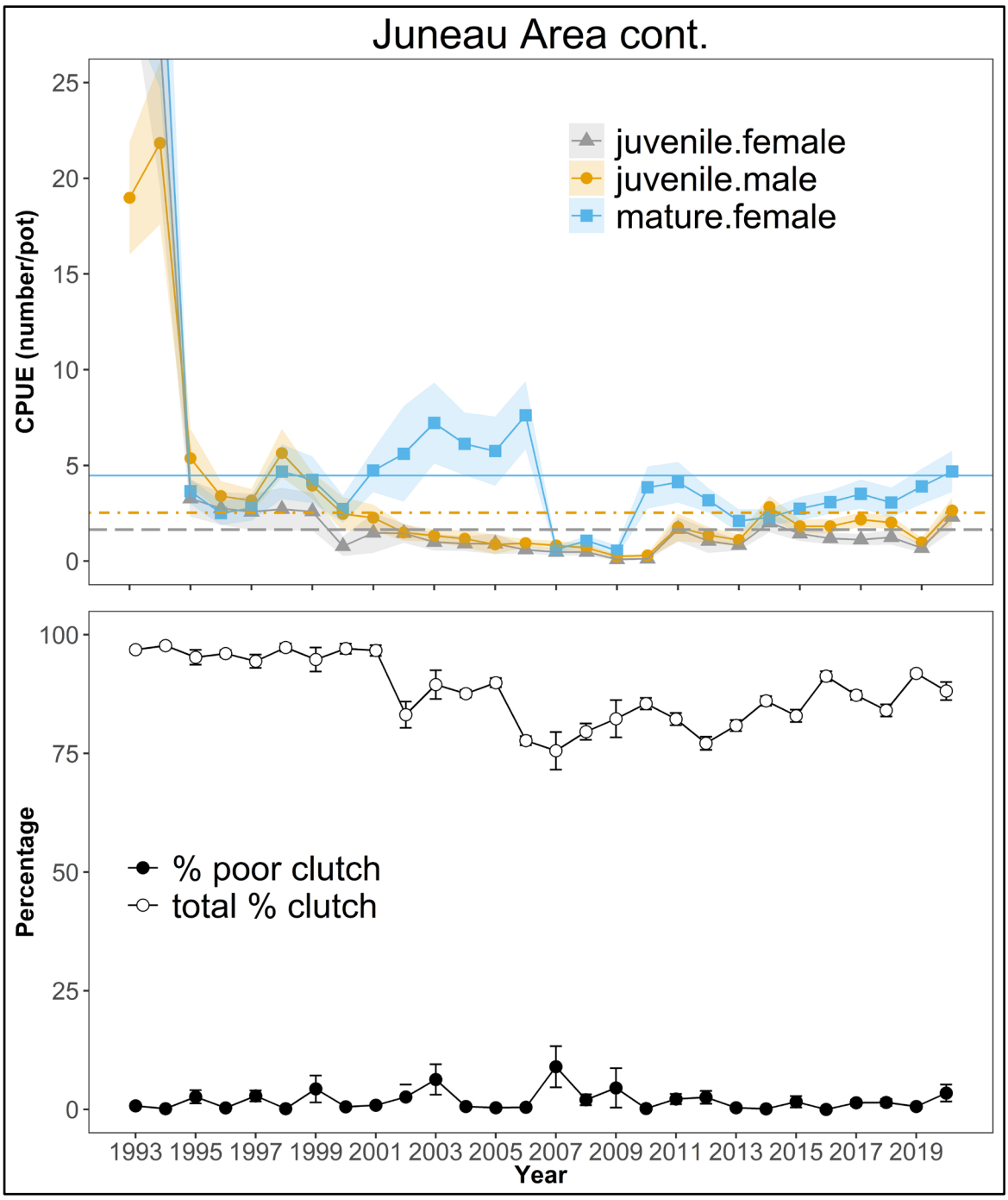

Figure 13.–Juneau area CPUEs for female and juvenile male size/sex classes of red king crab, clutch fullness and proportion of poor clutches. Reference lines represent long-term baselines for each parameter (1993–2007). There are no significant short-term trends for females or juveniles this year.

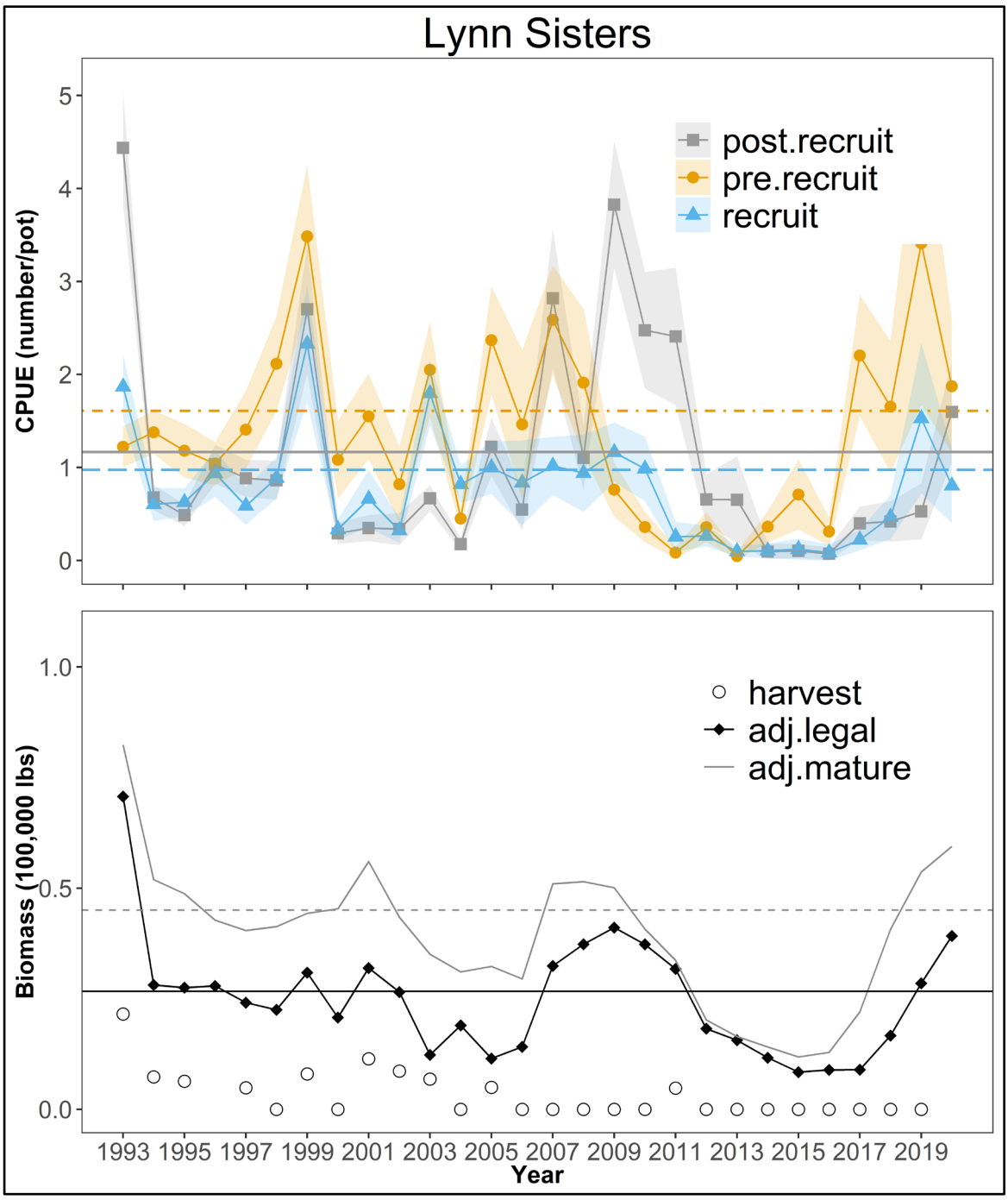

Figure 14.–Lynn Sisters CPUEs for male size/sex classes of red king crab, biomass estimates from the current year's CSA model and harvest data. Reference lines represent long-term baselines for each parameter (1993–2007). Gray dotted reference line in the biomass figure represents the long-term baseline for mature biomass, while the solid black refers to the legal biomass. There is a significant short-term increasing trend in postrecruit male CPUEs.

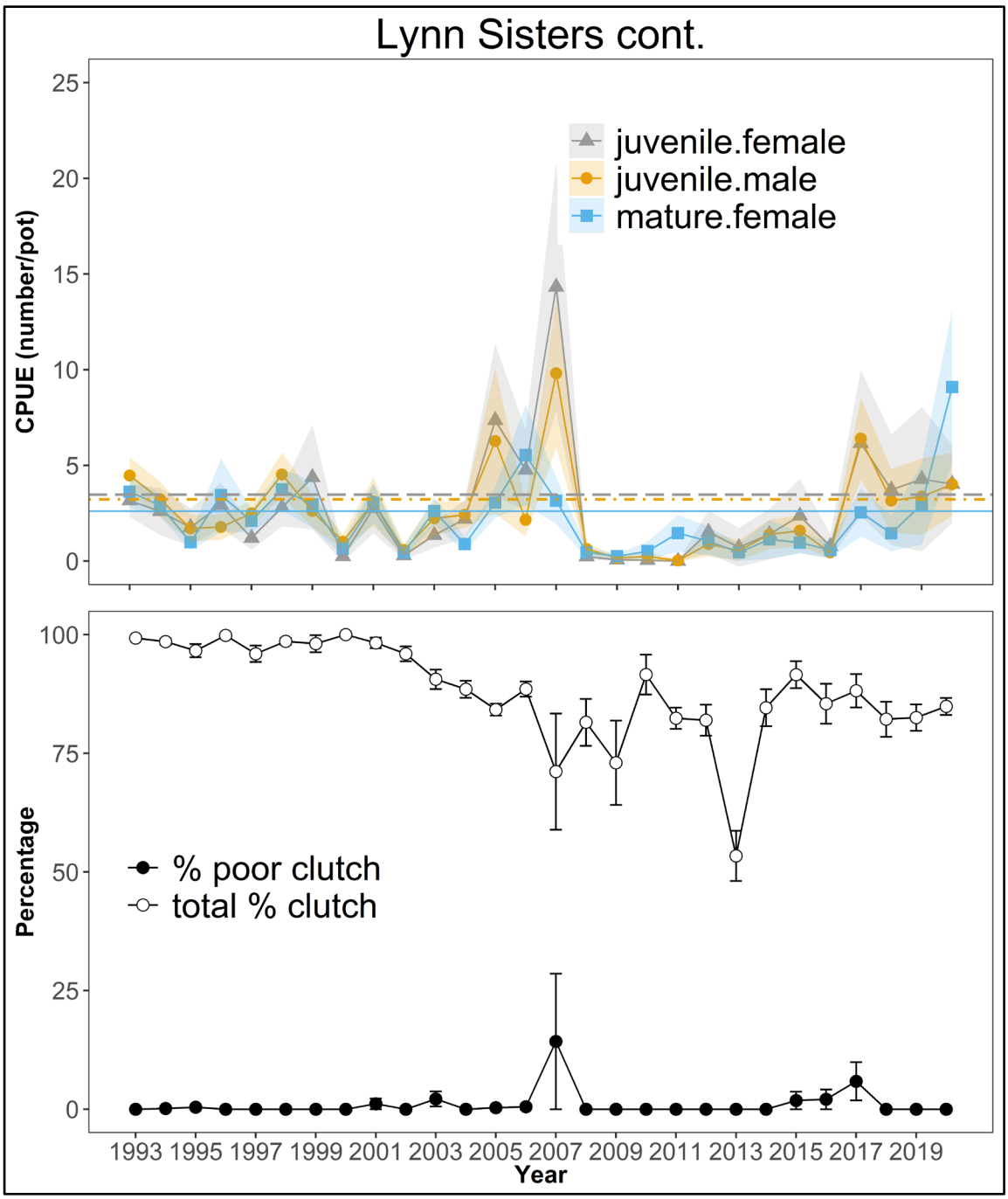

Figure 15.–Lynn Sisters CPUEs for female and juvenile male size/sex classes of red king crab, clutch fullness and proportion of poor clutches. Reference lines represent long-term baselines for each parameter (1993–2007). There is a significant short-term increasing trend in mature female CPUE.

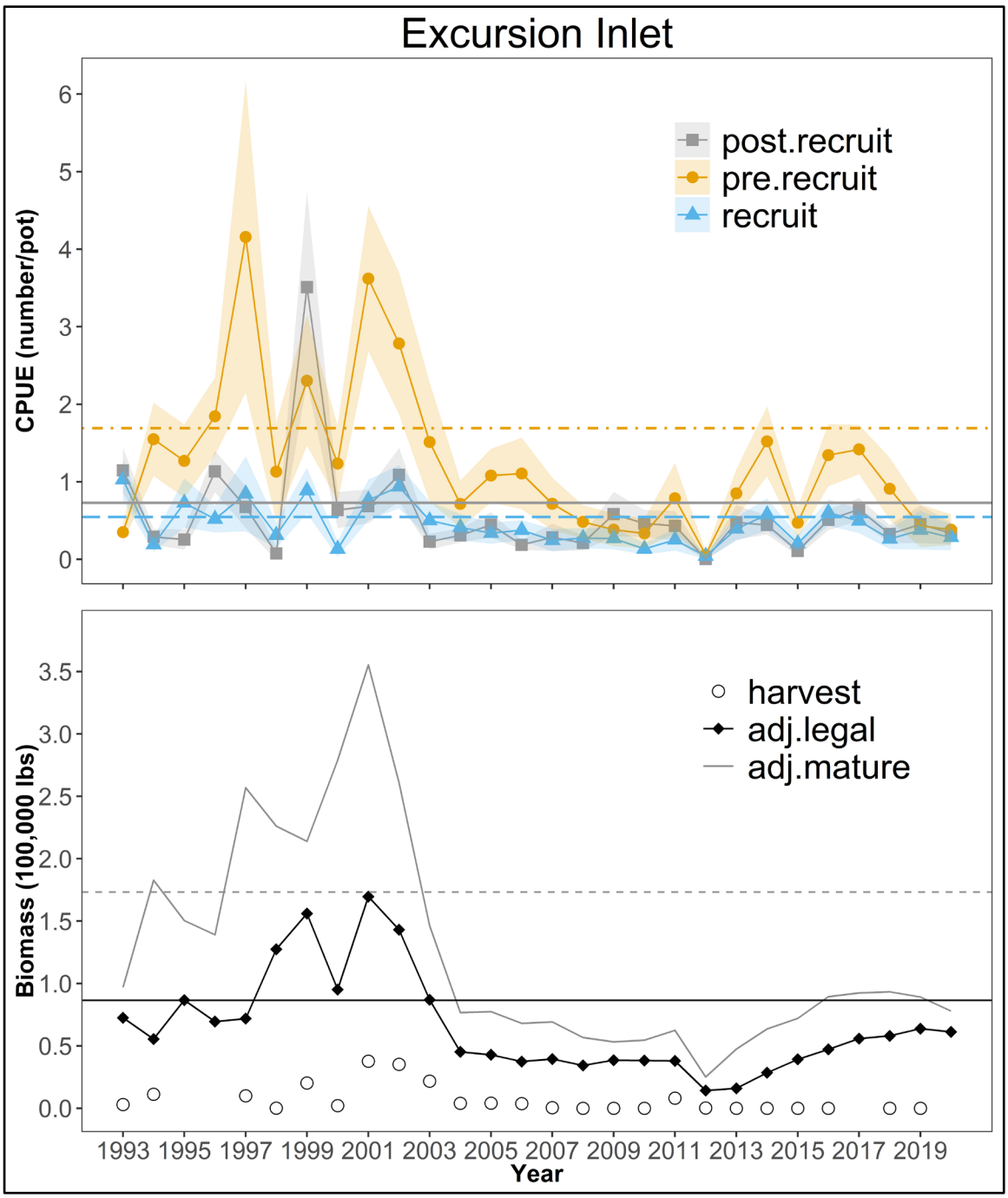

Figure 16.–Excursion Inlet CPUEs for male size/sex classes of red king crab, biomass estimates from the current year's CSA model and harvest data. Reference lines represent long-term baselines for each parameter (1993–2007). Gray dotted reference line in the biomass figure represents the long-term baseline for mature biomass, while the solid black refers to the legal biomass. There is a significant short-term decreasing trend in prerecruit male CPUE.

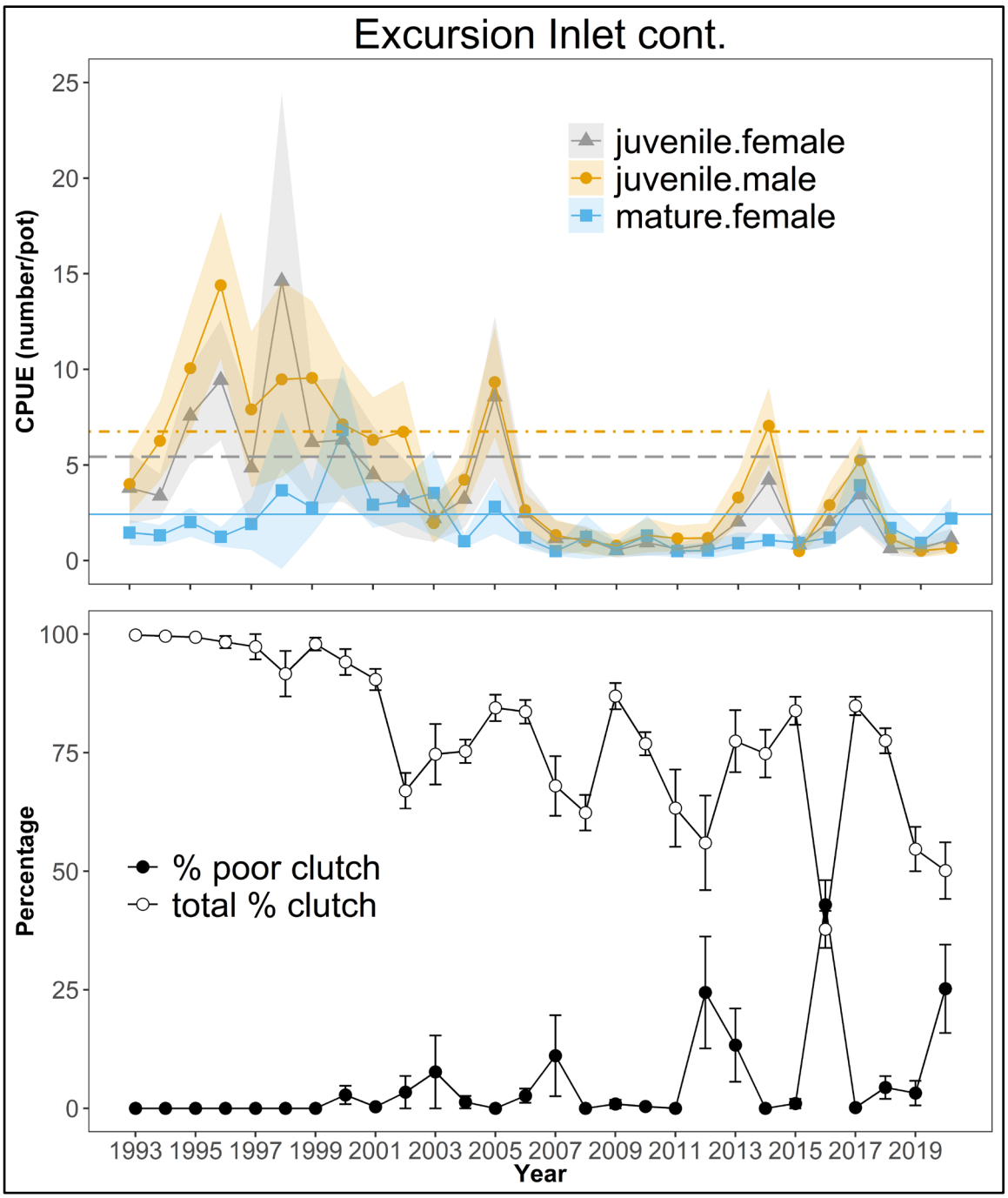

Figure 17.–Excursion Inlet CPUEs for female and juvenile male size/sex classes of red king crab, clutch fullness and proportion of poor clutches. Reference lines represent long-term baselines for each parameter (1993–2007). There is a significant short-term decreasing trend in juvenile male CPUE this year, along with a significant short-term increase in the percentage of females with poor clutches (<25% full).