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Historical Abundances of Tanner Crab *Chionoecetes bairdi* for Kodiak, Chignik, South Peninsula, and Eastern Aleutian Districts from Standardized Large-Mesh Trawl Surveys, 1988–2021

by

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and

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May 2022

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

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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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May 2022

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ABSTRACT

The Alaska Department of Fish and Game (ADF&G) is updating long-term average abundance indices of mature male Tanner crab *Chionoecetes bairdi* used to determine regulatory fishery thresholds in the Kodiak, Chignik, South Peninsula, and Eastern Aleutian Districts. Since 1988, trawl survey area-swept abundance estimates have been determined annually, using the same vessel and net configuration. Initial thresholds were established in 1999, when only 11 years of consistent trawl survey estimates were available. To provide for a longer time series, 4 different methods were used to reconstruct historical male abundances from 1973–1998. The trawl survey has been conducted annually since then, adding an additional 23 years of estimates to the survey time series. Trawl survey stations have been added, removed, modified, and in some years a station may not have been sampled due to unforeseen circumstances, leading to total abundance estimates based on different background information. To develop a single source of comparable abundance estimates, stations and station areas used for area-swept estimates have been standardized from 1988–2021. For each district or section standard stations were assigned to a high or low CPUE (number of crab caught per kilometer towed) stratum. Estimated abundance of each stratum was calculated by applying the mean CPUE of sampled stations, weighted by station size, to the overall area of the stratum. Strata abundances were summed by district or section. This allows the entire area of the survey to be considered, even when a station was not sampled. There are currently 34 years of consistent, standardized trawl survey data that contribute to understanding the productivity of these stocks. Annual area-swept abundance estimates of mature male and female Tanner crab abundance show substantial fluctuations of over 10 million crab within a 3-year period. Long-term (1988–2021) average abundance indices of mature males were determined and compared to previous long-term average abundance indices in use through 2022. Of the 12 management units considered, the mature male long-term average increased in 4 management units and decreased in 8. Long-term average abundance indices of mature females were also determined using the standardized 1988–2021 data. However, no comparisons to previous averages were made because the population reconstruction done in 1999 did not consider females.

Keywords: Tanner crab, thresholds, commercial fishery, long-term average, mature males, mature females, Kodiak, Chignik, South Peninsula, Eastern Aleutian

INTRODUCTION

The Kodiak District for Tanner crab *Chionoecetes bairdi* is subdivided into eight sections: Northeast, Eastside, Southeast, Southwest, Semidi Island Overlap, Westside, North Mainland, and South Mainland. The South Peninsula District is divided into two sections, Eastern and Western, by long 162° W. The Chignik District is managed as a single unit, and the Eastern Aleutian District is subdivided into four sections: Akutan, Unalaska/Kalekta Bay, Makushin/Skan Bay, and General (5 AAC 35.505(a–c) and (f); Figure 1).

BACKGROUND

ADF&G used pot surveys to assess crab abundance from 1973 to 1986, but those surveys targeted red king crab; Tanner crab were assessed as a secondary species. The large-mesh bottom trawl survey was developed in the 1980s with the intent of assessing the Tanner crab population. Starting in 1988 methods and survey locations were established and developed enough to estimate Tanner crab abundance consistently. The survey has been conducted annually using the R/V *Resolution* and provides area-swept abundance estimates considered when determining fishery openings (Spalinger and Knutson 2021).

Tanner crab fisheries have been prosecuted in the Kodiak, Chignik, and South Peninsula Districts since the 1970s and the State of Alaska has maintained full management authority since 1987 (Bevaart and Phillips 2021). In the early 1980s, Tanner crab abundance and commercial harvests began a decline that continued through the 1990s. No formal guidelines existed for determining when areas should remain closed or when they could reopen to fishing. In response, ADF&G developed harvest strategies with conservative management measures aimed at preventing

overharvest and localized depletion. In 1999 the Alaska Board of Fisheries (BOF) adopted 5 AAC 35.507 *Kodiak, Chignik, and South Peninsula Districts C. bairdi Tanner crab harvest strategies*, and in 2008 they adopted 5 AAC 35.509 *Eastern and Western Aleutian District Tanner crab harvest strategy*, which currently guide the fisheries.

The harvest strategies specify biological thresholds that require mature male[1] abundance within the district, or sections within a district, to meet or exceed 50% of the long-term average abundance of mature male crab. If mature male abundance and minimum GHL thresholds are met, a commercial fishery may occur in that management unit (Urban et al. 1999).

The initial long-term mature male abundance indices used to establish biological thresholds for Kodiak, Chignik, and South Peninsula Districts were determined retrospectively for each district, or section within a district, for the years 1973–1998 using a combination of four different methods; Leslie depletion, catch survey analysis, catch expansion, and area-swept (Urban and Vining 1999). Multiple methods were used because there were three different sources of Tanner crab information available (commercial harvest statistics, pot surveys, and trawl surveys), none of which covered the entire period of interest on its own, and each district and section had its own history of harvest and surveys.

During the time when the harvest strategies were developed, the trawl survey area-swept method was being used to estimate abundance. However, in 1999 there were only 11 years of trawl survey area-swept abundance estimates available to reconstruct the long-term abundance. It was recognized that for those 11 years any overlap between the results of the trawl survey and the other methods used would provide insight into the accuracy of the various estimates for years without trawl survey estimates. Upon comparison, it was determined that the best way to create a long-term time series was to average, by year, the estimates from the different techniques (Urban and Vining 1999). It was also intended that the thresholds and other aspects of the harvest strategy should evolve with the accumulation of new data, reassessment of old data, changes in fishery practices, and new insights into the population biology of Tanner crab and the management of fisheries (Urban et al. 1999). Sections for the South Peninsula District were established in 2005, and at that time trawl survey area-swept abundance estimates through 2004 were incorporated into the long-term abundance indices used to determine biological thresholds (Urban and Vining 2005). The harvest strategy for the Eastern Aleutian District was approved by BOF in 2008, and biological thresholds were based solely on trawl survey data from 1990–2007.

Throughout the course of the survey, stations have been added, eliminated, split, combined, or otherwise modified. Additionally, due to inclement weather, scheduling issues, equipment failure, or obstacles in the tow path, some stations were not sampled in a particular year. These station changes were not previously accounted for when comparing annual estimates and determining thresholds. However, the changes often resulted in increased estimates during years when stations were added, and decreased estimates when stations were removed or missed that did not necessarily correspond to a true abundance change. On an annual basis, any changes to stations towed directly affects the abundance estimate used to determine if an area is above threshold and could result in artificially increasing or decreasing the estimate.

Standardizing the stations used across the updated time series and restructuring the abundance calculations to account for all standard station areas, regardless of if a station was towed, provides

[1] Male Tanner crab > 114 mm carapace width (Donaldson et al. 1981, Knutson 2022)

a consistent and comparable abundance index that more accurately reflects abundance trends and is directly comparable across the entire survey time series. With up to 34 years of annual trawl survey data available from 1988 to 2021, the long-term average abundance indices for all management areas can be updated using consistent methodology.

PURPOSE

The purpose of this report is to present the methods used to standardize the large-mesh trawl survey time series and update abundance indices of mature male and mature female Tanner crab in the Chignik District and each section of the Kodiak, South Peninsula, and Eastern Aleutian Districts (Figure 1). The steps taken to standardize the trawl survey time series are described and updated average abundance indices for mature males and mature females provided.

METHODS

STANDARDIZATION OF TRAWL SURVEY TIME SERIES

Since 1988, changes to trawl survey stations and areas surveyed have occurred, including adding or eliminating stations, dividing or combining stations, and modifying the size of stations. The unique history of each station was examined, and each was classified as 1) standard, 2) predecessor, or 3) eliminated. Standard stations are those that are currently being sampled annually during the trawl survey. Predecessor stations are those that were surveyed at one point, but have since been split, combined, or reshaped and the resulting station(s) from that modification are currently being sampled annually. Eliminated stations are those that were surveyed at one point, but for a variety of reasons, including budget and time constraints, consistently low crab catches, or limited trawling area, it was decided that they would no longer be sampled (Appendix A).

Standard stations and related predecessor stations were scrutinized to ensure that the areas considered for area-swept estimates were consistent with changes made (i.e., if a predecessor station was split then the area of the predecessor station must equal the area of the resulting standard stations, and if multiple predecessor stations were combined then the area of the resulting standard stations must equal the sum of the areas of the predecessor stations).

MISSING VALUES

With the unpredictability of weather and fluctuations of funding over the 34 years that the survey has been conducted it is inevitable that in some years a standard station or its predecessor station(s) were not towed. This was mostly because of poor haul performance or time constraints but was also the case for stations that had not yet been created (Appendix B). In instances when a haul was mistakenly made in an adjacent station instead of the intended station, the haul was reassigned to the station it was physically located in. Rather than inferring a CPUE and abundance of zero for stations that were not sampled, the method for determining abundance presented here accounts for missed stations by applying the mean CPUE of sampled stations in a stratum, weighted by station size, to the total area of the stratum (i.e., including unsampled stations). Total abundance for a district or section is the sum of the strata abundances.

Post-stratification of Standard Stations

Standard stations within each section of the Kodiak and South Peninsula Districts, and within Chignik District were post-stratified into high and low CPUE groups based on their respective CPUE timeseries, guided by a *k*-means approach. Principal components analysis (PCA) was used to reduce dimensions of the 32-year timeseries of station CPUE and the three most informative principal components were retained for *k*-mean clustering (k = 2). Final station stratification deviated from initial k-means assignments in all sections except the Eastern Section of the South Peninsula District, as it was determined that to ensure adequate sampling representation, a minimum of 7 stations should be included in each stratum. When initial *k*-means assignments did not provide the minimum number of stations in the high catch strata, the stations assigned were removed from the analysis and it was performed again until a minimum of 7 stations were selected. Two iterations were required in all other sections except for the North Mainland Section of the Kodiak District, which required three iterations before the minimum number of stations per strata was achieved. Approximately 1/3 of stations were assigned to the high CPUE stratum and 2/3 were assigned to the low CPUE stratum.

Predecessor stations were examined retrospectively. If all stations resulting from the predecessor were assigned to the same stratum, the predecessor station was assigned to that stratum as well. If standard stations created from the same predecessor station were assigned to different strata, hauls conducted while the predecessor station was in use were reassigned to the standard station they were geographically located in and the predecessor station was reclassified as inactive.

Stations in the Eastern Aleutian District were not stratified because there are not enough stations in each section to achieve the minimum of 7 stations per strata.

Abundance Indices

Tanner crab abundance ($\widehat{N}_\tau$) is estimated as

$$\widehat{N}_\tau = \overline{U} \sum_{i=1}^{n} A_i$$

where $\overline{U}$ is the unbiased estimator of section/strata catch per unit effort (CPUE, or density) weighted by station area estimated as

$$\overline{U} = \frac{\sum_{i=1}^{h} U_i A_i}{\sum_{i=1}^{h} A_i}$$

where U is CPUE expressed as crab per square nautical mile and A is area (nmi^2) for station i of n.

Here, $\overline{U}$ is estimated using only stations that were towed within the given survey year, so that $h \leq n$, but is then scaled to abundance using the summed area of all stations within the strata.

Total district or section abundance is the sum of results from the strata within that area.

RESULTS

Review of the survey stations resulted in a total of 372 standard stations. Of those, 276 have been in place since 1988, 47 are derived from one or more predecessor stations that were in place since 1988, and 49 were created sometime during the period of 1989–2012. A total of 138 stations that

had been towed at least once were eliminated from the standard station list (Appendix A). The standard stations account for a total area of 13,146.1 km^2 (Appendix C).

After comparing the standard station list with stations sampled from 1988–2021, 376 standard stations were not sampled due to missed tows or poor performance and 309 standard stations were not sampled because the station had not been created yet (Appendix B).

Long-term average abundance indices for each management unit were calculated for mature males and mature females (Table 1, Figures 2–25, Appendix D). The section with the highest abundance of both mature males and mature females from 1988–2021 was the Eastside Section of the Kodiak District. The section with the lowest abundance was the Unalaska/Kalekta Section of the Eastern Aleutian District. Annual abundance fluctuated greatly, with abundance in several areas varying by more than 10 million crab over a period of 3 years.

DISCUSSION

Compared to the previous long-term averages, the 1988–2021 long-term average abundance of mature males increased by more than 50% in 3 management units (Eastside Kodiak, Unalaska/Kalekta, and Makushin/Skan) and decreased by more than 30% in 6 management units (Northeast Kodiak, Southwest Kodiak, Westside Kodiak, North Mainland Kodiak, Eastern South Peninsula, and Akutan). Southeast Kodiak, Chignik, and Western South Peninsula are within 15% of the previous long-term averages (Table 1). The 2 management sections with the greatest percentages of decline, Westside Kodiak and North Mainland Kodiak, are the only 2 sections that have not met fishery management thresholds for the past 20 years, indicating that either the previously determined abundance estimates were too high or that those populations, for unknown reasons, have not been able to recover from the stock decline seen in the mid-1980s (Bevaart and Phillips 2021, Urban and Vining 1999).

The standardized abundance estimates show a resource fluctuating naturally in response to occasional large recruitment events that occur with similar timing across the region, suggesting that recruitment strength may be strongly influenced by regionwide environmental factors (Zheng and Kruse 2000, 2006). As a result of those large recruitment pulses, mature male abundance peaked multiple times in all areas, with the largest magnitude peaks seen after 2000. A particularly large event was seen in 2009–2010 in Eastside Kodiak, Southeast Kodiak, Eastern South Peninsula, Western South Peninsula, and Chignik. That pulse was evident, but smaller, in Northeast Kodiak, Southwest Kodiak, and Westside Kodiak, but not recognized in North Mainland Kodiak or the Eastern Aleutian District. Another large event was seen again in 2021 in Eastside Kodiak, Southeast Kodiak, Southwest Kodiak, and Western South Peninsula. The 2021 pulse was evident to a lesser degree in Eastern South Peninsula and Chignik, but not recognized in Northeast Kodiak, Westside Kodiak, North Mainland Kodiak, or the Eastern Aleutian District. Generally, mature female crab abundance peaked 1–2 years prior to mature male abundance.

General abundance trends, and long-term averages should be recalculated every 5–6 years as annual data is collected so that comparisons necessary for management decisions are made using the most updated information. The 5–6-year time frame should capture changes in population trajectory while still accounting for quasi-periodic recruitment pulses (Spalinger et al. 2021). Additionally, if new environmental variables become available, a review of station stratification methods and results may be appropriate.

FUTURE STATION CHANGES

In future, modifying, adding, or removing stations from the standard survey may be desirable. Any changes need to be carefully considered.

1) If area considered for a station is changed, it is critical to ensure that area considered for any predecessor station(s) is modified accordingly. While CPUE will not be affected, abundance estimates, which use area-swept calculations, should be re-calculated and long-term averages reevaluated.
2) If a station is removed with no plans to tow again in future, removal of the area considered for the standard station must be equivalent to the area removed from any predecessor station(s) to ensure total station area remains consistent for abundance index estimation.
3) When adding a station, a time series of at least 10 years should be developed before incorporating into the index. This will provide enough time and data to determine which strata the station should be assigned to and allow recalculation of abundance estimates in prior years.
4) If entire station groups are added in unsurveyed areas, a new method may need to be developed to estimate historical CPUE; the method described above was not designed to estimate abundance in large groups of geographically unique stations.

CONCLUDING REMARKS

The long-term average abundance indices for mature Tanner crab presented here incorporate 32 years of standardized trawl survey data. This single source time series provides greater confidence in relative abundance comparisons, compared to the previous use of multiple data sources. The inclusion of a female abundance index when considering commercial fisheries, was not possible using the previous data sources, but could help preserve the reproductive potential of the population and be more responsive to quasi-periodic abundance fluctuations (Spalinger et al. 2021).

The long-term abundance indices should continue to evolve with the accumulation of new data, reassessment of old data, and new insights into the population biology of Tanner crabs. They improve upon the indices implemented in 1999 and should regularly be reevaluated to monitor for changes in abundance trends.

REFERENCES CITED

Bevaart, K., and K. Phillips. 2021. Annual management report for shellfish fisheries in the Kodiak, Chignik, and South Peninsula Districts, 2020. Alaska Department of Fish and Game, Fishery Management Report No. 21-29, Anchorage

Donaldson, W. E., R. T. Cooney, and J. R. Hilsinger. 1981. Growth, age and size at maturity of Tanner crab, *Chionoecetes bairdi* M. J. Rathbun, in the northern Gulf of Alaska (Decapoda, Brachyura). Crustaceana 40(3): 286–302.

Knutson, M. 2022. Evaluation of mature size of Tanner crab *(Chionoecetes bairdi)* from the Kodiak District large-mesh trawl survey, 1996–2019.

Spalinger, K. and M. Knutson. 2021. Large-mesh bottom trawl survey of crab and groundfish: Kodiak, Chignik, South Peninsula, and Eastern Aleutian Management Districts, 2020. Alaska Department of Fish and Game, Fishery Management Report No. 21-05, Anchorage.

Spalinger, K., N. Nichols, and M. Knutson. 2021. Updated Tanner crab harvest strategies for Kodiak, Chignik, and South Peninsula Districts: A report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K21-13, Kodiak.

Urban, D. and I. Vining. 1999. Reconstruction of historic abundances of Kodiak, Chignik, and South Peninsula Tanner crab, report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K99-17, Kodiak.

Urban, D., and I. Vining. 2005. Reconstruction of Historic Abundances of Tanner Crabs in the Proposed Eastern and Western Sections of the South Peninsula District, Report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Fishery Management Report No. 05-03, Anchorage.

Urban, D., D. Pengilly, D. Jackson, and I. Vining. 1999. A Tanner crab harvest strategy for Kodiak, Chignik, and the South Peninsula Districts, report to the Board of Fisheries. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K99-21, Kodiak.

Zheng, J. and G. H. Kruse. 2000. Recruitment patterns of Alaskan crabs and relationships to decadal shifts in climate and physical oceanography. ICES Journal of Marine Science, 57:438–451.

Zheng, J. and G. H. Kruse. 2006. Recruitment variation of eastern Bering Sea crabs: Climate-forcing or top-down effects? Progress in Oceanography, 68:184–204.

TABLES

Table 1.–Updated long-term averages of mature female and mature male Tanner crab abundance and previous long-term averages of mature male Tanner crab abundance.

		Updated Long-term Averages		Previous Long-term Averages
District	Section	Mature female	Mature male	Mature male[a]
Kodiak		1988–2021		1973–1998
	Northeast	2,215,344	1,481,537	2,246,000
	Eastside	5,191,918	5,175,357	3,104,000
	Southeast	1,387,738	1,640,042	1,466,000
	Southwest	766,422	1,117,562	2,472,000
	Westside	950,270	506,699	1,528,000
	North Mainland	630,980	666,828	2,938,000
South Peninsula		1988–2021		1974–2004
	Eastern	2,120,985	1,766,755	4,030,000
	Western	2,716,082	2,483,585	2,500,000
		1989–2021		1974–1998
Chignik		1,351,076	1,931,593	1,946,000
Eastern Aleutian		1990–2021		1990–2007
	Akutan	605,540	257,982	400,000
	Unalaska/Kalekta Bay	468,336	244,065	130,000
	Makushin/Skan Bay	668,815	274,639	90,000

[a] The 1999 harvest strategies did not consider female abundance, and it was not estimated using the methods used to establish the mature male long-term averages.

FIGURES

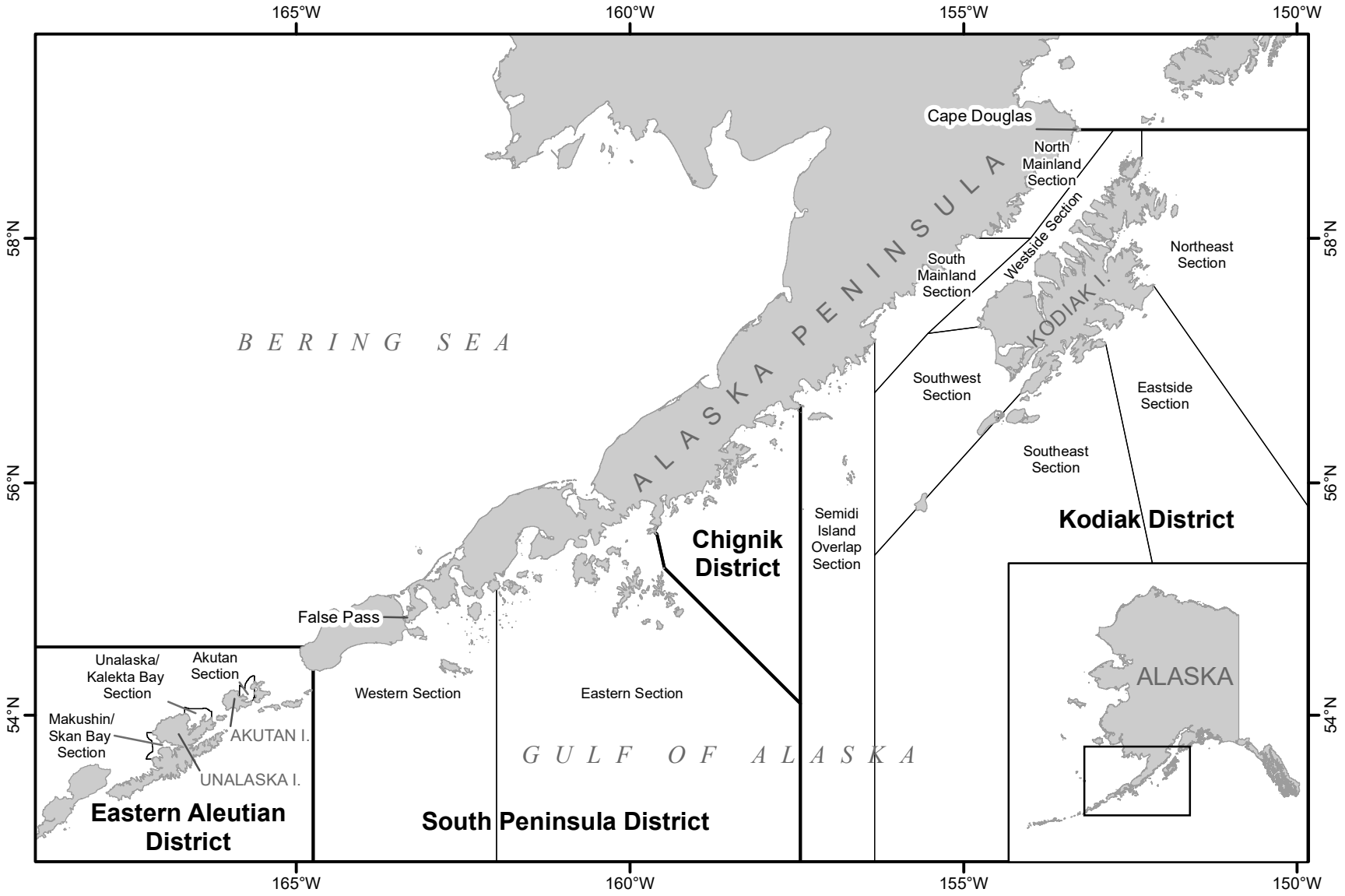

Figure 1.–Kodiak, Chignik, South Peninsula, and Eastern Aleutian Tanner crab management Districts and Sections.

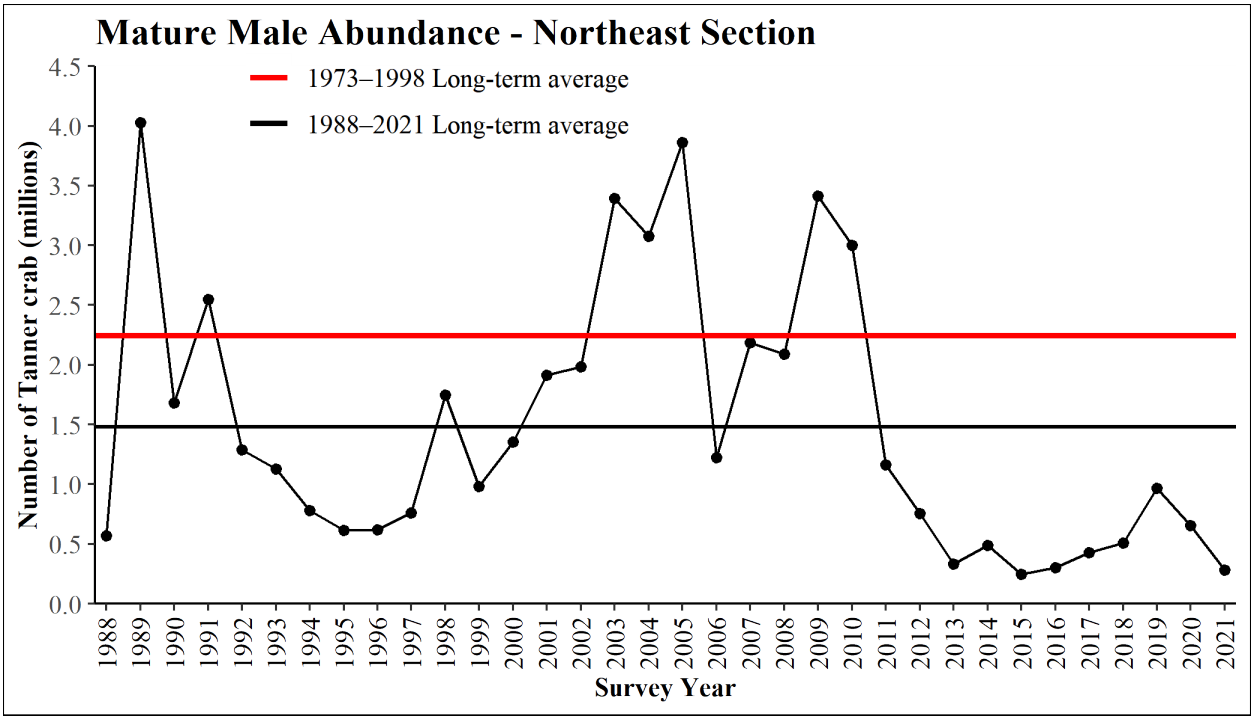

Figure 2.–Mature male Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Northeast Section of the Kodiak District, 1988–2021 along with previous long-term average used in the management strategy implemented in 1999.

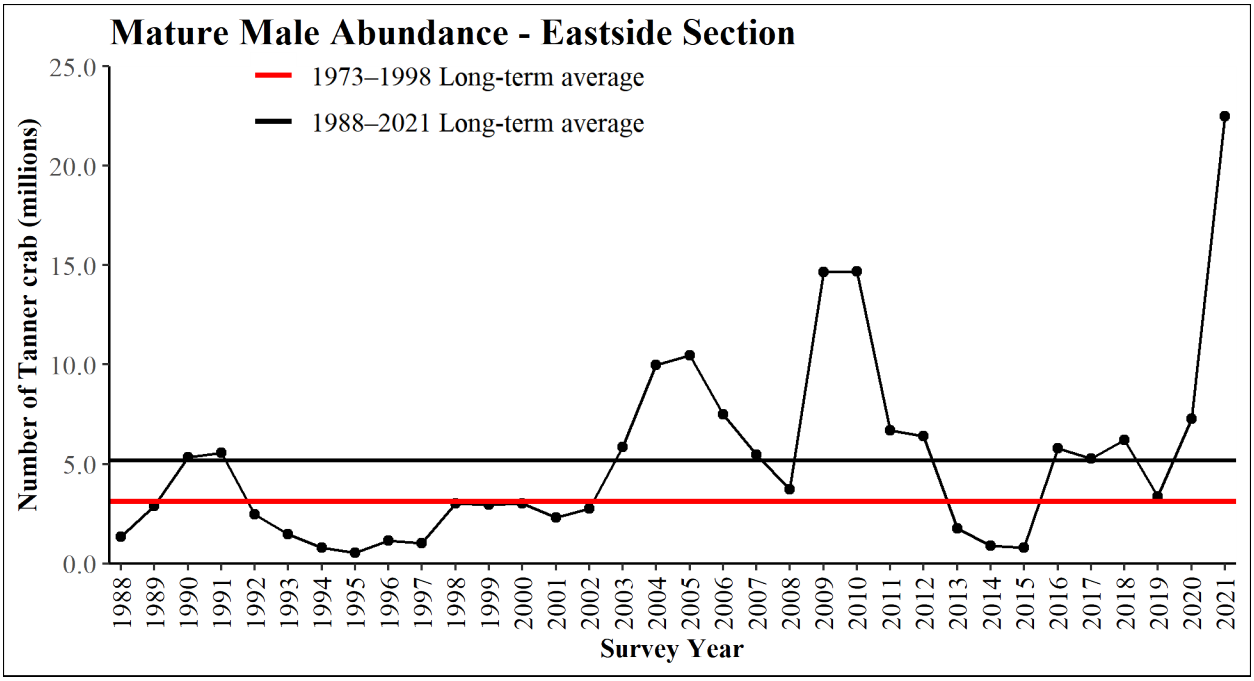

Figure 3.– Mature male Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Eastside Section of the Kodiak District, 1988–2021 along with previous long-term average used in the management strategy implemented in 1999.

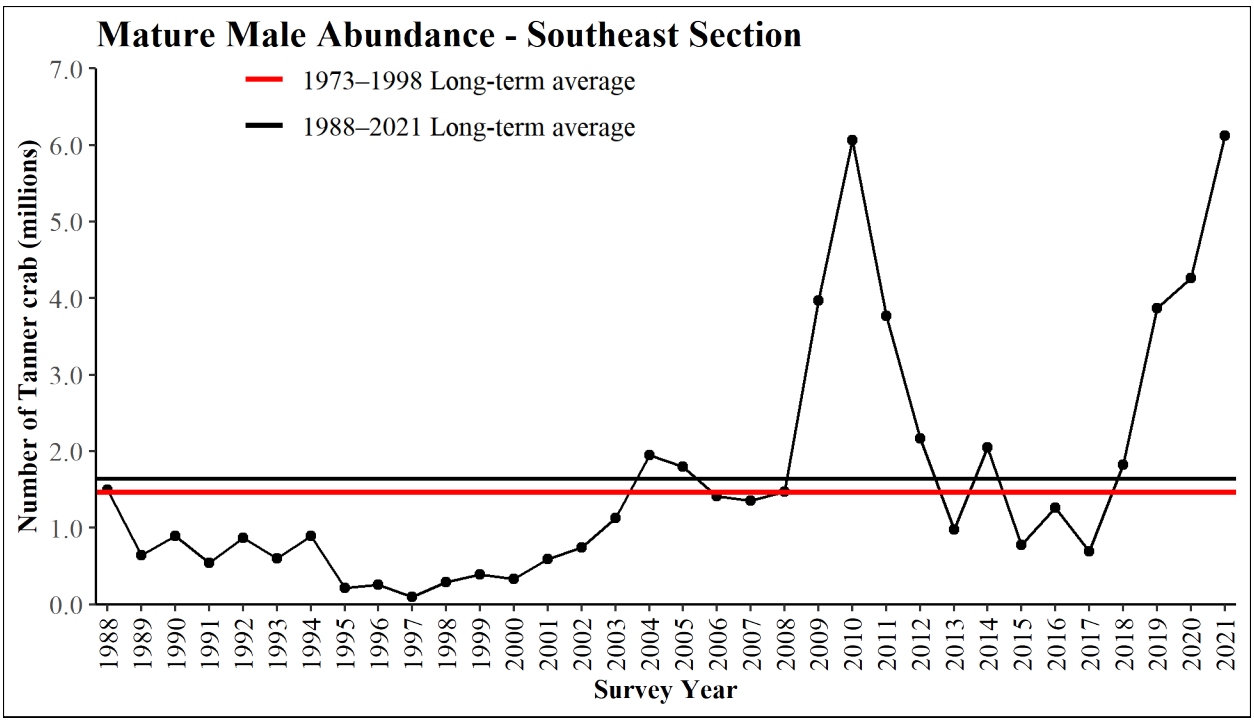

Figure 4.–Mature male Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Southeast Section of the Kodiak District, 1988–2021 along with previous long-term average used in the management strategy implemented in 1999.

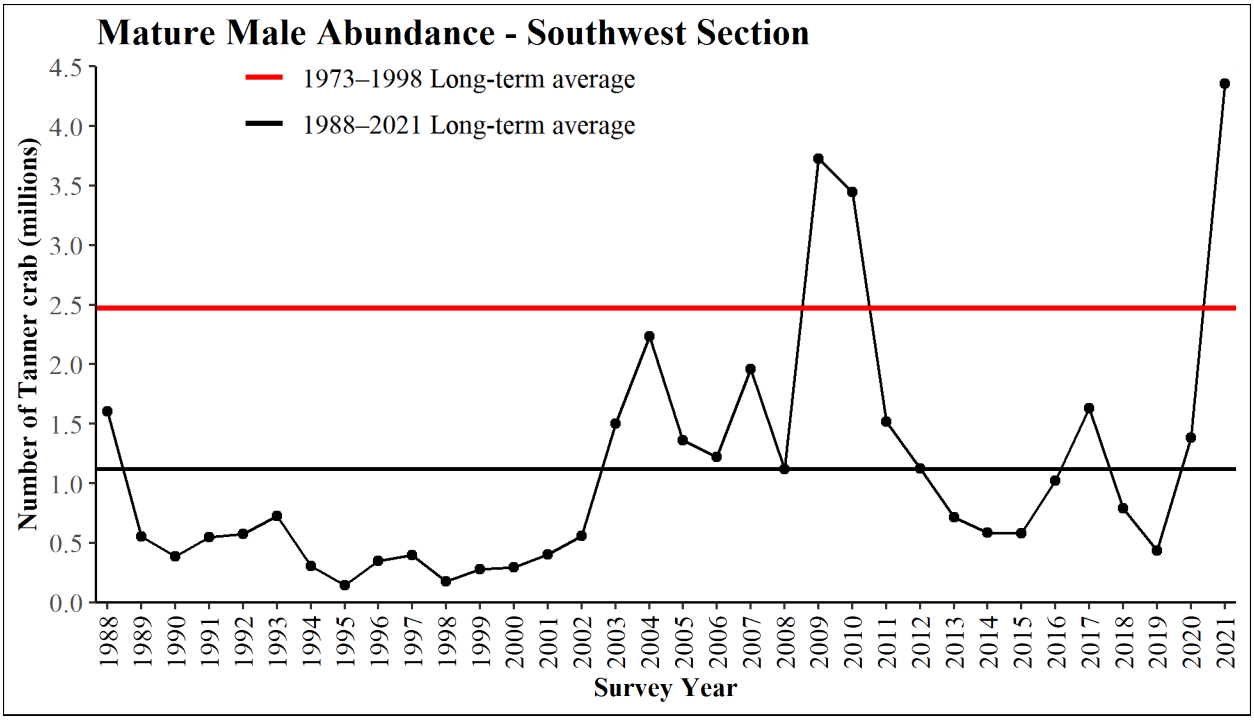

Figure 5.–Mature male Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Southwest Section of the Kodiak District, 1988–2021 along with previous long-term average used in the management strategy implemented in 1999.

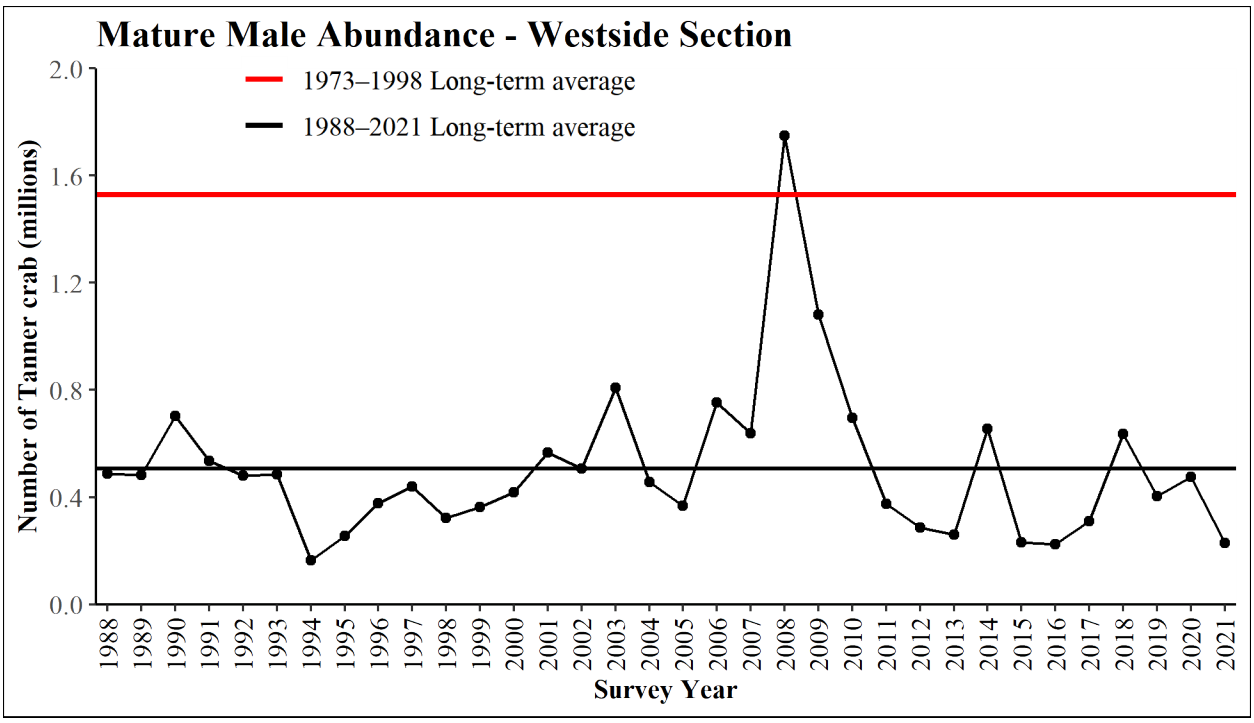

Figure 6.–Mature male Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Westside Section of the Kodiak District, 1988–2021 along with previous long-term average used in the management strategy implemented in 1999.

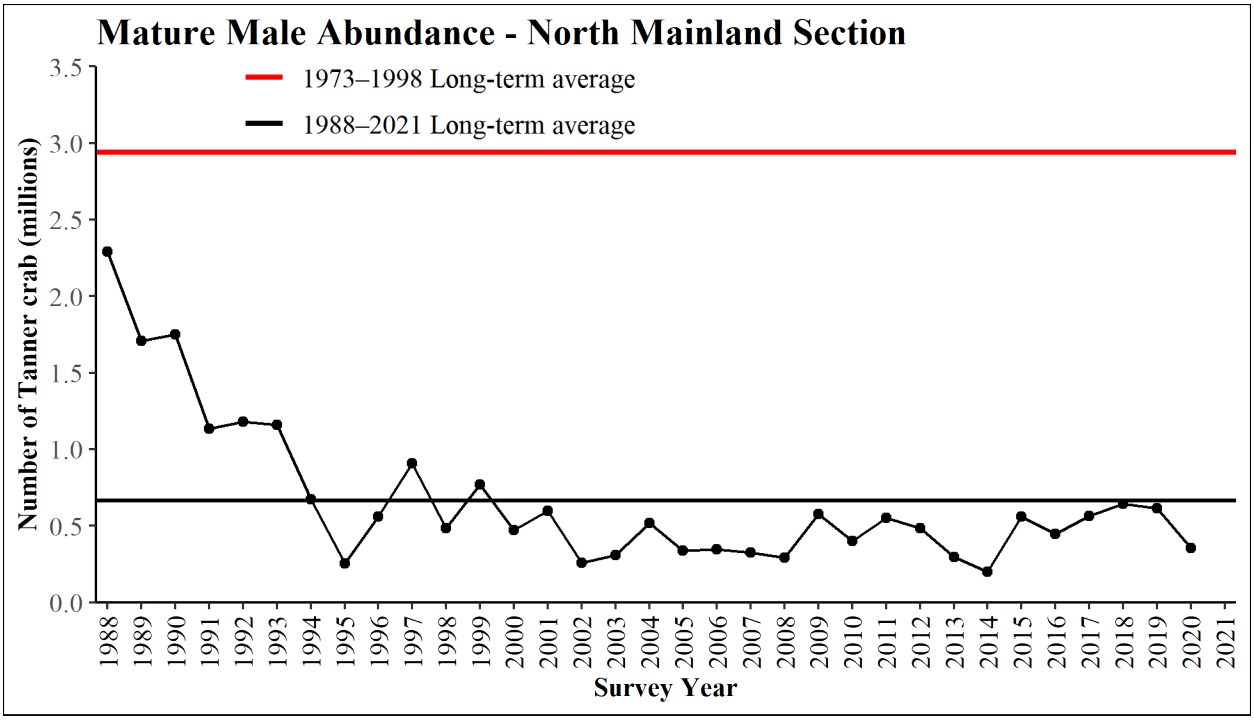

Figure 7.– Mature male Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the North Mainland Section of the Kodiak District, 1988–2021 along with previous long-term average used in the management strategy implemented in 1999.

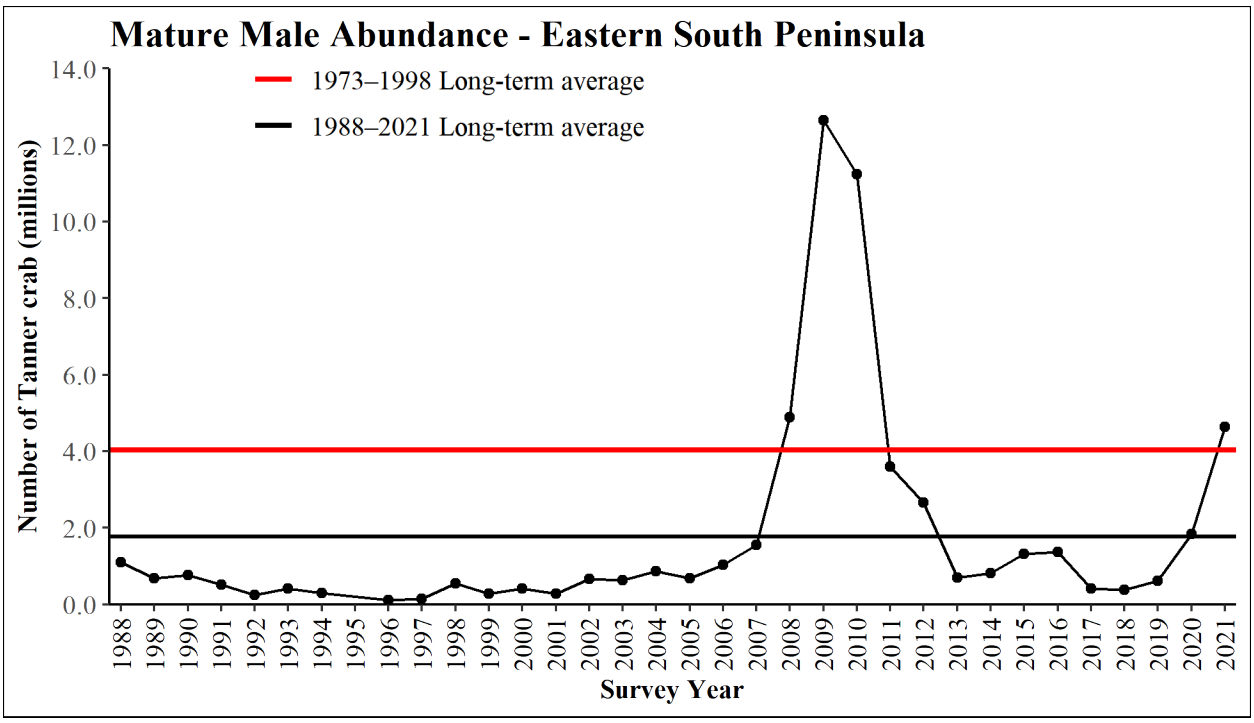

Figure 8.–Mature male Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Eastern Section of the South Peninsula District, 1988–2021 along with previous long-term average used in the management strategy implemented in 2005.

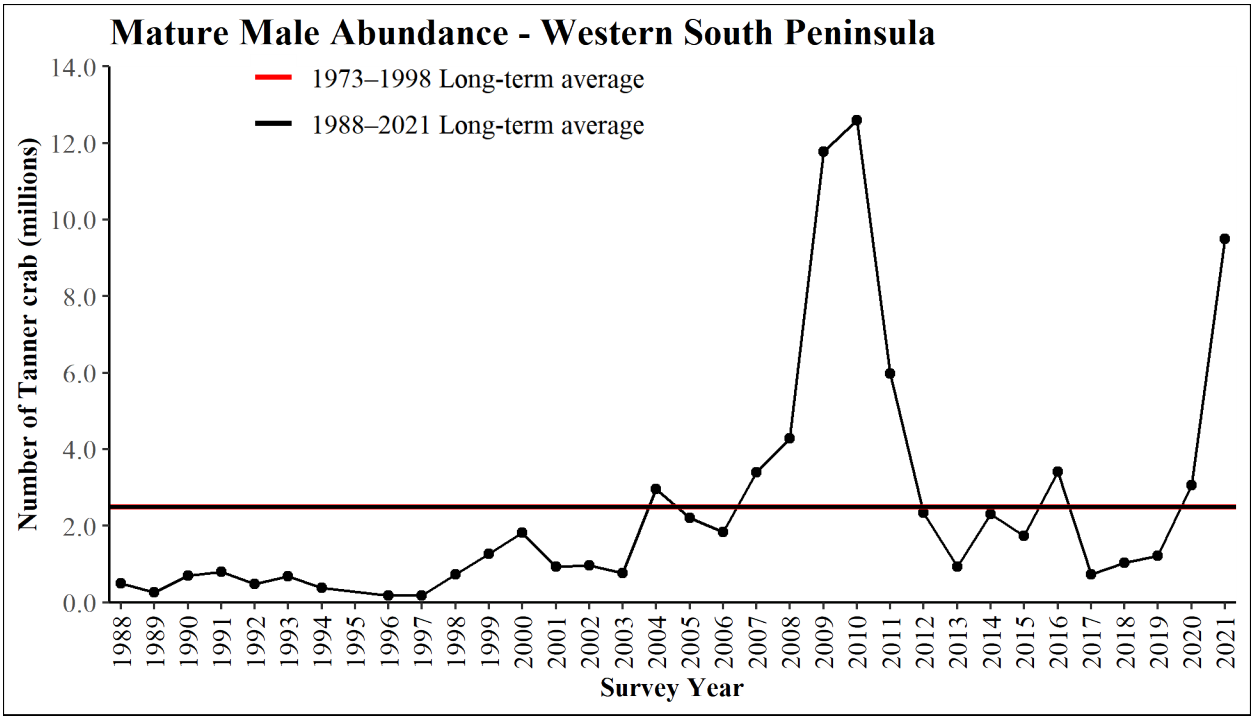

Figure 9.– Mature male Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Western Section of the South Peninsula District, 1988–2021 along with previous long-term average used in the management strategy implemented in 2005.

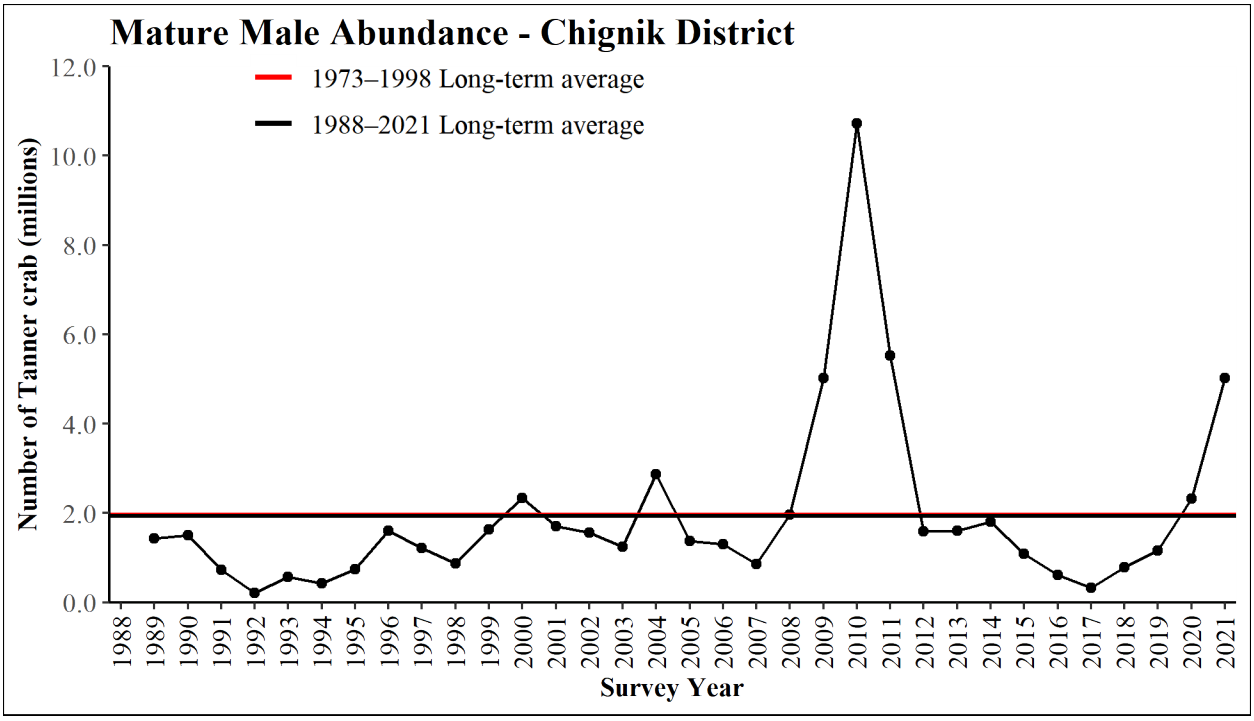

Figure 10.–Mature male Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Chignik District, 1989–2021 along with previous long-term average used in the management strategy implemented in 1999.

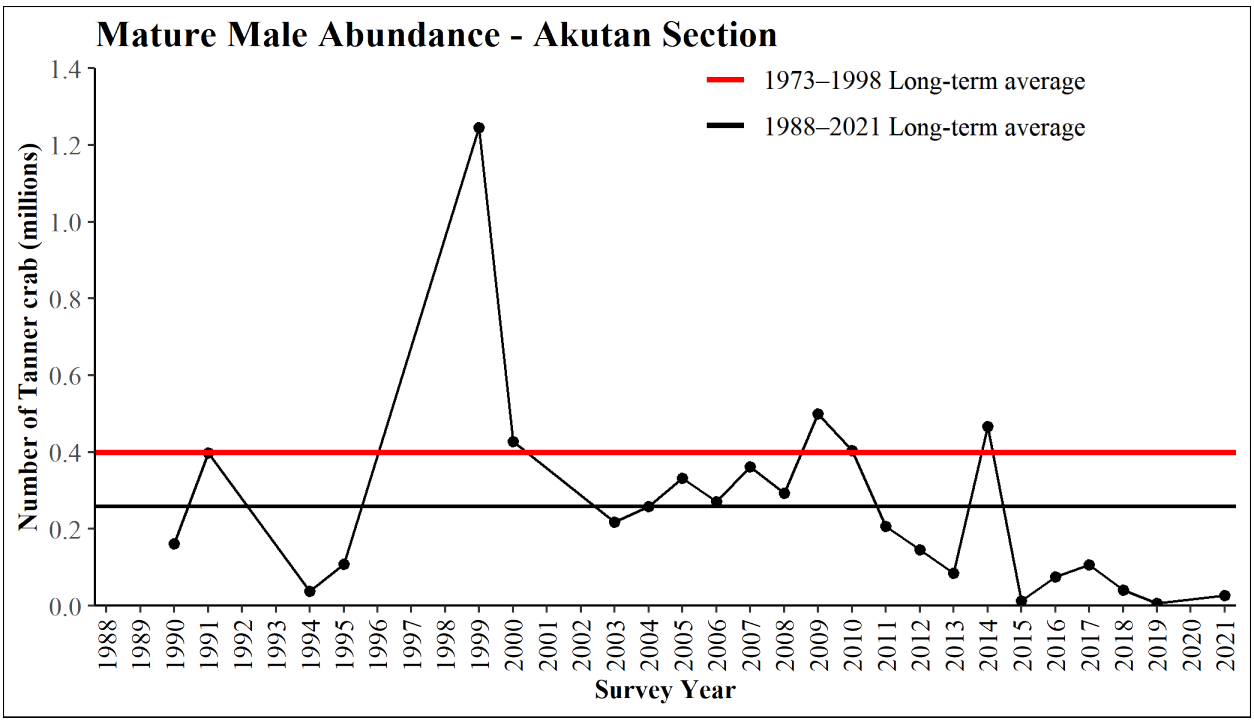

Figure 11.–Mature male Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Akutan Bay Section of the Eastern Aleutian District, 1990–2021 along with previous long-term average used in the management strategy implemented in 2008.

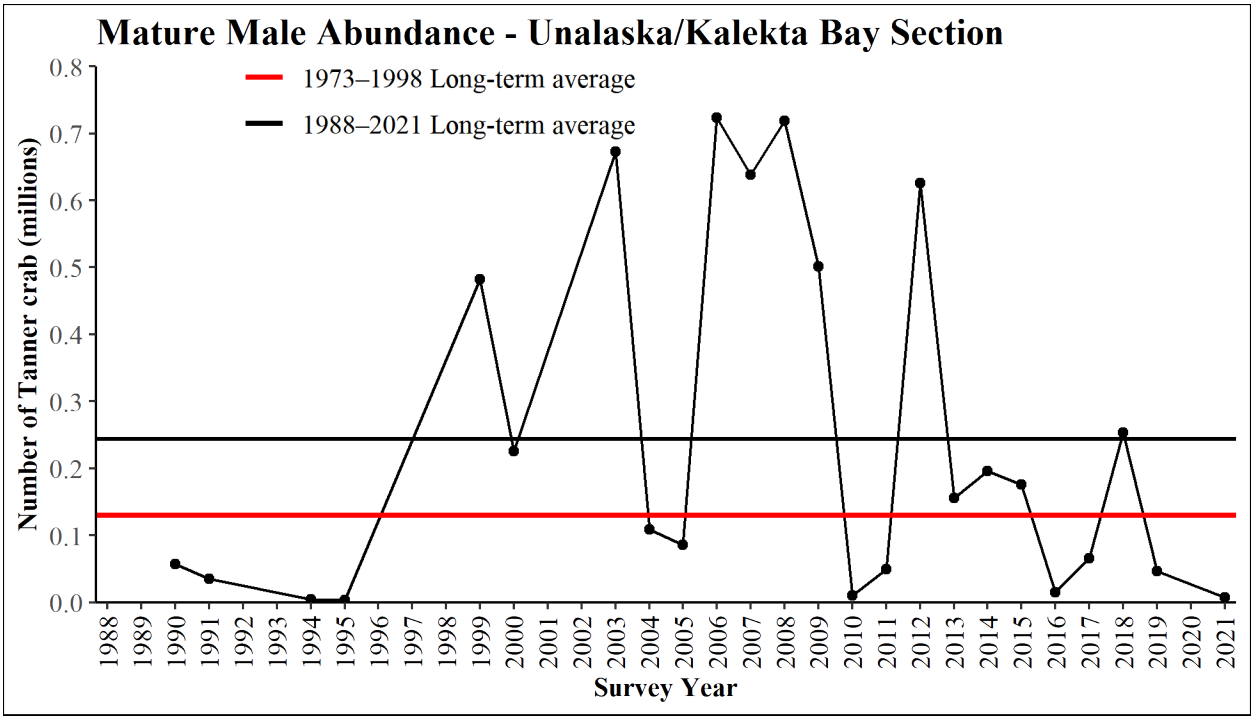

Figure 12.– Mature male Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Unalaska/Kalekta Bay Section of the Eastern Aleutian District, 1990–2021 along with previous long-term average used in the management strategy implemented in 2008.

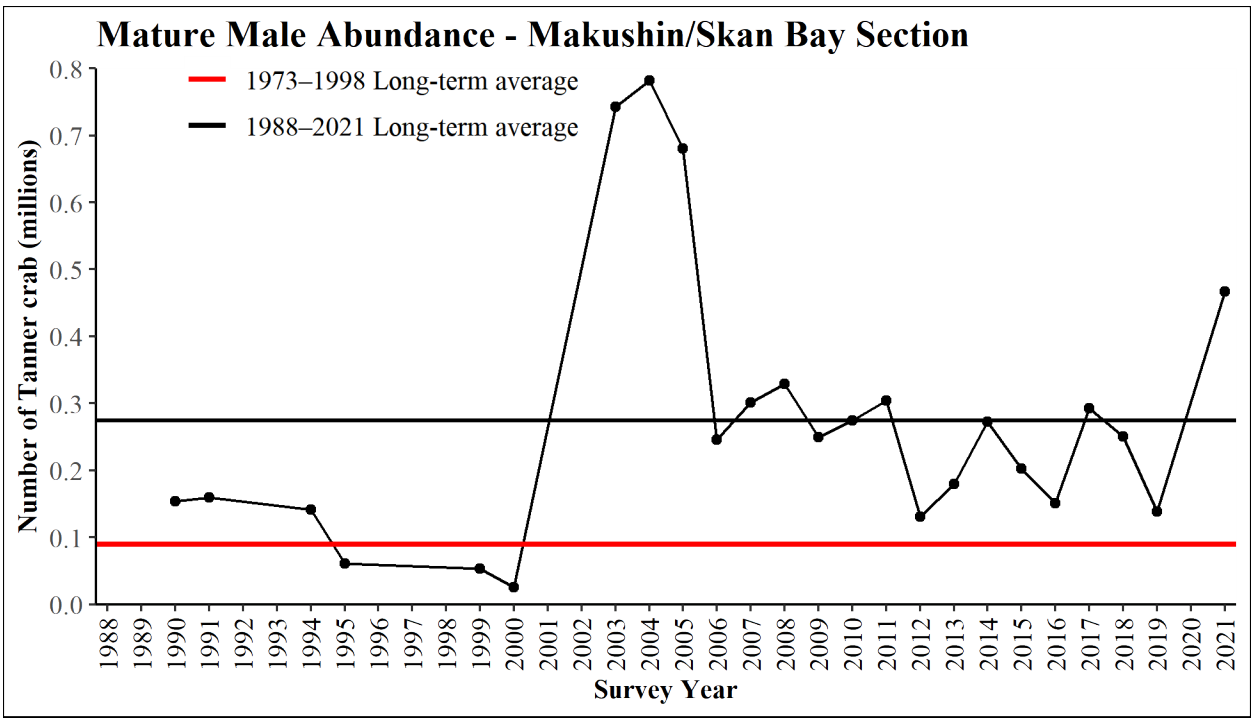

Figure 13.–Mature male Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Makushin/Skan Section of the Eastern Aleutian District, 1990–2021 along with previous long-term average used in the management strategy implemented in 2008.

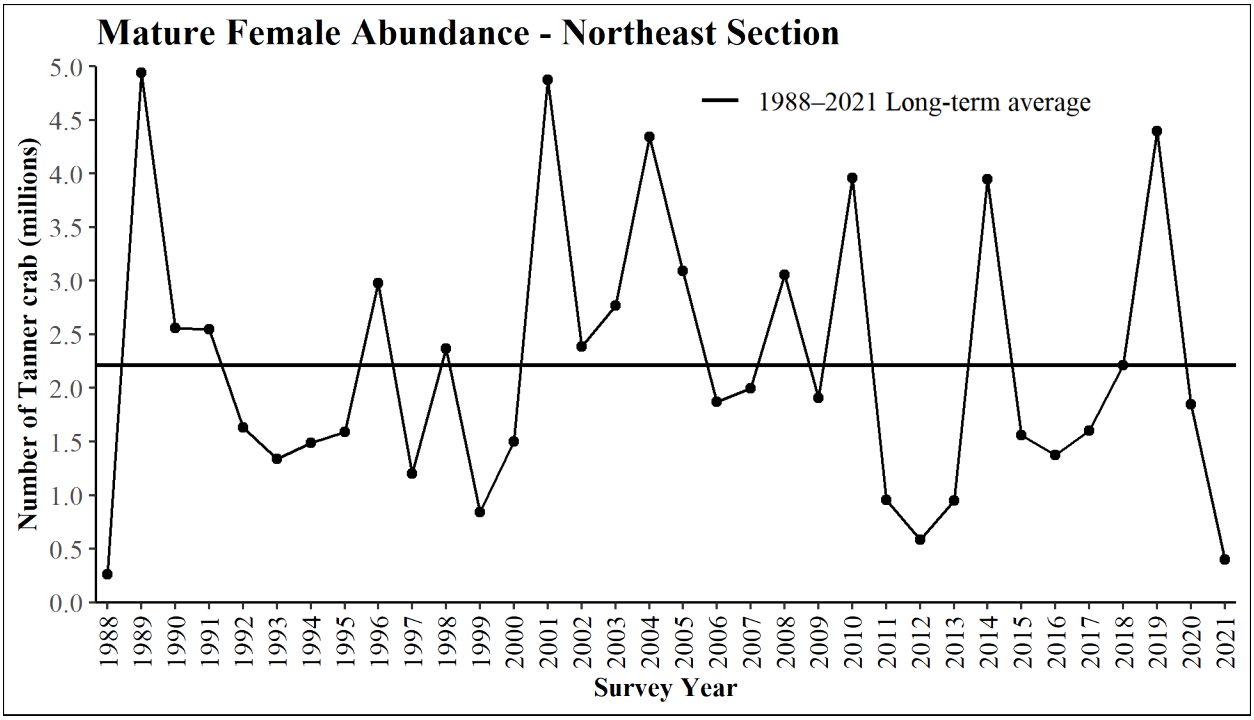

Figure 14.–Mature female Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Northeast Section of the Kodiak District, 1988–2021.

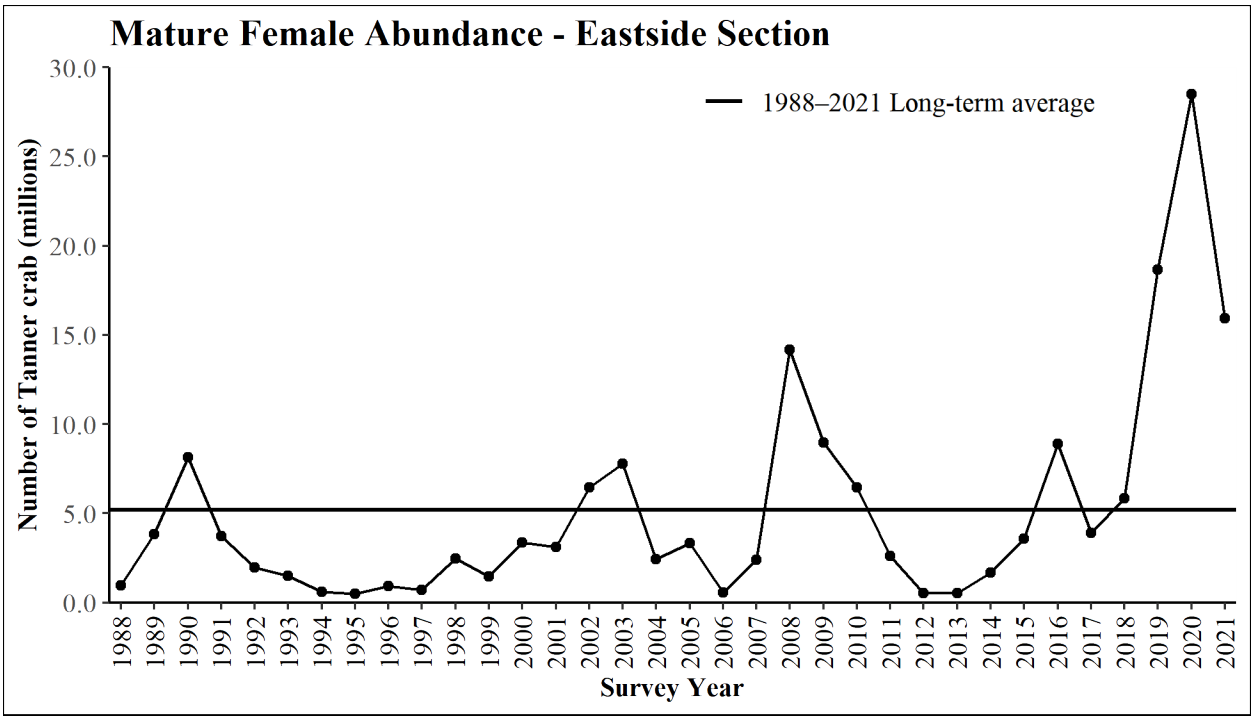

Figure 15.– Mature female Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Eastside Section of the Kodiak District, 1988–2021.

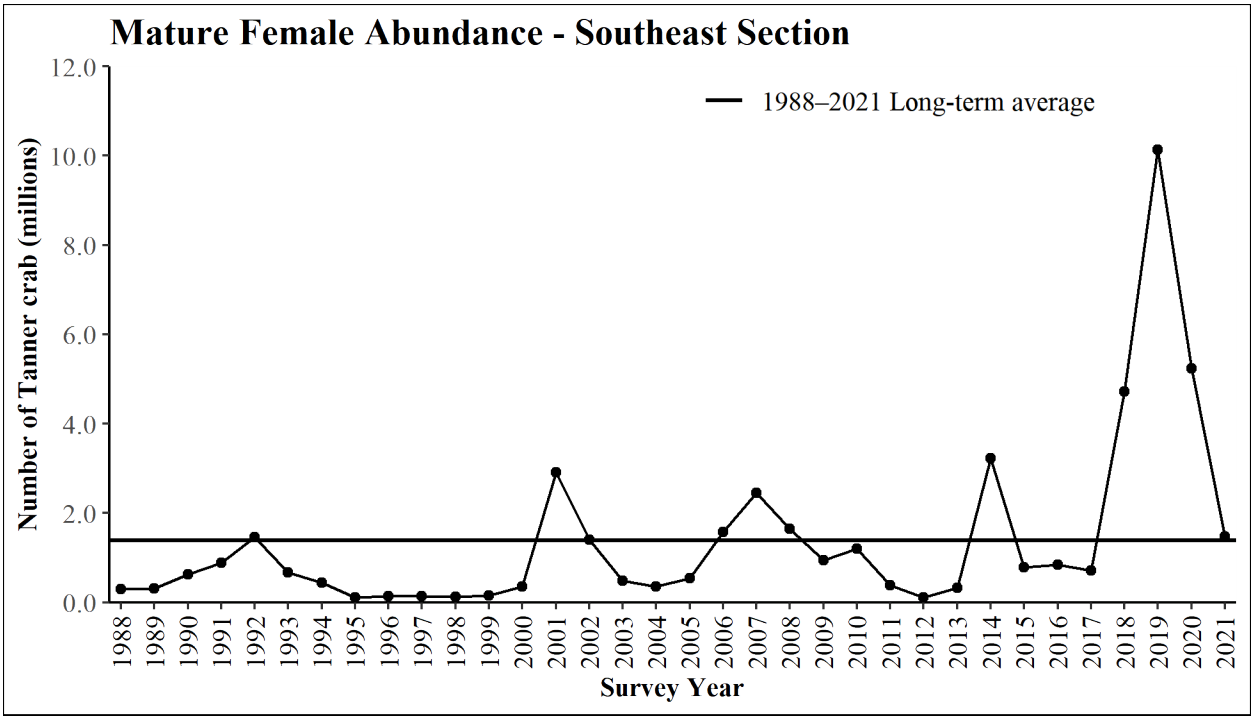

Figure 16.–Mature female Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Southeast Section of the Kodiak District, 1988–2021.

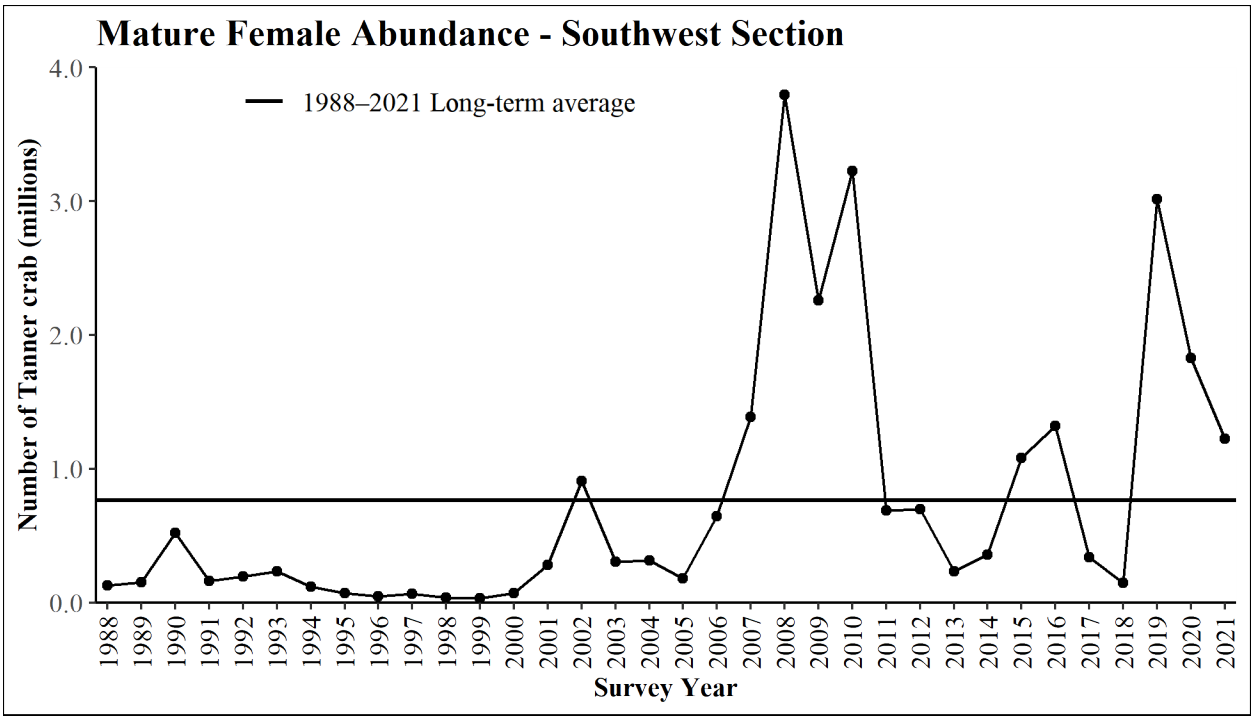

Figure 17.– Mature female Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Southwest Section of the Kodiak District, 1988–2021.

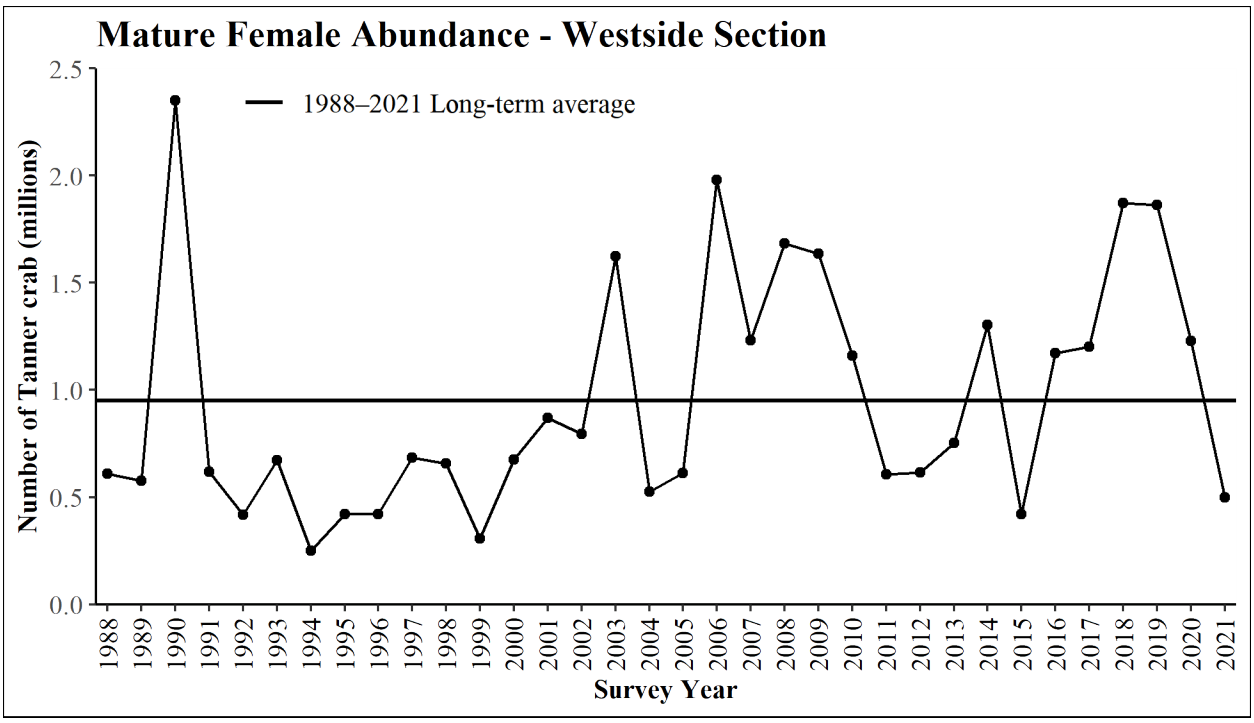

Figure 18.–Mature female Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Westside Section of the Kodiak District, 1988–2021.

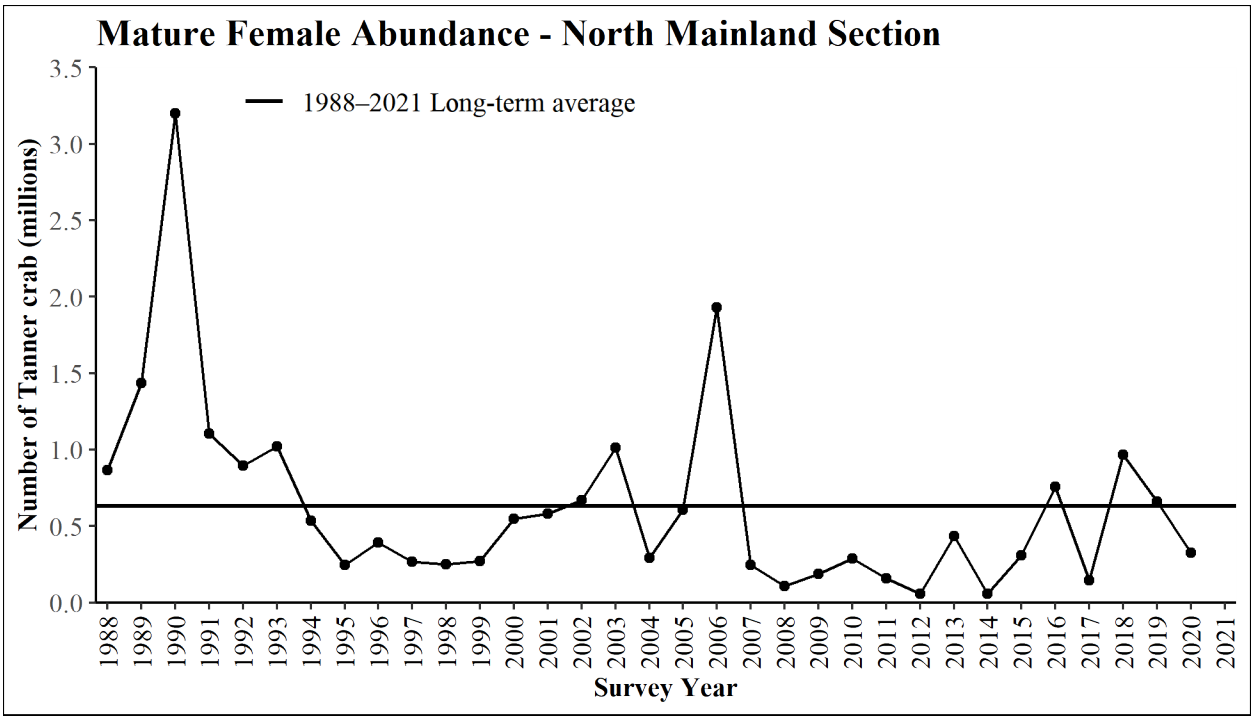

Figure 19.– Mature female Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the North Mainland Section of the Kodiak District, 1988–2021.

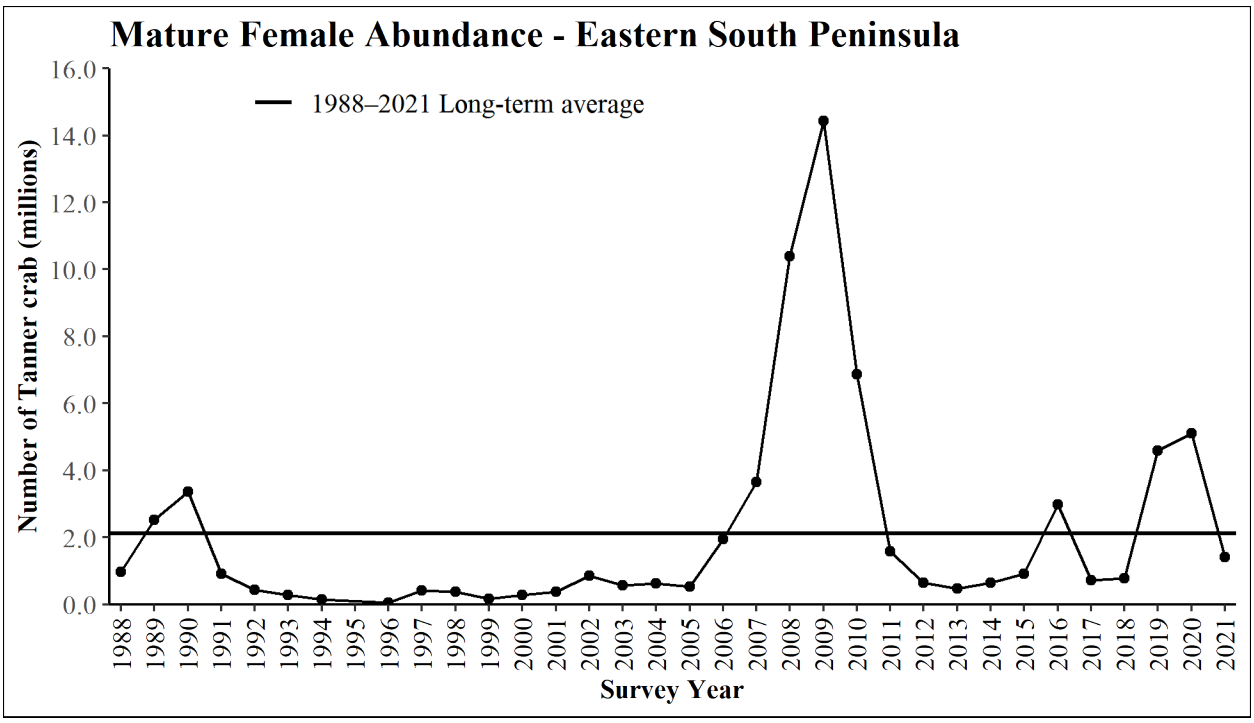

Figure 20.–Mature female Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Eastern Section of the South Peninsula District, 1988–2021.

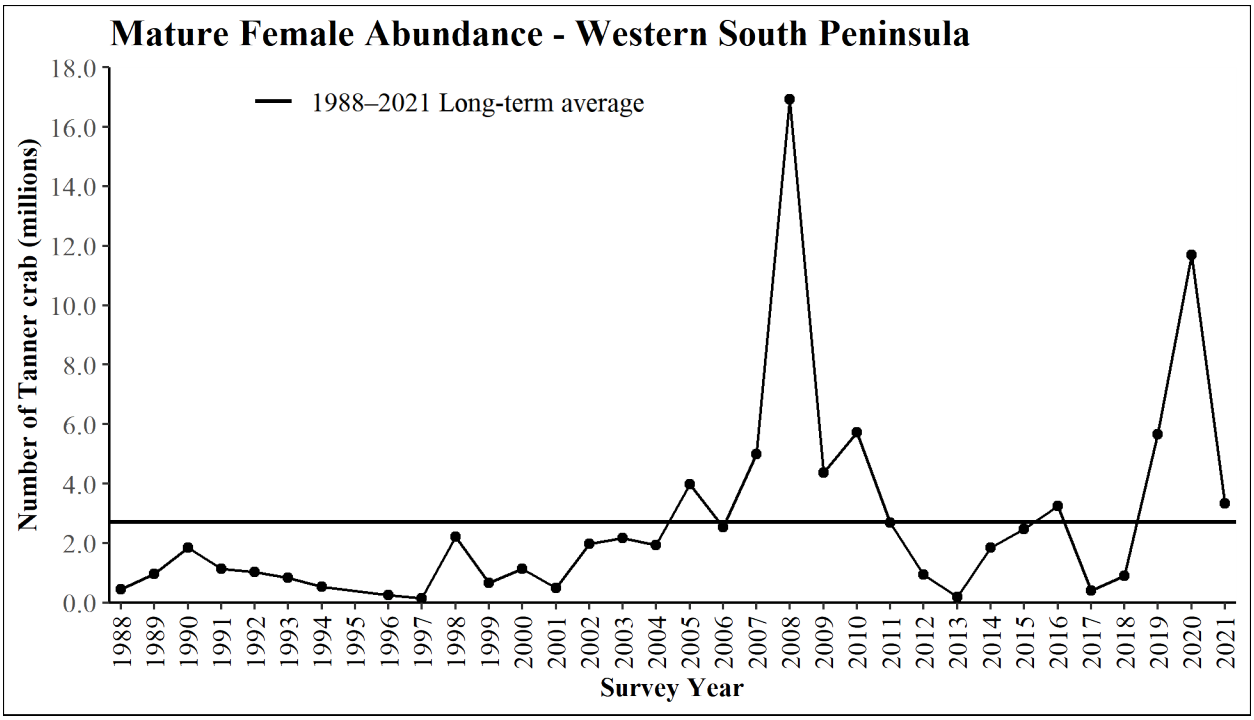

Figure 21.– Mature female Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Western Section of the South Peninsula District, 1988–2021.

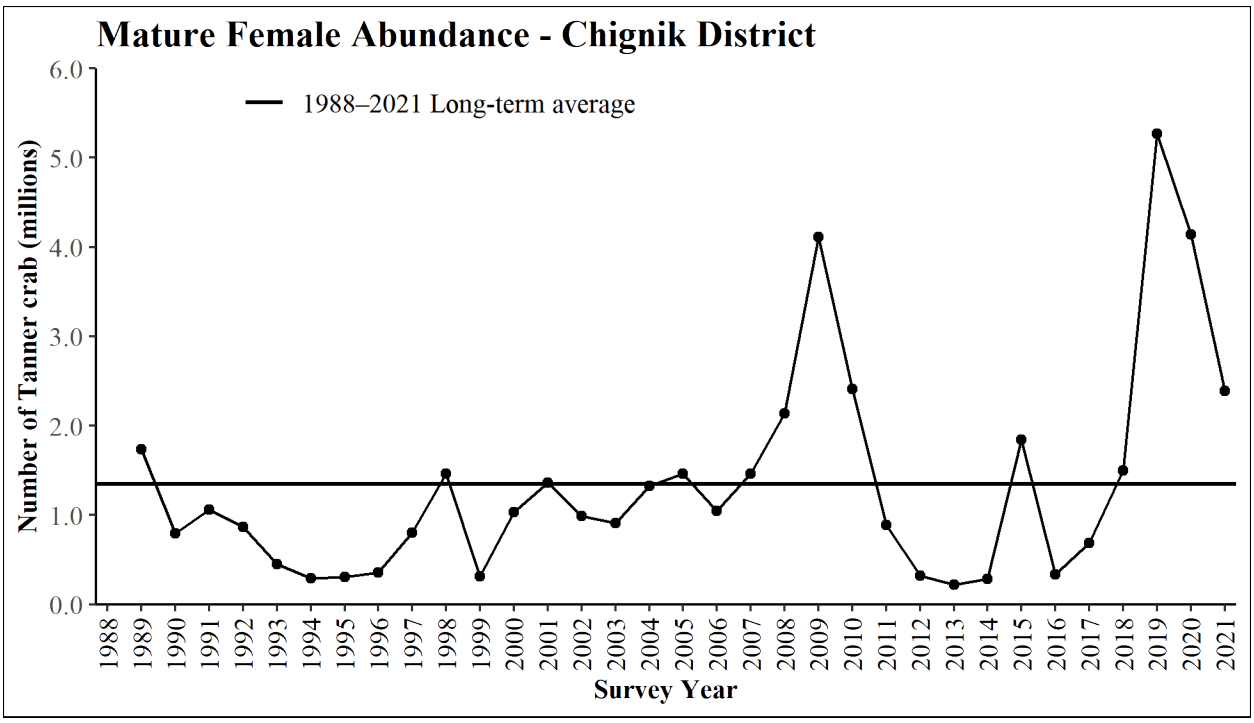

Figure 22.–Mature female Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Chignik District, 1989–2021.

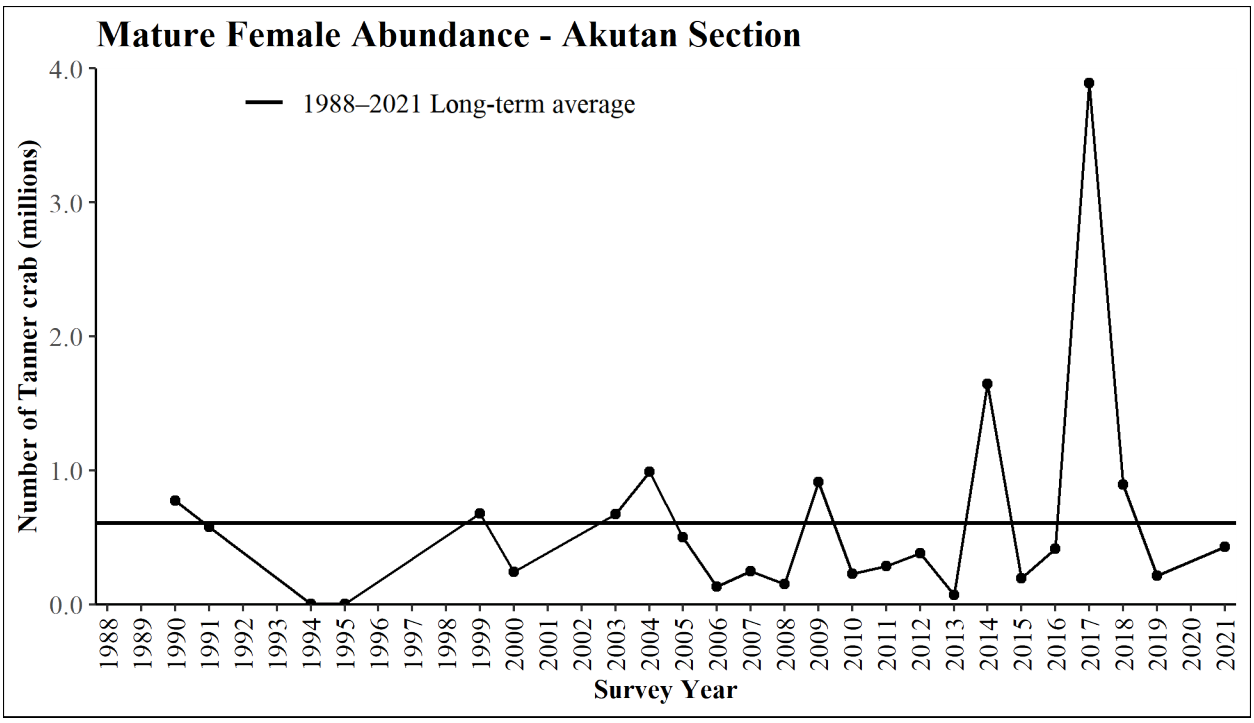

Figure 23.–Mature female Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Akutan Section of the Eastern Aleutian District, 1990–2021.

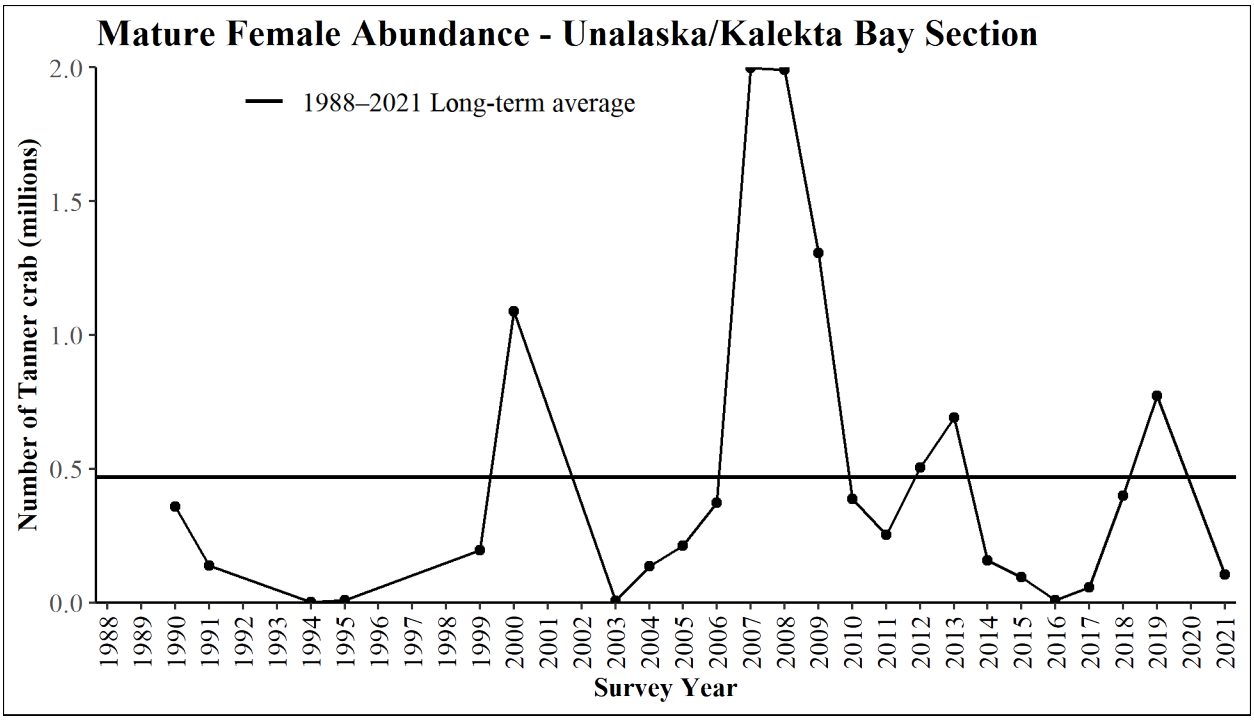

Figure 24.–Mature female Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Unalaska/Kalekta Bay Section of the Eastern Aleutian District, 1990–2021.

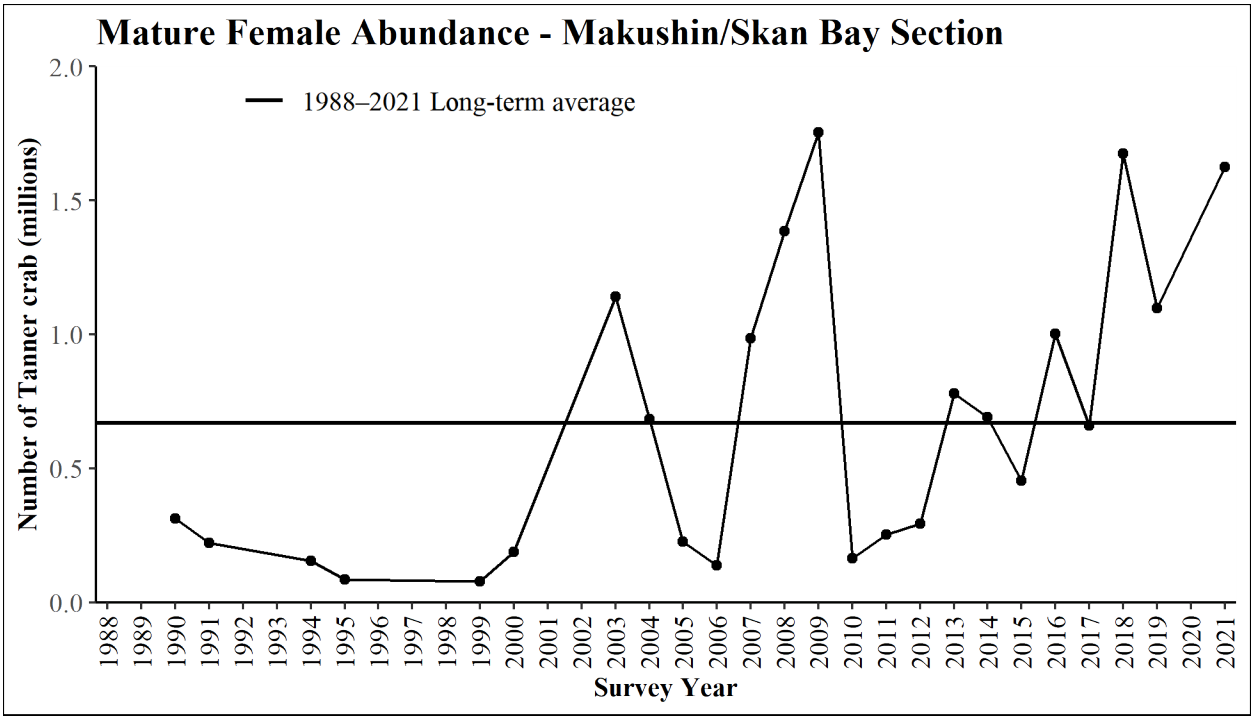

Figure 25.–Mature female Tanner crab abundance estimates and long-term average from the large-mesh trawl survey for the Makushin/Skan Bay Section of the Eastern Aleutian District, 1990–2021.

APPENDIX A. STANDARD SURVEY STATIONS

Appendix A1.–Trawl survey stations in the Northeast Section of the Kodiak District.

Kodiak District - Northeast Section						
Stations used in index		Stations used in index		Stations used in index		Eliminated
Standard	Predecessor	Standard	Predecessor	Standard	Predecessor	Stations
255A	255	369X		KZG		442
255B	255	CHA		KZJ		
256		CHB		KZK		
257		CHE		KZO		
283A		CHF		KZR		
283B		CHG		KZS		
284		CHJ		MOEX		
285		CHK		MOGX		
313		CHL		MOLA	MOLX	
314		KZA		MOLB	MOLX	
395		KZB		MONX		
420		KZC		MOPA	MOPX	
421		KZD		MOPB	MOPX	
443		KZE		MOXA	MOXX	
444		KZF		MOXB	MOXX	

Appendix A2.–Trawl survey stations in the Eastside Section of the Kodiak District.

Kodiak District - Eastside Section						
Stations used in index		Stations used in index		Stations used in index		Eliminated
Standard	Predecessor	Standard	Predecessor	Standard	Predecessor	Stations
486A		587		KLG		KLJ
486B		588		KLH		UGH
510C		589		KLI		UGK
510D		619		KLL		
511A		620		UGAA	UGA	
511B		621		UGAC	UGA, UGAB	
533A	533	654		UGAD	UGA, UGAB	
533B	533	655		UGB		
534BX	534	656		UGC		
534DX	534	695		UGD		
535A		696		UGE		
535B		KLA		UGF		
535C		KLB		UGG		
535D		KLC		UGI		
559		KLD		UGJ		
560		KLE		UGM		
561		KLF				

Appendix A3.–Trawl survey stations in the Southeast Section of the Kodiak District.

Kodiak District - Southeast Section					
Stations used in index		Stations used in index			
Standard	Predecessor	Standard	Predecessor	Eliminated Stations	
586		618A		558	920
614		THA		558B	946
615		THCX	THC, THD	650	947
651		THDX	THD, THC	689	973
688		THF		794	974
725		THG		795	975
726		THH		796	999
727		THI		857	1000
728		THJ		858	1022
729		THK		859	1045
759		THL		891	1046
760		THM		892	THB
761		THN		918	
585X					

Appendix A4.–Trawl survey stations in the Southwest Section of the Kodiak District.

Kodiak District - Southwest Section					
Stations used in index		Stations used in index			
Standard	Predecessor	Standard	Predecessor	Eliminated Stations	
645B		ALCA		752	682D
646A		ALD		783	683C
646B		ALF		817	684D
646C		ALG		850	712X
646D		ALH		882	748X
682B		ALI		883	750X
683A		ALJ		912	781X
683B		ALK		608X	815X
683D		ALL		676X	816X
684A		ALM		677X	881X
684B		ALO		678X	
684C		ALP			
ALA		ALQ			
ALBX		ALR			

Appendix A5.–Trawl survey stations in the Westside Section of the Kodiak District.

Kodiak District - Westside Section						
Stations used in index		Stations used in index		Stations used in index		Eliminated
Standard	Predecessor	Standard	Predecessor	Standard	Predecessor	Stations
KUD		KUS		UYBX		KUE
KUF		KUT		UYEX		KUH
KUG		KUU		UYFX		KUR
KUI		KUV		UYHX		
KUJ		KUW		UYKX		
KUK		KUXA	KUX	UYMX		
KULA	KUL	KUXB	KUX	UYO		
KULB	KUL	KUYA	KUY	UYQX		
KUM		KUYB	KUY	UYSS		
KUNX	KUN, KUO	MAA		UYT		
KUP		PMA				
KUQ		RAA				

Appendix A6.–Trawl survey stations in the North Mainland Section of the Kodiak District.

Kodiak District - North Mainland Section					
Stations used in index		Stations used in index		Stations used in index	
Standard	Predecessor	Standard	Predecessor	Standard	Predecessor
2		120		173	
3		121		174	
31		144		198	
60		145		199	
61		146		200	
90		147		222	
91		171A	171	223	
117		171C	171, 171B	224	
118		171D	171, 171B		
119		172			

Appendix A7.–Trawl survey stations in the Eastern Section of the South Peninsula District.

South Peninsula District - Eastern Section							
Stations used in index		Stations used in index		Stations used in index			
Standard	Predecessor	Standard	Predecessor	Standard	Predecessor	Eliminated Stations	
228		368A		PAU		246	PAC
245		373A		PAV		261	PAD
278		373B		STA		263	PAG
301		BAA		STB		264	PAN
311A	311	BAC		STD		265	PAOA
311B	311	BAD		STE		387	PAQ
311C	311	BAE		VOA		388	PAS
318		BAF		VOBX	VOB, VOC	389	PAT
329B		BVA		VOD		409	PAWA
329C		BVB		VOFB		410	VOE
334		BVC		VOG		312A	VOFA
335		PAEX	PAE, PAF	VOH		BVD	VOJ
337		PAH		VOI		PAA	VOK
348		PAIX	PAI, PAJ	VOM	VOMA, VOMB	PAB	VOT
353		PALX	PAL, PAM	VON		PABX	
354		PAOB		VOLX			
371		PAP		VOPX			
393		PARA	PAR	VOQ			
332B		PARB	PAR	VOR			

Appendix A8.–Trawl survey stations in the Western Section of the South Peninsula District.

South Peninsula District - Western Section				
Stations used in index		Stations used in index		
Standard	Predecessor	Standard	Predecessor	Eliminated Stations
87AX	87, 87A, 87B	COF		87E
87D	87	COGA	COG	97
113		COGB	COG	98
125		COH		98C
126		COM		169
137		COOX	CON, COO	132A
138A	138	MOB		145B
138B	138	MOD		COJ
138C	138	MOF		COL
156A		MOG		COP
157A		MOH		COQ
BEBX	BEA, BEB	MOI		MOA
BECX	BEC, BED	MOK		MOC
BEE		MOL		MOE
BEF		MOOX	MOO, MOP	MOJ
BEG		MORX	MOR, MOV	MOM
COB		MOSX	MOS, MON	MOT
COC				MOU
COE				MOW

Appendix A9.–Trawl survey stations in the Chignik District.

Chignik District						
Stations used in index		Stations used in index		Stations used in index		Eliminated
Standard	Predecessor	Standard	Predecessor	Standard	Predecessor	Stations
4007		4065		4274		4009
4008		4038A		4277		4053
4900X		4038B		4278		4039A
4000X		4050A		4282		4039B
4000Y		4050B		4286		4143
4915		4066A		4287		4260
4024		4066B		4312		4279
4025		4256		4964		4304
4026		4262		4290		4069
4035		4264		4296		4295
4036		4265		4298		4297
4037		4266		4301		4283
4048		4267		4302		
4049		4270		4308		
4063		4271				
4064		4272				

Appendix A10.–Trawl survey stations in the Eastern Aleutian District.

Eastern Aleutian District					
Stations used in index		Stations used in index			
Standard	Predecessor	Standard	Predecessor	Eliminated Stations	
Akutan Section		Makushin/Skan Bay Section		General Section	
AKA		MKB		ANA	INA
AKC		MKC		AND	INB
AKD		MKE		ANE	INF
AKG		MKF		BIB	INJ
AKL		MKJ		BID	INP
Unalaska/Kalekta Bay Section		MKK		BIG	PUA
KAA		MKN		BIK	PUB
UNC		MKP		BIN	USA
UND				BIT	USB
UNE				BIU	USC
UNF				IDG	USF
UNG				IDH	USG
UNI				IDK	
UNJ					

APPENDIX B. STANDARD SURVEY STATIONS THAT WERE NOT SAMPLED

Appendix B1.–Standard large-mesh survey stations in the Kodiak District that were not sampled, 1988–2021.

Kodiak District - Northeast Section		
Station	Years replacement needed	Reason
285	1988–1997	not created
313	1988–1997	not created
314	1988–1997	not created
395	1997, 1999	missed
420	1998	missed
421	1997, 2006	missed
443	1991, 1995, 2000, 2003, 2016, 2018, 2020	missed
444	1998, 2006, 2007, 2016, 2018	missed
255B	2011	missed
283A	1989–1997	not created
283B	1988	not created
CHB	2018	missed
CHE	2010–2012, 2015	missed
CHG	1995, 2014	missed
KZD	1989, 1990	missed
KZF	2016, 2020	missed
KZG	1988	missed
KZJ	1988	missed
KZO	2006	missed
KZS	1990, 2021	missed
MOEX	1988	missed
MOGX	2006–2008	missed
MONX	1989–1991	missed
MOPB	2013	missed
Kodiak District - Eastside Section		
Station	Years replacement needed	Reason
560	2021	missed
587	2006	missed
589	1994, 1997	missed
654	1988–1990, 2011	not created, missed
655	1990	missed
695	1988–1990	not created
696	1988–1990	not created
486A	1998	not created
486B	1989, 1990, 1994, 1996–1998, 2001–2003	not created, missed
510C	1988–1990	not created
511A	1988, 1989	not created
511B	1990, 1991	not created
534DX	2005–2007	missed
535A	1988–1990	not created
535B	1988–1990	not created
535C	1989	not created
535D	1988, 1990	not created
KLD	1993, 1997	missed
UGD	1988–1991, 2006	missed
UGF	1988	missed
UGG	2013	missed

-continued-

Kodiak District - Southeast Section		
Station	Years replacement needed	Reason
586	1988, 1989	not created
615	2007, 2008, 2018, 2020	missed
651	1988, 1989	not created
725	1994	missed
726	1994, 2007, 2008	missed
727	1994	missed
728	1994	missed
729	1994	missed
759	1988, 1990–1996, 1998, 2006, 2007	missed
760	1992, 1994	missed
761	1992, 1994, 2006, 2007	missed
585X	1988, 1989, 1993	not created, missed
618A	1988, 1989	not created
THH	2006	missed
Kodiak District - Southwest Section		
Station	Years replacement needed	Reason
645B	1996	missed
646B	2006–2008, 2017–2019	missed
646C	2008, 2020	missed
682B	1996–1998, 2000, 2005–2007	missed
ALBX	1988–1991, 2007	not created, missed
ALD	2018	missed
ALL	1988	missed
ALO	2004–2011, 2014, 2019–2021	missed
ALR	1988	missed
Kodiak District - Westside Section		
Station	Years replacement needed	Reason
KUD	1993	missed
KUF	1993	missed
KUG	1993, 2011, 2012	missed
KUI	1993	missed
KULB	1993, 1995	missed
KUXA	1995	missed
MAA	2004	missed
UYBX	1988, 1990, 1991	missed
UYHX	2004	missed
UYO	1988, 1990	missed
UYSS	1996, 2019–2021	missed
UYT	1988–1991, 1994–1997, 2008–2013, 2019–2021	not created, missed

-continued-

Appendix B1.–Page 3 of 3.

Kodiak District - North Mainland Section		
Station	Years replacement needed	Reason
2	2003, 2013, 2017	missed
3	1992, 1999–2002, 2004–2009, 2011, 2013, 2016–2020	missed
31	2017	missed
61	1991, 1996, 1998, 1999, 2018, 2020	missed
91	2003, 2007, 2020	missed
117	1998	missed
119	1998	missed
121	2004	missed
144	1997	missed
145	2018	missed
147	1999, 2008, 2017	missed
172	2020	missed
174	2017	missed
199	2017	missed
200	2017	missed
222	2007, 2008, 2020	missed
224	2017	missed
171D	1998, 2017	missed

Appendix B2.–Standard large-mesh survey stations in the South Peninsula District that were not sampled, 1988–2021.

South Peninsula District - Eastern Section		
Station	Years replacement needed	Reason
245	1997	missed
301	1988–1993, 2006, 2008, 2010, 2015, 2018, 2021	not created, missed
318	1988–1993, 2006, 2008, 2010, 2015, 2018, 2021	not created, missed
334	1988–1993	not created
335	1988–1993, 2006, 2010–2013, 2017–2021	not created, missed
337	1988–1993, 1997, 2006, 2008, 2015, 2018, 2021	not created, missed
348	1988, 1989	not created
353	1988	not created
354	1988, 1990–1993, 2007, 2008	not created, missed
371	1988, 2012	not created, missed
393	1988, 1997	not created, missed
311A	1989–2011	temporarily eliminated
329B	1988, 1989, 2001, 2010	missed
332B	1988	not created
368A	1988, 2018	not created, missed
373A	1988–1998, 2014	not created, missed
373B	1988, 2007	not created, missed
BAC	2007	missed
BAE	2008	missed
BVB	1993	missed
BVC	1989, 2008, 2010	missed
PAEX	2018	missed
PAH	1992, 2004–2008, 2021	missed
PAIX	2021	missed
PAJ	1988, 1990	missed
PALX	2018, 2021	missed
PAV	2012	missed
STA	1988, 1991, 2008	not created, missed
STB	1988, 1991	not created, missed
STD	1988	not created
STE	1988, 1991, 1992	not created, missed
VOA	2004	missed
VOH	1988, 1989	missed
VOR	1990	missed

-continued-

South Peninsula District - Western Section		
Station	Years replacement needed	Reason
113	1988	not created
125	1988	not created
126	1988	not created
137	1988, 1999	not created, missed
138A	1988, 2002, 2003	not created, missed
138B	1988	not created
138C	1988	not created
156A	2018	missed
157A	2018	missed
BEBX	2021	missed
BEF	1989	missed
BEG	2018	missed
COB	1989, 1990, 1993	missed
COC	1989	missed
COE	1989	missed
COH	1988, 1989, 2021	missed
COOX	1989	missed
MOB	1993, 2007, 2021	missed
MOD	1993	missed
MOF	1993	missed
MOPB	1989, 1990	missed
MOV	1989	missed

Appendix B3.– Standard large-mesh survey stations in the Chignik and Eastern Aleutian Districts that were not sampled, 1989–2021.

Chignik District		
Station	Years replacement needed	Reason
4024	1996	missed
4025	1989–2001	not created
4026	1989–2001, 2013	not created, missed
4035	1989, 1996	not created, missed
4036	1991–2001	temporarily eliminated
4037	1989–2001	not created
4048	1996, 2014	missed
4049	1996	missed
4063	1989, 1996	not created, missed
4064	1996, 2021	missed
4065	1996	missed
4256	1989	not created
4262	1989–1997, 2017	not created, missed
4271	2006	missed
4272	2013	missed
4282	1989, 1992	not created, missed
4286	1992, 1995	missed
4287	1992, 1995, 2002, 2003, 2007, 2008	missed
4290	1991, 1992, 1995, 1997	missed
4296	1991, 1992	missed
4301	1992, 1993	missed
4302	1992	missed
4308	1989–1991, 1995	missed
4312	1989	missed
4000X	2019	missed
4000Y	1989, 1990	missed
4038A	1989–2001	not created
4038B	1989–2001, 2007, 2008	not created, missed
4050A	1989–2001, 2020	not created, missed
4050B	1989–2001	not created
4066A	1989–2001	not created
4066B	1989–2001, 2004	not created, missed
4900X	1990, 1991, 1994, 1996, 1998, 2000, 2002–2004, 2007, 2008, 2019–2021	missed

Eastern Aleutian District		
Station	Years replacement needed	Reason
AKD	2006, 2007	missed
KAA	2000	missed
UNI	1995	missed
MKJ	1991, 2019, 2021	missed
MKK	1991, 2000	missed

APPENDIX C. STANDARD SURVEY STATIONS, STRATA DESIGNATIONS, AND AREAS CONSIDERED

Appendix C1.–Standard trawl survey locations, stations, station areas, and strata designations by section in the Kodiak District.

KODIAK DISTRICT

Northeast Section

Chiniak Gully

Station	KM²	Stratum
395	85.8	low
420	83.3	low
421	83.3	low
443	83.5	low
444	83.5	low
369X	142.8	low
Total	562.1	

Marmot Bay

Station	KM²	Stratum
MOEX	36.2	low
MOGX	65.9	low
MOLA	28.0	high
MOLB	44.8	high
MONX	75.5	high
MOPA	27.8	low
MOPB	19.9	low
MOXA	13.0	low
MOXB	29.5	low
256	82.1	low
257	82.1	low
284	82.4	low
285	82.4	low
313	85.8	low
314	82.5	low
255A	64.4	low
255B	63.9	low
283A	67.9	high
283B	64.0	low
Total	1,098.1	

Chiniak Bay

Station	KM²	Stratum
CHA	5.5	low
CHB	7.9	high
CHE	20.6	low
CHF	12.7	high
CHG	32.8	low
CHJ	11.3	low
CHK	8.6	high
CHL	14.1	low
Total	113.4	

Kizhuyak Bay

Station	KM²	Stratum
KZA	11.7	low
KZB	2.7	low
KZC	12.3	low
KZD	23.7	high
KZE	25.8	low
KZF	20.1	low
KZG	21.2	low
KZJ	21.4	low
KZK	21.4	low
KZO	21.4	low
KZR	10.8	high
KZS	3.1	high
Total	195.7	

Eastside Section

Ugak Bay

Station	KM²	Stratum
UGAA	16.0	high
UGAC	3.2	high
UGAD	4.4	high
UGB	5.8	low
UGC	17.5	low
UGD	11.0	low
UGE	12.7	high
UGF	15.8	low
UGG	11.0	low
UGI	22.3	high
UGJ	21.0	low
UGM	16.8	high
Total	157.4	

Kiliuda Bay

Station	KM²	Stratum
KLA	20.9	low
KLB	9.3	low
KLC	19.6	low
KLD	18.2	low
KLE	8.2	low
KLF	15.1	low
KLG	16.5	low
KLH	16.8	high
KLI	21.4	low
KLL	21.4	low
Total	167.4	

Barnabas Gully

Station	KM²	Stratum
486A	25.0	high
486B	29.4	low
510C	21.5	low
510D	38.0	high
511A	42.0	high
511B	42.9	low
533A	42.9	low
533B	42.9	low
534BX	20.8	low
534DX	29.0	low
535A	21.1	high
535B	21.4	high
535C	21.1	low
535D	21.4	high
559	85.8	low
560	85.8	low
561	85.8	low
587	85.8	low
588	85.8	low
589	85.8	low
619	85.8	low
620	85.8	low
621	85.8	low
654	85.8	low
655	85.8	low
656	85.8	low
695	85.8	low
696	85.8	low
Total	1,619.9	

Southeast Section

South Sitkalidak Strait

Station	KM²	Stratum
THA	15.1	low
THCX	20.0	low
THDX	28.6	low
THF	22.3	high
THG	21.1	low
THH	19.2	low
THI	21.6	low
THJ	17.8	high
THK	16.5	high
THL	9.3	high
THM	10.6	high
THN	5.1	high
Total	207.2	

Offshore Twoheaded

Station	KM²	Stratum
618A	42.9	low
585X	78.8	low
614	61.2	high
615	99.5	low
651	85.8	low
Total	368.1	

Horse's Head

Station	KM²	Stratum
586	85.8	low
688	85.8	low
725	85.8	low
726	85.8	low
727	85.8	low
728	85.8	low
729	85.8	low
759	85.8	low
760	85.8	low
761	85.8	low
Total	857.5	

Southwest Section

Alitak Flats

Station	KM²	Stratum
645B	34.3	low
646A	27.1	low
646B	16.5	low
646C	27.9	low
646D	37.4	low
682B	21.7	low
683A	22.2	low
683B	20.9	low
683D	9.3	low
684A	21.7	low
684B	10.3	low
684C	8.6	low
Total	257.9	

Alitak Bay

Station	KM²	Stratum
ALA	3.1	high
ALBX	12.8	low
ALCA	8.1	high
ALD	13.0	low
ALF	21.4	low
ALG	19.9	low
ALH	16.1	high
ALI	16.6	high
ALJ	15.1	low
ALK	9.9	low
ALL	8.2	high
ALM	16.1	low
ALO	16.8	low
ALP	18.4	low
ALQ	14.4	high
ALR	13.4	high
Total	223.5	

-continued-

Appendix C1.–Page 2 of 2.

KODIAK DISTRICT (Continued)

Westside Section

Uganik Bay

Station	KM²	Stratum
KUNX	10.7	high
KUP	13.3	high
KUQ	20.6	low
KUS	12.1	low
KUT	9.4	low
KUU	13.7	high
KUV	4.1	low
KUW	5.2	low
KUXB	4.1	high
KUXA	5.6	high
Total	98.7	

Uyak Bay

Station	KM²	Stratum
UYBX	21.5	low
UYEX	29.9	low
UYFX	22.1	high
UYHX	4.1	low
UYKX	13.9	low
UYMX	20.8	low
UYO	3.4	high
UYQX	7.7	low
UYSS	6.0	high
UYT	2.8	low
Total	132.1	

Kupreanof-Viekoda

Station	KM²	Stratum
KUD	27.1	low
KUF	11.3	low
KUG	15.4	low
KUI	6.4	low
KUJ	17.0	high
KUK	14.1	low
KULB	2.7	high
KULA	2.1	high
KUM	10.5	low
KUYA	4.1	low
KUYB	2.6	low
Total	113.2	

West Afognak

Station	KM²	Stratum
MAA	10.5	low
PMA	15.1	high
RAA	6.7	high
Total	32.3	

North Mainland Section

Station	KM²	Stratum
2	85.6	low
3	85.8	low
31	83.7	low
60	85.8	low
61	85.8	low
90	80.3	low
91	85.8	low
117	97.8	low
118	85.8	low
119	85.8	high
120	85.8	high
121	85.8	low
144	60.7	low
145	85.8	low
146	85.8	high
147	85.8	high
171A	11.4	high
171C	7.6	high
171D	28.6	low
172	79.5	low
173	85.8	high
174	85.8	high
198	85.8	high
199	85.8	high
200	85.8	high
222	103.2	low
223	85.8	high
224	85.8	high
Total	2,181.9	

SECTION TOTALS	KM²		
	High	Low	Total
Northeast Section	282.8	1,686.4	1,969.3
Eastside Section	261.2	1,683.5	1,944.7
Southeast Section	142.8	1,290.0	1,432.8
Southwest Section	80.0	401.5	481.4
Westside Section	122.3	254.1	376.4
North Mainland Section	962.3	1,219.6	2,181.9
KODIAK DISTRICT TOTAL	1,851.5	6,535.0	8,386.5

Appendix C2.–Standard trawl survey locations, stations, station areas, and strata designations by section in the South Peninsula District.

SOUTH PENINSULA DISTRICT

Eastern Section

Pavlof/Volcano Bay

Station	KM²	Stratum
228	12.8	high
245	21.0	high
PAH	14.2	low
PAEX	37.5	low
PAIX	38.3	low
PALX	39.9	low
PAOB	19.6	high
PAP	20.8	low
PARA	19.1	high
PARB	20.8	high
PAU	21.4	high
PAV	20.6	low
VOA	22.1	low
VOBX	43.5	high
VOD	20.8	high
VOFB	15.5	low
VOG	22.1	high
VOH	21.7	low
VOI	21.2	high
VOLX	17.7	low
VOM	27.5	low
VON	22.1	high
VOPX	29.7	high
VOQ	15.9	low
VOR	21.1	high
Total	586.9	

Stepovak Bay

Station	KM²	Stratum
STA	21.0	low
STB	18.9	low
STD	22.4	low
STE	15.5	low
Total	77.8	

West Nagai Strait

Station	KM²	Stratum
332B	42.9	low
373A	28.0	low
373B	20.5	high
301	85.8	low
318	85.8	low
334	85.8	high
335	85.8	low
337	85.8	low
353	86.1	low
354	85.8	low
371	76.0	low
393	42.0	low
Total	810.0	

Beaver/Balboa/Unga

Station	KM²	Stratum
278	71.4	low
348	85.8	low
311A	15.5	low
311B	19.4	low
311C	16.2	low
329B	21.4	high
329C	21.4	low
BAA	12.0	low
BAC	16.9	low
BAD	8.3	low
BAE	12.7	low
BAF	9.4	low
BVA	13.5	low
BVB	14.0	low
BVC	18.9	low
368A	43.9	low
Total	400.7	

Western Section

Cold/Belkofski Bay

Station	KM²	Stratum
156A	44.2	high
157A	21.0	low
BEBX	15.1	low
BECX	25.7	low
BEE	21.4	low
BEF	14.5	low
BEG	20.3	low
COB	20.8	low
COC	14.2	low
COE	20.2	low
COF	11.5	high
COGA	9.8	high
COGB	3.6	high
COH	4.8	low
COM	18.5	low
COOX	27.7	high
Total	293.5	

Morzhovoi Bay

Station	KM²	Stratum
87AX	42.9	high
87D	22.3	high
MOB	18.5	low
MOD	16.1	low
MOF	20.0	low
MOG	17.6	low
MOH	15.1	high
MOI	16.9	high
MOK	21.4	high
MOL	21.4	high
MOOX	43.8	high
MORX	33.7	low
MOSX	42.7	high
Total	332.4	

Sanak Island

Station	KM²	Stratum
138A	34.8	low
138B	18.4	low
138C	56.9	low
113	77.2	low
125	77.2	low
126	77.8	low
137	85.8	low
Total	428.0	

SECTION TOTALS	KM²		
	High	Low	Total
Eastern Section	423.0	1,452.4	1,875.4
Western Section	323.4	730.5	1,053.9
S PENINSULA DISTRICT TOTALS	746.4	2,183.0	2,929.4

Appendix C3.–Standard trawl survey locations, stations, station areas, and strata designations by section in the Chignik District.

CHIGNIK DISTRICT												
Chignik Bay			Ivanof Bay			Kujulik Bay			Mitrofania Island		
Station	KM^2	Stratum	Station	KM^2	Stratum	Station	KM^2	Stratum	Station	KM^2	Stratum
4256	22.5	low	4000X	5.6	high	4290	21.3	low	4038A	43.7	low
4262	21.4	high	4000Y	15.8	low	4296	10.3	low	4038B	43.7	low
4264	19.7	high	4900X	10.4	low	4298	19.0	low	4050A	25.9	high
4265	6.6	low	4007	37.2	low	4301	21.4	low	4050B	42.9	high
4266	19.6	low	4008	42.1	high	4302	18.2	low	4066A	43.6	low
4267	21.4	low	4915	51.0	low	4308	17.2	low	4066B	43.6	high
4270	17.1	high	Total	162.1		Total	107.3		4024	57.6	low
4271	10.0	high							4025	43.7	high
4272	15.9	low							4026	43.7	low
4274	21.4	low							4035	59.3	low
4277	21.4	high							4036	64.9	high
4278	21.4	high							4037	43.7	high
4282	21.4	low							4048	17.6	low
4286	21.4	low							4049	57.2	low
4287	28.5	high							4063	34.3	high
4312	21.9	high							4064	38.6	low
4964	9.6	low							4065	80.0	low
Total	321.5								Total	783.9	

	High	Low	
CHIGNIK DISTRICT TOTAL	508.0	866.7	1,374.8 km^2

Appendix C4.–Standard trawl survey locations, stations, and station areas by section in the Eastern Aleutian District.

EASTERN ALEUTIAN DISTRICT					
Unalaska/Kalekta Bay Section		Makushin Bay Section		Akutan Bay Section	
Station	KM^2	Station	KM^2	Station	KM^2
KAA	19.5	MKB	15.8	AKA	33.2
UNC	22.6	MKC	18.5	AKC	21.2
UND	11.7	MKE	29.1	AKD	22.5
UNE	17.9	MKF	20.9	AKG	21.4
UNF	21.4	MKJ	22.9	AKL	21.4
UNG	21.4	MKK	35.7	Total	119.7
UNI	19.7	MKN	26.2		
UNJ	21.4	MKP	11.1		
Total	155.7	Total	180.2		

E. ALEUTIAN DISTRICT TOTAL	455.6 km^2

APPENDIX D. ANNUAL ABUNDANCE ESTIMATES USED TO CALCULATE LONG-TERM AVERAGES OF MATURE MALES AND MATURE FEMALES

Appendix D1.–Annual Tanner crab abundance estimates from standard large-mesh trawl survey stations, from the Northeast, Eastside, and Southeast Sections of the Kodiak District, 1988–2021.

	Northeast Section		Eastside Section		Southeast Section	
Year	Mature females	Mature males	Mature females	Mature males	Mature females	Mature males
1988	262,210	571,572	948,148	1,348,530	301,126	1,497,580
1989	4,939,395	4,025,658	3,848,293	2,886,755	309,196	641,186
1990	2,560,819	1,682,649	8,133,531	5,350,857	627,862	892,587
1991	2,545,040	2,546,525	3,737,767	5,556,840	880,696	545,852
1992	1,631,791	1,289,639	1,962,597	2,473,788	1,455,288	866,883
1993	1,338,631	1,130,377	1,513,905	1,479,100	670,671	599,581
1994	1,486,509	779,104	603,774	784,094	435,554	897,413
1995	1,587,960	616,234	505,127	526,018	113,132	213,111
1996	2,977,052	620,235	930,860	1,160,366	139,953	260,793
1997	1,198,758	758,310	702,443	1,008,451	140,123	94,629
1998	2,369,060	1,746,680	2,462,612	3,008,254	131,980	287,953
1999	843,819	980,721	1,468,368	2,965,521	158,565	393,448
2000	1,497,823	1,355,263	3,360,677	3,032,535	351,683	331,852
2001	4,872,782	1,913,744	3,120,678	2,317,280	2,916,396	593,186
2002	2,385,993	1,986,305	6,458,222	2,770,747	1,402,954	743,387
2003	2,768,937	3,393,826	7,788,055	5,862,401	479,052	1,125,951
2004	4,341,339	3,075,082	2,426,489	9,977,292	359,706	1,947,612
2005	3,094,315	3,861,910	3,323,708	10,472,686	539,266	1,798,628
2006	1,872,655	1,221,211	577,341	7,515,193	1,572,271	1,415,213
2007	1,996,481	2,183,127	2,400,426	5,463,079	2,445,077	1,355,959
2008	3,056,613	2,091,363	14,169,100	3,731,278	1,641,791	1,472,586
2009	1,906,899	3,412,592	8,962,996	14,671,408	939,917	3,967,263
2010	3,961,144	3,002,614	6,443,398	14,697,669	1,195,022	6,064,520
2011	958,253	1,163,572	2,619,678	6,683,339	390,434	3,769,229
2012	583,658	755,231	523,392	6,419,655	114,050	2,165,325
2013	949,935	330,283	543,559	1,748,149	323,643	977,376
2014	3,950,097	490,866	1,677,985	879,619	3,226,074	2,048,689
2015	1,558,014	247,269	3,578,998	795,897	791,228	772,713
2016	1,372,060	302,927	8,881,758	5,779,760	840,166	1,258,629
2017	1,603,646	428,345	3,886,433	5,267,217	711,967	689,474
2018	2,209,531	509,235	5,856,343	6,207,283	4,722,072	1,824,560
2019	4,395,623	964,771	18,676,436	3,377,273	10,139,319	3,870,476
2020	1,848,289	653,787	28,496,323	7,266,442	5,236,504	4,259,196
2021	396,565	281,220	15,935,781	22,477,378	1,480,352	6,118,583
1988–2021 Average	2,215,344	1,481,537	5,191,918	5,175,357	1,387,738	1,640,042

Appendix D2.–Annual Tanner crab abundance estimates from standard large-mesh trawl survey stations, from the Southwest, Westside, and North Mainland Sections of the Kodiak District, 1988–2021.

	Southwest Section		Westside Section		North Mainland Section	
Year	Mature females	Mature males	Mature females	Mature males	Mature females	Mature males
1988	126,429	1,604,766	609,564	487,815	867,092	2,288,314
1989	151,353	554,993	575,421	483,780	1,434,812	1,705,844
1990	519,396	385,898	2,350,880	701,900	3,197,847	1,747,944
1991	162,354	548,952	618,513	535,955	1,106,702	1,136,039
1992	197,141	577,308	418,713	479,628	896,890	1,179,810
1993	233,856	724,588	672,382	484,172	1,019,024	1,157,706
1994	120,526	304,198	249,972	165,276	533,479	671,950
1995	68,346	144,748	420,188	254,255	246,196	252,450
1996	45,960	347,649	421,359	378,273	390,440	559,455
1997	66,519	395,842	682,839	440,573	265,381	906,791
1998	37,362	173,627	656,294	323,585	250,939	486,079
1999	29,802	276,300	306,353	363,697	272,095	769,437
2000	69,070	293,624	674,077	418,586	547,394	470,999
2001	280,644	400,926	868,407	565,960	583,029	597,069
2002	909,203	558,684	793,843	507,089	669,608	258,554
2003	305,945	1,502,923	1,624,911	808,588	1,011,730	307,992
2004	313,925	2,232,309	525,466	455,836	290,338	517,118
2005	180,702	1,361,506	612,815	368,167	606,567	336,180
2006	644,842	1,221,189	1,979,145	752,465	1,929,966	344,426
2007	1,387,764	1,957,143	1,230,371	638,267	244,836	325,855
2008	3,793,789	1,116,003	1,684,296	1,748,965	109,041	291,713
2009	2,260,145	3,726,999	1,637,049	1,080,465	185,968	576,200
2010	3,224,059	3,447,935	1,160,732	694,703	286,253	399,326
2011	687,372	1,514,822	607,315	375,006	158,917	552,415
2012	699,003	1,125,293	616,216	287,504	58,383	482,792
2013	231,582	712,043	752,124	260,524	434,824	295,783
2014	355,607	586,320	1,304,612	656,107	59,308	201,925
2015	1,080,845	581,810	422,111	231,923	307,366	561,949
2016	1,322,223	1,021,218	1,171,040	224,298	758,341	447,213
2017	340,237	1,631,458	1,200,544	310,470	143,940	566,001
2018	145,746	790,652	1,872,830	637,141	967,180	642,724
2019	3,012,419	437,182	1,862,373	404,173	662,398	614,026
2020	1,828,282	1,382,473	1,227,762	474,665	326,047	353,236
2021	1,225,917	4,355,728	498,680	227,951	no survey	
1988–2021 Average	766,422	1,117,562	950,270	506,699	630,980	666,828

Appendix D3.–Annual Tanner crab abundance estimates from standard large-mesh trawl survey stations, from the Eastern and Western Sections of the South Peninsula District and the Chignik District, 1988–2021.

	South Peninsula District Eastern Section		South Peninsula District Western Section		Chignik District	
Year	Mature females	Mature males	Mature females	Mature males	Mature females	Mature males
1988	961,658	1,100,109	438,034	502,305	no survey	
1989	2,518,101	674,984	963,394	268,498	1,734,782	1,426,274
1990	3,357,994	760,103	1,847,374	699,997	795,266	1,500,351
1991	908,502	520,574	1,129,190	800,837	1,060,801	728,085
1992	427,701	252,855	1,035,436	476,037	866,262	205,204
1993	275,118	411,406	827,620	690,038	451,662	574,241
1994	145,677	299,547	534,309	375,084	290,372	425,119
1995	no survey		no survey		308,040	746,743
1996	60,432	117,313	251,384	178,789	358,444	1,609,101
1997	416,196	140,134	149,581	187,260	801,986	1,213,522
1998	380,838	547,539	2,204,896	738,395	1,460,024	875,420
1999	173,841	285,474	651,138	1,260,301	314,802	1,639,063
2000	290,000	416,858	1,140,758	1,819,855	1,031,556	2,337,289
2001	372,959	271,704	479,387	925,025	1,364,465	1,704,071
2002	856,773	665,267	1,981,120	970,317	989,644	1,559,886
2003	569,269	629,724	2,161,132	765,543	910,174	1,242,119
2004	618,102	867,082	1,938,906	2,963,930	1,325,995	2,863,071
2005	528,948	682,158	3,979,937	2,204,150	1,463,081	1,377,257
2006	1,940,704	1,025,884	2,527,311	1,836,442	1,048,996	1,297,920
2007	3,646,350	1,548,304	4,988,172	3,396,263	1,463,121	855,850
2008	10,385,475	4,883,016	16,930,396	4,276,817	2,139,686	1,968,363
2009	14,428,411	12,652,645	4,366,830	11,778,129	4,112,240	5,021,390
2010	6,861,773	11,240,643	5,730,927	12,598,836	2,413,529	10,731,099
2011	1,587,209	3,590,263	2,695,694	5,974,409	888,452	5,529,196
2012	639,870	2,655,624	931,925	2,342,190	321,059	1,593,938
2013	478,141	703,085	195,746	931,773	222,780	1,604,069
2014	638,428	809,603	1,842,651	2,301,239	288,709	1,809,143
2015	916,972	1,310,382	2,467,296	1,738,502	1,840,091	1,082,898
2016	2,988,688	1,367,959	3,249,118	3,420,582	335,462	608,458
2017	729,622	406,189	410,469	733,065	687,006	330,967
2018	770,785	382,447	907,277	1,038,304	1,497,832	778,703
2019	4,594,010	612,214	5,661,183	1,213,950	5,266,293	1,160,365
2020	5,109,877	1,837,154	11,687,289	3,058,249	4,143,481	2,316,843
2021	1,414,074	4,634,673	3,324,840	9,493,181	2,389,400	5,026,553
1988–2021 Average	2,120,985	1,766,755	2,716,082	2,483,585	1,351,076	1,931,593

Appendix D4.–Annual Tanner crab abundance estimates from standard large-mesh trawl survey stations, from the Eastern Aleutian District, 1988–2021.

	Akutan Section		Unalaska/Kalekta Section		Makushin/Skan Section	
Year	Mature females	Mature males	Mature females	Mature males	Mature females	Mature males
1988	no survey		no survey		no survey	
1989	no survey		no survey		no survey	
1990	771,965	161,215	359,538	57,186	312,832	154,041
1991	578,257	398,197	137,467	34,933	220,808	159,788
1992	no survey		no survey		no survey	
1993	no survey		no survey		no survey	
1994	2,894	37,709	1,466	4,481	155,632	141,799
1995	5,696	108,472	8,697	3,673	84,784	61,019
1996	no survey		no survey		no survey	
1997	no survey		no survey		no survey	
1998	no survey		no survey		no survey	
1999	677,297	1,245,242	194,469	482,151	78,128	53,512
2000	243,581	427,004	1,088,738	225,222	188,763	25,246
2001	no survey		no survey		no survey	
2002	no survey		no survey		no survey	
2003	675,379	217,868	7,655	672,619	1,142,005	742,797
2004	988,764	258,956	136,330	108,910	683,605	781,799
2005	501,657	332,160	212,212	86,227	227,137	680,283
2006	134,799	270,382	372,419	723,336	137,178	245,415
2007	245,733	361,540	1,997,301	638,663	986,509	301,420
2008	149,953	293,474	1,990,322	718,758	1,384,632	329,040
2009	914,999	500,062	1,306,064	501,010	1,754,159	250,045
2010	228,100	404,649	386,350	10,542	165,486	274,705
2011	288,007	207,387	253,897	49,645	251,857	304,332
2012	379,431	145,476	503,997	625,835	293,261	130,897
2013	69,112	85,229	690,494	155,396	779,459	179,530
2014	1,644,330	467,082	157,234	196,112	690,640	272,424
2015	193,663	13,017	94,026	175,552	454,918	203,114
2016	414,308	74,854	8,842	14,865	1,002,701	150,736
2017	3,888,787	106,961	56,016	65,317	660,675	292,866
2018	891,867	40,697	399,940	253,449	1,673,816	250,735
2019	215,326	6,530	771,536	46,523	1,098,136	138,394
2020	no survey		no survey		no survey	
2021	429,052	27,404	105,050	7,150	1,624,438	467,402
1988–2021 Average	605,540	257,982	468,336	244,065	668,815	274,639