2021 Southeast Alaska Tanner Crab Stock Health Assessment and Management Plan for the 2022 Season

by Katie Palof Andrew Olson and Joe Stratman

April 2022

Alaska Department of Fish and Game



Division of Commercial Fisheries

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Weights and measures (metric)		General	Measures (fisheries)						
centimeter	cm	Alaska Administrative		fork length	FL				
deciliter	dL	Code	AAC	mideye-to-fork	MEF				
gram	g	all commonly accepted		mideye-to-tail-fork	METF				
hectare	ha	abbreviations	e.g., Mr., Mrs.,	standard length	SL				
kilogram	kg		AM, PM, etc.	total length	TL				
kilometer	km	all commonly accepted		-					
liter	L	professional titles	e.g., Dr., Ph.D.,	Mathematics, statistics					
meter	m		R.N., etc.	all standard mathematical					
milliliter	mL	at	a	signs, symbols and					
millimeter	mm	compass directions:		abbreviations					
		east	Е	alternate hypothesis	H _A				
Weights and measures (English)		north	Ν	base of natural logarithm	e				
cubic feet per second	ft ³ /s	south	S	catch per unit effort	CPUE				
foot	ft	west	W	coefficient of variation	CV				
gallon	gal	copyright	©	common test statistics	(F. t. γ^2 , etc.)				
inch	in	corporate suffixes:		confidence interval	CI				
mile	mi	Company	Co.	correlation coefficient	01				
nautical mile	nmi	Corporation	Com	(multiple)	R				
	07	Incorporated	Inc.	correlation coefficient	R				
pound	1b	Limited	Ltd.	(simple)	r				
quart	at	District of Columbia	DC	(simple)	COV				
vard	yd vd	et alii (and others)	et al	degree (angular)	0				
yaid	yu	et cetera (and so forth)	etc	degrees of freedom	4f				
Time and temperature		evempli gratia	ete.	avported value					
day	4	(for example)	ea	expected value					
day	u °C	Federal Information	c.g.		<				
degrees Celsius	-C 0E	Codo	FIC	greater than or equal to					
degrees Fairement	Г V	id est (that is)	in	harvest per unit enort	HPUE				
degrees keivin		latitudo or longitudo	let or long		~				
hour	n	monotory symbols	lat. of long.	less than or equal to	<u>≤</u>				
minute	mın	monetary symbols	¢	logarithm (natural)	ln				
second	S	(0.8.)	5, ¢	logarithm (base 10)	log				
		months (tables and		logarithm (specify base)	\log_{2} , etc.				
Physics and chemistry		figures): first three	I D	minute (angular)					
all atomic symbols		letters	Jan,,Dec	not significant	NS				
alternating current	AC	registered trademark	®	null hypothesis	Ho				
ampere	А	trademark	IM	percent	%				
calorie	cal	United States		probability	Р				
direct current	DC	(adjective)	U.S.	probability of a type I error					
hertz	Hz	United States of		(rejection of the null					
horsepower	hp	America (noun)	USA	hypothesis when true)	α				
hydrogen ion activity	pН	U.S.C.	United States	probability of a type II error					
(negative log of)			Code	(acceptance of the null					
parts per million	ppm	U.S. state	use two-letter	hypothesis when false)	β				
parts per thousand	ppt,		abbreviations	second (angular)	"				
	‰		(e.g., AK, WA)	standard deviation	SD				
volts	V			standard error	SE				
watts	W			variance					
				population	Var				
				sample	var				

REGIONAL INFORMATION REPORT NO. 1J22-11

2021 SOUTHEAST ALASKA TANNER CRAB STOCK HEALTH ASSESSMENT AND MANAGEMENT PLAN FOR THE 2022 SEASON

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ABSTRACT

This report provides an assessment of the 2021 Southeast Alaska Tanner crab stock health and an overview of harvest strategy and regulations for the 2022 (*Chionoecetes bairdi*) commercial fisheries season. The 2021 stock assessment survey estimate of mature male biomass for the 2022 fishery is 5.81 million lb, exceeding the upper regulatory threshold of 5.5 million lb. The 2021 commercial fishery opened on February 11 with 5,120 pots registered that allowed for 7 days of fishing in core areas, 12 days in non-core areas, and 26 days in exploratory areas for the season.

Key words: Tanner crab, Chionoecetes bairdi, stock assessment, catch per unit effort, CPUE, Southeast, biomass

OVERVIEW

The Alaska Department of Fish and Game (department) annually evaluates stock status for the Southeast Tanner crab commercial fishery using data from fishery independent stock assessment surveys (pot gear), commercial fishery catch per unit effort (CPUE), biological data (length, weight, and shell condition) from surveys and fishery. The survey is conducted annually in the summer and fall across 11 areas: Seymour Canal, Excursion Inlet, Pybus Bay, Gambier Bay, Peril Strait, Lynn Sisters, Icy Strait, Glacier Bay, Thomas Bay, Holkham Bay, and Juneau, which is subdivided into North Juneau and Stephens Passage (Rebert et al. 2019 and Stratman et al. 2019). The Southeast management area (Registration Area A) consists of all waters defined in 5 AAC 31.100 (Figure 1).

The Tanner crab harvest strategy [5 AAC 35.113] allows for a 5-day minimum season that avoids sensitive life history stages of reproduction (Stone 1999 and Webb 2008) and utilizes biological thresholds based on levels of mature male biomass from the survey to determine additional days for the fishing season that are allocated among core, non-core, and exploratory areas in conjunction with the quantity of pots registered for the fishery.

The projected estimate of mature male biomass for the 2022 season is 5.81 million lb, which exceeds the upper threshold of 5.5 million lb of mature male biomass in regulation [5 AAC 35.113(a)]. The commercial fishery opened on February 11, 2022, with 5,120 pots that provided for 7 days of fishing in core areas, 12 days in non-core areas, and 26 days in exploratory areas for the season.

2021 SOUTHEAST TANNER CRAB STOCK ASSESSMENT

SUMMARY OF STOCK STATUS

The estimated 2021/2022 Southeast Alaska mature male Tanner crab biomass is 5.81 million lb, an increase of approximately 0.85 million lb from the 2020/2021 estimate of 4.95 million lb. 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 of legal male Tanner crab is estimated to provide a basis for evaluating fishery performance and removals from the stock. Applying the recommended exploitation rate based on stock health status (15.3%) and maximum (20%) exploitation rate to mature male biomass gives a range of GHLs between 0.88 and 1.14 million pounds (Table 1). Harvesting at higher levels, when stock health is poor or moderate, increases the probability of population declines. Since 2010, the stock status of Southeast Alaska Tanner crab has generally improved or remained stable (Figure 2).

SURVEY AND ANALYSIS METHODOLOGY

Current methods to estimate mature male biomass and assess stock health are similar to those used since 2013 (Rebert et al. 2019); changes to the sampling areas, sampling methods, and catch per unit effort (CPUE) calculations are described below. Background and details of historical methods are found in Bishop et al. (2013). A three-stage catch-survey analysis (CSA) model is used to estimate biomass and the department survey data are used to assess stock health (Seber 2002; Zheng and Kruse 1999).

2015 Methodology 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 overall regional Tanner crab biomass, the survey area biomass is extrapolated to the non-surveyed areas using an expansion factor. This factor changed in 2015 by removing the average contribution of commercial catch from the two removed areas for the years used in expansion factor estimation (1980–2000). From 1980 to 2000, an average of 1% of the commercial harvest came from Port Frederick and 4% came from Port Camden. Therefore, the previous expansion factor of 71% changed to 66%, whereby 66% of the regional biomass is estimated to be in survey areas, reflected in this report's graphs and figures.

Additionally, in 2015 the Stephens Passage area was removed from the October Tanner crab survey. Previously, data from the dual summer red king/Tanner crab survey and the October Tanner crab survey were combined to assess stock health and biomass in this area. Retrospective analysis of these data showed that the summer red king crab survey alone adequately allowed for a reliable biomass estimate in Stephens Passage. 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 adjusted by a correction factor calculated using 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 with the difference used to adjust ONLY the red king crab survey data were 7% higher than those from both data sets. Since 2015, each year's biomass estimate is adjusted down 7% to compare to previous years using data from both surveys.

2013 Methodology Changes

To provide more statistically robust estimates of CPUE for use in the CSA model, prior to the 2013 Tanner crab survey, survey areas were stratified based on crab density and depth, modeled from red king crab survey stratification techniques (Clark 2008). This replaced simple random sampling for determining pot placement. To standardize the full time series, we recalculated past CPUE and biomass estimates to accommodate the changes in sampling methods.

The CSA requires that all harvest is accounted for in the model because some statistical areas adjacent to survey areas were not included when they should have been. A CSA model is generated for each of the survey areas, wherein accurate harvest data in each area is vital to reliable biomass estimates. Harvest numbers of crab are used in the model to scale the survey CPUE. To better match harvest with survey areas, the statistical areas were reevaluated. Historical harvests from

fish tickets were recalculated using improved statistical area divisions, which changed the magnitude of the biomass estimates in some survey areas.

Lastly, we altered the graphical representation of modeled legal biomass in the area figures. Previously, forecasted biomass for each year was shown, however this misrepresented the actual trend in historical legal biomass. Instead, estimated annual biomass is based on the current year's full data set model. This approach gives a more accurate representation of the trends in biomass over time, which more closely follows the historical harvest.

Future Adjustments

Tanner crab biomass estimates in areas sampled during the summer survey would benefit from crab density restratification. Initial steps would be to create new restratification maps specific to Tanner crab catch for summer survey areas, repeating methods used in 2013. After this, pots could be put into these strata for the entire survey time series to compare CPUE and resulting biomass estimates.

SURVEY AREA STOCK STATUS

STOCK STATUS BY SURVEY AREA

Stock health status is determined by a combination of long- and short-term trends in CPUE (Rebert et al. 2019). 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 of available survey data); 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; +0.25, 0, -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".

ICY STRAIT—ABOVE AVERAGE, 15%

The Icy Strait survey area score increased from poor to above average since 2020 (Table 2). This change is due to an increase in mature male CPUEs from the previous year (Figures 4 and 5). None of the mature male CPUEs are significantly different from their long-term baselines, however, postrecruit male CPUE has a significant increasing short-term trend. The percent of females with poor clutch fullness is significantly lower than the 10% baseline level. Harvest in Icy Strait has been close to the estimated legal biomass (relationship between circles and solid legal biomass line in Figure 4), suggesting that the population is not isolated to the survey area and that there is likely movement of crab in and out of this area. With consistent annual harvest and recent positive trends in sex/size classes contributing to an above average stock health score (Figure 4, Table 2), including a short-term positive trend in postrecruit CPUE, it is likely that stock assessments are underestimating Tanner crab abundance in the Icy Strait area, which is apparent in the high harvest rates in this area that are likely not sustainable without population fluctuations. Harvest from this area provided an average of 12.0% of the regional commercial harvest over the baseline years and 13.1% of the harvest for the 2020/2021 fishery (Figure 4). Since biomass estimates from surveyed areas are used to calculate abundance in non-surveyed areas, it will be important to explore ways to improve the survey biomass estimates in the Icy Strait area.

GLACIER BAY-MODERATE, 10%

The Glacier Bay survey area score increased from below average to moderate since 2020 (Table 2). Increased stock health score is primarily due to an increase in prerecruit male CPUE and a decrease of females with poor clutches. Recruit male and postrecruit male CPUEs are not significantly different from their long-term baselines, while mature female CPUE significantly lower than the long-term baseline value (Figures 6 and 7). Both prerecruit and recruit male CPUEs have significant decreasing short-term trends. The percent of females with poor clutch fullness is significantly lower than the 10% baseline level. The legal population is slightly below baseline levels, and 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 regional commercial harvest over the baseline years and 11.1% of the harvest for the 2020/2021 fishery (Figure 6).

THOMAS BAY—HEALTHY, 20%

The Thomas Bay survey area score remained healthy since 2020 survey (Table 2). Prerecruit and recruit male CPUEs are significantly above their long-term baseline, while postrecruit male CPUE and mature female CPUE are not significantly different from their long-term averages (Figure 8 and 9). Prerecruit, recruit and mature female CPUEs have significantly lower than the 10% baseline level. Both prerecruit male (second highest observation) and recruit male (highest observation) CPUE are at high points historically, and legal biomass projections for 2021 are the highest since the survey began. Thomas Bay commercial harvest provided an average of 4.8% of the regional commercial harvest over the baseline years and 3.5% of the harvest for the 2020/2021 fishery (Figure 8).

HOLKHAM BAY—ABOVE AVERAGE, 15%

The Holkham Bay survey area score remained above average since 2020 (Table 2). All recruit class CPUEs are at or above their long-term baselines, with none significantly different from the baseline values (Figures 10 and 11). There is a significant short-term decreasing trend in recruit male CPUE, primarily due to a recent reduction from historically high levels. The percentage of females with poor clutch fullness is significantly lower than the 10% baseline level. Biomass estimates are generally increasing and well above their long-term averages. Harvest from this area provided an average of 7.1% of the regional commercial harvest over the baseline years and 5.1% of the harvest for the 2020/2021 fishery (Figure 10).

PORT CAMDEN—NOT SURVEYED SINCE 2015

The Port Camden survey area was removed from the survey in 2015 due to budgetary constraints as well as its low contribution to the overall Tanner crab commercial harvest. Port Camden is now included in the non-surveyed area; the average annual contribution of the catch from Port Camden from 1980 to 2000 was removed from the survey expansion percentage. The harvest from this area provided an average of 3.8% of the regional commercial harvest over the baseline years and the harvest is confidential for the 2020/2021 fishery.

STEPHENS PASSAGE—HEALTHY, 20%

The Stephens Passage survey area score remained healthy since 2020 (Table 2). All recruit class CPUEs are significantly above their long-term baselines (Figures 12 and 13). All mature male CPUEs have significant short-term increasing trends. The percentage of females with poor clutch

fullness was significantly less than the 10% baseline level. The legal biomass estimate is above the baseline value, with both legal and mature biomass exceeding the high levels of the late 1990s. The harvest from this area provided an average of 9.5% of the regional commercial harvest over the baseline years and 14.1% of the harvest for the 2020/2021 fishery (Figure 12). Starting in 2015, only survey data from the summer crab survey has been used to assess the Stephens Passage area.

SEYMOUR CANAL—MODERATE, 10%

The Seymour Canal survey area score increased from below average to moderate since 2020 (Table 3). This score increase was driven by a rebounding of recruit male CPUE, and the elimination of the short-term decreasing trends in prerecruit and recruit CPUE. All size/sex categories are at or above their long-term baselines, with prerecruit male CPUE increasing to significantly above its long-term baseline value (Figures 14 and 15). The percentage of females with poor clutch fullness is at the 10% baseline level. The legal biomass estimate increased from the decrease last year to be similar to the estimate two years ago and remains above the baseline value. The harvest from this area provided an average of 6.3% of the regional commercial harvest over the baseline years and 5.0% of the harvest for the 2020/2021 fishery (Figure 14).

NORTH JUNEAU—HEALTHY, 20%

The North Juneau survey area score increased from above average to healthy since 2020 (Table 3). The increase is driven by all size/sex CPUEs significantly above their baseline values, with both prerecruit and recruit male CPUE having significant short-term increasing trends (Figures 16 and 17). The percentage of females with poor clutch fullness is less than the 10% baseline level, but not significantly so. The legal biomass estimate is increasing but still below the baseline value despite record high prerecruit CPUE, primarily due to high biomass levels for the baseline years. The harvest from this area provided an average of 7.1% of the regional commercial harvest over the baseline years and 4.6% of the harvest for the 2020/2021 fishery (Figure 16).

EXCURSION INLET—MODERATE, 10%

The Excursion Inlet survey area score remained at moderate since 2020 (Table 3). No recruit class CPUEs are significantly different from their baseline values, and there are no significant short-term trends in CPUEs. The recruit CPUE increased substantially from the 2020 survey, which is reflected in the increasing biomass trend (Figures 18 and 19). The percentage of females with poor clutches is at the 10% baseline level. The legal biomass estimate is above the baseline value and has an increasing trend. The harvest from this area provided an average of 6.3% of the regional commercial harvest over the baseline years and 1.6% of the harvest for the 2020/2021 fishery (Figure 18).

PYBUS BAY—BELOW AVERAGE, 5%

The Pybus Bay survey area score decreased from above average to below average since 2020 (Table 3). This is a result of decreases in all recruit class CPUEs, with all mature male CPUEs significantly below their baseline values, a substantial decrease from 2020 values. There are no significant short-term trends (Figures 20 and 21). The percentage of females with poor clutches was not significantly different from the 10% baseline level. The legal biomass estimate is slightly below the baseline value. The 2020 mature male CPUE data points do not fit well in this time series, and while future surveys will validate the trajectory of this stock, biomass estimates for the current year are highly uncertain. The harvest from this area provided an average of 1.2% of the

regional commercial harvest over the baseline years and the harvest is confidential for the 2020/2021 fishery (Figure 20).

GAMBIER BAY—POOR, 0%

The Gambier Bay survey area score remained at poor since 2020 (Table 3). All recruit classes are significantly below their baseline values. There is a significant short-term decreasing trend in mature female CPUE but a significantly short-term increasing trend in recruit male CPUE (Figures 22 and 23). The percentage of females with poor clutches is not significantly different from the 10% baseline level. The legal biomass estimate is below the baseline value and has an increasing trend over the last two years, suggesting some potential future improvement for this stock. The harvest from this area provided an average of 1.9% of the regional commercial harvest over the baseline years and the harvest is confidential for the 2020/2021 fishery (Figure 22).

PERIL STRAIT—HEALTHY, 20%

The Peril Strait survey area score increased from moderate to healthy since 2020 (Table 3). This increased score is driven by an increase in female health, with mature female CPUE increasing to be significantly above the baseline value and the percentage of females with poor clutches falling significantly below the 10% baseline level. Prerecruit and recruit CPUEs are significantly above their long-term baseline value, while postrecruit CPUE is at its long-term average (Figures 24 and 25). There is a significant short-term increasing trend in recruit male CPUE. The percentage of females with poor clutches is significantly below 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 regional commercial harvest over the baseline years and 1.2% of the harvest for the 2020/2021 fishery (Figure 24).

LYNN SISTERS—ABOVE AVERAGE, 15%

The Lynn Sisters survey area score remained at above average since 2020 (Table 3). Both prerecruit and recruit CPUEs are significantly above their long-term baseline values, while postrecruit male and mature female CPUEs are not significantly different from their long-term baselines (Figures 26 and 27). There is a significant short-term decreasing trend in mature female CPUE. The percentage of females with poor clutch fullness is significantly lower than the 10% baseline level. The legal biomass estimate is above the baseline value at historically high levels for the area and has remained high for the last few years. The harvest from this area provided an average of 0.7% of the regional commercial harvest over the baseline years and 1.6% of the harvest for the 2020/2021 fishery (Figure 26).

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 area. The average annual contribution of catch in Port Frederick from 1980 to 2000 was removed from the survey expansion percentage. The harvest from this area provided an average of 0.5% of the regional commercial harvest for the baseline years and 0.65% of the harvest for the 2020/2021 fishery.

FISHERY MANAGEMENT PLAN

Since the 2009/2010 fishing season, the Southeast Tanner crab fishery has been managed using a minimum mature male biomass threshold with a variable season length, determined by a regulatory

harvest strategy reliant on fishing effort and mature male biomass. Even though the fishery is managed without 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 to evaluate fishery performance. Based on Tanner crab biology and harvest strategies adopted in other areas of Alaska, regionwide exploitation rate (ER) should not exceed 20% of mature male or 38% of legal male biomass.

CSA modeling of the 2021 fishery and survey data yields a biomass estimate of 5.81 million lb of mature (greater than 108 mm carapace width) and 3.63 million lb of legal (greater than 140 mm carapace width) male Tanner crab (Table 1). This is an increase of 0.57 million lb of legal male Tanner crab (18.6%) from the 2020 estimate (Figure 2), predominantly due to legal biomass increases in Stephens Passage, Thomas Bay, Seymour Canal, North Juneau, Excursion Inlet, and Gambier Bay, despite decreases in Icy Strait, Glacier Bay, Holkham Bay, Pybus Bay, Peril Strait and Lynn Sisters. Harvesting at the maximum rate (20% of mature biomass) equates to a GHL of approximately 1.14 million pounds (Table 1). Harvest above this level will increase the probability of population declines. A more stable effect on the population is estimated by incorporating stock health information, which suggests a weighted average regional exploitation rate of 15.3% of the mature male biomass (Table 1).

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TABLES AND FIGURES

Table 1.–Results of the 2021 CSA modeling estimation of legal and mature Tanner crab biomass and GHL calculations using proposed maximum 20% regionwide mature exploitation rates and exploitation rates based upon the current stock health status for each of the 12 survey areas. The expansion factor of 66% (34% for non-surveyed areas) for the total legal and mature male crab biomass is based on the percent of commercial harvest taken from 1980 to 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.

				Healthy stock status			Current stock status			1997-2006**	
		Biomass of	Biomass of	Mature harvest	Legal harvest		Mature harvest	Legal harvest		Average	Est. mature
	Survey area	legal crab	mature crab	rate	rate	GHLª	rate	rate	GHL ^a	catch	biomass
	Icy Strait	124,737	231,052	20%	37%	46,210	15%	28%	34,658	160,673	375,023
	Glacier Bay	207,710	500,559	20%	48%	78,930*	10%	24%	50,056	118,541	659,423
	Stephens Passage	705,192	952,645	20%	27%	190,529	20%	27%	190,529	128,405	370,280
	Thomas Bay	205,683	327,339	20%	32%	65,468	20%	32%	65,468	54,997	182,570
	Holkham Bay	235,972	345,277	20%	29%	69,055	15%	22%	51,792	103,853	204,314
Summer											
Crab	Seymour Canal	287,294	472,933	20%	33%	94,587	10%	16%	47,293	89,027	256,921
Survey	North Juneau	201,552	288,184	20%	29%	57,637	20%	29%	57,637	91,575	271,604
	Excursion Inlet	219,643	340,699	20%	31%	68,140	10%	16%	34,070	80,896	279,146
	Pybus Bay	35,208	42,737	20%	24%	8,547	5%	6%	2,137	15,011	55,938
	Gambier Bay	37,934	58,644	20%	31%	11,729	0%	0%	0	27,005	89,805
	Peril Strait	94,076	203,676	20%	43%	35,749*	20%	43%	35,749*	10,989	94,317
	Lynn Sisters	40,626	68,392	20%	34%	13,678	15%	25%	10,259	11,220	38,146
	Other Areas	1,234,110	1,974,132			394,826			301,175	459,614	1,482,342
	Total	3,629,736	5,806,270	20%	32%	1,135,085	15.3%	24%	880,821	1,351,806	4,359,829

^a GHL is 20% of the mature male biomass unless this scenario creates a legal harvest rate that is greater than 38%; in that case

the GHL is adjusted to 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 from the 2021 Tanner crab survey. The long-term average is defined as the first 10 years of available data from 1997 to 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		% of		% of		% of		% of	
	baseline	Score	baseline	Score	baseline	Score	baseline	Score	baseline	Score
Large/mature females Percent clutch fullness < 25%										
-vs. long-term average -short term trend	-70	1 0	-100	1 0	-93	1 0	-40	1 0.25	-66	1 0
- CPUE vs. long-term average - CPUE vs. short-term trend	26	0 0	-69	-1 0	111	1 0	56	0 0.25	328	0 0
Prerecruit males - CPUE vs. long-term average - CPUE short-term trend	-6	0 0	-11	0 -0.25	181	1 0.25	91	1 0.25	78	0 0
Recruit males - CPUE vs. long-term average - CPUE short-term trend	-30	0 0	27	0 -0.25	200	1 0.25	204	1 0.25	94	0 -0.25
Postrecruit males - CPUE vs. long-term average - CPUE short-term trend	-4	0 0.25	-36	0 0	239	1 0.25	-10	0 0	29	0 0
2020 Total score	-3.5	0	-2.5	50	5.5	0	4.5	0	1.5	50
2020 Stock status 2020 Mature harvest rate	Poc 0%	or b	Below A 5%	verage	Healt 20%	thy ⁄₀	Healthy 20%		Above A	verage %
2021 Total score	1.2	5	-0.5	50	5.7	5	4.00		1.7	5
2021 Stock status 2021 Mature harvest rate	Above A 15%	verage %	Mode 109	erate %	Healt 20%	thy ∕₀	Heal 20 ^o	thy %	Above A	verage %

Table 3.–Matrix of Tanner crab stock status from the 2021 red king crab survey. The long-term average is defined from 1997 to 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 Ju	uneau	Excursio	n Inlet	Pybus Bay		
	% of		% of		% of		% of		
	Baseline	Score	Baseline	Score	Baseline	Score	Baseline	Score	
Large/Mature female									
percent clutch fullness < 25%									
- vs. long-term average	-29	0	-37	0	-67	0	-33	0	
- short term trend		0		0		0		0	
- CPUE vs. long-term average	119	0	113	1	59	0	86	0	
- CPUE vs. short-term trend		0		0		0		0	
Prerecruit males									
- CPUE vs. long-term average	148	1	123	1	31	0	-47	-1	
- CPUE short-term trend		0		0.25		0		0	
Recruit males									
- CPUE vs. long-term average	92	0	96	1	61	0	-49	-1	
- CPUE short-term trend		0		0.25		0		0	
Postrecruit males									
- CPUE vs. long-term average	103	0	67	1	20	0	-77	-1	
- CPUE short-term trend		0		0		0		0	
2020 Total score	-2.00		1.5	0	-0.50		1.50		
2020 Stock status	Below A	verage	Above A	verage	Mode	rate	Above A	verage	
2020 Mature harvest rate	5%)	15%	6	10%	6	15%	6	
2021 Total score	1.00	0	4.5	0	0.00		-3.0	0	
2021 Stock status	Moderate		Healt	Healthy		Moderate		Below Average	
2021 Mature harvest rate	10%	6	20%	6	10%		5%		

Table 3.–Continued

	Gambier	r Bay	Peril St	trait	Lynn Sisters	
	% of		% of		% of	
	Baseline	Score	Baseline	Score	Baseline	Score
Large/Mature female						
percent clutch fullness < 25%						
- vs. long-term average	-44	0	-87	1	-84	1
- short term trend		0		0		0
- CPUE vs. long-term average	-75	-1	162	1	5	0
- CPUE vs. short-term trend		-0.25		0		-0.25
Prerecruit males						
- CPUE vs. long-term average	-53	-1	79	1	279	1
- CPUE short-term trend		0		0		0.25
Recruit males						
- CPUE vs. long-term average	-50	-1	129	1	104	1
- CPUE short-term trend		0.25		0.25		0
Postrecruit males						
- CPUE vs. long-term average	-51	-1	-17	0	46	0
- CPUE short-term trend		0		0		0
2020 Total score	-4.75		1.00		2.00	
2020 Stock status	Poor		Moderate		Above A	verage
2020 Mature harvest rate	0%	1	10%		15%	0
2021 Total score	-4.0	0	4.25		3.00	
2021 Stock status	Poor		Healthy		Above Average	
2021 Mature harvest rate	0%		20%		15%	



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



Figure 2.–Trends in Southeast Alaska Tanner crab mature and legal biomass estimated from the current year's catch-survey (CSA) modeling using the pot survey data for Southeast Alaska. Prior to 2001 the biomass of areas initially not surveyed (Thomas Bay, Glacier Bay), but added in subsequent years, is estimated as their average percent contribution to the total surveyed biomass in all subsequent years (first year surveyed to current year's survey). Bar graphs represent commercial harvest from fish tickets. Threshold lines indicate the lower (dashed orange) and upper (dashed green) thresholds of mature male biomass for the Tanner crab harvest strategy.



Figure 3.–Southeast Alaska commercial Tanner crab harvest and standardized commercial catch per unit effort (CPUE) for 1991/1992 through 2020/2021 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 using a similar number of pot lifts each year, based on the year (2008/2009) with the fewest number of pot lifts (12,521).



Figure 4.–Icy Strait Tanner crab survey area biomass estimates of legal and mature Tanner crab based on a catch-survey analysis model. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997–2006) for prerecruit male (orange), recruit (blue), and postrecruit (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 postrecruit catch per unit effort (CPUE) (p < 0.05).



Figure 5.–Female information for Icy Strait Tanner crab survey area. Reference lines represent long-term benchmark (1997–2006) values. There are no significant short-term trends for female measures.



Figure 6.–Glacier Bay Tanner crab survey area biomass estimates of legal and mature Tanner crab based on a catch-survey analysis model. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997–2006) prerecruit male (orange), recruit (blue), and postrecruit (grey) crabs. Reference line for biomass (dashed line) represents the long-term average (1997–2006) for legal biomass (lb). There are significant short-term decreasing trends for prerecruit and recruit male catch per unit effort (CPUE) (p < 0.05).



Figure 7.–Female information for Glacier Bay Tanner crab survey area. Reference lines represent long-term benchmark (1997–2006) values. There are no significant short-term trends for females measures.

Figure 8.–Thomas Bay Tanner crab survey area biomass estimates of legal and mature Tanner crab based on a catch-survey analysis model. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997–2006) for prerecruit male (orange), recruit (blue), and postrecruit (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 prerecruit male catch per unit efforts CPUEs (p < 0.05).

Figure 9.–Female information for Thomas Bay Tanner crab survey area. Reference lines represent long-term benchmark (1997–2006) values. There are significant short-term increasing trends mature female catch per unit effort (CPUE) and the proportion of poor clutches (p < 0.05).

Figure 10.–Holkham Bay Tanner crab survey area biomass estimates of legal and mature Tanner crab based on a catch-survey analysis model. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997–2006) for prerecruit male (orange), recruit (blue), and postrecruit (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 catch per unit effort (CPUE) (p < 0.05).

Figure 11.–Female information for Holkham Bay Tanner crab survey area. Reference lines represent long-term benchmark (1997–2006) values. There are no significant short-term trends in female measures.

Figure 12.–Stephens Passage red king crab survey area biomass estimates of legal and mature Tanner crab based on a catch-survey analysis model. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997–2006) for prerecruit male (orange), recruit (blue), and postrecruit (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 prerecruit, recruit and postrecruit male catch per unit effort (CPUE) (p < 0.05).

Figure 13.–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 catch per unit effort (CPUE) or the proportion of poor clutches.

Figure 14.–Seymour Canal red king crab survey area biomass estimates of legal and mature Tanner crab based on a catch-survey analysis model. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997–2006) for prerecruit male (orange), recruit (blue), and postrecruit (grey) crabs. Reference line for biomass (dashed line) represents the long-term average for legal biomass (lb). There are no significant short-term trends in male catch per unit efforts (CPUEs).

Figure 15.–Female information for Tanner crab in the Seymour Canal red king crab survey area. Reference lines represent long-term benchmark (1997–2006) values. There are no significant short-term trends in mature female catch per unit effort (CPUE) or in the proportion of poor clutches.

Figure 16.–North Juneau red king crab survey area biomass estimates of legal and mature Tanner crab based on a catch-survey analysis model. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997–2006) for prerecruit male (orange), recruit (blue), and postrecruit (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 prerecruit male catch per unit efforts (CPUEs) (p < 0.05).

Figure 17.–Female information for Tanner crab in the North Juneau red king crab survey area. Reference lines represent long-term benchmark (1997–2006) values. There are no significant short-term trends in mature female catch per unit effort (CPUE) or in the proportion of poor clutches.

Figure 18.–Excursion Inlet red king crab survey area biomass estimates of legal and mature Tanner crab based on a catch-survey analysis model. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997–2006) for prerecruit male (orange), recruit (blue), and postrecruit (grey) crabs. Reference line for biomass (dashed line) represents the long-term average for legal biomass (lb). There are no significant short-term trends for male catch per unit efforts (CPUEs).

Figure 19.–Female information for Tanner crab in the Excursion Inlet red king crab survey area. Reference lines represent long-term benchmark (1997–2006) values. There are no significant short-term trends in mature female catch per unit effort (CPUE) or in the proportion of poor clutches.

Figure 20.–Pybus Bay red king crab survey area biomass estimates of legal and mature Tanner crab based on a catch-survey analysis model. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997–2006) for prerecruit male (orange), recruit (blue), and postrecruit (grey) crabs. Reference line for biomass (dashed line) represents the long-term average for legal biomass (lb). There are no significant short-term trends for male catch per unit effort (CPUEs).

Figure 21.–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 trends for either mature female catch per unit effort (CPUE) or the proportion of poor clutches.

Figure 22.–Gambier Bay red king crab survey area biomass estimates of legal and mature Tanner crab based on a catch-survey analysis model. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997–2006) for prerecruit male (orange), recruit (blue), and postrecruit (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 for recruit male catch per unit effort (CPUE) (p < 0.05).

Figure 23.–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 catch per unit effort (CPUE, p < 0.05).

Figure 24.–Peril Strait red king crab survey area biomass estimates of legal and mature Tanner crab based on a catch-survey analysis model. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997–2006) for prerecruit male (orange), recruit (blue), and postrecruit (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 for recruit male catch per unit effort (CPUE, p < 0.05).

Figure 25.–Female information for Tanner crab in the Peril Strait red king crab survey area. Reference lines represent long-term benchmark (1997–2006) values. There are no significant short-term trends in mature female CPUE or in the proportion of poor clutches.

Figure 26.–Lynn Sisters red king crab survey area biomass estimates of legal and mature Tanner crab based on a catch-survey analysis model. Commercial harvest is the total pounds harvested in associated and adjacent statistical areas. Reference lines represent long-term benchmark (1997–2006) for prerecruit male (orange), recruit (blue), and postrecruit (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 for prerecruit male catch per unit effort (CPUE, p < 0.05).

Figure 27.–Female information for Tanner crab in the Lynn Sisters 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 catch per unit effort (CPUE, p < 0.05).