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Alaska Department of Fish and Game Summary of the 2005/2006 Mandatory Shellfish Observer Program Database for the Rationalized Crab Fisheries

by

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and

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February 2007

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fish**

Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

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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TABLE OF CONTENTS

Page

LIST OF TABLES

Table **Page**

LIST OF FIGURES

Figure **Page**

LIST OF FIGURES (Continued)

LIST OF APPENDICES

LIST OF APPENDICES (Continued)

ABSTRACT

Since 1988, the Alaska Department of Fish and Game has required varying levels of observer coverage aboard vessels participating in Bering Sea and Aleutian Islands (BSAI) crab fisheries. This report summarizes data collected in the 2005/2006 rationalized BSAI crab fisheries by shellfish observers deployed on catcher-processor vessels, floater-processor vessels, and catcher-only vessels. The data summaries include catch rates of targeted species by soak time and depth, female reproductive condition, total bycatch from sampled pot lifts, estimates and standard errors of catch per unit effort, retained male catch size frequency distributions, legal tally sample results, and sample pot lift locations by fishery. In the 2005/2006 rationalized fisheries, commercially harvested crab species include golden king crab *Lithodes aequispinus* from the Aleutian Islands, and red king crab *Paralithodes camtschaticus,* snow crab *Chionoecetes opilio* and Tanner crab *C. bairdi* from the Bering Sea.

Key words: Alaska Department of Fish and Game, Bering Sea, Aleutian Islands, shellfish observers, database summary, golden king crab *Lithodes aequispinus,* red king crab *Paralithodes camtschaticus,* snow crab *Chionoecetes opilio,* and Tanner crab *C. bairdi*.

INTRODUCTION

Regulations adopted by the Alaska Board of Fisheries (BOF) in 1999 have provided the Alaska Department of Fish and Game (ADF&G) with the full authority and responsibility for deploying onboard observers on any vessel participating in the commercial Bering Sea and Aleutian Islands (BSAI) crab fisheries or in any fishery conducted under a commissioner's permit as necessary for fishery management and data-gathering needs. Those regulations required deployment of observers on all vessels that process Tanner crab *Chionoecetes spp.*, red king crab *Paralithodes camtschaticus*, blue king crab *P. platypus*, or golden king crab *Lithodes aequispinus*. Additionally, those regulations charged ADF&G with deploying observers as needed on catcher-only vessels participating in commercial BSAI king and Tanner crab fisheries (excluding those of Norton Sound and St. Lawrence Island Sections). ADF&G (*In prep*) provides details on the regulations pertaining to the State of Alaska Shellfish Onboard Observer Program and a history of that program from its inception in 1988.

In March 2005 new federal regulations were issued to establish the BSAI Crab Rationalization Program according to the provisions adopted by the North Pacific Fishery Management Council (NPFMC) in Amendments 18 and 19 to the Fishery Management Plan for the commercial king and Tanner crab fisheries in the BSAI (NPFMC/NMFS 2006). The Crab Rationalization Program established a quota system for allocating the entire harvest in each of the Bristol Bay red king crab, St. Matthew blue king crab, Pribilof red and blue king crab, Bering Sea snow crab *Chionoecetes opilio*, Bering Sea Tanner crab *C. bairdi*, Eastern Aleutian Islands golden king crab, Western Aleutian Islands golden king crab, and Western Aleutian Islands red king crab fisheries. With implementation of the Crab Rationalization Program, ADF&G now establishes a total allowable catch (TAC) for each fishery according to state regulations and the National Marine Fisheries Service (NMFS) distributes the TAC as quota shares (QS), with 10% of the TAC allocated to the community development quota (CDQ) and the remaining 90% of the TAC allocated to qualifying vessels as individual fishing quotas. ADF&G no longer manages the rationalized fisheries inseason; harvesters may harvest their QS at any time within the fishery seasons established in state regulations. The 2005/2006 commercial fishery season was the first to be prosecuted under the new Crab Rationalization Program.

Observers collect biological data from the catch in sampled pot lifts and from samples of retained or delivered catch, document vessel catch, bycatch, and effort, and monitor vessel

activities for regulatory compliance. Those data are used in management and research applications to develop stock-assessment models, to estimate the magnitude and composition of bycatch, to chronicle female reproductive cycles, and as an aid in preseason and inseason projections of fishery performance. ADF&G Westward Region staff maintains a database of data collected by observers that includes gear types fished, pot-lift locations and soak times, and species composition, size distribution, and reproductive condition in sampled catches. That database provides a source of information crucial to the comprehensive management of Alaska's shellfish resources in the Bering Sea and Aleutian Islands.

This report summarizes data collected by onboard observers during the commercial crab fisheries that began after the implementation of the BSAI Crab Rationalization Program in August of 2005. Those fisheries were: the 2005/2006 Bering Sea snow crab fishery; the 2005/2006 Bering Sea Tanner crab fishery; the 2005/2006 Bristol Bay red king crab fishery, and the 2005/2006 Aleutian Islands golden king crab fisheries east and west of 174° W longitude. Under the rationalization program, observer vessel coverage was increased for the Bering Sea snow and Tanner crab fisheries and the Bristol Bay red king crab fishery. Observer coverage was reduced for Aleutian Islands golden king crab fisheries.

Due to the substantial volume of available information, the scope of the data presented here has been narrowed. For each fishery, this report includes estimates of catch and bycatch of crabs from sampled pot lifts, information on the sizes and shell conditions of retained crabs and crabs captured as bycatch, and summaries of the catch composition for all species encountered in sampled pot lifts.

METHODS

Comprehensive shellfish observer sample methods are outlined in the most recent edition of the ADF&G Shellfish Observer Field Manual (ADF&G 2003). Methods described in this report correspond only to the data presented and are not inclusive of all observer sampling duties. As in previous seasons, observers were deployed on all catcher-processor and floating-processor vessels that participated in each of the reported fisheries. Observers were also deployed on randomly selected catcher-only vessels that participated in the Bering Sea snow crab fishery, Bering Sea Tanner crab fishery, and the Bristol Bay red king crab fishery. Observers were deployed on approximately 30% of catcher-only vessels participating in the Bering Sea snow crab and Tanner crab fisheries, and 20% of the catcher-only vessels participating in the Bristol Bay red king crab fishery. In the Aleutian Islands golden king crab fisheries, all catcher-only vessels were required to carry an observer for at least 50% of their assigned quota caught and landed in each three-month trimester of the nine month season.

TERMS

For the purposes of this report, terms related to the discussion of sampled crabs and observer sampling duties are defined as follows:

Pot-lift sample – A randomly selected pot lift from which crabs of all species captured are identified and enumerated, and, from a subset of the selected pot lifts, measurements and assessments of ancillary characteristics are recorded from crabs of selected species.

Legal tally – Examination of up to 600 crabs randomly selected from the retained catch to assure regulatory compliance regarding the retention of crabs by species, size, and sex.

Carapace length (CL) – The biological size measurement of all species of king crabs and hair crabs *Erimacrus isenbeckii* taken as the straight-line distance from the posterior margin of the right eye orbit to the medial-posterior carapace margin.

Carapace width (CW) – The biological size measurement of all species of *Chionoecetes* taken as the greatest straight-line distance perpendicular to a line midway between the eyes to the medial-posterior margin, not including the spines.

Legal measurement – The greatest straight-line distance across the carapace of male crabs, including the spines, at a right angle to a line midway between the eyes to the medial-posterior margin.

Size frequency sample – Biological measurements of up to 100 randomly selected retained crabs for the purpose of determining carapace size and shell condition distribution.

Catch per unit effort (CPUE) – The mean catch (number) of crabs for a standardized unit of fishing effort; in this report CPUE represents the mean catch per pot lift.

Shell condition (or age) is recorded to provide an estimate of the time since a crab's last molt (ADF&G 2003; Jadamec et al. 1999; Donaldson and Byersdorfer 2005). Observers scored the shell condition of sampled crabs as either "soft", "new pliable", "new", "old", or "very old" on the basis of the presence and amount of abrasions, discoloration, and wear on the ventral surfaces, the presence and amount of epibionts on the dorsal surface, the color of the dorsal surface, and the degree of wear on spines and dactyls.

Soft-shell – Exoskeleton is not yet hardened, 0 to 2 weeks after molting.

New pliable-shell – Exoskeleton is thin, flexible and not fully calcified, 2 to 8 weeks after molting.

New-shell – Exoskeleton estimated to be 8 weeks to 12 months old (8 weeks to 18 months for golden king crabs).

Old-shell – Exoskeleton estimated to be more than 12 months and up to 24 months old (up to 36 months for golden king crabs).

Very old-shell – Exoskeleton estimated to be more than 24 months old (more than 36 months old for golden king crabs).

Uneyed eggs – Early developmental stages of an egg with no distinguishing markings.

Eyed eggs – Later developmental stages of an egg distinguished by dark eye spots.

Ovigerous –	Bearing eggs, either eyed or uneyed (pertaining to female crabs).
Mated/barren –	Not carrying eggs but displaying evidence of previous mating activity (pertaining to female crabs).
Non-mated/barren –	Not carrying eggs and not displaying evidence of previous mating activity (pertaining to female crabs).
Recruit –	New-shell male crab of legal size in its first year of availability to the commercial fishery.
Post-recruit –	All old-shell male crabs of legal size and all new-shell male crabs one or more molts larger than recruit size.

SAMPLING DUTIES

During the 2005/2006 BSAI crab fisheries, observers were deployed on floater-processor vessels, catcher-processor vessels, and catcher-only vessels. Observers deployed on floater-processors had access only to previously-sorted, retained catches, whereas observers placed on catcher-processor and catcher-only vessels were able to examine the contents of pot lifts prior to sorting.

Floater-Processors

Observers deployed on floater-processors primarily monitor deliveries from catcher-only vessels. Sampling duties during each delivery included obtaining a size frequency sample and conducting a legal tally.

Catcher-Processors

Sampling duties for observers deployed on catcher-processors included size frequency sampling, legal tally sampling from the retained catch, pot-lift sampling, and determination of average crab weight for each day the vessel retains catch. Occasionally, catcher-only vessels delivered to a catcher-processor. In those situations, the observer sampled the catcher-only vessel catch as if deployed on a floater-processor.

Catcher-Only Vessels

Sampling duties for observers deployed on catcher-only vessels included pot-lift sampling, which was usually the main sampling activity for each day the vessel retained catch. When the vessel delivered to a processing facility (at-sea or on-shore), the observer obtained a size frequency sample, conducted a legal tally, and determined average crab weight. If deliveries were made at-sea, all sampling was completed by the observer deployed on the catcher-only vessel.

Attaining daily sampling goals for observers on board catcher-processor and catcher-only vessels (e.g., quantity of pot-lift samples conducted) was dependent upon a number of variables unique to each fishery and year. These variables include weather, catch rates, research data collection projects, and the order of sampling priorities established by ADF&G.

For ease of reading, 2005/2006 fishery specific methods, results, and discussions are combined in the results section of this report. Inconsistencies between previously published shellfish observer database reports and results presented here are due to correction of errors and more complete interpretation of historical data.

ESTIMATION OF CPUE AND TOTAL FISHERY CATCH

Estimates of CPUE and their standard errors were generated using weighted mean and variance formulas for stratified sampling (Cochran 1977; Appendices A1 and A2). With this technique, each vessel-day was considered a separate stratum where the weighting reflected the relative importance of each vessel's daily effort (number of pot lifts) compared to the vessel's total effort. The greater the number of pot lifts on a given day, the greater the weight given to the samples collected on that day. Variances were calculated for each vessel-day then summed over all vessels and all days for the entire fishery. In fisheries with partial coverage of catcher-only vessels, vessels were stratified by vessel type (catcher-only versus catcher-processor) to account for differences in observer coverage levels (see Appendix A2).

Different estimates of CPUE were calculated depending on the information available. The "stratified CPUE" with standard error estimate used the Cochran stratified technique as described above and in Appendices A1 and A2. The "sample CPUE" was generated from observer data and is based solely on the pot lifts sampled and was calculated as total catch from the sampled pot lifts divided by the total number of sampled pot lifts. This estimate was reported in observer reports prior to 1996 (e.g., Tracy 1994, 1995a, b). The stratified estimates outlined in Appendix A1 were introduced in this report series in 1996, and the additional vessel-type stratum described in Appendix A2 was introduced in 2003. The "actual total fishery (ATF) CPUE" was based on fish ticket information reported in the annual management reports for commercial crab fisheries in the BSAI management areas. The ATF CPUE was generated for retained legal crabs only.

Estimated total catch was calculated by multiplying a CPUE estimate by the total number of pot lifts in the fishery. For fisheries with 100% observer coverage, the total pot lifts information is taken from confidential interviews. Otherwise, total pot lifts data are generated from fish ticket summaries.

When viewing CPUE estimates for the directed catch and bycatch, the precision and accuracy of the estimates should be noted. Precision is indicated by the standard error estimates. Accuracy may be gauged by the similarity of the estimates for legal retained crabs obtained from observer data to those obtained from confidential interviews and fish tickets. The reader should take note of whether the CPUE and total catch estimates provided here were based on data gathered by observers deployed on all participating fishing vessels, on a representative sample of all fishing vessels, or on catcher-processor vessels only. The application of CPUE estimates obtained from catcher-processor vessels to the entire fishing fleet assumes that catch rates for that distinct portion of the fleet are comparable to the remaining catcher-only vessel component of the fleet.

RESULTS

BERING SEA SNOW CRAB

During the 2005/2006 fishing season, observers were deployed on 4 catcher-processor vessels, 2 floating-processor vessels, and 27 of 74 catcher-only vessels participating in the fishery. The pot-lift sampling goals for observers on catcher-processors was 4 pot lifts during each day of fishing activity. The pot-lift sampling goal for observers on catcher-only vessels was 6 pot lifts during each day of fishing activity. The season opened 15 October 2005, fishing began in November and continued until 27 May 2006. Most of the effort took place from January through April 2006. A total of 2,578 pot lifts selected for sampling accounted for 2.1% of the 120,512 pot lifts

reported by vessel operators (ADF&G *In prep*). The locations of pot lifts sampled by observers during the 2005/2006 Bering Sea snow crab fishery are displayed in Appendix B1.

Measurements of CW for size frequency samples were taken from 40,416 retained male snow crabs throughout the season by onboard observers and ADF&G staff stationed at shore-side processing locations (Table 1). The mean CW of retained male snow crabs was 116.6 mm.

Measurements of CW from pot-lift samples were taken from 126,037 male snow crabs throughout the season by onboard observers. The mean CW for male snow crabs from sampled pot lifts was 109.7 mm. The size frequency distribution revealed a prominent mode between 111 and 120 mm (Figure 1). The percentage of male snow crabs sampled that were categorized as old shell and very-old shell was 17.5%. Measurements of CW were taken from 132 female snow crabs during pot-lift sampling and the mean CW was 63.6 mm with 59.8% being categorized as old and very-old shell.

The stratified CPUE estimate of 201.5 legal retained snow crabs per pot lift (Table 2) was a 21.1% decrease from the 2005 pre-rationalization fishery CPUE estimate (Figure 2). The stratified CPUE estimate of 201.8 (SE = 11.7) for all legal retained crabs (including Tanner x snow crab hybrids) was a 22.2% decrease from 2005. The precision of the stratified CPUE estimate was good for all legal retained crabs; the standard error was 5.8% of the estimated mean. The 95% confidence interval for the CPUE of legal retained crabs estimated from sampled pot lifts was 178.6 to 224.5 crabs per pot lift. This interval included the ATF CPUE of 204, indicating that the sampled pot lifts were representative of the total fishery. Approximately 30% of the total catch of snow crabs were legal-sized male crabs < 102 mm (4 inches) and were discarded as bycatch. Although the minimum legal size for snow crabs was 79 mm (3.1 inches) CW, processing plants generally do not accept crabs < 4 inches CW. Sublegal male and female snow crabs made up less than 2% of the total catch and 6% of the bycatch.

Total catches of all animals identified in sampled pot lifts during the 2005/2006 season are provided in Appendix C1. Additional appendices contain CPUE by soak time (Appendix C2) and depth (Appendix C3), and the reproductive condition of female snow crabs in pot-lift samples (Appendix C4).

Legal tallies conducted on catcher-processors and catcher-only vessels delivering to processors totaled 61,065 crabs, which accounted for 0.25% of the cumulative reported harvest (Appendix D1). Of all sampled crabs, 0.44% were illegal, either due to size, sex, or species.

BERING SEA TANNER CRAB

The Bering Sea Tanner crab fishery was closed following the 1996 season due to poor fishery performance and low estimated abundances of legal male Tanner crabs. The fishery was allowed to proceed in 2005/2006 west of 166° W longitude after minimum stock thresholds were met. During the 2005/2006 fishery, observers were deployed on 4 of 6 catcher-only vessels registered to take directed catch in the Bering Sea Tanner crab fishery. The Tanner crab fishery was conducted concurrently with the Bering Sea snow crab fishery and regulations permit properly licensed vessels fishing for snow crab to retain legal male Tanner crabs as incidental catch. The pot-lift sampling goal for observers on catcher-processors was 4 pot lifts during each day of fishing activity. The pot-lift sampling goal for observers on catcher-only vessels was 6 pot lifts during each day of fishing activity. The season opened 15 October 2005, fishing began in November and continued until the season closed 31 March 2006. A total of 160 pot lifts selected

for pot-lift sampling accounted for 4.1% of the 3,948 pot lifts reported by vessel operators in the directed fishery (ADF&G *In prep*). The locations of pot lifts sampled by observers during the 2005/2006 Bering Sea Tanner crab fishery are displayed in Appendix B2.

Size frequency sample measurements of CW were taken from 705 retained male Tanner crabs throughout the directed-catch season by onboard observers and ADF&G staff stationed at shore-side processing locations (Table 3). The mean CW of retained male Tanner crabs was 144.5 mm. Additional size frequency sample measurements taken from 2,601 incidentally retained male Tanner crabs throughout the Bering Sea snow crab season by onboard observers and ADF&G staff stationed at shore-side processing locations resulted in a mean CW of 143.3 mm for retained male Tanner crabs.

Pot-lift sample measurements of CW were taken throughout the season by onboard observers from 9,792 male Tanner crabs captured in the Bering Sea snow crab fishery and 19,762 male Tanner crabs captured in the directed Bering Sea Tanner crab fishery (Figure 3). The mean CW for male Tanner crabs from pot lifts sampled from the Bering Sea snow crab fishery was 119.1 mm, and the mean CW was 130.1 mm from the Bering Sea Tanner crab fishery. Pot-lift sample measurements of CW were taken throughout the season by onboard observers from 386 female Tanner crabs from the Bering Sea snow crab fishery and 1,108 female Tanner crabs from the Bering Sea Tanner crab fishery (Figure 4). The mean CW for female Tanner crabs from sampled pot lifts in the Bering Sea snow crab fishery was 85.6 and the mean CW was 90.7 mm for female Tanner crabs from the Bering Sea Tanner crab fishery.

The stratified CPUE estimate in the directed Tanner fishery was 46.4 legal retained Tanner crabs per pot lift (Table 4). The precision of the stratified CPUE estimate for all legal retained crabs was fair; the standard error was 10.6% of the estimated mean. The 95% confidence interval for the CPUE for legal retained crabs estimated from the sampled pot lifts was 36.8 to 56.0 crabs per pot lift. This interval does not include the ATF CPUE of 12. This was likely due to approximately half the landed catch coming from the Bering Sea snow crab fishery where the estimated CPUE was 1.6 legal crabs per pot lift (Table 2). An estimated 68% of all Tanner crabs captured during the 2005/2006 directed fishery were sublegal male crabs and were discarded as bycatch.

Summaries of CPUE by soak time and depth for Tanner crabs caught incidentally during the 2005/2006 Bering Sea snow crab fishery can be found in Appendices C5 and C6, respectively. Total catches of all animals identified in sampled pot lifts during the 2005/2006 Tanner crab directed fishery are provided in Appendix C7. Additional appendices contain CPUE by soak time (Appendix C8) and depth (Appendix C9) and the reproductive condition of female Tanner crabs from the bycatch (Appendix C10).

Legal tallies conducted on catcher-only vessels delivering to processors totaled 2,700 crabs by the end of the 2005/2006 season and comprised 0.7% of the cumulative reported harvest (Appendix D1). From all sampled crabs, 0.74% were illegal, either due to size, sex, or species.

BRISTOL BAY RED KING CRAB

Observers were deployed on 4 catcher-processor vessels, 1 floating-processor vessel, and 20 of 85 catcher-only vessels during the 2005/2006 rationalized fishery. The bycatch-sampling goal for observers on catcher-processors and catcher-only vessels was 10 pot lifts during each day of fishing activity. Fishing began on 15 October 2005 and continued until 16 January 2006. A total

of 1,855 pot lifts selected for bycatch sampling accounted for 1.6% of the 114,949 pot lifts reported by vessel operators (ADF&G *In prep*). Locations of pot lifts sampled by observers during the 2004 Bristol Bay red king crab fishery are displayed in Appendix B3.

Size frequency sample measurements of CL were taken from 27,971 retained male red king crabs throughout the season by onboard observers and ADF&G staff stationed at shore-side processing locations (Table 5). The mean CL of retained male red king crabs was 152.3 mm.

Bycatch sample measurements of CL were taken from 94,641 male red king crabs throughout the season by onboard observers. The mean CL for all male red king crabs from sampled pot lifts was 138.2 mm. The size frequency distribution of these measurements reveals a prominent mode between 151 and 155 mm (Figure 5). The percentage of old-shell and very-old-shell male red king crabs in bycatch samples was 16.9%. Measurements of CL were taken from 26,784 female red king crabs (Figure 6). The mean CL for all female red king crabs from sampled pot lifts was 116.4 mm.

The stratified CPUE estimate of 23.8 legal retained red king crabs per pot lift (Table 6) was a 3.0% increase from the 2004 general fishery estimate (Figure 7). The precision of the stratified CPUE estimate was good for all legal retained crabs; the standard error was 6.8% of the estimated mean. The 95% confidence interval for the CPUE for legal retained crabs estimated from the sampled pot lifts was 20.6 to 27.0 crabs per pot lift. This interval includes the ATF CPUE of 24, indicating the sampled pot lifts were representative of the total fishery. An estimated 47% of all male red king crabs captured during the 2005/2006 fishery were discarded due to minimum size regulations. An estimated 20% of legal male red king crabs were discarded during the fishery (Barnard and Pengilly 2006).

Total catches of all animals identified in sampled pot lifts during the 2005/2006 season are provided in Appendix C11. Additional appendices contain CPUE by soak time (Appendix C12), depth (Appendix C13), and the reproductive condition of female red king crabs from bycatch samples (Appendix C14).

Legal tallies conducted on catcher-processors and catcher-only vessels delivering to processors totaled 20,695 crabs by the end of the 2005/2006 season and comprised 0.8% of the cumulative reported harvest (Appendix D1). Approximately 0.42% were illegal due to size, sex, or species regulations.

ALEUTIAN ISLANDS GOLDEN KING CRAB

In March 1996, the BOF established the Aleutian Islands king crab registration area by combining the two existing areas, Dutch Harbor and Adak, and directed ADF&G to manage the golden king crab stocks of the Aleutians Islands east and west of 174° W longitude as two distinct stocks (ADF&G *In prep*). Results from the 2005/2006 fishery east of 174° W longitude and the 2005/2006 fishery west of 174° W longitude are reported here.

Aleutian Islands East of 174° W Longitude

During the 2005/2006 Aleutian Islands golden king crab fishery east of 174° W longitude, observers were deployed on 1 catcher-processor vessel and 6 catcher-only vessels. The bycatch-sampling goal for observers on catcher-only vessels was 14 pot lifts per fishing day and for observers on the catcher-processor the goal was 9 pot lifts per fishing day. Fishing began 15 August 2005 and continued until 28 March 2006. A total of 1,193 pot lifts selected for bycatch sampling accounted for 4.9% of the 24,559 pot lifts reported by vessel operators (ADF&G *In*

prep). The locations of pot lifts sampled by observers during the 2005/2006 Aleutian Islands golden king crab fishery east of 174° W longitude are displayed in Appendix B4.

Size frequency sample measurements of CL were taken from 2,063 retained male golden king crabs throughout the season by onboard observers and ADF&G staff stationed at shore-side processing locations (Table 7). The mean CL of retained male golden king crabs was 151.3 mm.

Bycatch sample measurements of CL were taken from 12,694 male golden king crabs throughout the season by onboard observers. The mean CL for all male golden king crabs from sampled pot lifts was 144.8 mm, a 5.5 mm increase over the 2004 season. The size and shell age frequency distributions of sublegal and legal male golden king crabs show a mode at a larger size (146-150 mm) than previous seasons (Figure 8). From bycatch samples, measurements of CL were taken from 1,521 female golden king crabs throughout the season by onboard observers. The mean CL for all female golden king crabs from sampled pot lifts was 119.3 mm (Figure 9).

The stratified CPUE estimate of 27.1 legal retained golden king crabs per pot lift (Table 8) was a 56.6% increase from the 2004 fishery estimate (Figure 10). The precision of the stratified CPUE estimate was good for all legal retained crabs; the standard error was 6.5% of the estimated mean. The 95% confidence interval for the CPUE for legal retained crabs estimated from the sampled pot lifts was 23.6 to 30.7 crabs per pot lift. This interval includes the ATF CPUE of 25, indicating the sampled pot lifts were representative of the total fishery. An estimated 34% of all golden king crabs captured during the 2005/2006 fishery were discarded as bycatch, a decrease in bycatch of 21% from 2004 (Figure 10).

Total catches of all animals identified in sampled pot lifts during the 2005/2006 season are provided in Appendix C15. Additional appendices contain CPUE by soak time (Appendix C16) and depth (Appendix C17), and the reproductive condition of female golden king crabs from the bycatch (Appendix C18).

Legal tallies conducted on catcher-processors and catcher-only vessels delivering to processors from both east and west of 174° W longitude totaled 67,177 crabs by the end of the 2005/2006 season and comprised 5.3% of the cumulative reported harvest (Appendix D1). From all sampled crabs, 0.54% were illegal, either due to size, sex, or species.

Aleutian Islands West of 174° W Longitude

During the 2005/2006 Aleutian Islands golden king crab fishery west of 174° W longitude, observers were deployed on 1 catcher-processor vessel and 2 catcher-only vessels. The bycatch-sampling goal for observers on catcher-only vessels was 10 pot lifts and for observer on the catcher-processor vessel was 5 pot lifts during each day of fishing activity. Fishing began 15 August 2005 and continued until 25 March 2006. A total of 1,370 pot lifts selected for bycatch sampling accounted for 4.6% of the 30,116 pot lifts reported by vessel operators (ADF&G *In prep*). The locations of pot lifts sampled by observers during the 2005/2006 Aleutian Islands golden king crab fishery west of 174° W longitude are displayed in Appendix B5.

Size frequency sample measurements of CL were taken from 11,983 retained male golden king crabs throughout the season by onboard observers and ADF&G staff stationed at shore-side processing locations (Table 9). The mean CL of retained male golden king crabs was 148.2 mm.

Bycatch sample measurements of CL were taken from 24,220 male golden king crabs throughout the season by onboard observers. The mean CL for all male golden king crabs from sampled pot lifts was 140.9 mm, 6.0 mm larger than 2004/2005. The size and shell age frequency

distributions of sublegal and legal male golden king crabs indicated fewer male crabs less than 100 mm relative to the 2004/2005 season (Figure 11). Bycatch sample measurements of CL were taken from 5,809 female golden king crabs throughout the season by onboard observers. The mean CL for all female golden king crabs from sampled pot lifts was 129.8 mm. The general size and shell age distributions and proportions of female golden king crabs show a mode at a larger size (136-140 mm) than the previous season (Figure 12).

The stratified CPUE estimate of 20.2 legal retained golden king crabs per pot lift (Table 10) was a 87% increase from the 2004/2005 fishery estimate (Figure 13). The precision of the stratified CPUE estimate was good for all legal retained crabs; the standard error was 6.3% of the estimated mean. The 95% confidence interval for the CPUE for legal retained crabs estimated from the sampled pot lifts was 17.7 to 22.7 crabs per pot lift. This interval includes the ATF CPUE of 21, indicating the sampled pot lifts were representative of the total fishery. An estimated 48% of all golden king crabs captured during the 2005/2006 fishery were discarded bycatch, a decrease in bycatch of 17% from the previous season (Figure 13).

Total catches of all animals identified in sampled pot lifts during the 2005/2006 season are provided in Appendix C19. Additional appendices contain CPUE by soak time (Appendix C20) and depth (Appendix C21), and the reproductive condition of female golden king crabs from the bycatch (Appendix C22).

Accuracy and Precision of CPUE Estimates

In using CPUE estimates based on observer data it was important to have some assessment of their reliability for observed vessels and, especially, for all vessels participating in a fishery. Although the observer data were the only source of information on bycatch CPUEs for the fisheries presented in this report, fish tickets also provided data for independent estimates of the CPUE of retained legal crabs. We can gain some understanding of the reliability of the CPUE estimated from observer sample data by comparing it to the ATF CPUE computed from fish ticket data.

Fish ticket data from all landings of all vessels participating in a fishery provided an independent estimate of the total fishery CPUE of retained legal crabs. This was particularly useful for fisheries in which observers were required on catcher-processor vessels and only a fraction of the catcher-only vessels.

With the exception of two fisheries, CPUE estimates for retained legal crabs computed from observer pot-lift samples were within 5% of the ATF CPUE for the reported fisheries (Table 11). The exceptions were the Bering Sea Tanner crab fishery and the Aleutian Islands golden king crab fishery east of 174° W longitude. Additionally, with one exception all ATF CPUEs were contained within the 95% confidence intervals for CPUEs derived from observer data. The close agreement between the observer-based estimates and the ATF CPUE for retained legal crab in those BSAI crab fisheries indicated that observer pot-lift sample data provide reliable estimates of CPUE for the entire fleet.

CPUE estimates computed from observer data for retained legal crabs in the 2005/2006 Bering Sea Tanner crab fishery (Table 4) differed from the ATF CPUE by 286.7% or 34.4 more crabs per pot lift. The directed Tanner crab fishery landed 49.7% of the total catch, the remaining 50.3% were landed in the Bering Sea snow crab fishery as incidental catch where the estimated legal male CPUE was 1.6 crabs per pot lift (Table 2). ATF CPUEs are calculated from the total catch divided by the total number of pot lifts. In this case, the total pot lifts from the snow crab

fishery that could be counted only for incidental catch of Tanner crabs is not clear. The other fishery with less reliable estimates was the Aleutian Islands golden king crab fishery (Table 10). The 8.4% difference between the observer CPUE estimate and the ATF CPUE, or 2.1 crabs per pot lift, represents 1.2 standard errors.

Comparing observer-based CPUE estimates for retained legal crabs with the ATF CPUE in the Bering Sea snow crab, the Bristol Bay red king crab, and the Aleutian Islands west of 174° W longitude golden king crab fisheries indicated the coverage provided adequate data for estimation of total fishery CPUE.

The "stratified" observer-based CPUE estimator used in this report was different from the "sample" observer-based CPUE estimate used in Mandatory Shellfish Observer Database Summaries prior to 1996 (e.g., Tracy 1994, 1995a, b). Although the stratified estimation method can provide more accurate and precise estimates, the stratified and sample CPUE estimates are generally very close to each other. Therefore, the stratified estimates presented here are comparable to those CPUE estimates included in previous observer data summaries. The value of using the stratified CPUE estimates was that the estimation method allows for computation of the standard errors of the CPUE estimates.

The standard errors provided in this report give a measure of the precision or repeatability of the CPUE estimates. A general measure of statistical precision was the ratio of the standard error of an estimate to the estimate itself; they are expressed here as a percent (ratio × 100%). Ratios that are less than 10% are considered to be acceptable for the estimates made using data collected by observers; 5% or less are desirable. Generally, the stratified CPUE estimates appeared to be precise for the 2005/2006 Bering Sea snow crab fishery, the Bristol Bay red king crab fishery, and the Aleutian Islands golden king crab fisheries east and west of 174° W longitude, as all ratios of standard errors to CPUE estimates were less than 10%. They ranged from a low of 5.8% for the Bering Sea snow crab fishery to 6.8% for the Bristol Bay red king crab fishery. The precision of the 2005/2006 Bering Sea Tanner crab CPUE estimates was less acceptable with a ratio of 10.6%. However, these estimates come from limited data (160 pot lifts from 4 vessels). We also computed 95% confidence intervals for the CPUE estimates even though the sample size within each stratum (vessel-day) was not large enough to assume an asymptotic normal distribution. However, bootstrap simulation of observer data collected in the 1995 BSAI crab fisheries suggested that the stratified CPUE estimates plus or minus two standard errors was adequate to characterize the true CPUE of the targeted species (Byrne and Pengilly 1998).

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TABLES AND FIGURES

Table 1.-Carapace width frequency distributions by shell age from biological measurements of retained snow crabs sampled during the 2005/2006 Bering Sea snow crab fishery.

Carapace width (mm)[a]	New	Old	Very old	All
	Percent	Percent	Percent	Percent
< 76	< 0.1	< 0.1	0	< 0.1
76-80	< 0.1	0	0	< 0.1
81-85	< 0.1	< 0.1	0	< 0.1
86-90	0.1	< 0.1	< 0.1	0.1
91-95	0.2	< 0.1	< 0.1	0.2
96-100	0.9	0.2	< 0.1	1.1
101-105	4.8	1.0	< 0.1	5.8
106-110	11.0	2.5	0.1	13.6
111-115	18.1	4.2	0.2	22.4
116-120	20.8	4.8	0.1	25.7
121-125	15.9	3.6	0.1	19.6
126-130	7.3	1.4	< 0.1	8.8
131-135	1.9	0.4	0	2.3
> 135	0.3	< 0.1	0	0.3
Total Crab	32,911	7,271	234	40,416
Total Percent	81.4	18.0	0.6	100

[a] Average CW = 116.6 mm

Table 2.-Estimated catch per pot (CPUE) of selected crab species from pot lifts sampled by observers deployed during the 2005/2006 Bering Sea snow crab fishery. The estimates are from 2,578 pot lifts.

Species / Sex class	Sampled Fleet Estimates		Estimated Total Catch [a]
	CPUE	SE	
Snow crab			
Legal males - retained	201.5[b]	11.86	24,287,003[c]
Legal males - not retained	88.1	6.07	10,618,298
Sublegal males	5.2	1.47	630,103
Females	0.3	0.10	34,732
Tanner/Snow hybrid			
Legal males - retained	0.7[b]	0.23	80,868[c]
Legal males - not retained	0.3	0.06	34,042
Sublegal males	0.4	0.09	46,689
Females	< 0.1	< 0.01	664
Tanner crab			
Legal males – retained[d]	1.6	0.64	186,811
Legal males - not retained	1.0	0.19	121,550
Sublegal males	17.6	2.33	2,121,250
Females	0.8	0.21	96,548

[a] Estimated catch is the product of the CPUE estimate and 120,512, the total number of pots pulled for the 2005/2006 Bering Sea snow crab fishery (ADF&G *In prep*).

[b] Actual total fishery CPUE of retained legal snow crabs was 204 for all vessels (ADF&G *In prep*).

[c] Actual catch of retained legal snow crabs for the fishery was 24,511,191 (ADF&G *In prep*).

[d] Legal male Tanner crabs were retained by qualified vessels as incidental catch in the 2005/2006 Bering Sea snow crab fishery which was prosecuted concurrently with the 2005/2006 Bering Sea Tanner crab fishery.

Table 3.-Carapace width frequency distributions by shell age from biological measurements of retained Tanner crabs sampled during the 2005/2006 Bering Sea Tanner crab fishery.

Carapace width (mm)[a]	New Percent	Old Percent	Very old Percent	All Percent
126-130	0.1	0	0	0.1
131-135	0	0	0	0
136-140	17.3	1.8	0	19.1
141-145	40.9	3.3	0	44.1
146-150	25.0	1.6	0.1	26.7
151-155	7.5	1.0	0	8.5
156-160	1.1	0.1	0	1.3
161-165	0.1	0	0	0.1
Total Crab	649	55	1	705
Total Percent	92.1	7.8	0.1	100

[a] Average CW = 144.5 mm

Table 4.-Estimated catch per pot (CPUE) of selected crab species from pot lifts sampled by observers deployed during the 2005/2006 Bering Sea Tanner crab fishery. The estimates are from 160 pot lifts.

Species / Sex class	Sampled Fleet Estimates		Estimated Total Catch [a]
	CPUE	SE	
Tanner crab			
Legal males - retained	46.4[b]	4.92	183,025[c]
Legal males - not retained	1.0	1.04	3,926
Sublegal males	136.9	11.49	540,582
Females	17.5	8.59	69,206
Tanner/Snow hybrid			
Legal males - retained	0[b]	0	0[c]
Legal males - not retained	0.5	0.24	1,966
Sublegal males	0.2	0.10	859
Females	< 0.1	0.01	22
Snow crab			
Legal males – retained[d]	0.3	0.30	1,312
Legal males - not retained	13.8	3.47	54,628
Sublegal males	1.9	2.99	7,592
Females	0.1	0.27	578

[a] Estimated catch is the product of the CPUE estimate and 3,948, the total number of pots pulled for the 2005/2006 Bering Tanner snow crab fishery (ADF&G *In prep*).

[b] Actual total fishery CPUE of retained legal Tanner crabs was 12 for all vessels (ADF&G *In prep*).

[c] Actual catch of retained legal Tanner crabs for the fishery was 368,292 (ADF&G *In prep*).

[d] Legal male snow crabs were retained by qualified vessels as incidental catch in the 2005/2006 Bering Sea Tanner crab fishery which was prosecuted concurrently with the 2005/2006 Bering Sea snow crab fishery.

Table 5.-Carapace length frequency distributions by shell age from biological measurements of retained red king crabs sampled during the 2005/2006 Bristol Bay red king crab fishery.

Carapace length (mm)[a]	New Percent	Old Percent	Very old Percent	All Percent
< 106	< 0.1	0	0	< 0.1
106-110	< 0.1	0	0	< 0.1
111-115	< 0.1	0	0	< 0.1
116-120	< 0.1	0	0	< 0.1
121-125	< 0.1	0	0	< 0.1
126-130	0.1	< 0.1	0	0.1
131-135	2.1	0.3	< 0.1	2.4
136-140	9.1	1.4	0.1	10.6
141-145	13.3	2.4	0.1	15.9
146-150	13.6	3.3	0.2	17.0
151-155	13.3	3.8	0.3	17.4
156-160	10.8	3.4	0.3	14.5
161-165	7.9	2.4	0.3	10.5
166-170	5.0	1.5	0.2	6.7
171-175	2.3	0.7	0.1	3.1
176-180	0.8	0.3	< 0.1	1.1
181-185	0.2	0.1	< 0.1	0.3
186-190	0.1	< 0.1	< 0.1	0.1
191-195	0	< 0.1	< 0.1	< 0.1
196-200	< 0.1	0	0	< 0.1
Total Crab	21,997	5,506	468	27,971
Total Percent	78.6	19.7	1.7	100

[a] Average CL = 152.3 mm.

Table 6.-Estimated catch per pot (CPUE) of selected crab species from pot lifts sampled by observers deployed during the 2005/2006 Bristol Bay red king crab fishery. The estimates are from 1,855 pot lifts.

Species / Sex class	Sampled Fleet Estimates		Estimated Total Catch [a]
	CPUE	SE	
Red king crab			
Legal males - retained	23.8[b]	1.61	2,740,645[b]
Legal males - not retained	5.8	0.87	664,947
Sublegal males	26.6	3.70	3,058,384
Females	17.4	1.99	2,001,588

[a] Estimated catch is the product of the CPUE estimate and 114,949, the total number of pot lifts for the 2005/2006 Bristol Bay red king crab general fishery (ADF&G *In prep*).

[b] Actual total fishery CPUE of retained legal crabs was 24 for all vessels (ADF&G *In prep*).

[c] Actual catch of retained legal crabs for the fishery was 2,732,574 (ADF&G *In prep*).

Table 7.-Carapace length frequency distributions by shell age from biological measurements of retained golden king crabs sampled during the 2005/2006 Aleutian Islands golden king crab fishery east of 174° W longitude.

Carapace length (mm)[a]	New Percent	Old Percent	Very old Percent	All Percent
131-135	1.7	< 0.1	0	1.8
136-140	10.2	0.1	0	10.3
141-145	18.4	0.5	0	18.9
146-150	20.1	0.6	0.1	20.7
151-155	17.2	0.7	< 0.1	17.9
156-160	12.7	1.1	< 0.1	13.9
161-165	6.7	0.6	0	7.4
166-170	3.8	0.3	0	4.1
171-175	3.2	0.2	0	3.4
176-180	0.9	0	< 0.1	0.9
181-185	0.5	0	< 0.1	0.5
186-190	0.2	0	0	0.2
Total Crab	1,971	86	6	2,063
Total Percent	95.5	4.2	0.3	100

[a] Average CL = 151.3 mm.

Table 8.-Estimated catch per pot (CPUE) of selected crab species from pot lifts sampled by observers deployed during the 2005/2006 Aleutian Islands golden king crab fishery east of 174° W longitude. The estimates are from 1,193 pot lifts.

Species / Sex class	Sampled Fleet Estimates		Estimated Total Catch [a]
	CPUE	SE	
Golden king crab			
Legal males - retained	27.1[b]	1.77	665,792[c]
Legal males - not retained	0.7	0.16	17,691
Sublegal males	8.2	0.99	202,329
Females	4.8	1.09	118,969

[a] Estimated catch is the product of the CPUE estimate and 24,559, the total number of pot lifts for the 2005/2006 eastern Aleutian Islands golden king crab fishery (ADF&G *In prep*).

[b] Actual total fishery CPUE of retained legal crabs was 25 for all vessels (ADF&G *In prep*).

[c] Actual catch of retained legal crabs for the fishery was 623,962 (ADF&G *In prep*).

Table 9.-Carapace length frequency distributions by shell age from biological measurements of retained golden king crabs sampled during the 2005/2006 Aleutian Islands golden king crab fishery west of 174° W longitude.

Carapace length (mm)[a]	New Percent	Old Percent	Very old Percent	All Percent
126-130	0.1	0	0	0.1
131-135	3.4	< 0.1	0	3.4
136-140	16.6	0.1	< 0.1	16.7
141-145	24.7	0.3	< 0.1	25.0
146-150	20.5	0.3	0.1	20.8
151-155	14.6	0.4	0.1	15.2
156-160	8.4	0.2	< 0.1	8.6
161-165	4.8	0.2	< 0.1	5.0
166-170	2.5	0.1	< 0.1	2.6
171-175	1.6	< 0.1	< 0.1	1.7
176-180	0.7	< 0.1	0	0.7
181-185	0.2	0	0	0.2
186-190	0.1	< 0.1	0	0.1
191-195	0	0	0	0
196-200	< 0.1	0	0	< 0.1
Total Crab	11,755	191	37	11,983
Total Percent	98.1	1.6	0.3	100

[a] Average CL = 148.2 mm.

Table 10.-Estimated catch per pot (CPUE) of selected crab species from pot lifts sampled by observers deployed during the 2005/2006 Aleutian Islands golden king crab fishery west of 174° W longitude. The estimates are from 1,370 pot lifts.

Species / Sex class	Sampled Fleet Estimates		Estimated Total Catch [a]
	CPUE	SE	
Golden king crab			
Legal males - retained	20.2[b]	1.27	609,815[c]
Legal males - not retained	0.4	0.14	11,881
Sublegal males	10.0	1.36	301,343
Females	8.5	1.31	257,468

[a] Estimated catch is the product of the CPUE estimate and 30,116, the total number of pot lifts for the 2005/2006 western Aleutian Islands golden king crab fishery (ADF&G *In prep*).

[b] Actual total fishery CPUE of retained legal crabs was 21 for all vessels (ADF&G *In prep*).

[c] Actual catch of retained legal crabs for the fishery was 639,368 (ADF&G *In prep*).

Table 11.-Observer coverage, pot lift sampling effort by observers, and relative difference of the weighted CPUE estimates for retained legal crabs from the Actual Total Fishery (ATF) CPUE. Data is from crab fisheries with mandatory observers.

Fishery	Vessels		Pot Lifts		Percent difference of the weighted CPUE estimate from ATF CPUE[a]
	Observed	Total Fishery	Observed	Total Fishery	
2005/06 Bering Sea snow crab (with legal hybrids)	31	78	2,578	120,512	-1.1[b]
2005/06 Bering Sea Tanner crab (with legal hybrids)	4	6	160	3,948	286.7
2005/06 Bristol Bay red king crab	24	89	1,855	114,949	-0.8[b]
2005/06 Aleutian Islands golden king crab east of 174° W	7	7	1,193	24,559	8.4[b]
2005/06 Aleutian Islands golden king crab west of 174° W	3	3	1,370	30,116	-3.8[b]

[a] ATF CPUE is based on fish ticket data on all landings in the fishery. Percent difference is calculated as:

$$\left[\frac{(weightedCPUE)-(ATFCPUE)}{(ATFCPUE)}\right]\times 100\% .$$

[b] ATF CPUE is contained within the 95% confidence interval for the stratified, weighted CPUE estimate.

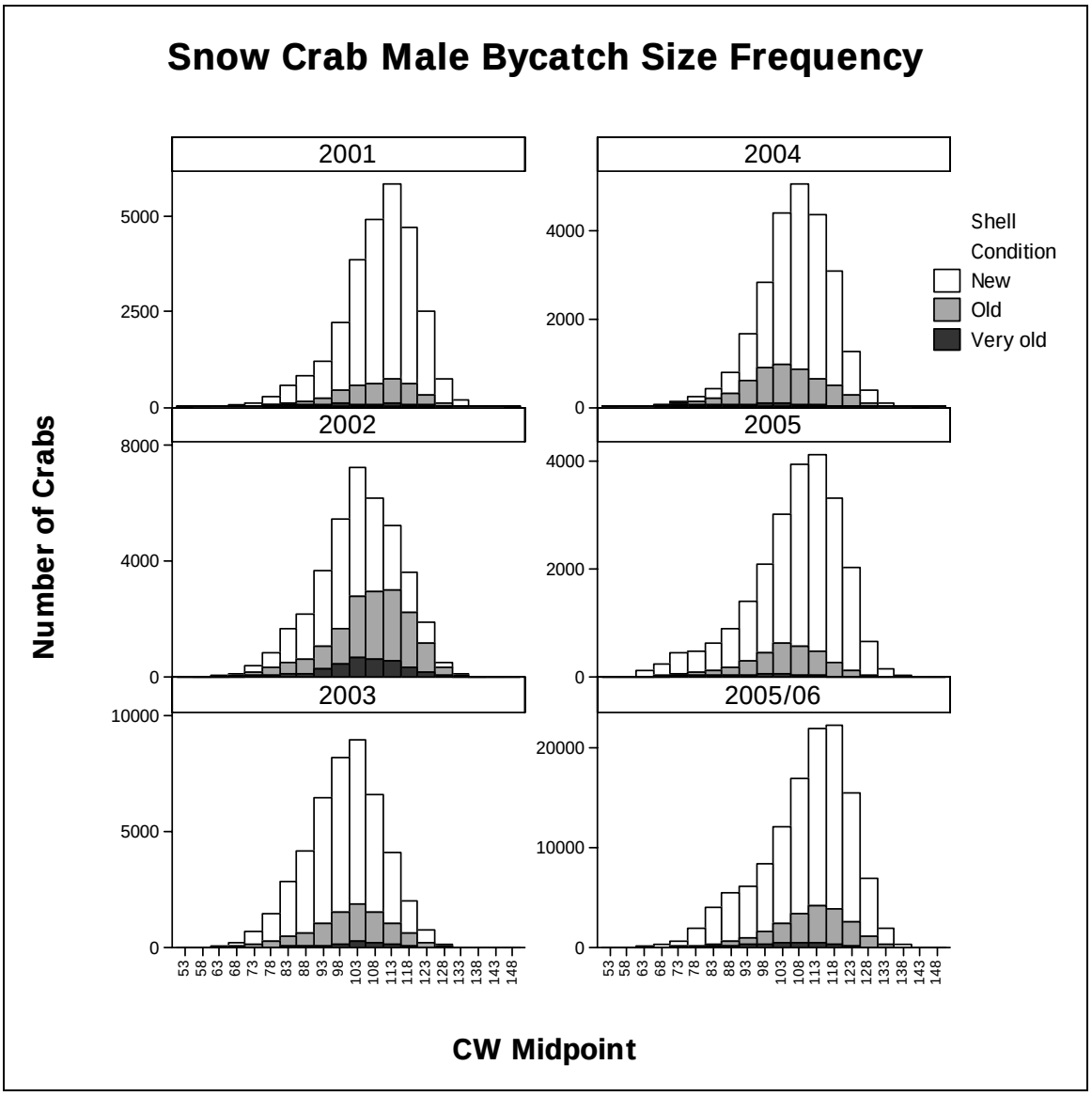


Figure 1.-Carapace width (CW, mm) frequency distributions with corresponding shell condition for male snow crabs from bycatch samples taken during the 2001-2005/2006 Bering Sea snow crab fisheries.

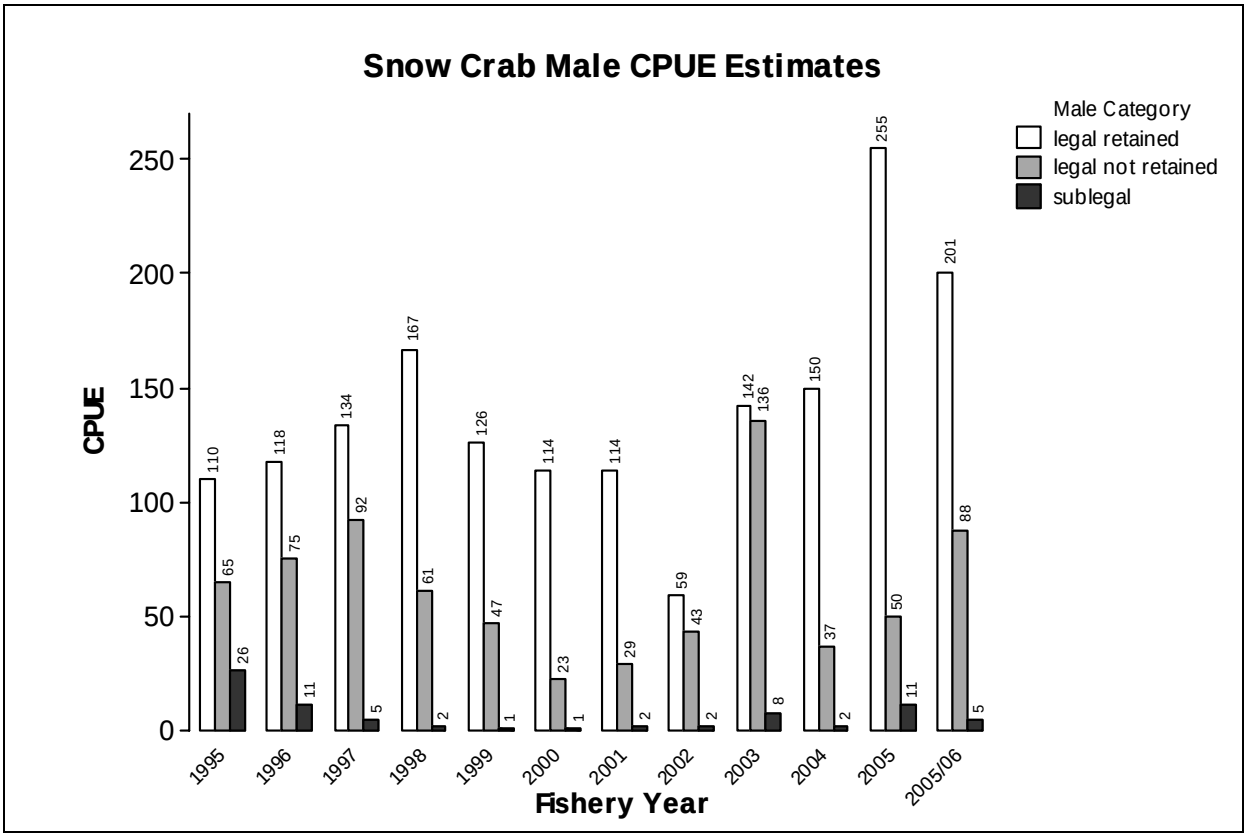


Figure 2.-Estimated CPUE of male snow crab from bycatch samples taken during the 1995-2005/2006 Bering Sea snow crab fisheries.

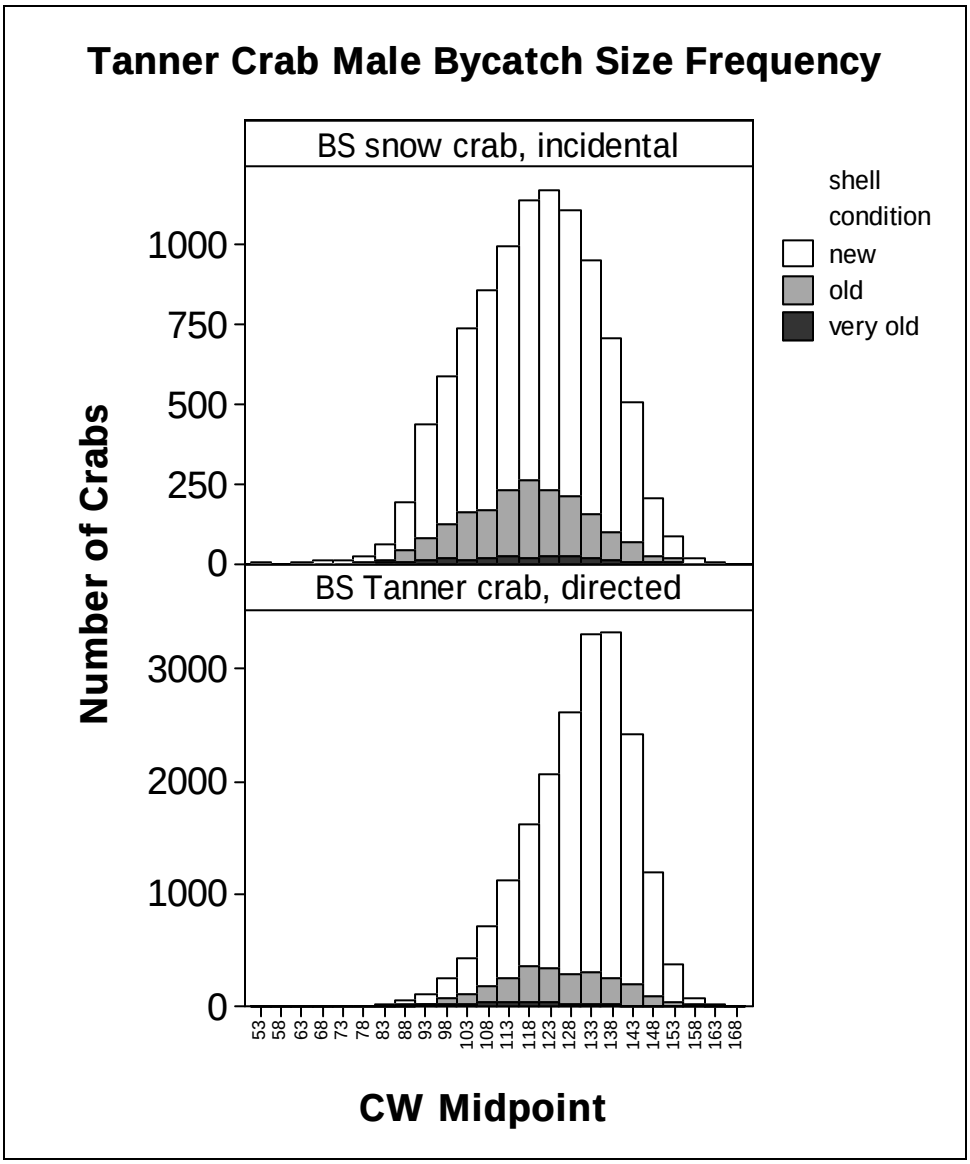


Figure 3.-Carapace width (CW, mm) frequency distributions with corresponding shell condition for male Tanner crabs from bycatch samples taken during the 2005/2006 Bering Sea snow crab and Tanner crab fisheries.

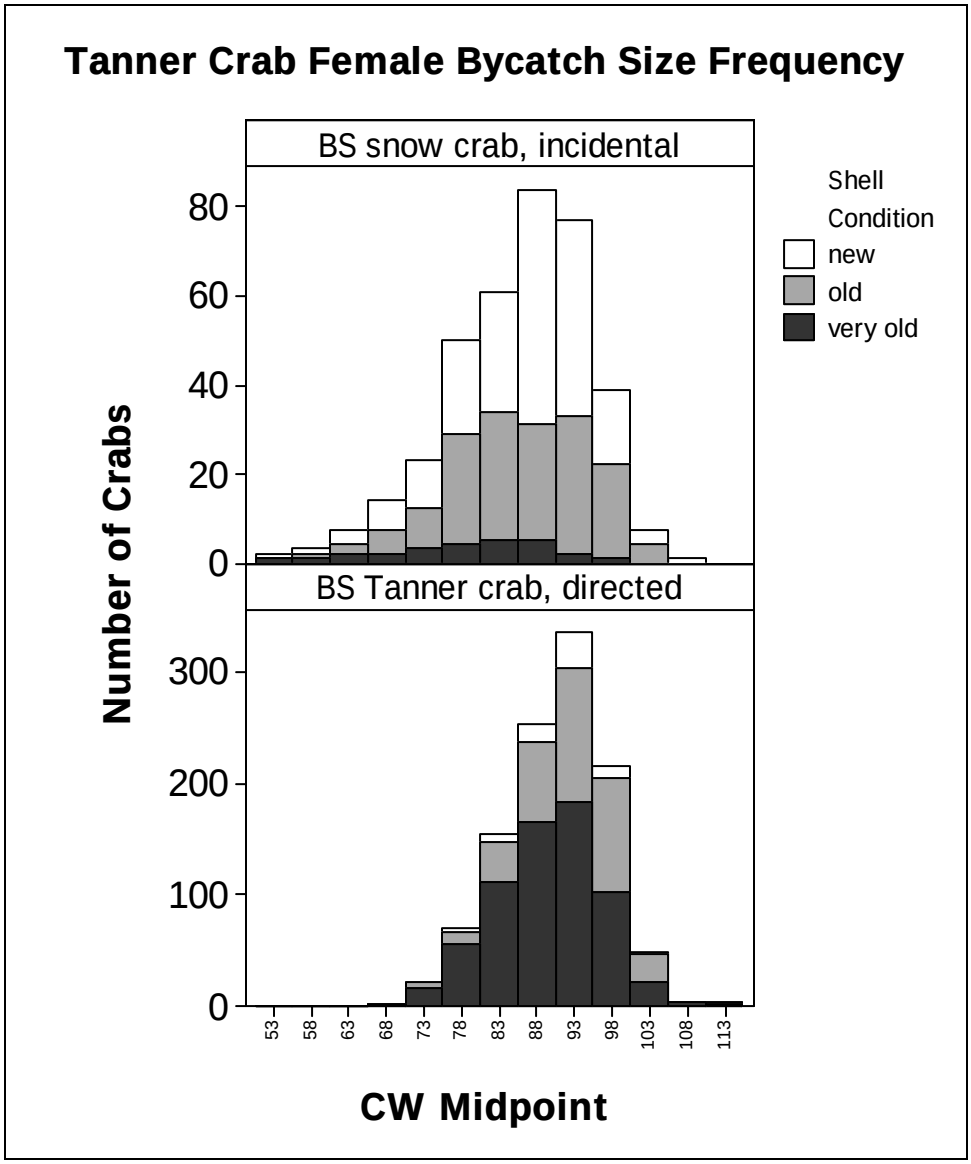


Figure 4.-Carapace width (CW, mm) frequency distributions with corresponding shell ages for female Tanner crabs from pot lifts sampled during the 200/2006 Bering Sea snow crab and Tanner crab fisheries.

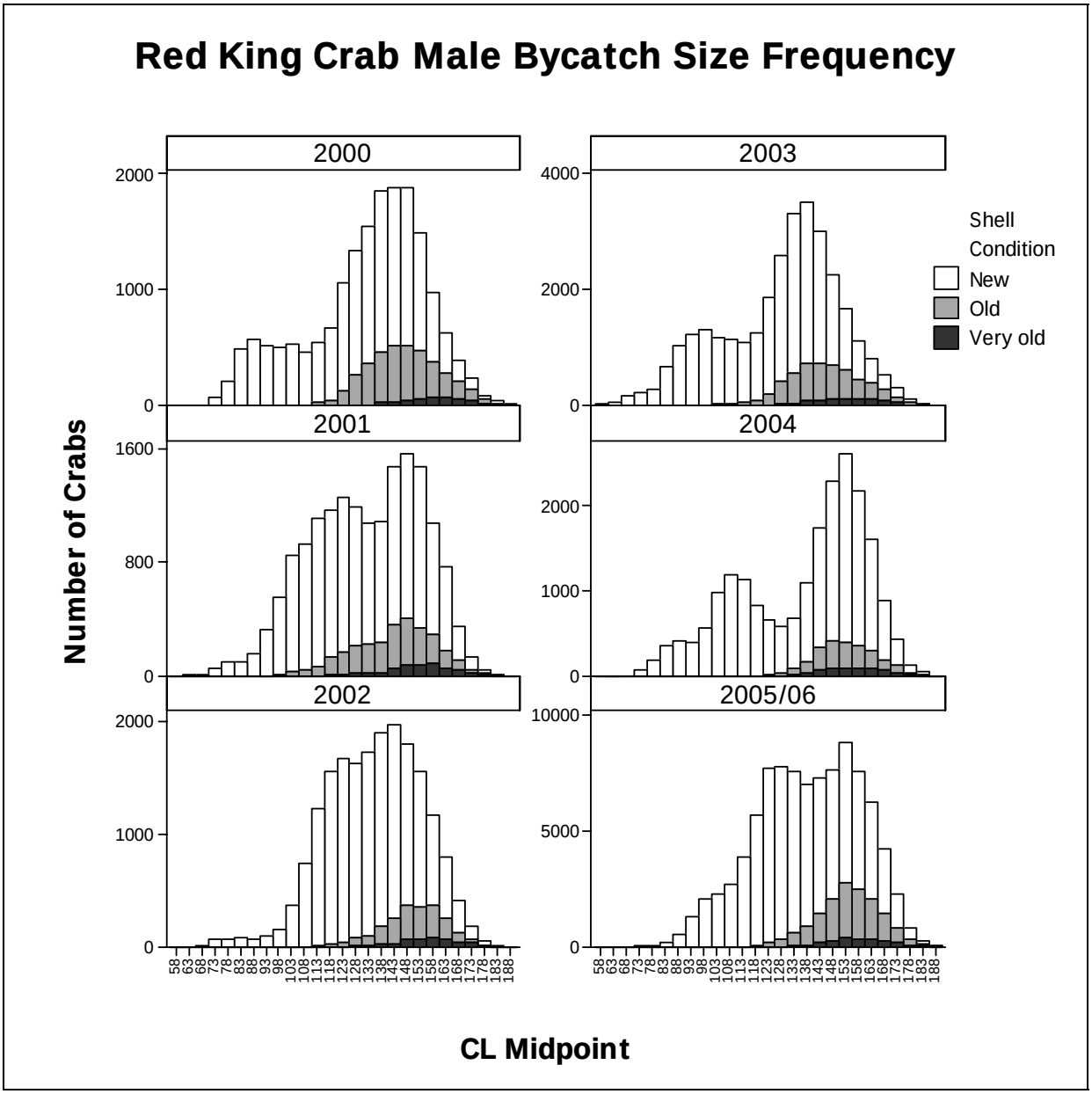


Figure 5.-Carapace length (CL, mm) frequency distributions with corresponding shell ages for male red king crabs from pot lifts sampled during the 2000-2005/2006 Bristol Bay red king crab fisheries.

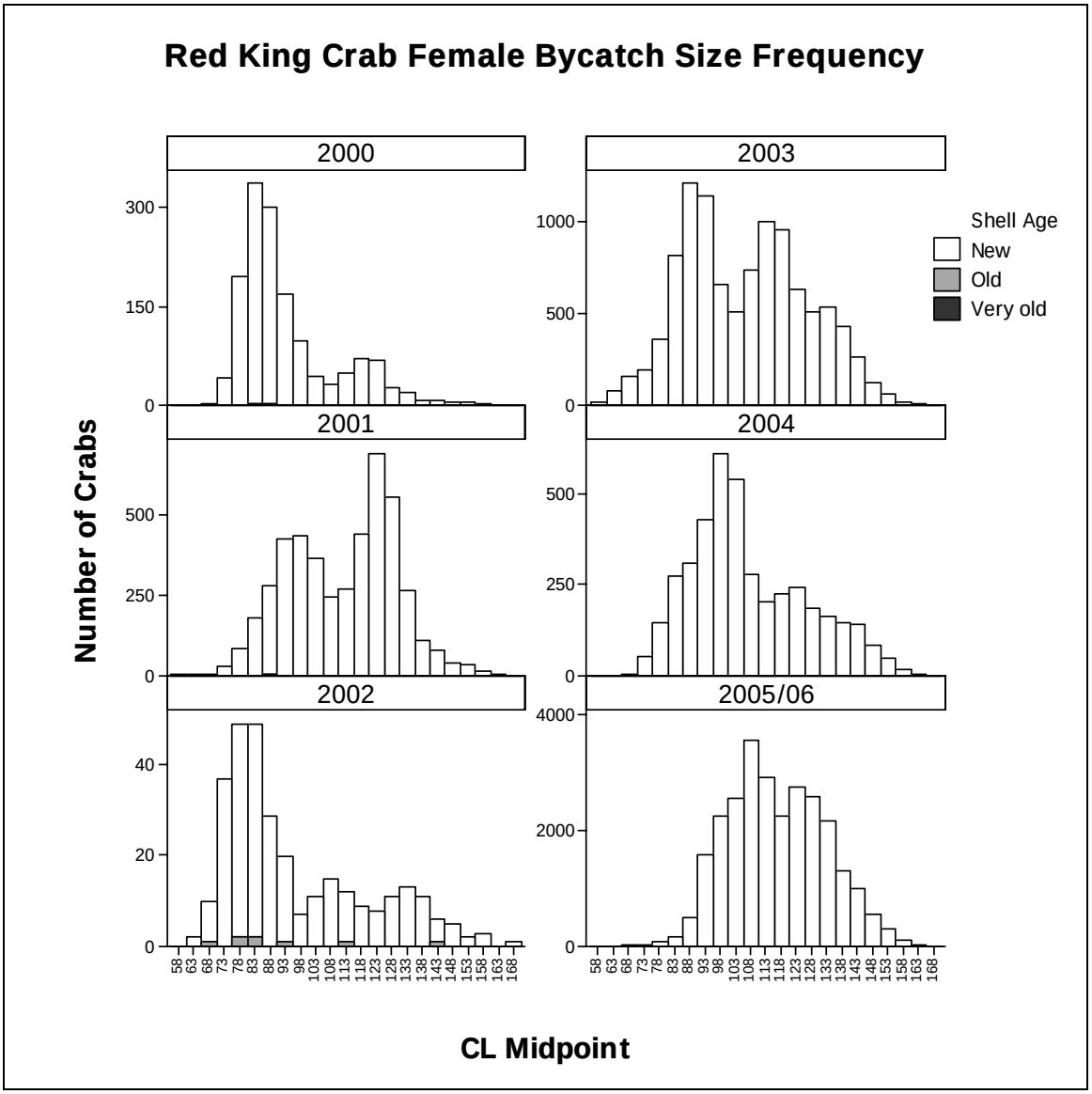


Figure 6.-Carapace length (CL, mm) frequency distributions with corresponding shell ages for female red king crabs from pot lifts sampled during the 2000-2005/2006 Bristol Bay red king crab fisheries.

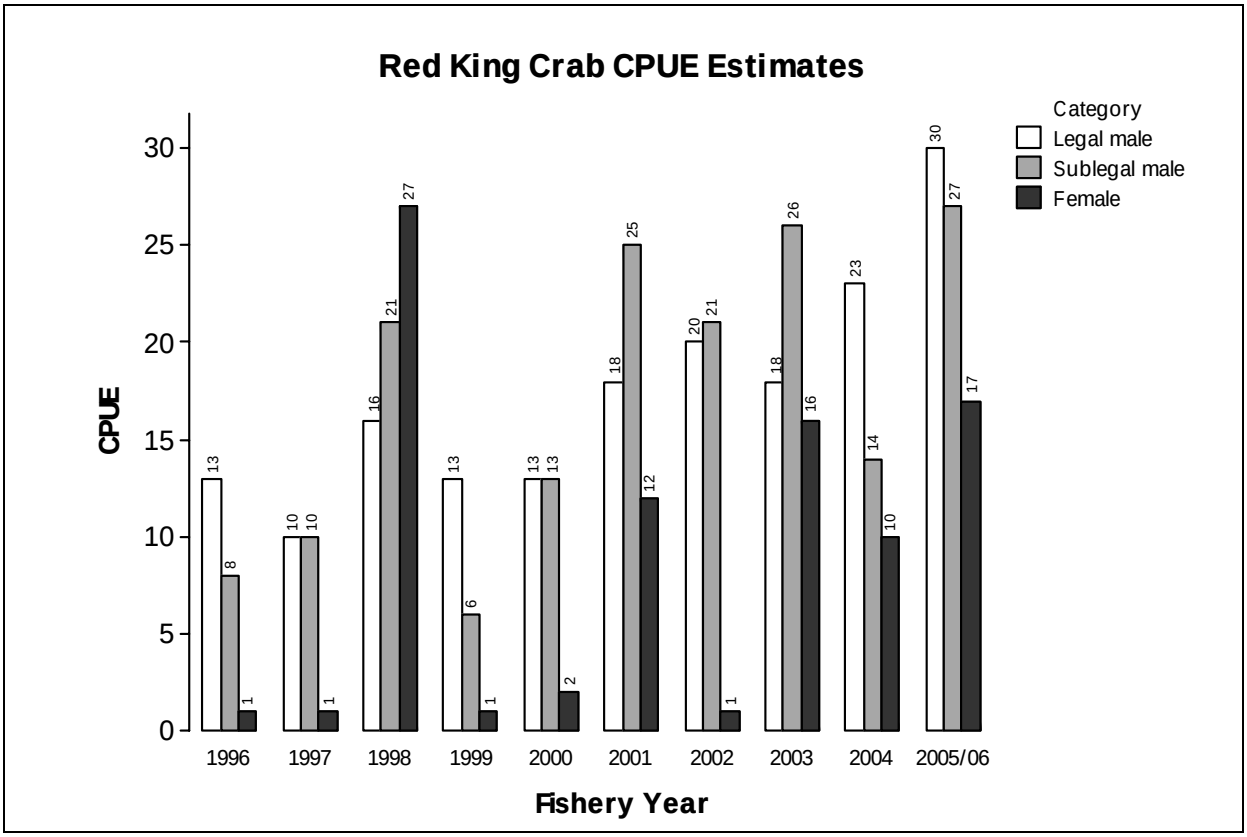


Figure 7.-Estimated CPUE of red king crabs from pot lifts sampled during the 1996-2005/2006 Bristol Bay red king crab fisheries.

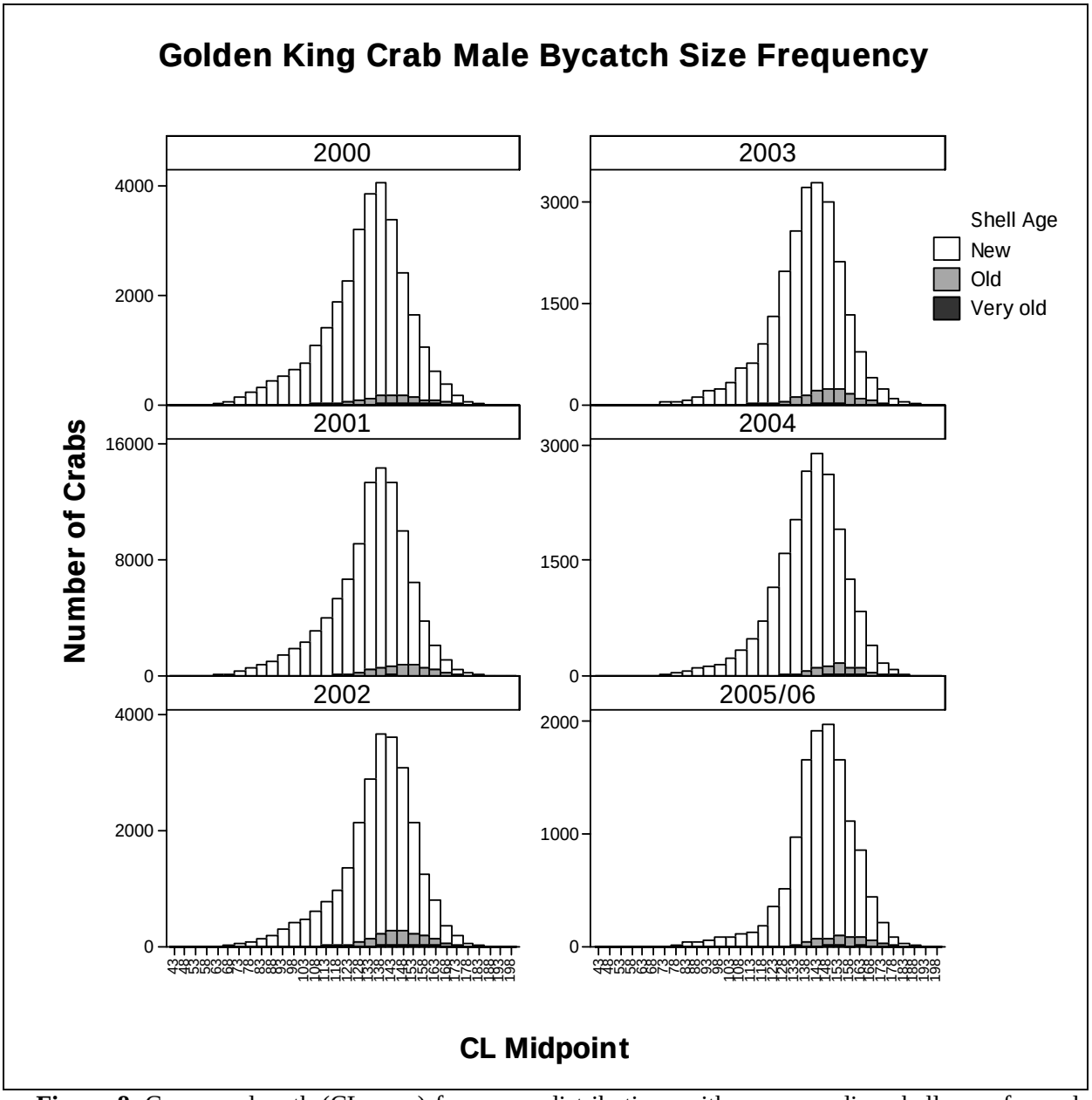


Figure 8.-Carapace length (CL, mm) frequency distributions with corresponding shell ages for male golden king crabs from pot lifts sampled during the 2000-2005/2006 Aleutian Islands golden king crab fisheries east of 174° W longitude.

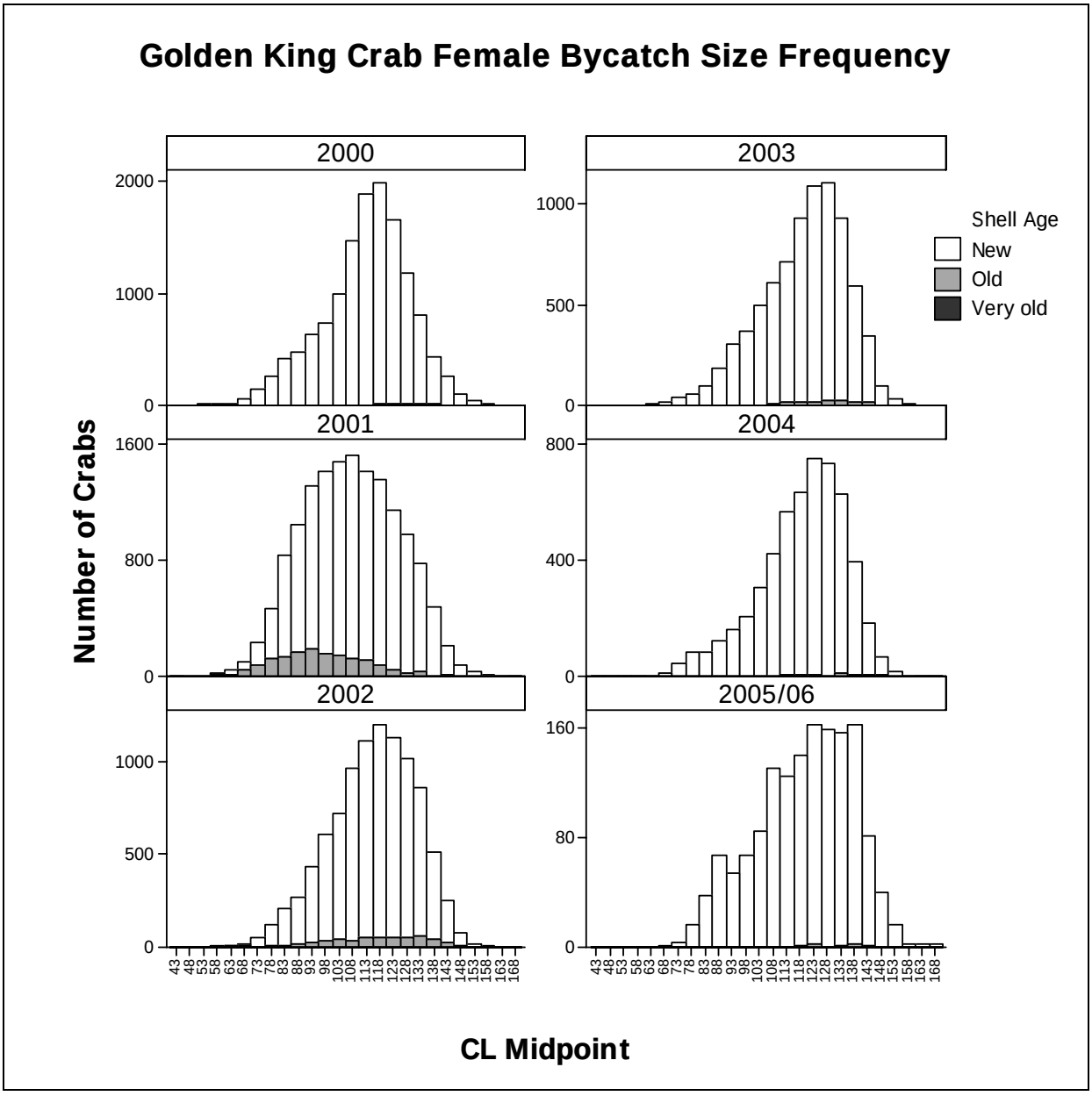


Figure 9.-Carapace length (CL, mm) frequency distributions with corresponding shell ages for female golden king crabs from pot lifts sampled during the 2000-2005/2006 Aleutian Islands golden king crab fisheries east of 174° W longitude.

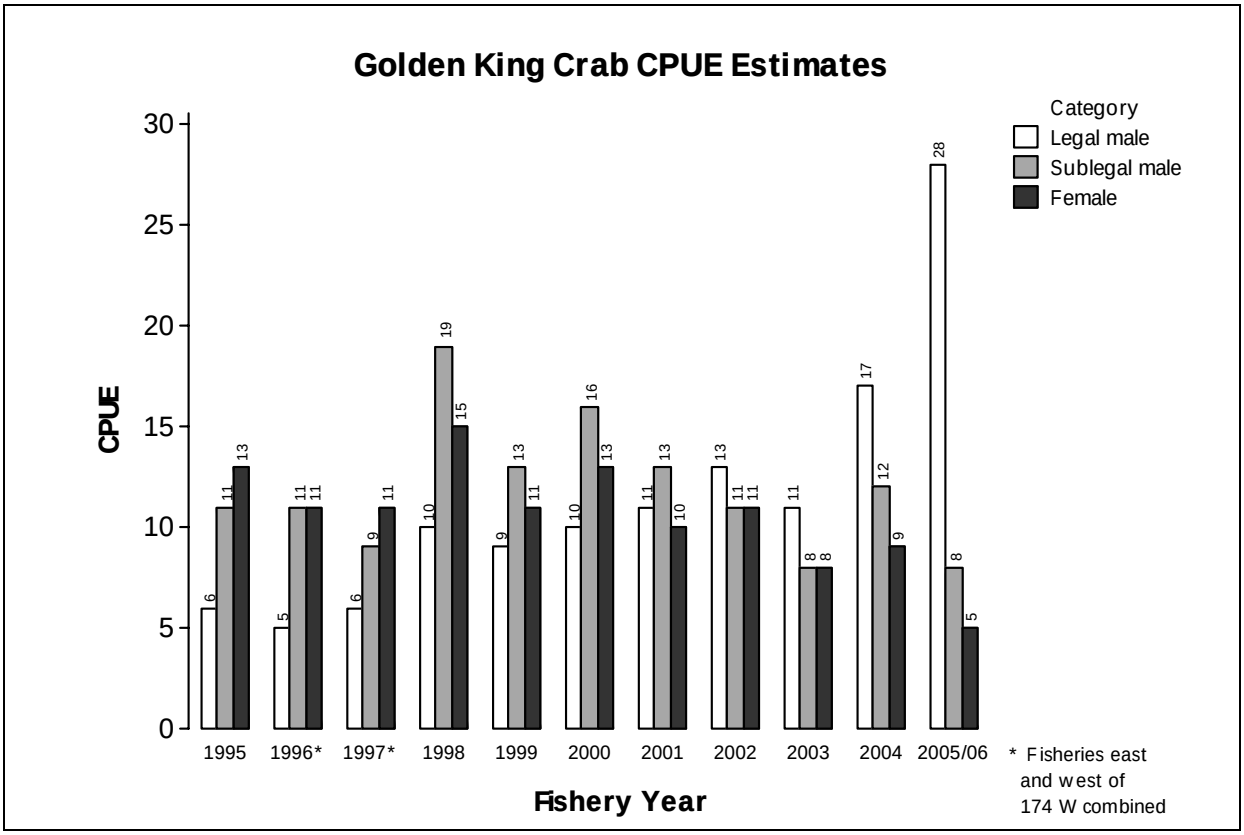


Figure 10.-Estimated CPUE of male golden king crabs from pot lifts sampled during the 1995-2005/2006 Aleutian Islands golden king crab fisheries east of 174° W longitude.

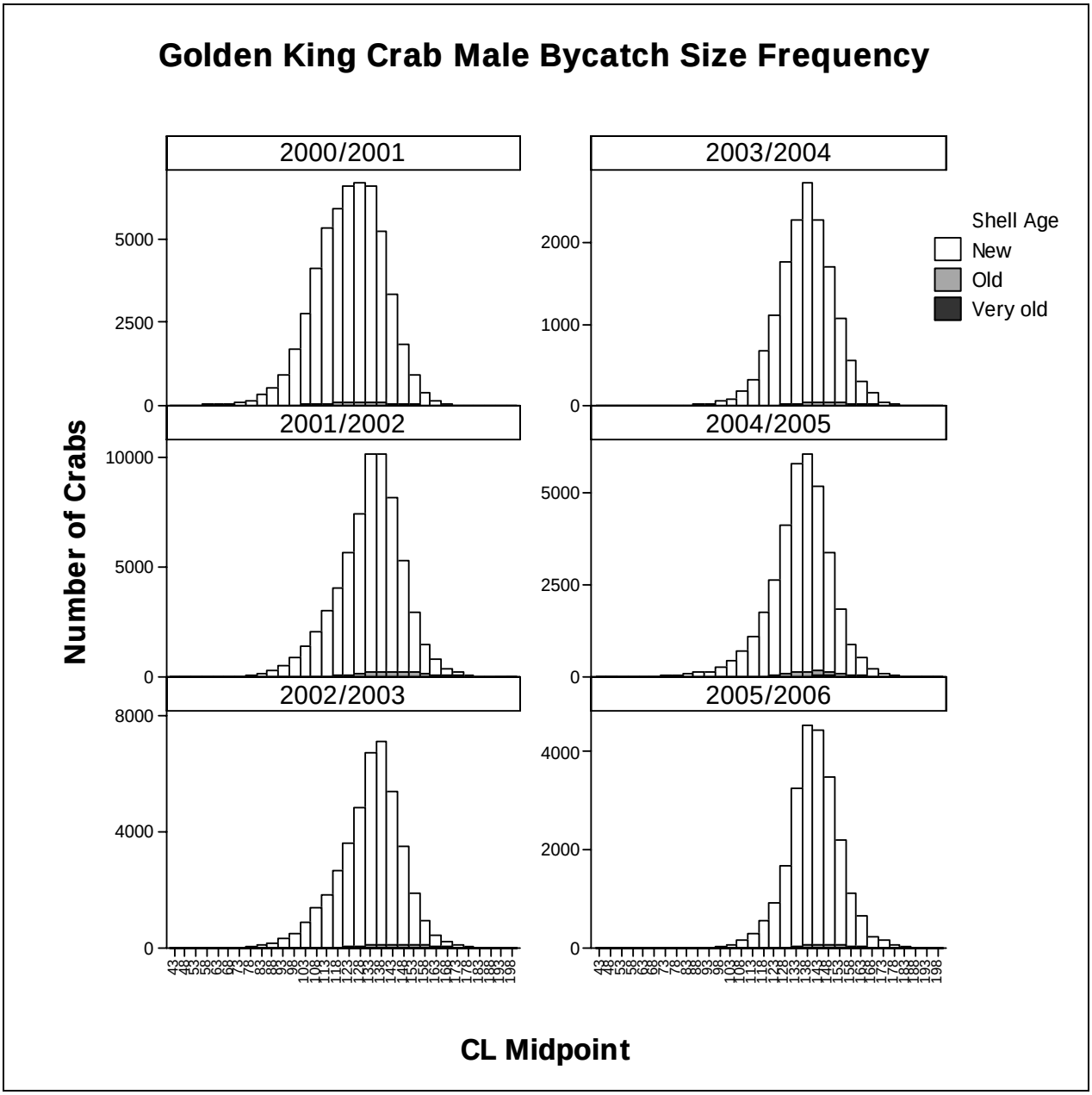


Figure 11.-Carapace length (CL, mm) frequency distributions with corresponding shell ages for male golden king crabs from pot lifts sampled during the 2000/2001-2005/2006 Aleutian Islands golden king crab fisheries west of 174° W longitude.

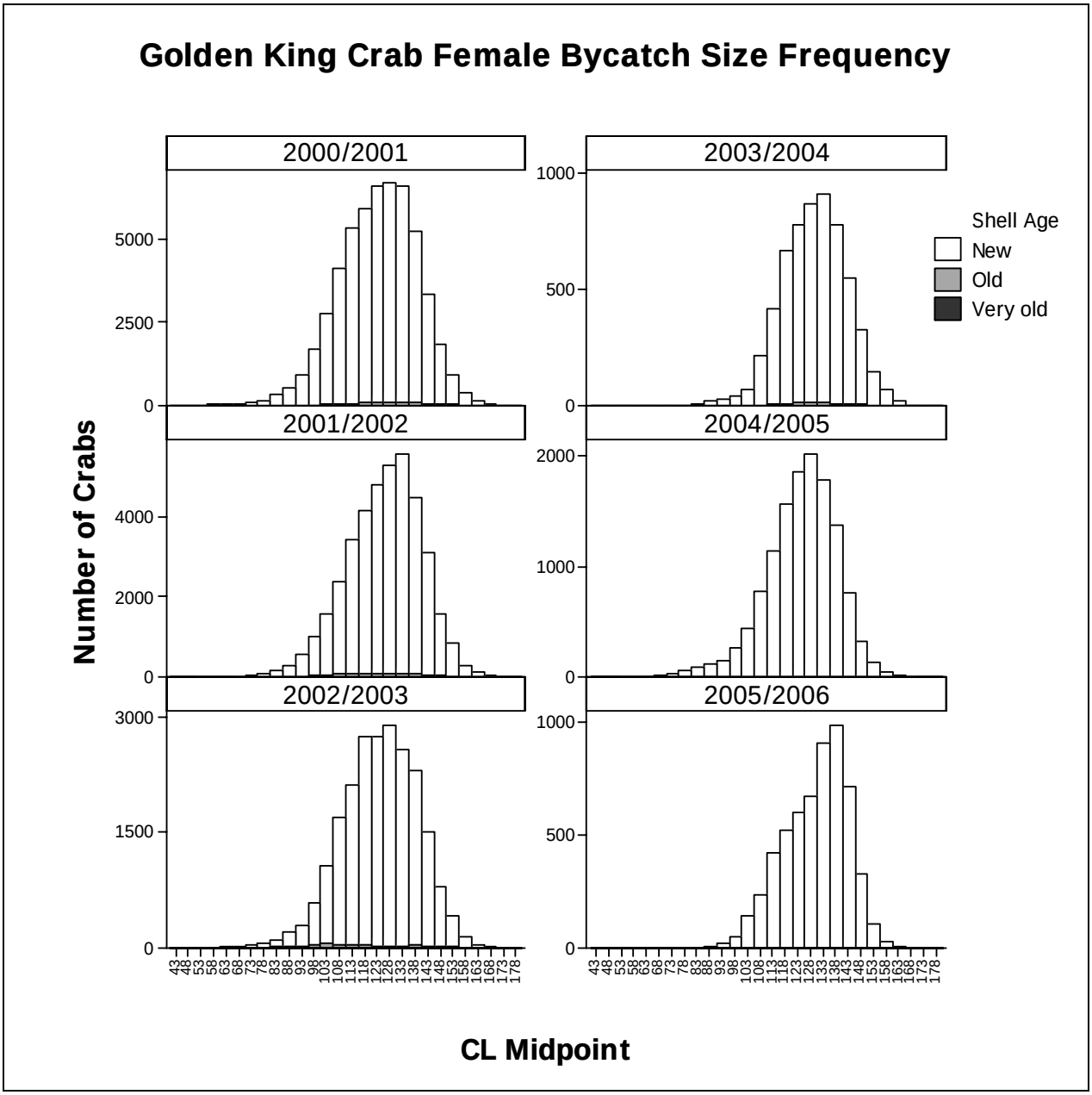


Figure 12.-Carapace length (CL, mm) frequency distributions with corresponding shell ages for female golden king crabs from pot lifts sampled during the 2000/2001-2005/2006 Aleutian Islands golden king crab fisheries west of 174° W longitude.

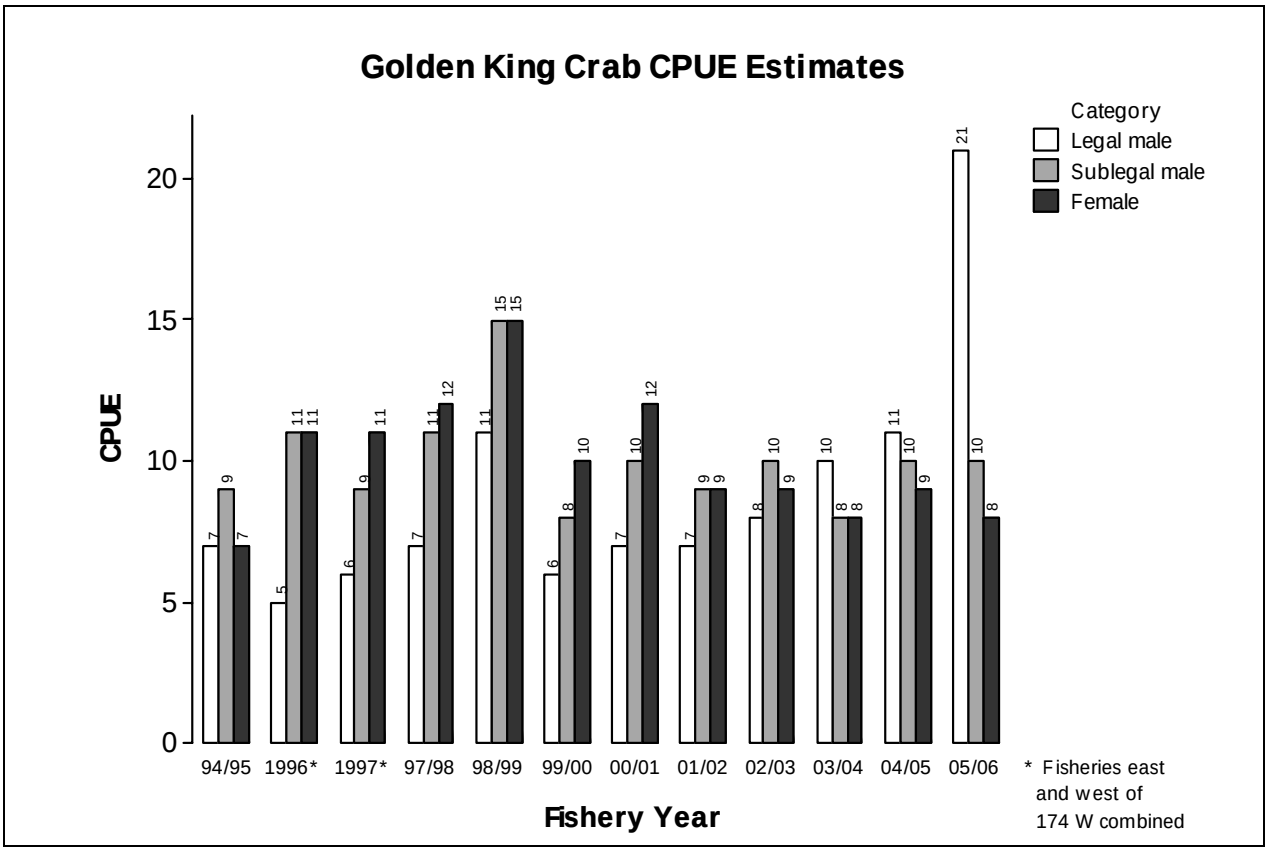


Figure 13.-Estimated CPUE of golden king crabs from pot lifts sampled during the 1994/1995-2005/2006 Aleutian Islands golden king crab fisheries west of 174° W longitude.

APPENDIX A: FORMULAS USED TO CALCULATE WEIGHTED MEAN AND VARIANCE ESTIMATES

Appendix A1.-Formulas used to calculate weighted mean and variance estimates for CPUE in fisheries with 100% observer coverage.

For a given fishery, observers are instructed to randomly sample n pot lifts per day. In practice this number will vary by day, vessel and observer. Observers actually sample n_{jk} pots per day from a total of N_{jk} pots pulled by vessel j on day k. Formulas follow Cochran (1977).

The mean CPUE for vessel j on day k is $$\bar{c}_{jk.} = \frac{1}{n_{jk}}\left(\sum_{l} c_{jkl}\right)$$

and the variance for this estimator is $$\hat{\text{var}}\left(\bar{c}_{jk.}\right) = \frac{1}{n_{jk}}\left[\frac{\sum_{l}\left(c_{jkl} - \bar{c}_{jk.}\right)^2}{n_{jk} - 1}\right]$$

where c_{jkl} is the number of crab in a sampled pot lift where

j is the vessel

k is the day

l is the pot sampled

It follows that

the estimated total catch by vessel j on day k is $\left(\bar{c}_{jk.} \times N_{jk}\right)$,

the estimated total catch by vessel j over the fishery is $\sum_{k}\left(\bar{c}_{jk.} \times N_{jk}\right)$,

the estimated weighted mean catch per pot lift by vessel j over the fishery is

$$\frac{1}{N_{j.}}\left[\sum_{k}\left(\bar{c}_{jk.} \times N_{jk}\right)\right]$$

$$= \sum_{k}\left(\bar{c}_{jk.} \times w_{jk}\right)$$

$$= \bar{c}_{j..}$$

and $$\hat{\text{var}}\left(\bar{c}_{j..}\right) = \sum_{k}\left[\hat{\text{var}}\left(\bar{c}_{jk.}\right) \times w_{jk}^2\right]$$

where $w_{jk} = N_{jk} / N_j$. The weights reflect the importance of a day's sampling based on the number of pots lifted on day k by vessel j relative to the total number of pots lifted by vessel j over the course of the fishery.

-continued-

The estimated mean catch per pot lift for all vessels over the fishery is

$$\begin{aligned}\bar{c}_{...} &= \frac{1}{N_{..}}\left[\sum_j \left(\bar{c}_{j..} \times N_{j.}\right)\right] \\ &= \frac{1}{N_{..}}\left[\sum_j \left(\sum_k \left(\bar{c}_{jk.} \times w_{jk}\right)\right) \times N_{j.}\right] \\ &= \frac{1}{N_{..}}\left[\sum_j \left(\sum_k \left(\bar{c}_{jk.} \times \frac{N_{jk}}{N_{j.}}\right)\right) \times N_{j.}\right] \\ &= \frac{1}{N_{..}} \sum_j \sum_k \left(\bar{c}_{jk.} \times N_{jk}\right).\end{aligned}$$

The variance of this estimator is

$$\begin{aligned}\hat{\mathrm{var}}\left(\bar{c}_{...}\right) &= \sum_j \left[\hat{\mathrm{var}}\left(\bar{c}_{j..}\right) \times w_{j.}^2\right] \\ &= \sum_j w_{j.}^2 \left\{\sum_k \left[\hat{\mathrm{var}}\left(\bar{c}_{jk.}\right) \times w_{jk}^2\right]\right\} \\ &= \sum_j \left(\frac{N_{j.}}{N_{..}}\right)^2 \left\{\sum_k \left[\hat{\mathrm{var}}\left(\bar{c}_{jk.}\right) \times \left(\frac{N_{jk}}{N_{j.}}\right)^2\right]\right\} \\ &= \sum_j \left\{\sum_k \left[\hat{\mathrm{var}}\left(\bar{c}_{jk.}\right) \times \left(\frac{N_{jk}}{N_{..}}\right)^2\right]\right\} \\ &= \frac{1}{N_{..}^2} \sum_j \sum_k \left[\hat{\mathrm{var}}\left(\bar{c}_{jk.}\right) \times N_{jk}^2\right]\end{aligned}$$

where $w_{j.} = N_{j.} / N_{..}$.

Appendix A2.-Formulas used to calculate weighted mean and variance estimates for CPUE in fisheries with partial observer coverage.

Let c_{ijkl} = number of crabs in sampled pot lift *l* for day *k* on vessel *j* of type *i*

n_{ijk} = number of sampled pot lifts for day *k* on vessel *j* of type *i*

N_{ijk} = total number of pot lifts pulled for day *k* on vessel *j* of type *i*

m_i = number of vessels observed of type *i*

M_i = number of vessels of type *i*

where *i* = vessel type (CP, CV > 125 ft, CV ≤ 125 ft), a stratum

j = vessel observed, element of a simple random sample

k = day fished, a stratum

l = pot lift sampled, element of a simple random sample

For each observed vessel, consider each day fished as a separate stratum where the sampled pot lifts (n_{ijk}) are a simple random sample of all pot lifts pulled (N_{ijk}) for vessel *j* of type *i* on day *k*. Then the estimated mean number of crabs per pot lift (and its variance) for day *k* on vessel *j* of type *i* is

$$\bar{c}_{ijk.} = \frac{1}{n_{ijk}} \sum_{l} c_{ijkl} \qquad \text{and} \qquad \hat{v}(\bar{c}_{ijk.}) = \frac{1}{n_{ijk}} \left[\frac{\sum_{l} (c_{ijkl} - \bar{c}_{ijk.})^2}{(n_{ijk} - 1)} \right]. \qquad \textbf{(A)}$$

This formulation ignores the finite population correction factor (fpc), the penalty being an overestimation of the population variance as the ratio, $n_{ijk}/N_{ij.}$, is usually less than 10% for the fisheries in question.

It follows from (A) that the estimated weighted mean number of crabs per pot lift (and variance) for vessel *j* of type *i* over the fishery is

$$\bar{c}_{ij..} = \sum_{k} (\bar{c}_{ijk.} \times w_{ijk}) \qquad \text{and} \qquad \hat{v}(\bar{c}_{ij..}) = \sum_{k} \left[\hat{v}(\bar{c}_{ijk.}) \times w_{ijk}^2 \right] \qquad \text{where } w_{ijk} = \frac{N_{ijk}}{N_{ij.}}. \qquad \textbf{(B)}$$

This is a straightforward, weighted, stratified, mean estimate for vessel *j* of type *i*.

-continued-

Vessel *j* is a randomly chosen element from the vessel type stratum *i*. After Cochran (1977) it follows from (B) that the vessel stratum estimates are

$$\bar{c}_{i\ldots} = \frac{1}{m_i}\sum_j \bar{c}_{ij..} \quad \text{and} \quad \hat{v}(\bar{c}_{i\ldots}) = \left[\frac{M_i - m_i}{M_i} \times \frac{1}{m_i}\left(\frac{\sum_j (\bar{c}_{ij..} - \bar{c}_{i\ldots})^2}{(m_i - 1)}\right)\right] + \left[\frac{1}{M_i m_i}\sum_j \hat{v}(\bar{c}_{ij..})\right]. \qquad \textbf{(C)}$$

The first term of the variance estimator accounts for the error among vessels of type *i* and includes the fpc. The fpc may be ignored if m_i/M_i is negligible. The second term is the mean within vessel variance for the sampled vessels of type *i*. No weighting was used at this stage as it was assumed that all vessels within a type stratum were treated as equal in terms of catch.

The final stage combined the results of the separate strata into an overall estimate of mean catch. Taking the results in (C), we arrive at

$$\bar{c}_{\ldots\ldots} = \sum_i \left(\bar{c}_{i\ldots} \times \frac{M_i}{M_.}\right) \quad \text{and} \quad \hat{v}(\bar{c}_{\ldots\ldots}) = \sum_i \left(\hat{v}(\bar{c}_{i\ldots}) \times \frac{M_i^2}{M_.^2}\right). \qquad \textbf{(D)}$$

Calculating forms

The estimated mean catch for the fishery, we can substitute results for the means from (C), (B) and (A) into (D) to arrive at the following

$$\begin{aligned}
\bar{c}_{\ldots\ldots} &= \sum_i \left(\frac{1}{m_i}\sum_j \bar{c}_{ij..} \times \frac{M_i}{M_.}\right) = \sum_i \frac{M_i}{m_i M_.}\sum_j \bar{c}_{ij..} \\
&= \sum_i \frac{M_i}{m_i M_.}\sum_j \left(\sum_k (\bar{c}_{ijk.} \times w_{ijk})\right) \\
&= \sum_i \frac{M_i}{m_i M_.}\sum_j \left[\frac{1}{N_{ij.}}\sum_k \left(\bar{c}_{ijk.} \times N_{ijk}\right)\right] \qquad \textbf{(E)}
\end{aligned}$$

-continued-

Similarly, the estimated variance of the mean estimate is

$$\hat{v}(\bar{c}_{....}) = \sum_i \left[\frac{M_i^2}{M_.^2} \left(\left[\frac{M_i - m_i}{M_i} \times \frac{1}{m_i} \left(\frac{\sum_j (\bar{c}_{ij..} - \bar{c}_{i...})^2}{(m_i - 1)} \right) \right] + \left[\frac{1}{M_i m_i} \sum_j \hat{v}(\bar{c}_{ij..}) \right] \right) \right]$$

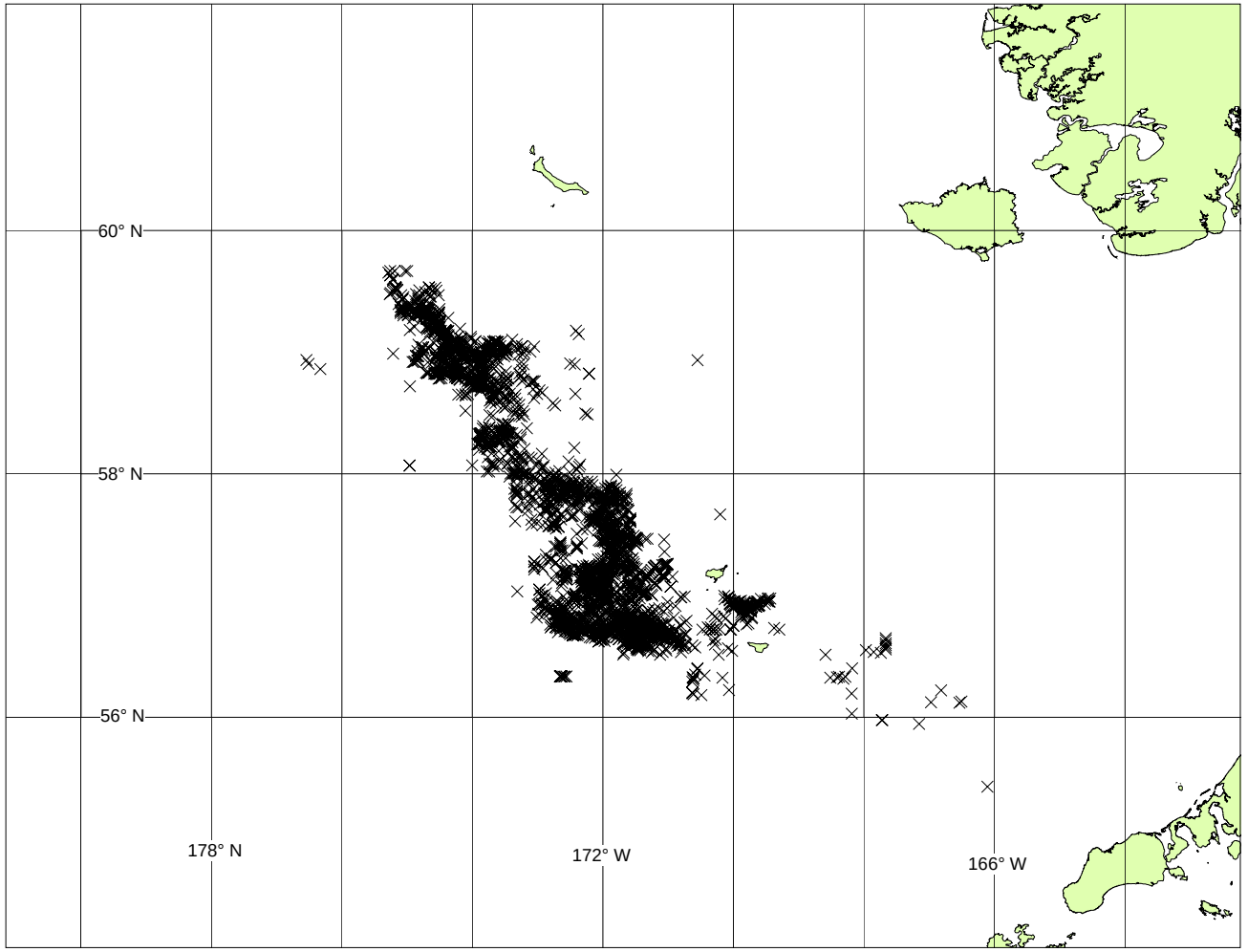
$$= \sum_i \frac{M_i^2}{M_.^2} \left[\left(\frac{M_i - m_i}{M_i} \times \frac{1}{m_i} \left(\frac{\sum_j (\bar{c}_{ij..} - \bar{c}_{i...})^2}{(m_i - 1)} \right) \right) + \frac{1}{M_i m_i} \sum_j \left(\sum_k \left[\hat{v}(\bar{c}_{ijk.}) \times \left(\frac{N_{ijk}}{N_{ij.}} \right)^2 \right] \right) \right]$$

$$= \sum_i \frac{M_i^2}{M_.^2} \left[\left(\frac{M_i - m_i}{M_i} \times \frac{1}{m_i} \left(\frac{\sum_j (\bar{c}_{ij..} - \bar{c}_{i...})^2}{(m_i - 1)} \right) \right) + \frac{1}{M_i m_i} \sum_j \left(\sum_k \left[\hat{v}(\bar{c}_{ijk.}) \right] \times \left(\frac{N_{ijk}}{N_{ij.}} \right)^2 \right) \right]$$

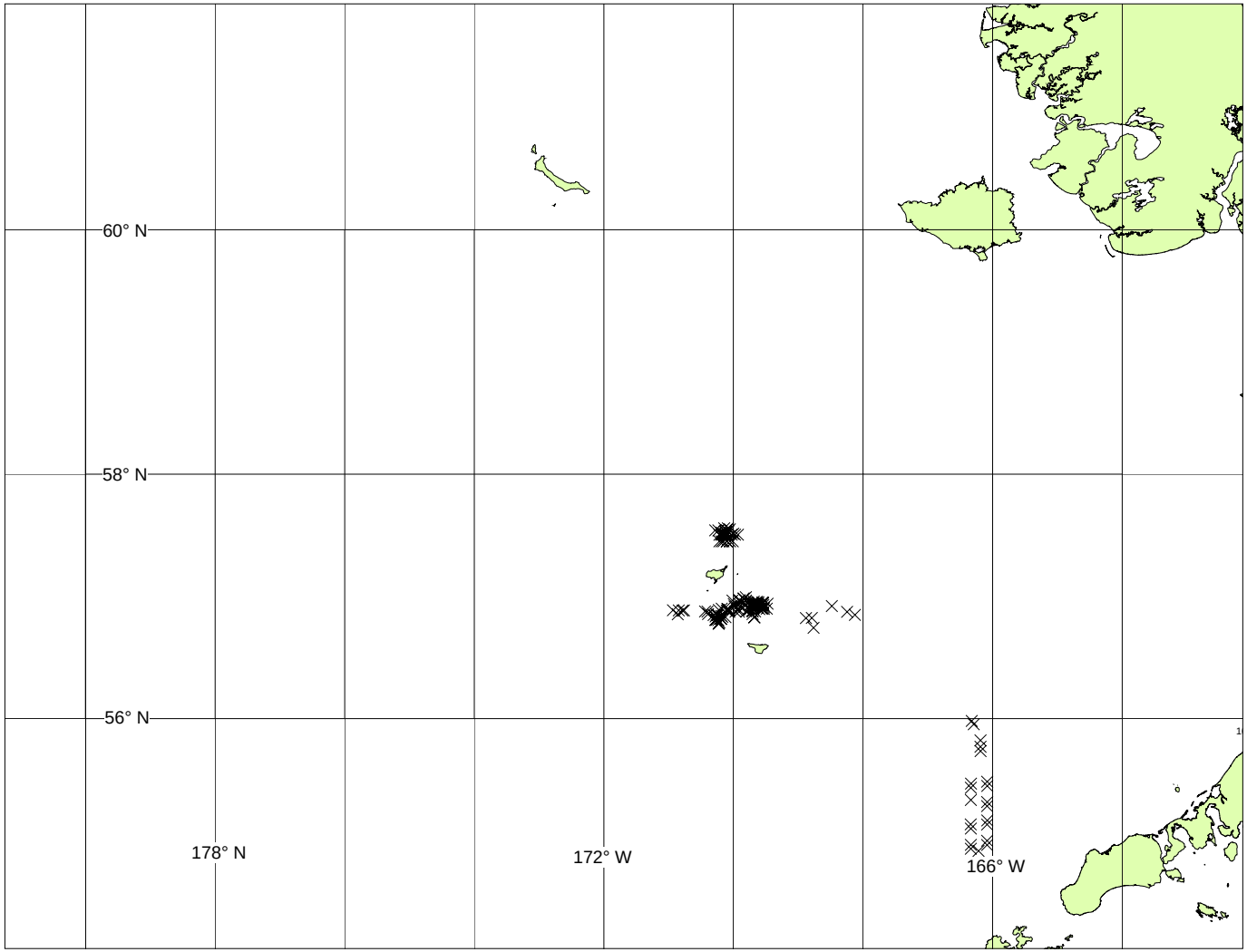
Let $\hat{v}(\bar{a}_i) = \left(\frac{M_i - m_i}{M_i} \times \frac{1}{m_i} \left(\frac{\sum_j (\bar{c}_{ij..} - \bar{c}_{i...})^2}{(m_i - 1)} \right) \right)$ and $\hat{v}(\bar{b}_i) = \left(\frac{1}{M_i m_i} \sum_j \left(\frac{1}{N_{ij.}^2} \sum_k \left[\hat{v}(\bar{c}_{ijk.}) \right] \times N_{ijk}^2 \right) \right)$

Then $\hat{v}(\bar{c}_{....}) = \sum_i \frac{M_i^2}{M_.^2} \left[\left(\hat{v}(\bar{a}_i) \right) + \left(\hat{v}(\bar{b}_i) \right) \right]$. **(F)**

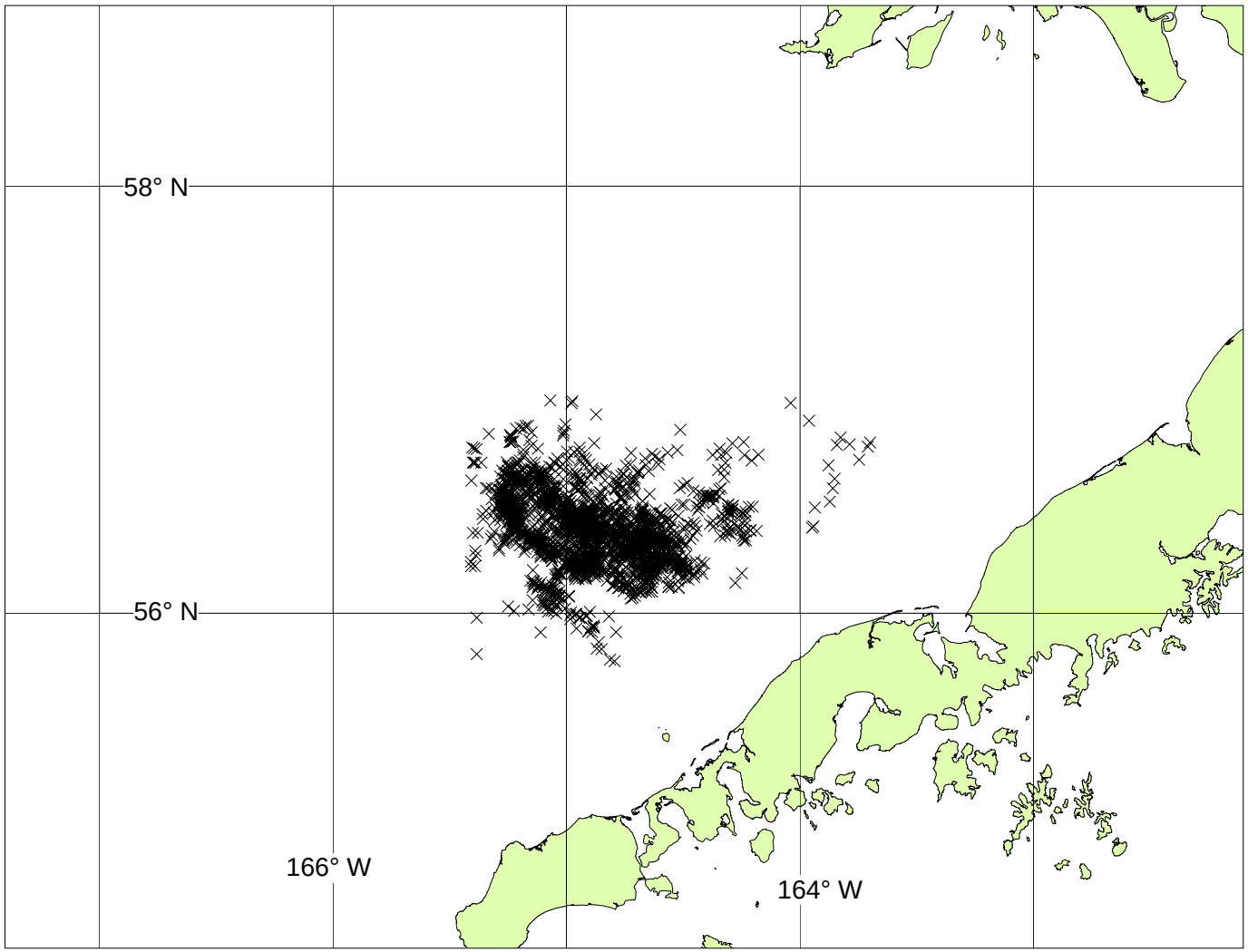
APPENDIX B: LOCATIONS OF SAMPLED POT LIFTS



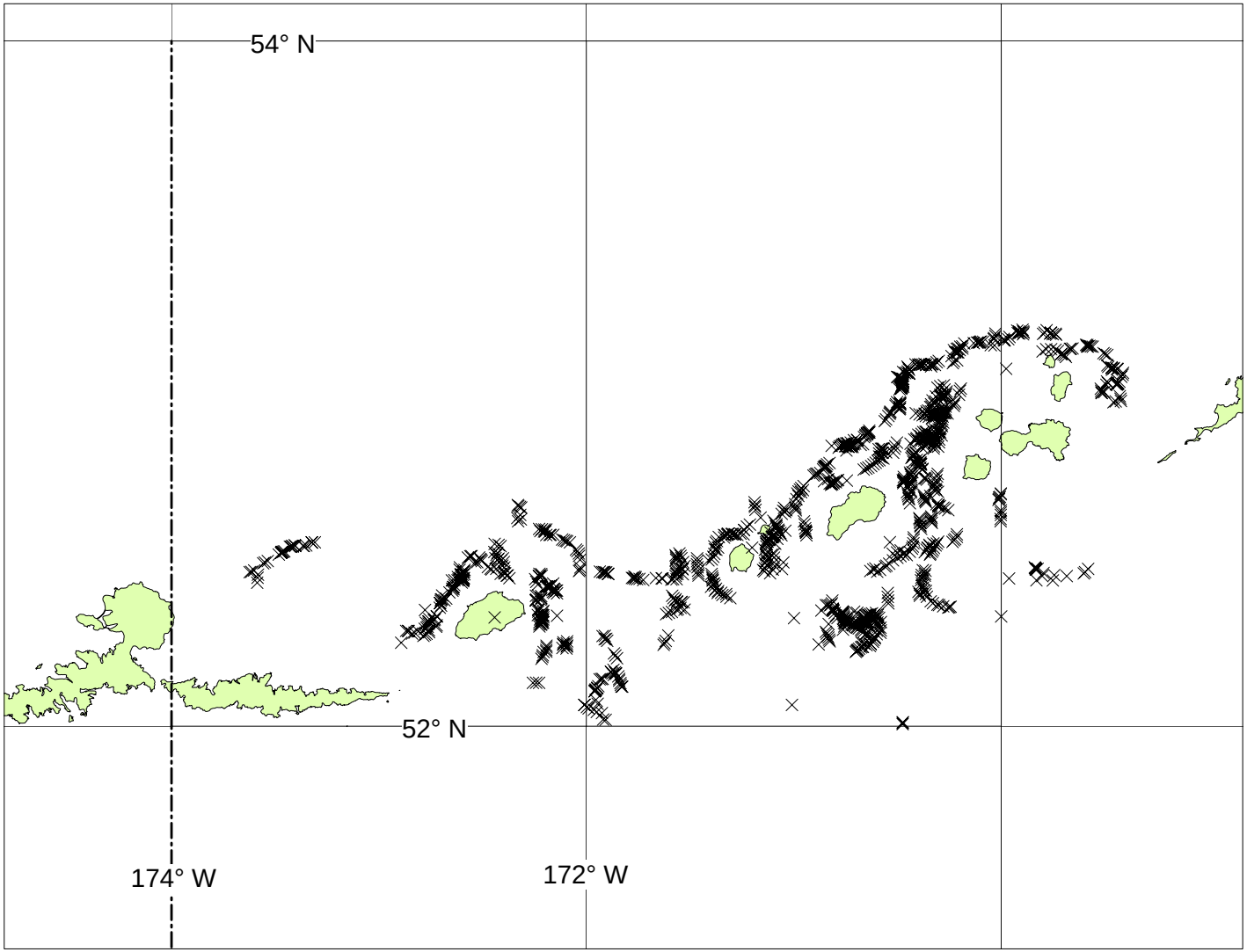
Appendix B1.-Locations of pot lifts sampled by observers during the 2005/2006 Bering Sea snow crab fishery.



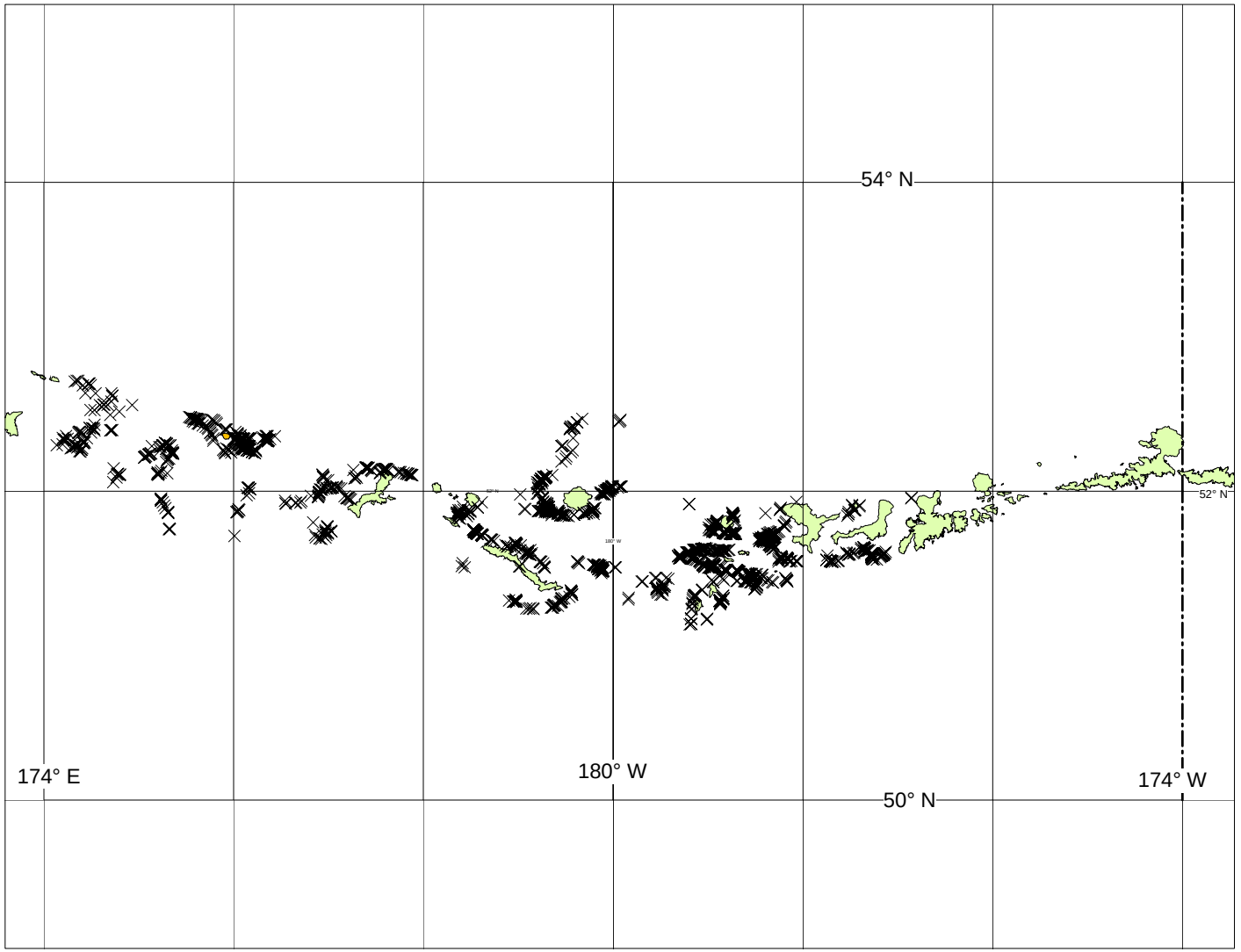
Appendix B2.-Locations of pot lifts sampled by observers during the 2005/2006 Bering Sea Tanner crab fishery.



Appendix B3.-Locations of pot lifts sampled by observers during the 2005/2006 Bristol Bay red king crab fishery.



Appendix B4.-Locations of pot lifts sampled by observers during the 2005/2006 Aleutian Islands golden king crab fishery east of 174° W longitude.



Appendix B5.-Locations of pot lifts sampled by observers during the 2005/2006 Aleutian Islands golden king crab fishery west of 174° W longitude.

APPENDIX C: ADDITIONAL CATCH AND BIOLOGICAL SUMMARIES

Appendix C1.-Total pot contents for 2,578 bycatch samples taken during the 2005/2006 Bering Sea snow crab fishery.

Species	Total Catch	Species	Total Catch
Snow crab			
Legal males	648,613	Yellow Irish lord	142
Sublegal males	8,651	Basket sea star (unidentified)	110
Females	853	Sea jelly (unidentified)	51
		Sea anemone (unidentified)	51
Tanner/Snow crab hybrid		Octopus	44
Legal males	1,952	Pacific halibut	33
Sublegal males	2,768	Walleye pollock	33
Females	796	Brittle star (unidentified)	30
		Flatfish (unidentified)	14
Tanner crab		Great sculpin	12
Legal males	6,082	Helmet crab	7
Sublegal males	41,937	Rock sole (unidentified)	7
Females	1,981	Leech (unidentified)	5
		Sea urchin (unidentified)	5
Blue king crab		Sea whip (unidentified)	4
Legal males	0	Skate (unidentified)	4
Sublegal males	1	Arrowtooth flounder	3
Females	2	Invertebrate (unidentified)	3
		Buccinum snail (unidentified)	2
Hair crab		Circumboreal toad crab	2
Legal males	1	Mussel (unidentified)	2
Sublegal males	2	Rockfish (unidentified)	2
Females	0	Bivalve (unidentified)	1
		Bryozoan (unidentified)	1
Snail (unidentified)	17,318	Cockle (unidentified)	1
Pacific cod	1,839	Eelpout (unidentified)	1
Hermit crab (unidentified)	555	Fanellia sp.	1
Sculpin (unidentified)	527	Flathead sole	1
Sea star (unidentified)	520	Kelp crab (unidentified)	1
Lyre crab	261	Poacher (unidentified)	1
Yellow fin sole	231	Prow fish	1
		Silky buccinum	1

Appendix C2.-Mean snow crab CPUE by soak times for 2,574 bycatch samples taken during the 2005/2006 Bering Sea snow crab fishery.

Soak Hours[a]	Percent of Sampled Pots	Catch per sampled pot				
		Legal Retained	Legal Not Retained	Sublegal	Female	Total
1-12	1.4	36.7	16.4	1.4	0.8	55.3
13-24	13.4	115.5	51.8	2.6	0.1	169.9
25-36	22.3	160.6	67.5	4.3	0.3	232.7
37-48	20.4	172.8	75.1	4.4	0.4	252.7
49-60	11.3	180.2	69.1	2.2	1.1	252.6
61-72	7.7	182.7	68.7	2.7	0.2	254.3
73-84	3.6	255.3	89.7	3.7	0.1	348.8
85-96	3.5	201.5	78.1	1.3	0	280.9
97-108	1.9	282.9	76.9	1.2	0	361.0
109-120	2.8	218.2	99.4	3.3	0.1	321.0
121-132	1.1	241.0	123.2	2.2	0	366.4
133-144	1.5	281.5	112.9	1.8	0	396.3
145-156	0.9	273.7	90.0	2.8	0	366.5
157-168	1.6	242.2	74.8	2.6	0	319.5
169-180	0.9	334.0	113.6	4.3	0.6	452.4
181-192	0.7	264.2	81.8	3.2	0.1	349.2
193-204	0.4	329.6	117.3	17.9	0	464.8
205-216	1.4	284.9	77.7	2.8	0	365.4
217-228	0.2	272.0	99.3	0.3	0	371.5
229-240	0.9	206.1	53.0	1.2	0	260.3
241-252	0.2	295.7	122.2	12.5	3.0	433.3
253-264	0.7	267.0	105.6	1.4	0.1	374.1
265-276	0.1	255.0	113.5	2.0	0	370.5
277-288	0.2	248.0	66.0	13.2	0	327.2
289-300	--	--	--	--	--	--
301-312	0.1	100.5	35.0	0	0	135.5
--	--	--	--	--	--	--
337-348	0.2	251.5	110.3	1.3	0	363.0
--	--	--	--	--	--	--
409-420	0.2	222.8	54.7	1.0	0	278.5
--	--	--	--	--	--	--
529-540	< 0.1	353.0	115.0	0	0	468.0
--	--	--	--	--	--	--
577-588	0.2	104.8	75.0	0	0	179.8
589-600	0.1	254.3	61.3	0.7	0.3	316.7
--	--	--	--	--	--	--
673-684	0.1	66.0	10.0	0	0	76.0

[a] Mean soak time = 64.8 hours

Appendix C3.-Mean snow crab CPUE by depth for 2,573 bycatch samples taken during the 2005/2006 Bering Sea snow crab fishery.

Depth[a] (fathoms)	Percent of Sampled Pots	Catch per sampled pot				
		Legal Retained	Legal Not Retained	Sublegal	Female	Total
21-25	< 0.1	221.0	11.0	0	0	232.0
26-30	--	--	--	--	--	--
31-35	0.7	54.9	15.6	0.1	0	70.6
36-40	2.6	2.7	6.5	1.0	< 0.1	10.3
41-45	0.3	36.7	26.1	2.0	1.7	66.4
46-50	0.8	57.2	42.3	8.4	0	107.8
51-55	2.5	97.1	45.3	2.2	0.8	145.4
56-60	18.9	203.8	90.3	2.4	0.4	296.9
61-65	32.5	174.1	66.5	3.5	0.2	244.3
66-70	27.5	197.8	77.3	3.9	0.5	279.5
71-75	13.6	193.7	69.6	3.8	< 0.1	267.2
76-80	0.3	50.6	43.6	0.1	0	94.3
81-85	0.1	1.5	0	0	0	1.5
86-90	0.1	1.5	0	0	0	1.5
91-95	< 0.1	289.0	64.0	1.0	0	354.0

[a] Mean depth = 63.5 fathoms

Appendix C4.-Reproductive condition of female snow crabs from pot lifts sampled during the 1995-2005/2006 Bering Sea snow crab fisheries.

Year	Crabs Sampled	Eyed Eggs Percent	Uneyed Eggs Percent	Barren, Mated Percent	Barren, Non-mated Percent
1995	423	80.4	12.5	6.1	0.9
1996	136	59.6	3.7	16.2	20.6
1997	789	40.9	0.6	30.4	28.0
1998	90	21.1	8.9	37.8	32.2
1999	99	68.7	5.1	22.2	4.0
2000	6	0	16.7	16.7	66.6
2001	11	18.2	36.4	0	45.4
2002	19	26.3	57.9	10.5	5.3
2003	62	41.9	45.2	9.7	3.2
2004	10	10.0	30.0	0	60.0
2005[a]	9	88.9	11.1	0	0
2005/06	129	6.2	89.2	2.3	2.3

[a] Pre-rationalized

Appendix C5.-Mean Tanner crab CPUE by soak times for 2,574 pot lifts sampled during the 2005/2006 Bering Sea snow crab fishery.

Soak Hours[a]	Percent of Sampled Pots	Catch per sampled pot				
		Legal Retained	Legal Not Retained	Sublegal	Female	Total
1-12	1.4	0	0.4	19.6	1.2	21.3
13-24	13.4	1.5	1.1	14.6	1.0	18.2
25-36	22.3	2.2	0.6	18.3	1.1	22.2
37-48	20.4	1.0	1.4	16.4	0.6	19.5
49-60	11.3	0.1	1.2	13.6	0.1	15.0
61-72	7.7	3.3	1.0	20.0	2.1	26.3
73-84	3.6	0.1	0.4	10.1	0.0	10.6
85-96	3.5	1.4	0.4	10.6	0.2	12.6
97-108	1.9	0.2	1.3	14.9	< 0.1	16.4
109-120	2.8	1.7	0.4	13.6	0.2	15.9
121-132	1.1	2.6	1.2	21.4	2.5	27.7
133-144	1.5	0.9	0.6	19.8	0.1	21.4
145-156	0.9	6.8	0.5	39.0	0.8	46.9
157-168	1.6	1.8	0.9	22.3	0	24.9
169-180	0.9	0.0	0.9	11.1	0	12.0
181-192	0.7	0.1	0.2	6.8	0.1	7.2
193-204	0.4	0	1.2	5.5	0	6.7
205-216	1.4	0	0.8	10.9	< 0.1	11.7
217-228	0.2	0	0.8	9.3	0	10.0
229-240	0.9	0	1.1	25.5	1.6	28.2
241-252	0.2	0	0.5	5.7	0	6.2
253-264	0.7	0.2	0.6	8.4	0	9.2
265-276	0.1	0	0.5	12.0	0	12.5
277-288	0.2	0	1.2	5.4	0	6.6
289-300	--	--	--	--	--	--
301-312	0.1	0	0	3.5	0	3.5
--	--	--	--	--	--	--
337-348	0.2	0	0	5.5	0	5.5
--	--	--	--	--	--	--
409-420	0.2	0	1.0	4.8	0	5.8
--	--	--	--	--	--	--
529-540	< 0.1	0	1.0	8.0	0	9.0
--	--	--	--	--	--	--
577-588	0.2	0	9.5	69.8	0	79.3
589-600	0.1	0	2.3	7.0	0	9.3
--	--	--	--	--	--	--
673-684	0.1	0	3.7	21.3	0	25.0

[a] Mean soak time = 64.8 hours.

Appendix C6.-Mean Tanner crab CPUE by depth for 3,573 pot lifts sampled during the 2005/2006 Bering Sea snow crab fishery.

Depth[a] (fathoms)	Percent of Sampled Pots	Catch per sampled pot				
		Legal Retained	Legal Not Retained	Sublegal	Female	Total
21-25	< 0.1	0	0	0	0	0.0
26-30	--	--	--	--	--	--
31-35	0.7	16.5	5.6	61.1	0.4	83.6
36-40	2.6	38.6	1.2	107.8	14.1	161.7
41-45	0.3	21.2	1.4	51.3	0.1	74.1
46-50	0.8	0.9	2.5	38.5	0.4	42.2
51-55	2.5	1.1	0.7	27.0	0	28.8
56-60	18.9	0.2	1.2	18.8	0.2	20.5
61-65	32.5	0.2	1.0	15.0	0.7	16.9
66-70	27.5	0.1	0.9	9.3	0.3	10.6
71-75	13.6	0.1	0.4	5.3	0.2	6.0
76-80	0.3	0	0.0	1.1	0	1.1
81-85	0.1	0	2.5	48.0	0	50.5
86-90	0.1	0	7.5	75.0	0	82.5
91-95	< 0.1	0	0	1.0	0	1.0

[a] Mean depth = 63.5 fathoms.

Appendix C7.-Total pot lift contents for 160 pot lifts sampled during the 2005/2006 Bering Sea Tanner crab fishery.

Species	Total Catch	Species	Total Catch
Tanner crab		Yellowfin sole	270
Legal male	6,612	Sea star (unidentified)	156
Sublegal male	18,578	Sculpin (unidentified)	132
Female	2,838	Snail (unidentified)	129
		Pribilof Neptune	62
Snow crab		Pacific cod	55
Legal male	2,726	Hermit crab (unidentified)	27
Sublegal male	258	Lyre crab	18
Female	16	Yellow Irish lord	16
		Sea jelly (unidentified)	10
Red king crab		Sea urchin (unidentified)	8
Legal male	0	Brittle star (unidentified)	7
Sublegal male	29	Pacific halibut	5
Female	137	Arrowtooth flounder	2
		Bryozoan (unidentified)	1
Tanner x snow crab hybrid		Flatfish (unidentified)	1
Legal male	107	Prow fish	1
Sublegal male	50	Rock sole (unidentified)	1
Female	2	Sea cucumber (unidentified)	1
Blue king crab			
Legal male	8		
Sublegal male	112		
Female	0		

Appendix C8.-Mean CPUE by soak times for 160 pot lifts sampled during the 2005/2006 Bering Sea Tanner crab fishery.

Soak Hours[a]	Percent of Sampled Pots	Catch per sampled pot			
		Legal	Sublegal	Female	Total
1-12	1.3	1.5	33.5	1.0	36.0
13-24	21.3	29.4	89.4	10.0	128.9
25-36	41.3	42.3	116.4	7.9	166.7
37-48	13.8	60.0	172.2	67.7	299.9
49-60	11.9	22.3	78.4	13.6	114.3
61-72	2.5	65.8	169.8	55.5	291.0
73-84	3.8	51.2	151.8	0.7	203.7
85-96	1.9	14.3	92.7	0	107.0
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289-300	2.5	114.5	160.0	0.3	274.8

[a] Mean soak time = 42.6 hours.

Appendix C9.-Mean CPUE by depth for 160 pot lifts sampled during the 2005/2006 Bering Sea Tanner crab fishery.

Depth[a] (fathoms)	Percent of Sampled Pots	Catch per sampled pot			
		Legal	Sublegal	Female	Total
21-25	1.3	12.5	86.0	90.5	189.0
26-30	0.6	77.0	187.0	69.0	333.0
31-35	18.1	72.3	167.9	4.2	244.4
36-40	34.4	50.4	129.5	33.5	213.4
41-45	10.0	20.6	67.9	0.4	89.0
46-50	11.3	34.5	131.4	9.3	175.2
51-55	8.8	33.1	106.9	17.1	157.1
56-60	3.1	28.6	143.0	1.4	173.0
61-65	--	--	--	--	--
66-70	6.3	7.0	30.3	5.8	43.1
71-75	1.9	1.3	35.0	9.3	45.7
76-80	4.4	1.0	22.4	16.4	39.9

[a] Mean depth = 44.4 fathoms.

Appendix C10.-Reproductive condition of female Tanner crabs from pot lifts sampled during the 2005/2006 Bering Sea Tanner crab fishery.

Year	Crabs Sampled	Eyed Eggs	Uneyed Eggs	Barren, Mated	Barren, Non-mated
		Percent	Percent	Percent	Percent
2005/06	1101	21.9	75.8	0.6	1.6

Appendix C11.-Total pot lift contents for 1,855 pot lifts sampled during the 2005/2006 Bristol Bay red king crab fishery.

Species	Total Catch	Species	Total Catch
Red king crab		Snail (unidentified)	5,963
Legal male	50,736	Pacific cod	643
Sublegal male	44,065	Yellowfin sole	268
Female	26,826	Hermit crab (unidentified)	247
		Great sculpin	128
Tanner crab		Sea star (unidentified)	117
Legal male	288	Pacific halibut	81
Sublegal male	698	Sea jelly (unidentified)	80
Female	74	Sculpin (unidentified)	68
		Brittle star (unidentified)	47
Snow crab		Leech (unidentified)	41
Legal male	251	Sponge (unidentified)	28
Sublegal male	11	Spiny head sculpin	21
Female	4	Sea cucumber (unidentified)	16
		Rockfish (unidentified)	15
Tanner x snow crab hybrid		Bigmouth sculpin	11
Legal male	35	Lyre crab	10
Sublegal male	14	Basket star (unidentified)	8
Female	0	Walleye pollock	8
		Pygmy cancer crab	7
Hair crab		Kelp crab (unidentified)	5
Legal male	2	Octopus (unidentified)	3
Sublegal male	0	Arrowtooth flounder	2
Female	1	Flatfish (unidentified)	2
		Invertebrate (unidentified)	2
Blue king crab		Mussel (unidentified)	2
Legal male	0	Yellow Irish lord	2
Sublegal male	3	Pacific herring	1
Female	0	Scallop (unidentified)	1
		Skate (unidentified)	1
		Shrimp (unidentified)	1
		Flathead sole	1
		Starry flounder	1

Appendix C12.-Mean CPUE by soak times for 1,844 pot lifts sampled during the 2005/2006 Bristol Bay red king crab fishery.

Soak Hours[a]	Percent of Sampled Pots	Catch per sampled pot			
		Legal	Sublegal	Female	Total
1-12	0.6	8.0	6.5	1.5	16.0
13-24	6.0	25.3	40.6	15.0	80.9
25-36	16.5	22.8	26.4	9.1	58.3
37-48	22.9	25.8	26.7	15.7	68.2
49-60	19.3	26.3	19.7	19.9	65.9
61-72	7.7	25.8	18.3	11.3	55.3
73-84	4.6	28.5	18.9	17.4	64.8
85-96	4.1	26.5	19.6	7.9	53.9
97-108	2.9	31.4	41.6	19.5	92.5
109-120	4.3	37.0	17.0	12.5	66.5
121-132	2.4	30.3	19.8	24.5	74.5
133-144	2.7	29.4	18.6	13.5	61.4
145-156	1.3	48.5	32.5	11.3	92.3
157-168	1.3	44.2	12.8	8.8	65.8
169-180	0.9	46.8	12.9	6.7	66.4
181-192	0.5	37.1	11.6	5.4	54.1
193-204	0.7	53.7	6.0	1.3	60.9
205-216	0.2	71.3	14.0	1.0	86.3
217-228	0.2	58.5	2.8	0.0	61.3
229-240	0.3	15.5	25.2	11.0	51.7
241-252	0.1	45.0	29.5	0.5	75.0
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265-276	0.1	31.0	6.5	38.0	75.5
277-288	0.2	0.0	0.0	0.0	0.0
289-300	0.1	44.0	17.0	0.0	61.0
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349-360	0.1	37.0	29.0	2.0	68.0
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373-384	0.1	62.0	15.0	1.0	78.0

[a] Mean soak time = 65.4 hours.

Appendix C13.-Mean CPUE by depth for 1,844 pot lifts sampled during the 2005/2006 Bristol Bay red king crab fishery.

Depth[a] (fathoms)	Percent of Sampled Pots	Catch per sampled pot			
		Legal	Sublegal	Female	Total
31-35	0.3	8.2	8.2	54.0	70.3
36-40	10.0	19.2	17.4	28.9	65.6
41-45	54.7	29.6	26.7	14.0	70.4
46-50	34.8	26.4	21.1	10.3	57.8
51-55	0.2	9.0	33.0	4.7	46.7

[a] Mean depth = 44.2 fathoms.

Appendix C14.-Reproductive condition of female red king crabs from pot lifts sampled during the 1996-2005/2006 Bristol Bay red king crab fisheries.

Year	Crabs Sampled	Eyed Eggs	Uneyed Eggs	Barren, Mated	Barren, Non-mated
		Percent	Percent	Percent	Percent
1996	11	0	0	0	100.0
1997	70	65.7	18.6	0	15.7
1998	4,091	45.6	51.8	<0.1	2.6
1999	36	0	86.1	2.8	11.1
2000	1,486	4.0	22.3	0.5	73.2
2001	4,574	66.0	18.7	0.3	15.0
2002	311	32.1	2.6	0.6	64.6
2003	10,391	9.1	51.5	3.4	35.9
2004	4,111	21.4	48.4	0.6	29.6
2005/06	26,753	41.3	45.0	0.2	13.4

Appendix C15.-Total pot lift contents for 1,193 pot lifts sampled during the 2005/2006 Aleutian Islands golden king crab fishery east of 174° W longitude.

Species	Total Catch	Species	Total Catch
Golden king crab		*Paragorgia* spp.	13
Legal male	32,927	Arrowtooth flounder	10
Sublegal male	9,763	Sea jelly (unidentified)	7
Female	5,912	*Anthomastus* spp.	6
		Clavularia spp.	6
Scarlet king crab		Lyre crab	6
Legal male	3	*Crypthelia* spp.	5
Sublegal male	0	*Errinopora* spp	4
Female	1	*Arthrogorgia* spp.	3
		Greenland turbot	3
Grooved Tanner crab		Plexauridae (unidentified)	3
Legal male	0	Red tree coral	3
Sublegal male	1	Rockfish (unidentified)	3
Female	0	Sculpin (unidentified)	3
		Sea spider (unidentified)	3
Hydroid (unidentified)	1,757	*Calcigorgia* spp.	2
Sponge (unidentified)	443	Cup coral (unidentified)	2
Basket star (unidentified)	328	Grenadier (unidentified)	2
Brittle star (unidentified)	326	Primnoidae (unidentified)	2
Stylaster spp.	106	Sablefish	2
Sea urchin (unidentified)	101	Tunicate (unidentified)	2
Snail (unidentified)	70	Bryozoan (unidentified)	1
Primnoa Group I	58	Chiton (unidentified)	1
Distichopora spp.	41	Great sculpin	1
Sea star (unidentified)	39	Hydrocoral (unidentified)	1
Cyclohelia spp.	38	*Ideogorgia* sp.	1
Skate (unidentified)	37	Pacific ocean perch	1
Pacific halibut	24	Scale worm (unidentified)	1
Fanellia spp.	18	Soft coral (unidentified)	1
Pacific cod	16		

Appendix C16.-Mean CPUE by soak times for 1,190 pot lifts sampled during the 2005/2006 Aleutian Islands golden king crab fishery east of 174° W longitude.

Soak Hours[a]	Percent of Sampled Pots	Catch per sampled pot			
		Legal	Sublegal	Female	Total
49-96	9.2	11.1	7.5	4.8	23.4
97-144	10.7	19.9	8.9	6.6	35.4
145-192	8.5	25.5	12.0	7.8	45.4
193-240	5.8	30.4	8.0	5.8	44.2
241-288	14.5	33.4	9.3	4.5	47.2
289-336	8.2	27.2	6.4	4.1	37.7
337-384	13.4	32.4	12.4	8.2	53.0
385-432	6.8	30.6	8.9	3.3	42.7
433-480	2.3	34.2	4.7	2.1	41.0
481-528	3.7	29.3	8.1	2.8	40.3
529-576	3.8	33.3	5.0	3.1	41.4
577-624	2.7	19.5	1.8	1.6	22.9
625-672	1.1	47.2	4.2	2.1	53.5
673-720	2.2	24.0	2.1	0.2	26.3
721-768	2.1	25.3	1.3	0.5	27.0
769-816	0.8	23.3	1.7	0.8	25.8
817-864	0.5	22.7	1.5	1.0	25.2
865-912	0.8	9.7	0.6	0.3	10.6
913-960	1.4	47.9	3.9	3.1	55.0
961-1008	0.8	34.9	3.6	4.7	43.1
1009-1056	0.8	55.9	6.6	4.5	67.0
1057-1104	--	--	--	--	--
1105-1152	0.2	3.0	1.0	0.0	4.0

[a] Mean soak time = 340.3 hours.

Appendix C17.-Mean CPUE by depth for 1,190 pot lifts sampled during the 2005/2006 Aleutian Islands golden king crab fishery east of 174° W longitude.

Depth[a] (fathoms)	Percent of Sampled Pots	Catch per sampled pot			
		Legal	Sublegal	Female	Total
1-25	0.1	16.0	0	4.0	20.0
--	--	--	--	--	--
76-100	6.5	23.7	6.4	1.8	31.8
101-125	16.0	32.9	6.5	1.6	41.0
126-150	15.7	27.9	7.2	4.7	39.7
151-175	15.6	25.4	5.9	3.7	35.1
176-200	8.4	28.7	7.4	6.4	42.5
201-225	8.8	32.4	8.1	5.9	46.4
226-250	8.2	29.5	13.8	9.1	52.3
251-275	11.8	21.7	13.0	8.6	43.2
276-300	6.9	22.7	7.3	3.5	33.6
301-325	1.6	28.5	9.3	9.4	47.1
326-350	0.3	24.0	11.5	8.3	43.8
376-400	0.1	11.0	2.0	0	13.0
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451-475	0.1	56.0	3.0	0	59.0

[a] Mean depth = 182.7 fathoms.

Appendix C18.-Reproductive condition of female golden king crabs from pot lifts sampled during the 1996-2005/2006 Aleutian Islands golden king crab fisheries east of 174° W longitude.

Year	Crabs Sampled	Eyed Eggs	Uneyed Eggs	Barren, Mated	Barren, Non-mated
		Percent	Percent	Percent	Percent
1996	59,210	20.8	22.5	18.6	38.1
1997	54,383	25.2	19.3	22.1	33.4
1998	44,352	18.1	21.0	23.9	37.0
1999	36,695	22.1	21.0	23.1	33.8
2000	13,615	26.9	18.7	20.1	34.3
2001	14,912	20.4	12.5	15.4	51.1
2002	9,651	29.6	19.2	18.9	32.3
2003	7,990	20.9	33.2	13.6	31.5
2004	5,430	24.9	24.7	24.9	25.5
2005/06	1,489	25.8	25.2	18.3	30.7

Appendix C19.-Total pot lift contents for 1,370 pot lifts sampled during the 2005/2006 Aleutian Islands golden king crab fishery west of 174° W longitude.

Species	Total Catch	Species	Total Catch
Golden king crab		Plexauridae (unidentified)	25
Legal male	29,363	Invertebrate (unidentified)	23
Sublegal male	16,066	Octopus	21
Female	12,479	*Crypthelia* spp.	20
		Rockfish (unidentified)	19
Red king crab		Rougheye rockfish	19
Legal male	2	*Anthomastus* spp.	17
Sublegal male	0	*Calcigorgia* spp.	16
Female	1	*Clavularia* spp.	14
		Oregon triton	14
Scarlet king crab		Sculpin (unidentified)	14
Legal male	7	*Cyclohelia* spp.	13
Sublegal male	0	*Paragorgia* spp.	8
Female	1	Pacific halibut	8
		Red tree coral	8
Triangle Tanner crab		Feather star (unidentified)	8
Legal male	0	Pacific cod	7
Sublegal male	1	Skate (unidentified)	6
Female	0	Sea spider (unidentified)	5
		Sea anemone (unidentified)	4
Paralomis multispina		Hydrocoral (unidentified)	3
Legal male	1	Atka mackerel	2
Sublegal male	0	Grenadier (unidentified)	2
Female	0	*Javiania* spp.	2
		Sea cucumber (unidentified)	2
Hydroid (unidentified)	3,502	Snailfish (unidentified)	2
Brittle star (unidentified)	947	Soft coral (unidentified)	2
Sponge (unidentified)	673	Arrowtooth flounder	1
Bryozoan (unidentified)	351	Coral (unidentified)	1
Basket star (unidentified)	330	Graceful decorator crab	1
Primnoa Group I	246	Sea jelly (unidentified)	1
Stylaster spp.	179	Cup coral (unidentified)	1
Fanellia spp.	108	*Lillipathes* sp.	1
Sea urchin (unidentified)	77	Octopus (unidentified)	1
Snail (unidentified)	62	*Ptilosarcus* sp.	1
Sea star (unidentified)	53	Sablefish	1
Arthrogorgia spp.	37	Shortspine thornyhead	1
Distichopora spp.	30		

Appendix C20.-Mean CPUE by soak times for 1,370 pot lifts sampled during the 2005/2006 Aleutian Islands golden king crab fishery west of 174° W longitude.

Soak Hours[a]	Percent of Sampled Pots	Catch per sampled pot			
		Legal	Sublegal	Female	Total
1-48	0.4	16.2	5.2	0	21.4
49-96	0.4	9.2	1.6	0	10.8
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145-192	4.5	13.8	23.7	9.8	47.3
193-240	3.1	13.9	10.0	16.9	40.8
241-288	7.4	23.6	18.2	14.0	55.8
289-336	7.7	28.2	25.2	13.3	66.8
337-384	10.9	26.5	17.3	13.1	56.9
385-432	12.7	21.0	8.5	11.9	41.4
433-480	7.1	24.9	10.1	10.4	45.4
481-528	8.5	28.1	17.7	7.3	53.2
529-576	4.2	21.6	6.8	4.1	32.5
577-624	1.5	20.5	5.7	4.4	30.7
625-672	0.5	17.6	1.4	9.0	28.0
673-720	3.1	18.8	5.4	6.7	31.0
721-768	2.7	21.4	6.8	4.0	32.2
769-816	1.8	30.5	3.5	7.8	41.7
817-864	2.6	29.0	5.4	7.9	42.3
865-912	3.4	16.2	2.9	4.1	23.3
913-960	4.2	20.0	3.8	5.9	29.7
961-1008	1.2	20.4	4.8	2.9	28.1
1009-1056	1.2	13.8	1.8	2.1	17.6
1057-1104	3.0	16.7	6.0	4.6	27.3
1105-1152	2.8	11.0	10.5	4.8	26.3
1153-1200	1.1	7.6	2.5	0.5	10.5
1201-1248	1.0	3.0	0.6	1.1	4.7
1249-1296	0.9	9.0	2.3	8.7	20.0
1297-1344	0.8	8.5	3.4	4.6	16.5
1345-1392	0.4	6.8	0.7	0.2	7.7
1393-1440	0.1	2.0	4.0	0	6.0

[a] Mean soak time = 560.0 hours.

Appendix C21.-Mean CPUE by depth for 1,370 pot lifts sampled during the 2005/2006 Aleutian Islands golden king crab fishery west of 174° W longitude.

Depth[a] (fathoms)	Percent of Sampled Pots	Catch per sampled pot			
		Legal	Sublegal	Female	Total
051-075	0.1	1.0	6.0	0.0	7.0
076-100	1.6	31.1	14.0	13.0	58.2
101-125	6.9	25.9	11.6	7.8	45.3
126-150	20.9	23.9	17.2	6.7	47.8
151-175	26.2	22.5	12.3	6.8	41.6
176-200	16.9	17.9	9.5	6.6	34.0
201-225	13.7	19.2	9.4	15.1	43.7
226-250	9.2	19.4	7.3	16.9	43.6
251-275	2.9	18.9	7.9	13.2	40.0
276-300	0.9	21.5	7.0	6.2	34.7
301-325	0.5	15.1	1.7	0.3	17.1
326-350	0.1	11.5	0.5	1.0	13.0

[a] Mean depth = 177.0 fathoms.

Appendix C22.-Reproductive condition of female golden king crabs from pot lifts sampled during the 1996/1997-2005/2006 Aleutian Islands golden king crab fisheries west of 174° W longitude.

Year	Crabs Sampled	Eyed Eggs	Uneyed Eggs	Barren, Mated	Barren, Non-mated
		Percent	Percent	Percent	Percent
1996/1997	67,314	23.6	25.5	21.2	29.6
1997/1998	39,343	24.0	26.8	19.8	29.4
1998/1999	22,208	23.4	25.9	16.3	34.4
1999/2000	45,645	21.3	29.6	19.1	29.9
2000/2001	53,716	26.2	28.7	17.1	27.9
2001/2002	38,829	26.6	27.8	22.4	23.2
2002/2003	22,479	32.8	20.9	11.9	33.9
2003/2004	5,946	32.8	26.8	19.2	21.2
2004/2005	12,970	26.1	31.7	21.6	20.6
2005/2006	5,798	35.2	33.5	21.7	9.6

APPENDIX D: RESULTS OF LEGAL TALLY SAMPLES

Appendix D1.-Results of legal tally samples taken during the 2005/2006 Bering Sea and Aleutian Islands crab fisheries.

Fishery	Sample Size	Male Target Species Percent Illegal	Female Target Species Percent Illegal	Non-target Species Percent Illegal	Total Percent Illegal	Estimated Number of Illegal Crabs[a]
Bering Sea snow crab	61,065	0.08	< 0.01	0.36	0.44	108,025
Bristol Bay red king crab	20,695	0.39	0.03	0	0.42	11,488
Bering Sea Tanner crab	2,700	0.74	0	0	0.74	2,725
Aleutian Islands golden king crab	67,177	0.53	0.01	< 0.01	0.54	6,822

[a] Estimated number of illegal crabs derived from percentage of total illegal crabs multiplied by number of crabs harvested during the fishery.