

NEARSHORE BLUE KING CRAB SURVEY
ST. MATTHEW ISLAND, 1999

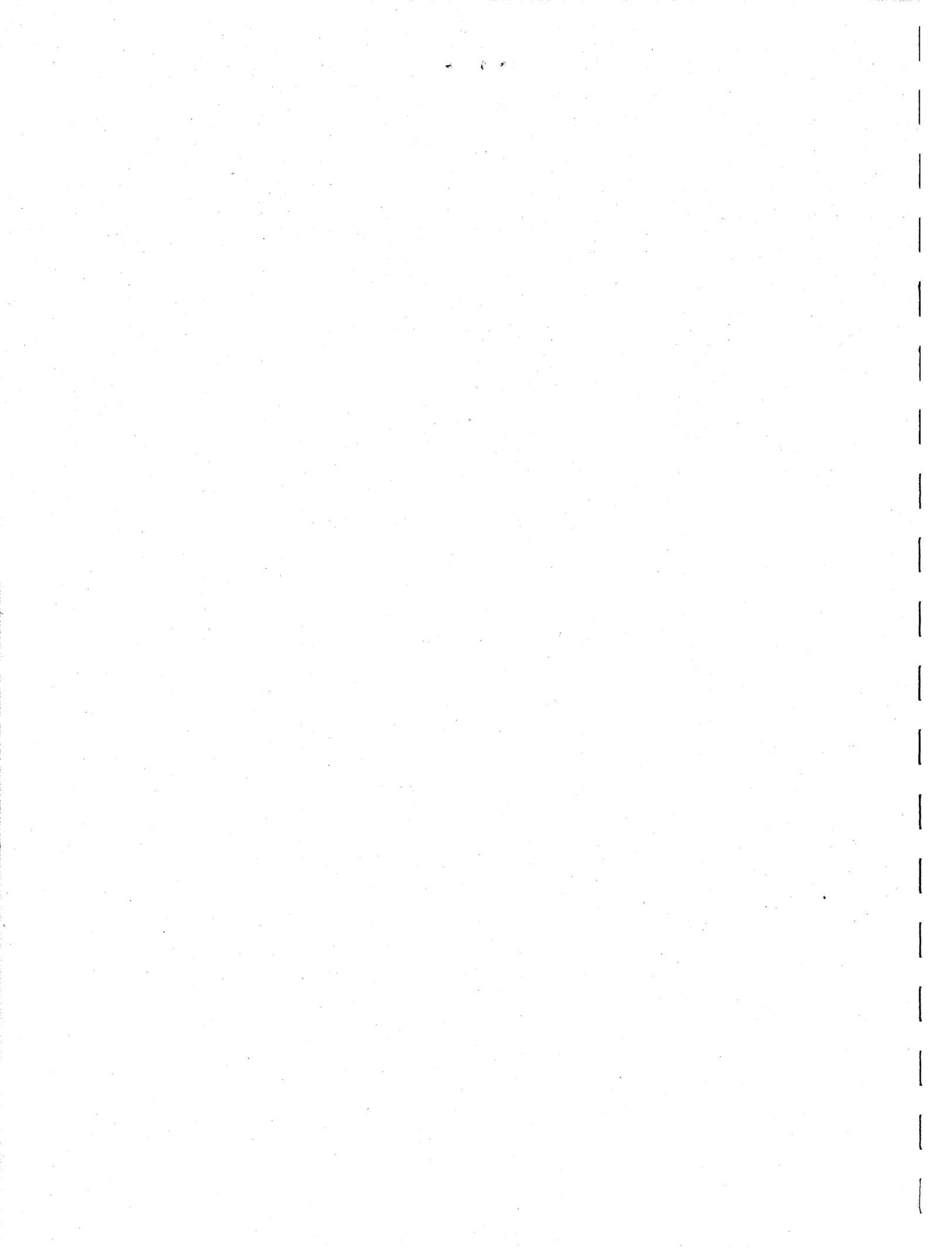


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Alaska Department of Fish and Game
Division of Commercial Fisheries
211 Mission Road
Kodiak, Alaska 99615

May 2000

Gordon Kruse
Juneau



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By

S. Forrest Blau

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AUTHOR

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This report is dedicated to the memory of Bill Wever, coworker, diver and friend who lost his life in a diving accident in February 2000, six months after being on the 1999 St. Matthew blue king crab nearshore survey.

We acknowledge and thank the owners and crew of the FV *Notorious* for fulfilling the contract with the Alaska Department of Fish and Game (ADF&G) for the 1999 St. Matthew Island blue king crab nearshore survey. Vessel crew during the survey consisted of Bill Esselstrom, captain, Robert Stafford, mate, and deck hands Jesus Avila, James Benson and John Esselstrom. In addition to regular shipboard duties the crew assisted the biological staff by sorting the catch on board the FV *Notorious* and assisting launching and retrieving the RV *Instar* from the FV *Notorious* after crab fishing or scuba diving in shallow waters.

ADF&G staff on board the FV *Notorious* consisted of Forrest Blau, fishery biologist and crew leader, Mary Schwenzfeier, fishery biologist, and Bill Wever, Fish and Wildlife Technician. Rounding out the biological crew was Peter Cumiskey, fishery biologist with the National Marine Fisheries Service (NMFS). The biological crew sorted, measured, and recorded data. They also edited forms, maintained equipment, and compiled a trip report while at sea.

Special thanks to Rich MacIntosh, NMFS fishery biologist in Kodiak for providing the information on female blue king crabs which molted in captivity.

The following ADF&G personnel are acknowledged for their pre- and post-charter efforts, essential for the completion of the survey and this report. Douglas Pengilly provided input into the survey design and final report editing. Donn Tracy and Roxie Aragonese secured the FV *Notorious* through contracting procedures. Tom Emerson maintained and made improvements to the RV *Instar*. Donn Tracy, Mary Schwenzfeier and Susan Byersdorfer conducted cost recovery fishing for the Bering Sea Test Fish (BSTF) program by capturing red king crabs from Bristol Bay during September and October 1999. Holly Moore provided logistic support. Savanna Kochuten entered the data. Jim Blackburn set up the computer database and assisted in various data summaries. Leslie Watson co-authored the 1999 St. Matthew operational plan and edited this report. Dan Connolly and Denby Lloyd also reviewed this report. Thanks to Lucinda Neel for final report formatting and distribution.

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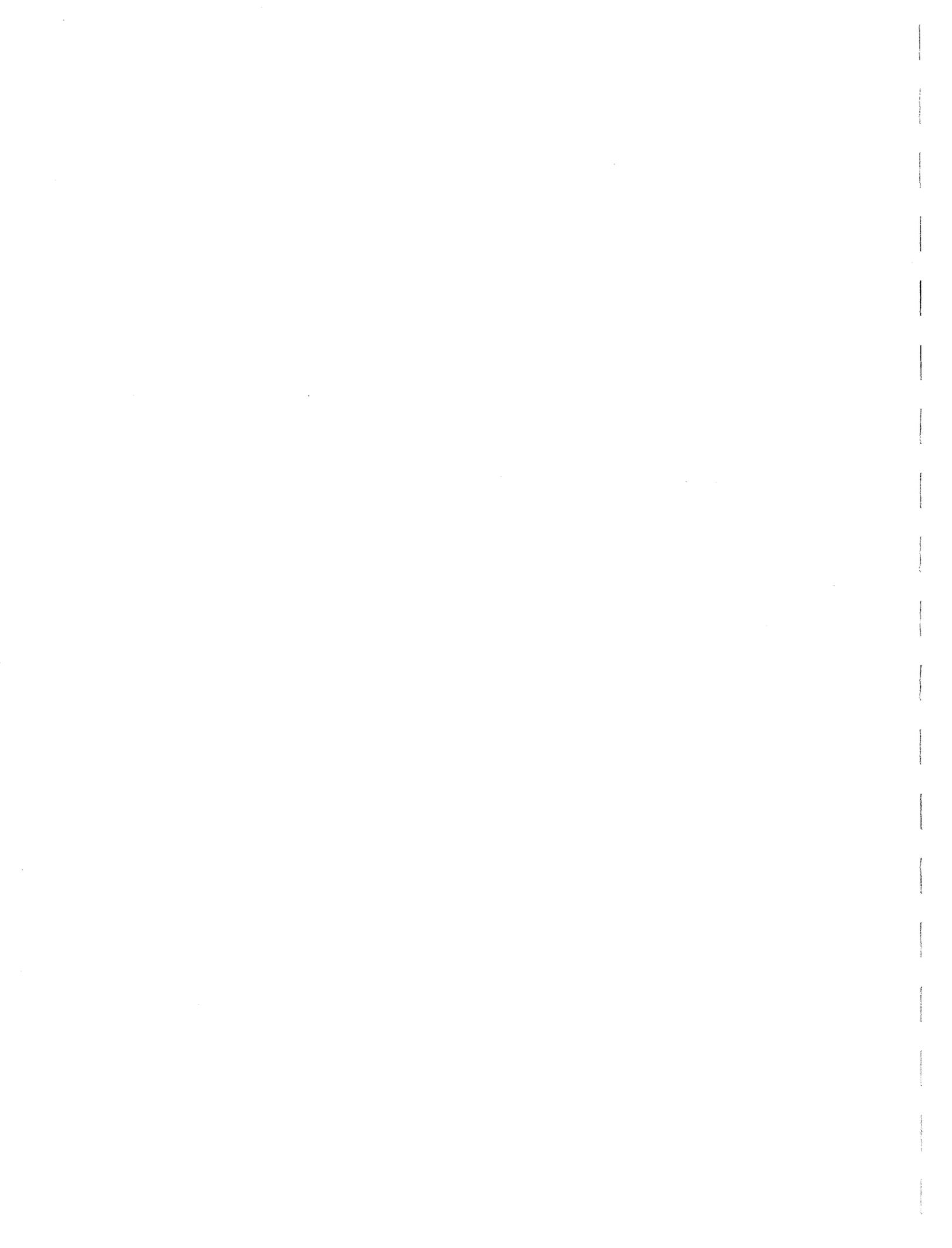


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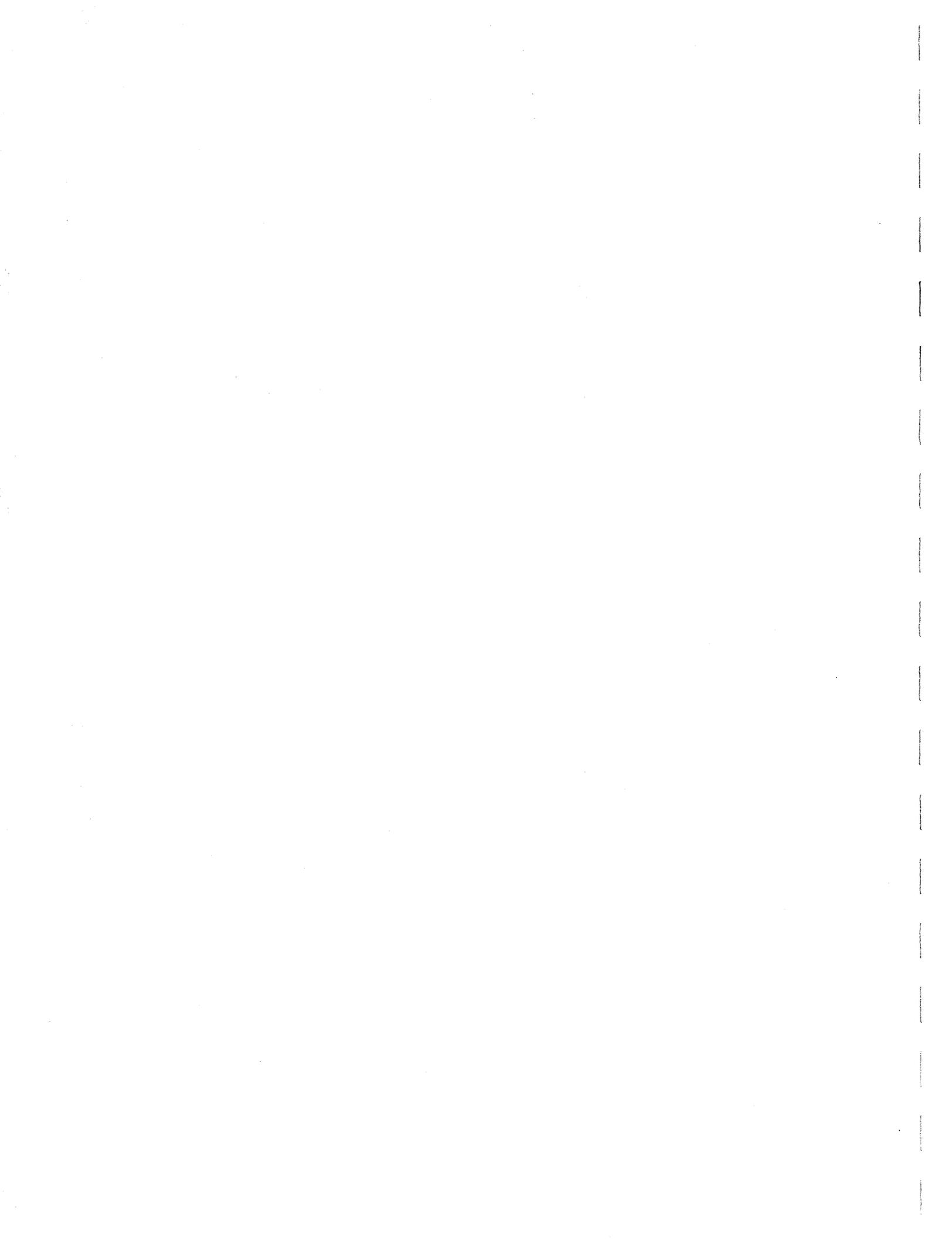
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FOREWORD

The 1999 St. Matthew Island blue king crab project was funded under the State of Alaska Bering Sea Crab Test Fishery (BSTF) program. Initiated in 1990, the program focuses on king crab research in the Bering Sea/Aleutian Islands. In 1991, under the BSTF program, Alaska Department of Fish and Game (ADF&G) surveyed a portion of the golden king crab population in the Aleutian Islands (Blau and Pengilly 1994). In 1995 ADF&G implemented a triennial king crab survey plan that included surveys of St. Matthew Island blue king crabs (1995 and 1998), Norton Sound red king crabs (1996), and Aleutian Islands golden king crabs (1997). Operational plans for the 1995 and 1998 St. Matthew Island blue king crab studies are contained in Watson et al. (1995) and Blau and Watson (1998); operational plans for other BSTF projects are listed in Tracy and Pengilly (1997).

The 1999 St. Matthew blue king crab project consisted of a 15-day vessel charter to conduct a nearshore survey around St. Matthew Island. The 1999 Bering Sea Crab Test Fishery program was budgeted at \$459,100, of which approximately \$108,100 was allocated for the St. Matthew blue king crab project (Blau and Watson 1999b).

INTRODUCTION

The St. Matthew Section of the Bering Sea King Crab Management Area has supported annual commercial fisheries for blue king crabs *Paralithodes platypus* since 1977, with a peak harvest of 9.5 million pounds landed in 1983 (Morrison et al. 1998). In 1978, the National Marine Fisheries Service (NMFS) began conducting annual trawl surveys to assess population abundance and distribution of blue king crabs in the St. Matthew Section (Otto et al. 1979). Much of the nearshore rocky portions of St. Matthew and Hall Islands blue king crab habitat are untrawlable, resulting in imprecise estimates of population abundance (Otto et al. 1984; Stevens and MacIntosh 1989). In an effort to refine and supplement annual trawl survey catch data, ADF&G conducted triennial pot surveys in the St. Matthew section in 1995 and 1998 (Blau 1996; Blau and Watson 1999a). Major objectives of those surveys were to determine the distribution and relative abundance of blue king crabs using pot gear and allow recovery of tagged crabs in the subsequent commercial fisheries. These surveys used pots instead of trawls to index crabs on both soft and rocky bottoms. Survey stations were primarily offshore at depths greater than 20 fathoms (fm).

The estimated number of female blue king crabs caught during the 20-year history of NMFS trawl surveys in the St. Matthew area has averaged one-third the number of males (Stevens and three co-authors 1998). Similar results were found on the 1995 and 1998 ADF&G St. Matthew Island pot surveys where female blue king crabs composed 37% and 40% of the total number of blue king crabs captured (Blau 1996; Blau and Watson 1999a). In addition, on both the NMFS and ADF&G surveys small blue king crabs <80 mm CL were under-represented in the catches.

Various aspects of the reproductive biology of female blue kings in the Bering Sea have been studied. The estimated size at 50% maturity for St. Matthew females is 80.6 mm CL (Somerton and MacIntosh 1985). Multiparous females are biennial spawners, whereas some small females can spawn in two consecutive years (Somerton and MacIntosh 1985, Jensen and Armstrong 1989). However, the distribution of ovigerous blue king crabs around St. Matthew and Hall Islands has been largely unknown. NMFS and ADF&G surveys and inseason fishery observer data from offshore waters (>20 fm) around St. Matthew and Hall Islands has revealed high percentages of females with matted setae (empty embryo cases) (Stevens and MacIntosh 1989; Tracy 1995; Blau 1996; Boyle and Moore 1997; Blau and Watson 1999a).

Several small-scale blue king crab studies have been conducted in nearshore waters (≤ 20 fm) around St. Matthew Island and the Pribilof Islands. In late June 1983 NMFS captured 640 male and 944 female blue king crabs in a string of 40 pots fished at average depth of 13 fm (NMFS 1984; and NMFS unpublished data). Of the 146 females measured, 85% had newly-extruded clutches, a condition not found in offshore waters. In the Pribilof Islands, a number of nearshore sites were also sampled but produced scant blue king crab data (Palacios et al. 1985; Armstrong and five co-authors 1985). In the most recent nearshore survey conducted in August 1998 by ADF&G, 70% of the 1,462 female blue king crabs captured had newly-extruded embryos (Blau and Watson 1999a).

Hair crabs or Korean hair crabs *Erimacrus isenbeckii* are distributed in Alaska from Aleutian Islands waters northward in the Bering Sea to St. Matthew Island (Armetta and Stevens 1987). The bulk of the commercial fishery occurs around the Pribilof Islands (Moore et al. 1998; Morrison and five co-authors 1999). No commercial hair crab fishery has been prosecuted in the St. Matthew Section of

the Bering Sea. Since its inception in 1978, the hair crab fishery in the Bering Sea peaked at 2.4 million pounds in the 1980/81 season with an exvessel value of \$5.3 million during the 1993/94 season. Size at maturity for female hair crabs is unknown for the eastern Bering Sea and fecundity estimates have been calculated from only six females (Armetta and Stevens 1987). No hair crabs were captured offshore during ADF&G's St. Matthew blue king crab surveys, but during two days of nearshore fishing, hair crabs were one of the most common nontarget species captured (Blau and Watson 1999a).

The Alaska Board of Fisheries (BOF) has written goals and policies regarding commercial king crab species. One goal states "...to minimize risks of irreversible adverse effects on [king crab] reproductive potential..." (ADF&G 1998). A BOF policy states, "Routinely monitor crab resources to provide information on abundance of females as well as prerecruit, recruit, and postrecruit males. This is necessary to detect changes in the population which may require adjustments in management to prevent irreversible damage to the reproductive potential of each stock...". Additional research on both sexes is necessary to follow-up on the intent of the preceding BOF policy. The St. Matthew Island blue king crab fishery has occurred for 22 consecutive years, yet nearshore surveys around St. Matthew and Hall Islands have not been conducted. Nearshore areas may contain the key to finding the alternating ovigerous portion of the biennial spawning female population that is not present during offshore surveys. Size, shell age, and sex ratio data may be obtained from male blue king crabs, as well. Nearshore surveys may also increase knowledge on potential commercial hair crab harvests and necessary female hair crab reproductive data.

OBJECTIVES

The primary objective of this research was to conduct a nearshore survey around St. Matthew Island using pots and characterize the depth and spatial distribution, by sex and size, of blue king and hair crabs in depths from 4 to 20 fm. Clutch fullness and embryo development of captured females were also assessed; miscellaneous species were identified and counted. A secondary objective was to estimate female hair crab size at maturity and fecundity from those captured. The third objective was to identify and document nearshore habitats inhabited by blue king and hair crabs from observations and photography made during scuba diving.

METHODS

Survey Design and Mechanics

Station locations around St. Matthew and Hall Islands, sampling goals and shipboard instructions, including all forms used on the survey, are documented in the project operational plan (Blau and Watson 1999b).

Station Layout, Area Covered, and Pots Fished

Stations were placed two nautical miles (nmi) apart and set perpendicular to the shoreline. There were 32 stations identified around St. Matthew Island and six around Hall Island (Blau and Watson 1999b). The goal was to fish either the shallower or deeper “half” of three stations each day during 11 days of maximum fishing time. Each station ideally consisted of 17 pots (10 king crab pots and seven conical pots). Pots were fished singly and set at one fathom depth intervals, from 4 to 20 fm. Conical pots were fished at the shallowest portion of each station (4 to 10 fm) and were set and retrieved using the RV *Instar*. King crab pots were fished at the deepest portion of each station (11 to 20 fm) and they were set and retrieved using the FV *Notorious*.

The nearshore survey occurred between 172° 20' and 173° 09' W longitude and 60° 17' and 60° 36' N latitude. Twenty-two stations were fished around St. Matthew Island in 11 days of retrieving pots from August 3-13 (Table 1 and Figure 1). Thirteen stations were fished with both pot types, portions of eight stations were fished only with king crab pots and one station was only fished with conical pots. A total of 292 pots (84 conical and 208 king) were retrieved in good condition from four to 20 fathoms (Table 2).

The data from nine other pots could not be used because the pots were either lost, moved from where set, or malfunctioned. Portions of five additional stations were fished but their data were unusable because the pots were either fished in the wrong location or they had excessive pot soak-times, or crab forms were lost overboard.

Soak Times

The target soak time for each pot was 14-18 hours. Each pot was baited with one gallon of chopped herring. Detailed conical and king crab pot descriptions are in Appendix A. King and conical pots had soak times ranging from 11 to 25 hours (Table 3). Sixty-six percent of the pot soak times fell within the soak-time goal of 14-18 hours.

Substrate Types

The captain of the FV *Notorious* and the skipper of the RV *Instar* recorded the type of substrate for each pot location by interpreting the bottom colors displayed on their fathometers. Of the 292 pots lifted, 64% of the pots were on rock, and 36% landed on sand substrates (Table 4). Eleven stations had only rock substrates, four stations had only sand substrates and seven stations had pots on both substrate types.

Charter Vessel and Crews

ADF&G chartered the 39-m (130-ft) FV *Notorious* and five-man crew from August 1-15, 1999 at the rate of \$5,470 per day, for a total charter cost of \$82,050. The St. Matthew charter began and ended in Dutch Harbor. Biological crew aboard the vessel consisted of two ADF&G biologists, an ADF&G technician and a NMFS biologist.

Navigational and Bathymetric Equipment

Navigational equipment used on the FV *Notorious* to establish station locations, relocate pots, and production of bottom type profiles included: Trimbal¹ (NT 200) Global Positioning System (GPS), Furuno¹ fathometer, and Simrad/Inritsu¹ marine radar, with a 60 nmi maximum range. The GPS and fathometer were interfaced with a SeaNav¹ 1050, 486 computer/plotter using SeaNav software. A Compaq¹ Presario computer was also coupled with Nobeltech¹ navigational software.

On the RV *Instar*, pot depths were identified using a Furuno¹ (model 1621) fathometer. Latitude and longitude coordinates for each pot were made using a Magellan¹ Nav 5000DX GPS.

Catch Sampling

All species in each pot retrieved were enumerated to allow for catch per unit of effort calculation.

Crab Measurements

Crab measurements were taken to the nearest millimeter (mm) using Vernier calipers. Carapace length (CL) on blue and red king crabs and hair crabs was measured from the right eye orbit to the midpoint of the posterior margin of the carapace. Carapace width (CW) was taken from the greatest straight-line distance across the carapace at a right angle to a line midway between the eyes to the midpoint of the posterior portion of the carapace. Minimum legal male blue and red king crab carapace width (CW) was 139.7 mm (5.5 in) outside the spines (ADF&G 1998). For this survey the minimum legal size for male hair crabs was set at 82.5 CW (3.25 in). Male crabs were checked for legal size using the appropriate "go-no-go" measuring stick.

Male Blue King Crab Size Categories

Sublegal male blue king crabs were separated by size into 1) prerecruits (<105 mm CL), or 2) prerecruit ones (\geq 105 mm CL, but less than legal width). Male blue king crab categories were based on growth studies (Otto and Cummiskey 1989) and followed closely the size categories used by NMFS on annual Bering Sea surveys (Stevens et al. 1994). Legal-sized new-shell male crabs <135 mm CL were classified as recruits. All other legal-sized male crabs were classified as postrecruits.

Shell-Aging

Estimating the exoskeletal ages of blue and red king crabs and hair crabs followed the classification system outlined in Appendix B.

¹ Use of a company's name does not constitute endorsement by ADF&G.

Diving Observations

Scuba diving was used to observe and photograph the habitat occupied by blue king and hair crabs in nearshore waters. Two to three divers composed a team and dove on an opportunistic basis after daily pulling and setting of pots had been completed.

Ocean Bottom Temperatures

Bottom temperatures were obtained by placing Brancker¹ Model TR-1000 submersible temperature recorders (STRs) in king crab and conical pots. STRs were programmed to record temperatures every hour. Two pots were selected to carry the STRs each day and they were fished at different depths, generally one fathom apart in depth. Each STR was housed in protective rubber tubing and fastened to the pot webbing with carabiners. STRs were moved pot to pot in order to sample most depths fished.

Database

After completion of the survey all data forms were keyed, verified, and edited by ADF&G staff from the Dutch Harbor and Kodiak offices and added to the R:Base¹ 6.0 database named StMatt99.

RESULTS

Blue King Crabs

Number Captured

A total of 2,420 blue king crabs were captured during the survey, of which 1,535 (63%) were females and 885 (37%) were males (Table 1). Legal-sized crabs constituted 48% of the number of males captured whereas sublegal males made up the remaining 52%. The overall catch per unit of effort (CPUE) was 8.3 crabs (5.3 for females and 3.0 for males). CPUE by male category was as follows: 0.8 for males <105 mm CL, 0.8 for prerecruit ones, and 1.5 for legals. Legal-sized crabs were 30% recruits and 70% postrecruits.

Distribution

Blue king crabs were captured around St. Matthew Island at every station except station 19 (Table 1 and Figure 2). Stations 3, 4, and 10 produced the most crabs (200-500) and most of the catches were females. Stations along the western side of the island generally had greater numbers of crabs (predominately females); the reverse was true on the eastern side of the island where males dominated crab catches at most stations.

¹ Use of a company's name does not constitute endorsement by ADF&G.

The number of blue king crabs captured nearshore was proportional to the percentage of pots set on the two bottom types recorded during the survey. Sixty-four percent of the pots were set on rocky bottoms and captured 64% of the blue king crabs, while the remaining 36% of the pots were set on sandy bottoms and accounted for 36% of the blue king crabs captured (Table 4).

The CPUEs of female blue king crabs were greater than the CPUEs of males at depths of 4 to 16 fm and were highest at 6 fm (Figure 3). Male CPUEs were greater than female CPUEs at depths of 17 to 20 fm, but were <2 male crabs at depths <14 fm.

Size Frequencies and Size by Depth

Carapace lengths of female blue king crabs ranged from 56 to 127 mm while male lengths ranged from 54 to 163 mm (Figure 4). The prominent size mode was 97 mm CL for females and 127 mm CL for males. Of the 2,420 blue king crabs captured only one female was not measured. The mean size of male crabs generally increased with increasing depth while female average size was more uniform but decreased slightly in depths ≥ 17 fm (Table 5).

Shell Age Composition

All blue king crabs captured were shell-aged. Of the 885 males captured 4% (34) were classified as new-pliable, 58% (512) were new-hard, 35% (315) were old-shell, and 3% (24) were very old-shell. Ninety-eight percent (1,511) of the females had new-hard exoskeletons; the remaining 2% (24) had new-pliable exoskeletons.

Female Reproductive Condition

All females captured during the survey were examined for external reproductive condition (Table 6). Sixty-five percent of the clutches contained embryos, 30% were barren with empty embryo cases from prior larval hatching and 5% were barren having only clean pleopodal setae. Barren females with clean setae averaged 77 mm CL and were predominately smaller than the 80.6 mm CL size-at-maturity of estimated by Somerton and MacIntosh (1985).

Six different clutch colors of embryos were documented. Brown, purple or purple-brown colored clutches composed 81% of the clutches with embryos (Table 6). Ninety-nine percent of the clutches with embryos were composed of uneyed embryos, while the remaining 1% had eyed embryos from small clutches that were still hatching their larvae. Dead embryos were apparent in <1% of the clutches with embryos.

Tagged Crab Recovered

A legal-sized blue king crab tagged in 1998 at 30 fm was recaptured at station 20 in 18 fm, approximately 10 nmi north of the release location. This crab was shell-aged as new-hard on the ADF&G 1998 St. Matthew blue king crab survey and subsequently assessed as an old-shell in 1999, with no growth since initially being tagged. The crab was released with the original tag in place.

Shell Disease

Two male and six female blue king crabs were observed with shell disease on their exoskeletons.

Females That Molted in Captivity

Four female blue king crabs that were brought back to Kodiak molted in captivity. For more details see Appendix C.

Hair Crabs

Only 31 male and 10 female hair crabs were captured, with an overall CPUE ≤ 0.1 crabs per pot (Table 1). Hair crabs generally were found on the southern side of the island, with nearly half of them captured at station 20. Sixty-one percent of the hair crabs were captured in pots that were judged to have been on sandy substrates, while 39% of the hair crabs came from pots fished on rock bottoms (Table 4). One or more hair crabs were captured at every fathom interval fished (4 to 20 fm). Carapace lengths ranged from 52 to 76 mm for females and 69 to 99 mm for males. All females and 90% of the males had new-hard exoskeletons; one male was new-pliable and two males were in old-shell condition. All females were barren having only clean setae, but one had white spermathecal plugs in her gonopores, indicating mating had been fairly recent. No hair crabs were noted to have shell disease.

Nontarget Species

There were eight fish and six invertebrate species captured in the pots (Table 7). Yellowfin sole, Pacific halibut and Pacific cod were the most abundant fish species captured. Few nontarget invertebrate species were captured with five red king crabs being the most notable. No snow crabs *Chionoecetes opilio* were captured in nearshore waters.

Diving Observations

Four different dives were made in depths ranging from 3 to 10.8 fm (Appendix D). Bottom types ranged from large kelp-covered boulders to flat, sandy habitats. Four ovigerous new-shell blue king crabs were observed during the shallowest dive amongst kelp. Two hair crabs were found on sandy bottoms.

Ocean Bottom Temperatures

Ocean bottom temperatures were taken with two submersible thermographs attached to 18 pots at nine stations around St. Matthew Island in depths ranging from 7 to 20 fm (Table 8). Average temperatures ranged from 2.9° to 4.0° C and generally increased with decreasing depth. Average temperatures were colder at station 18 compared to pots set at comparable depths.

Video

An hour long documentary color video tape was made which included scenes of the following: start of the charter, pot deployment and retrieval, sampling procedures, RV *Instar* use, sea life, scenes of St. Matthew Island from land and sea, interviews with personnel during the charter, and post charter overview. Copies of the video are at ADF&G offices in Dutch Harbor and Kodiak.

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Table 1. Station locations and number of blue king and hair crabs captured from 22 stations fished during the August 1999 St. Matthew Island blue king crab nearshore survey conducted by ADF&G.

Sta- tion	Pots Lifted ^a	Dates				Mean		Hair Crabs		Blue King Crabs					Total Kings
		N. Latitude ^b		W. Longitude		Soak Hours	Depth (fm)	Fem.	Males	Males			Total		
		Deg.	Min.	Deg.	Min.					<105 ^c Ones ^d	Legals ^e	Total			
1	4	60	29.01	173	3.92	17.8	15	0	0	5	1	1	17	19	24
2	4	60	28.29	173	0.20	18.0	15	0	0	81	16	16	48	80	161
3	4, 6	60	27.00	172	56.86	18.6	12	0	0	230	21	20	45	85	315
4	5, 6	60	25.74	172	54.04	19.8	12	0	0	162	4	6	32	42	204
5	5, 6	60	24.10	172	51.44	19.9	12	0	0	64	1	5	18	24	88
6	5, 6	60	22.43	172	49.06	20.7	14	0	0	93	6	2	4	12	105
8	9, 12	60	18.35	172	32.63	17.5	12	3	6	92	4	2	8	14	106
9	9, 12	60	18.79	172	23.02	17.7	12	3	2	98	6	6	8	20	118
10	12	60	18.87	172	24.88	23.4	12	0	0	438	11	13	35	59	497
11	12	60	18.47	172	21.08	23.0	12	1	1	103	2	6	42	50	153
18	8, 11	60	23.89	172	28.19	14.8	12	0	1	22	31	27	31	89	111
19	8	60	23.40	172	30.29	15.9	7	0	7	0	0	0	0	0	0
20	8, 11	60	24.22	172	33.89	14.8	12	3	12	21	50	32	16	98	119
21	8, 11	60	25.18	172	37.53	15.0	11	0	0	16	10	18	9	37	53
22	13	60	27.22	172	44.05	14.9	15	0	0	8	7	15	14	36	44
23	13	60	28.67	172	47.18	14.6	15	0	1	3	12	25	24	61	64
24	13	60	30.20	172	50.25	14.4	15	0	0	0	3	2	6	11	11
25	10	60	31.71	172	52.49	15.3	15	0	1	6	5	7	5	18	24
26	10	60	33.60	172	53.60	14.8	12	0	0	80	2	8	8	18	98
27	10	60	35.57	172	53.54	14.6	13	0	0	1	8	14	10	32	33
30	3	60	34.64	173	4.67	12.5	15	0	0	13	24	9	15	48	61
31	3	60	32.82	173	4.69	12.8	15	0	0	1	2	3	27	32	33
Totals:															
22 Stations						17.8	12	10	31	1,535	227	233	426	885	2,420
292 Pots						Catch Per Pot:		<0.1	0.1	5.3	0.8	0.8	1.5	3.0	8.3

^aSince a station was usually composed of conical and king crab pots each half of the station was often fished on different days.

^bThe latitude and longitude readings for each station is given at its midpoint (12 fm). The only exception was for station 19 where only conical pots were fished and the lat./long. readings are given for the pot fished (10 fm).

^cMale blue king crabs <105 mm CL.

^dPrerecruit ones are male blue king crab ≥ 105 mm CL but <139.7 mm (5.5 in) CW outside the spines.

^eLegal-sized male blue king crabs included all males ≥ 139.7 mm (5.5 in) CW measured outside the carapace spines.

Table 2. Number of king and conical pots retrieved by depths fished during the August 1999 St. Matthew blue king crab nearshore survey
 *conducted by ADF&G.

Depth (Fathoms)	King Crab Pots	Conical Pots
4	0	11
5	0	12
6	0	12
7	0	13
8	0	13
9	0	12
10	0	11
11	20	0
12	21	0
13	21	0
14	21	0
15	21	0
16	21	0
17	21	0
18	20	0
19	21	0
20	21	0
Totals:	208	84

Table 3. Soak times of king and conical pots fished during the August 1999 St. Matthew Island blue king crab nearshore survey conducted by ADF&G.

Pot Soak Times (Hours)	Number of Pots	Percent of Pots
11	2	<1%
12	14	5%
13	16	5%
14	64	22%
15	35	12%
16	14	5%
17	41	14%
18	39	13%
19	6	2%
20	19	7%
21	22	8%
22	0	0%
23	2	<1%
24	8	3%
25	10	3%
Totals:	292	100%

Table 4. Number of hair and blue king crabs captured in pots fished on rock or sand substrates during the August 1999 St. Matthew Island blue king crab nearshore survey conducted by ADF&G.

Station	Number of Pots		Number of Crabs by Bottom Type			
	Substrate Types ^a		Hair Crabs		Blue King Crabs	
	Rock	Sand	Rock	Sand	Rock	Sand
1	10	0	0	0	24	0
2	10	0	0	0	161	0
3	16	0	0	0	315	0
4	17	0	0	0	204	0
5	16	0	0	0	88	0
6	12	0	0	0	105	0
8	10	6	9	0	62	44
9	17	0	5	0	118	0
10	1	15	0	0	58	439
11	10	7	1	1	125	28
18	7	10	0	1	1	110
19	0	7	0	7	0	0
20	0	17	0	15	0	119
21	7	9	0	0	13	40
22	0	10	0	0	0	45
23	10	0	1	0	64	0
24	0	10	0	0	0	11
25	2	8	0	1	3	19
26	9	7	0	0	83	15
27	12	0	0	0	33	0
30	10	0	0	0	61	0
31	10	0	0	0	33	0
Totals.:	186	106	16	25	1,551	869
Percent:	64%	36%	39%	61%	64%	36%

^aThe substrate type was decided by the captain of the FV *Notorious* or skipper of the RV *Instar* based on their interpretation of the bottom color shown on each vessel's fathometer.

Table 5. Number and average carapace length (CL) of male and female blue king crabs by depth intervals fished during the August 1999 St. Matthew Island blue king crab nearshore survey conducted by ADF&G.

Depth (Fathoms)	Blue King Crabs			
	Males		Females	
	Number	Avg. CL (mm)	Number	Avg. CL (mm)
4	0	-0-	25	95
5	3	71	27	96
6	1	77	132	94
7	3	75	120	94
8	0	-0-	46	96
9	0	-0-	15	96
10	1	99	25	92
11	27	111	132	93
12	29	107	169	95
13	41	106	177	95
14	52	111	72	97
15	69	110	111	95
16	82	118	85	95
17	102	117	100	93
18	127	122	87	92
19	131	120	102	92
20	217	120	110	89
Totals:	883	117	1,537	94

Table 6. External reproductive conditions of female blue king crabs by shell age categories during the August 1999 St. Matthew Island blue king crab nearshore survey conducted by ADF&G.

Clutch & Embryo Categories	Shell-Age Categories	
	New-Pliable	New-Hard
Clutch		
Barren, clean setae	0	78
Barren, empty embryo cases	0	454
Clutch 1-29% full	0	89
Clutch 30-59% full	1	84
Clutch 60-89%	1	91
Clutch 90-100%	22	715
Totals:	24	973
Embryo Color		
Tan	0	2
Purple	9	189
Brown	10	562
Orange	0	2
Purple-brown	0	40
Reddish	5	178
Totals:	24	977
Embryo Development		
Uneyed	24	970
Eyed	0	0
Hatching	0	7
Totals:	24	1,001
Dead Embryos		
Not Apparent	24	997
Less Than 20%	0	3
Greater Than 20%	0	1
Totals:	24	1,511

^aHatching clutches are 1-29% full with eyed embryos and have matted setae from hatched larvae.

Table 7. Nontarget species captured in pots retrieved during the August 1999 St. Matthew Island blue king crab nearshore survey conducted by ADF&G.

Common Names	Scientific Names	Number
	Fish	Captured
Skate unidentified	Rajidae	13
Pacific Halibut	<i>Hippoglossus stenolepis</i>	68
Yellowfin Sole	<i>Pleuronectes asper</i>	107
Rock Sole	<i>Pleuronectes bilineatus</i>	6
Pacific Cod	<i>Gadus macrocephalus</i>	142
Great Sculpin	<i>Myoxocephalus polyacanthocephalus</i>	52
Myoxocephalus sp.	<i>Myoxocephalus</i> sp.	17
Snailfish unidentified	Cyclopteridae	1
Invertebrates		
Red King Crab	<i>Paralithodes camtschaticus</i>	5
Circumboreal Toad Crab	<i>Hyas coarctatus</i>	12
Hermit Crab	Paguridae	2
Volutopsius Snail sp.	<i>Volutopsius</i> sp.	1
Blood Star	<i>Henricia</i> sp.	1
Sea Glob Tunicate	<i>Aplidium</i> sp.	1

Table 8. Ocean bottom temperatures recorded during the August 1999 St. Matthew Island blue king crab nearshore survey conducted by ADF&G.

Station	Sequential Pot No.	Set		Retrieved		No. of Hourly Readings	Depth (fm)	Temperature (°C)		
		Dat	Time	Date	Time			Avg.	Min.	Max.
9	295	11	16:01	12	09:25	18	7	4.0	3.6	4.3
9	296	11	17:00	12	09:30	17	8	3.8	3.2	4.1
3	114	5	17:00	6	11:58	19	9	4.0	3.7	4.1
3	115	5	17:00	6	12:13	19	10	3.8	3.6	4.0
30	1	2	21:30	3	10:36	13	11	3.9	3.5	4.1
18	228	10	18:00	11	07:26	14	11	3.0	2.7	3.2
30	2	2	21:32	3	10:30	13	12	3.9	3.6	4.2
18	229	10	18:00	11	07:29	14	12	3.0	2.7	3.3
1	33	3	15:00	4	07:36	17	13	3.6	3.3	3.9
23	318	12	20:00	13	10:36	15	13	3.4	3.3	3.9
1	34	3	15:00	4	07:41	17	14	3.5	3.2	3.9
23	319	12	20:00	13	10:40	15	14	3.4	3.2	4.0
4	65	4	11:16	5	07:50	20	15	3.5	3.4	3.6
4	66	4	11:20	5	07:55	20	16	3.5	3.2	3.6
8	174	8	17:00	9	09:55	17	17	3.3	3.1	3.7
8	175	8	17:00	9	09:58	17	18	3.2	3.0	3.1
27	195	9	17:00	10	07:50	15	19	2.9	2.5	3.5
27	196	9	17:00	10	07:48	15	20	2.9	2.5	3.6

^aBrancker submersible temperature recorders (model 1000) were used.

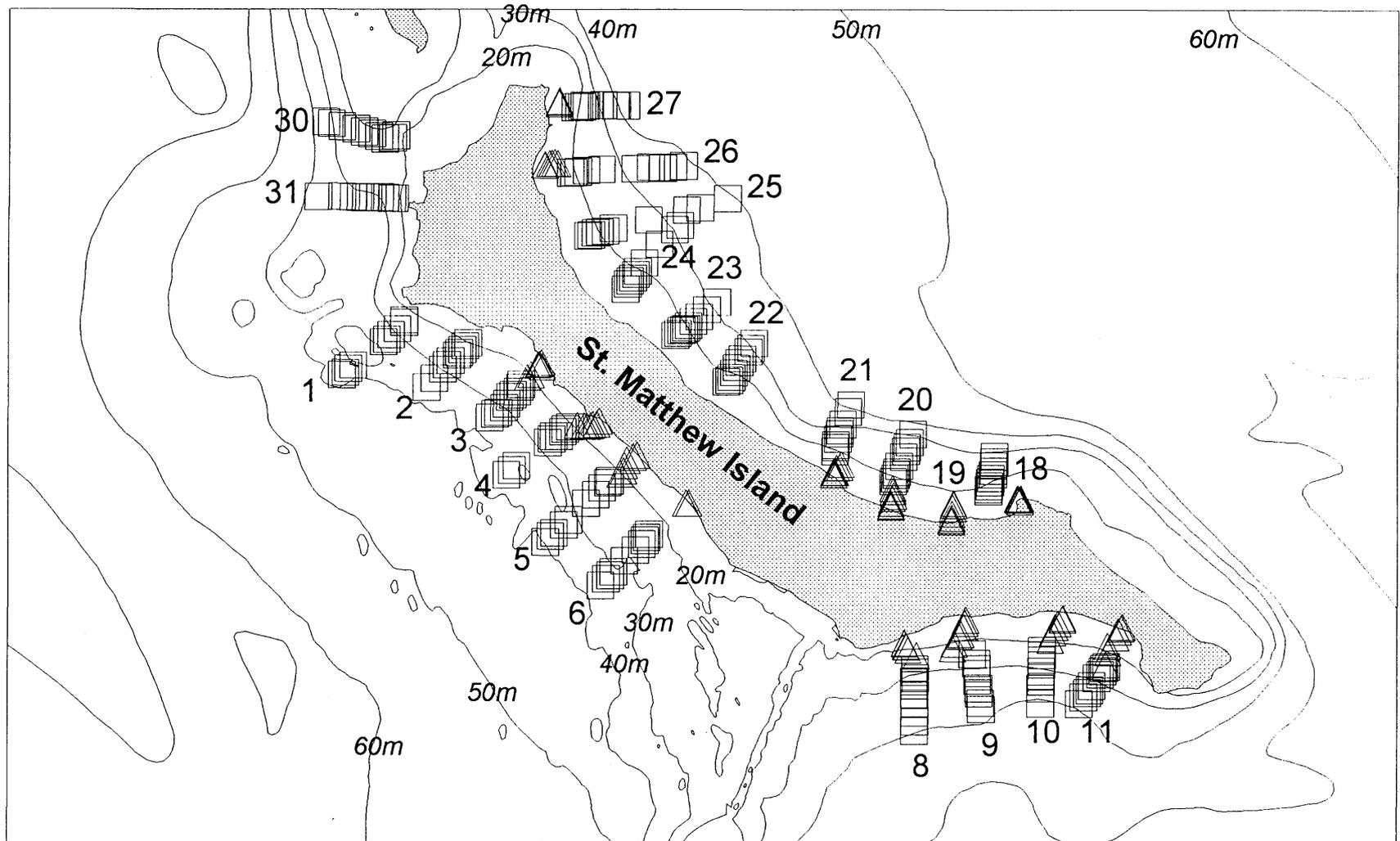


Figure 1. Station retrieval locations of 208 king crab pots (squares) and 84 conical pots (triangles) during the August 1999 St. Matthew Island blue king crab nearshore survey conducted by ADF&G. Station numbers are next to strings of pots and range from 1 to 31. Bathymetric contours are in 10-meter intervals.

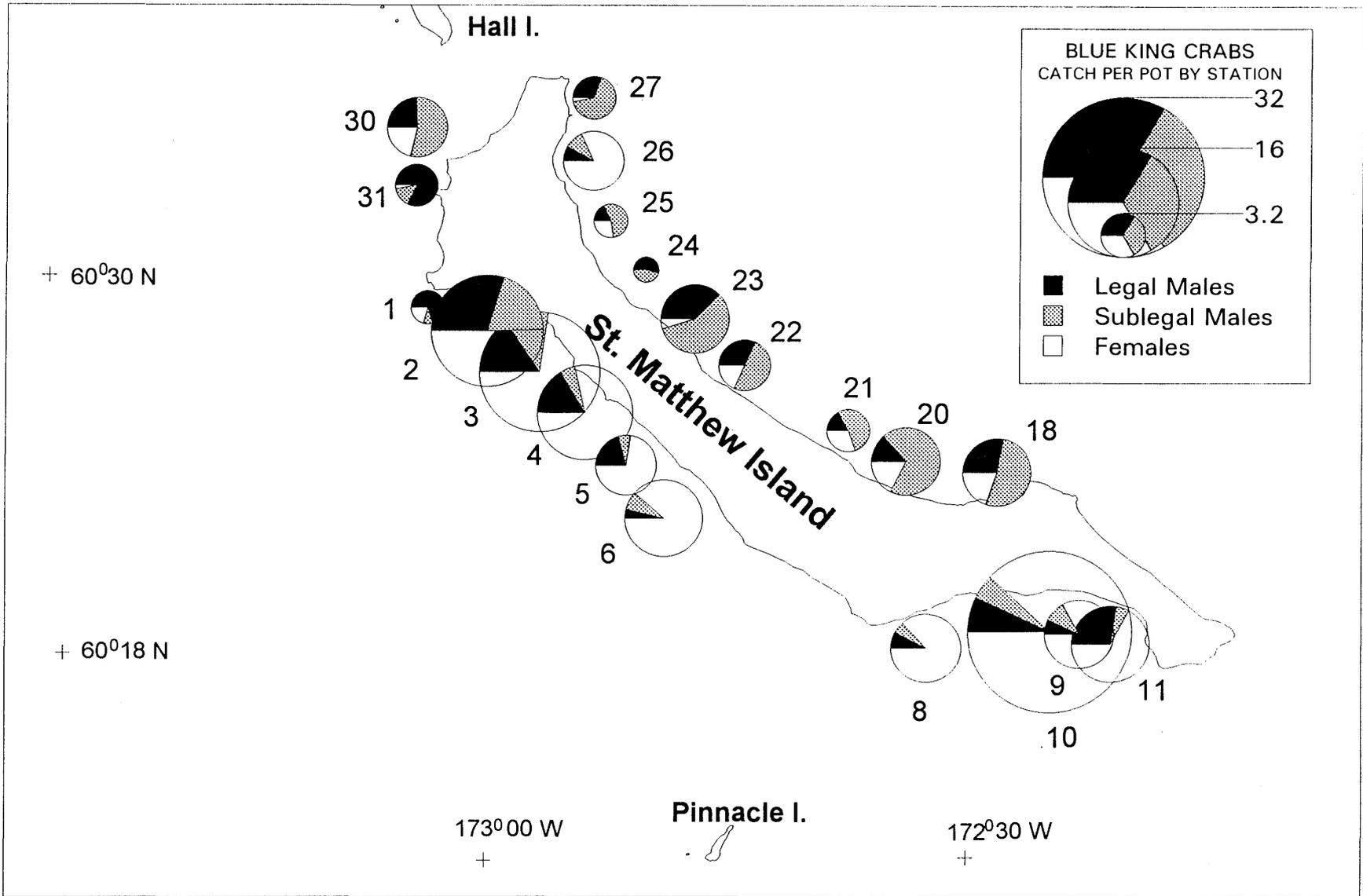


Figure 2. Distribution and catch per unit of effort (CPUE) of legal and sublegal male and female blue king crabs captured by station during the August 1999 St. Matthew Island blue king crab nearshore survey conducted by ADF&G. Station numbers are adjacent to their respective CPUE circles.

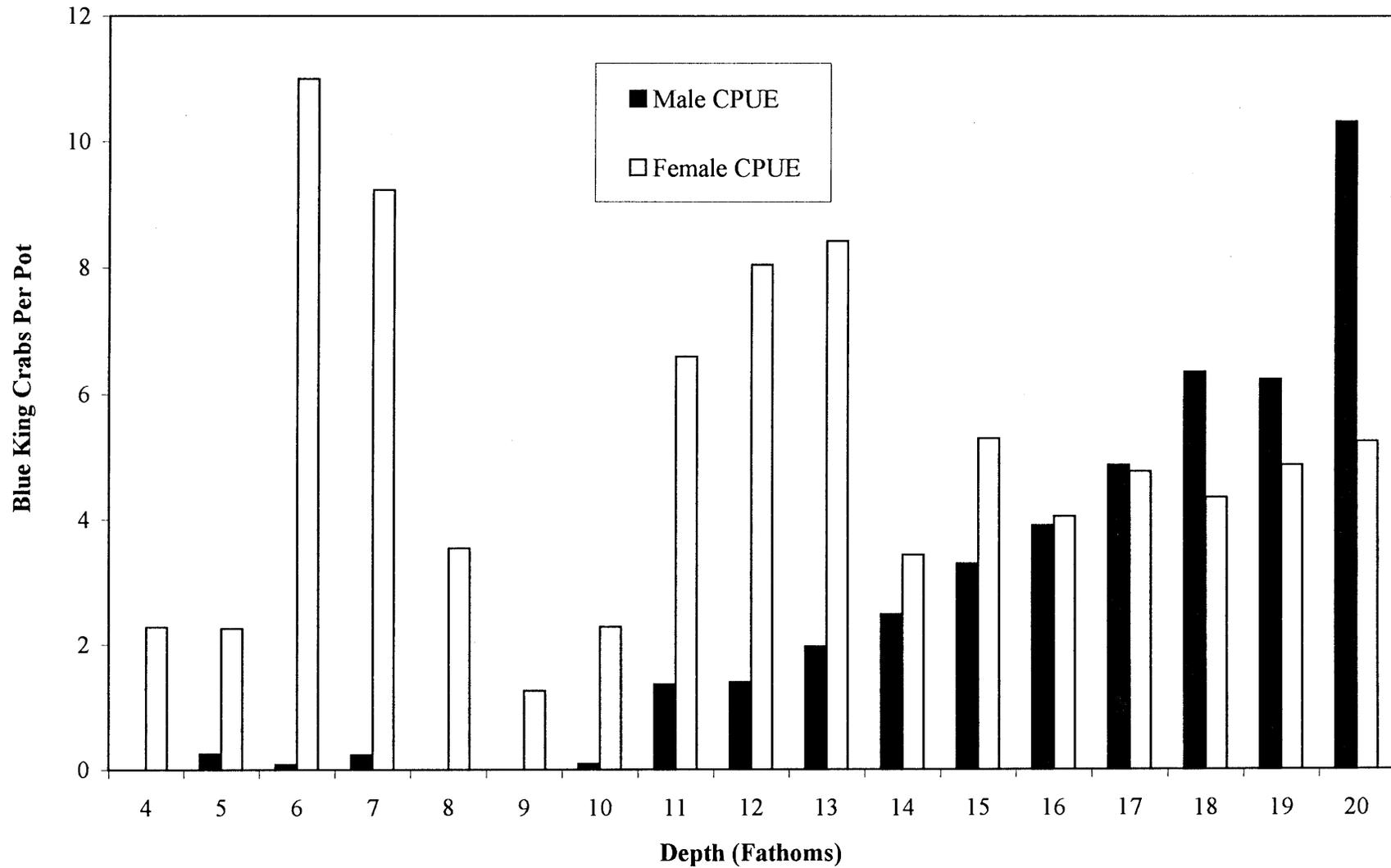


Figure 3. Catch per unit of effort (CPUE) by depth of male and female blue king crabs captured during the August 1999 St. Matthew Island blue king crab nearshore survey conducted by ADF&G. Conical pots were fished from 4 to 10 fm and king crab pots were fished from 11 to 20 fm.

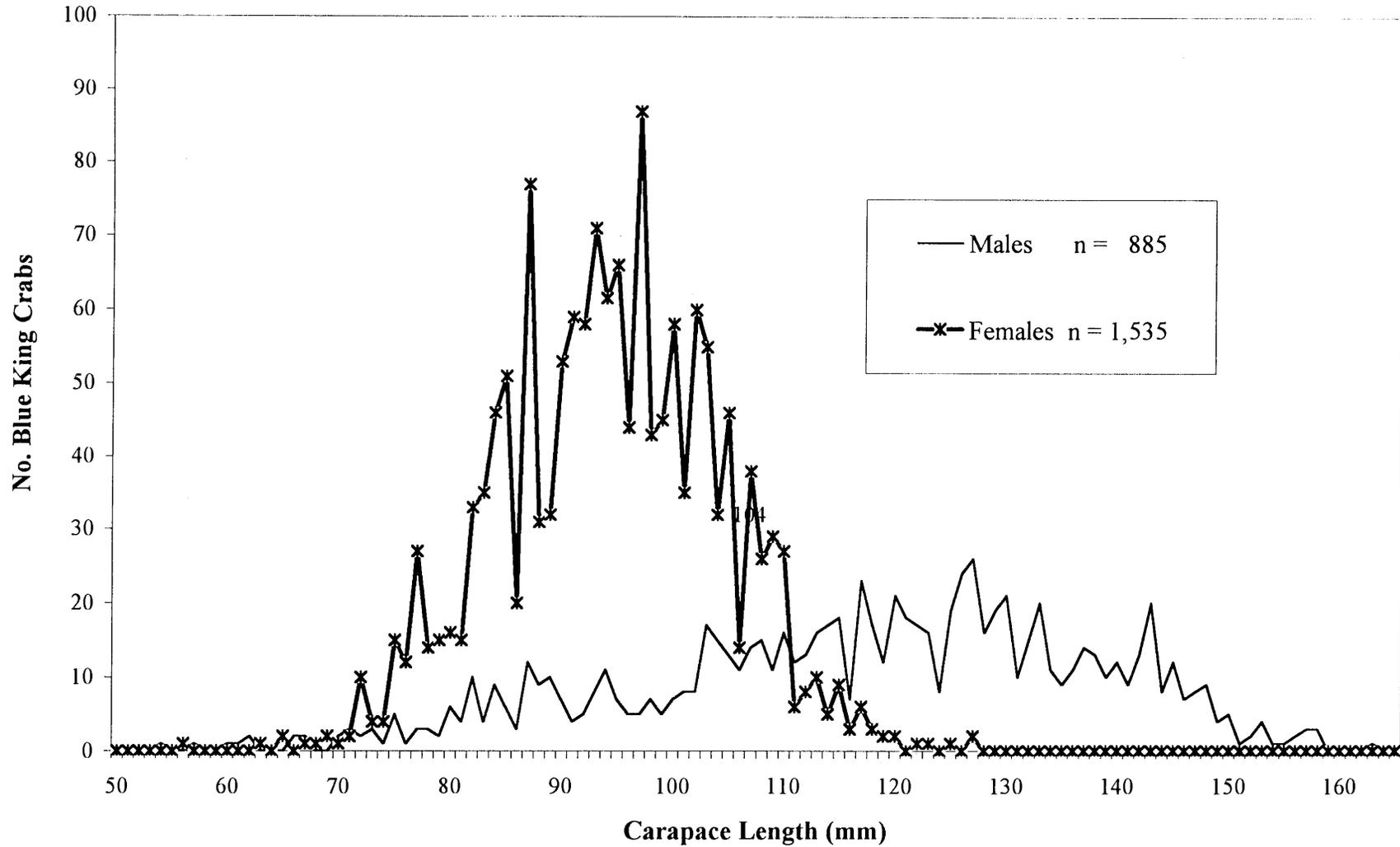


Figure 4. Length frequencies of male and female blue king crabs captured during the August 1999 St. Matthew Island blue king crab nearshore survey conducted by ADF&G. Conical pots were fished from 4 to 10 fm and king crab pots were fished from 11 to 20 fm.

APPENDIX



Appendix A. Description of pot types used during the August 1999 St. Matthew Island blue king crab nearshore survey conducted by ADF&G.

Two different crab pot types were used during the survey. King crab pots were made specifically for the Bering Sea Test Fish project. Each pot was made from welded steel, rectangular-shaped (7'x7'x34" OD) and weighed approximately 700 pounds. These pots were webbed with #92 nylon; tarred nylon covered most of the pot and nontarred nylon was used in the tunnels. Stretch mesh was 2 3/4" on all webbing. Two opposing tunnel eyes were made of 5/8" round-stock steel and measured 8"x 36" ID. An escapement mechanism was sewn into the black panel wall using #30 cotton twine, near the bottom of each pot. Its dimensions were rectangular, 2" x 18".

Conical pot frames were made from round-stock steel. Each pot weighed about 40 pounds. Pots had a 5' diameter at their base, 3' diameter at the top, and stood 4' tall. Each pot had a 2' diameter hole at the top where crabs could enter. An 8" plastic funnel was lashed to the hole to prevent crabs from escaping. Each pot was webbed twice; first with 3 1/2" stretch mesh red nylon, and secondly on the outside with 1 1/2" tarred nylon. Each pot opened and closed at the bottom by means of a drawstring. A 2"x18" escapement mechanism of #30 cotton twine was sewn into the side, near the bottom of each pot.

Appendix B. Shell age classification of male blue king crabs used on the August 1999 St. Matthew Island blue king crab nearshore survey conducted by ADF&G.

Shell-age Categories	Estimated Shell Age	Ventral Surface of Walking Legs Coxae & Meri	Carapace Spines	Walking Leg Spines	Dactyls	Exoskeleton	Leg Meat Fullness	Gills
Soft-shell	0-2 weeks	White, supple.	Base reddish	Predominately white.	Pliable, sharp tips; white band above tips.	Soft, shell not formed.	None.	Translucent.
New –Shell Pliable	2 wks-3mo	White, shiny not scratched.	Base reddish	Approx. ½ white above & ½ orangish at base.	Hard, sharp tips; white band above tips.	Pliable, cracks & punctures easily.	<30 % full.	Light yellowish.
New-Shell Hard	4 mo-18?	White or slightly off white. Coxae and meri generally devoid of scratches. <u>May</u> have brown or black scratches on distal rim but not in a continuous band.	Base reddish	Approx. ½ white above & ½ orangish at base	Hard, sharp tips; white band above tips.	Firm.	>30% full.	Light gray.
Old-Shell	19-36 mo?	Offwhite. Distal portion of coxae rimmed with brown or black scratches. Meri sometimes have brown areas from spine abrasion.	Base of spines darker than above. Reddish-brown.	Mostly reddish -brown.	Tips worn, angled. Brown to black above tips.	Firm.	Full.	Dark gray.
Very-Old-Shell	>36mo?	Light cream color. Distal portion of coxae rimmed with scratches which are black. Middle of coxae and portions of meri often scratched, and may have brown areas.	Base of spines black.	Mostly black.	Tips angled & rounded, black above tips.	Firm but more pliable than new - hard or old-shell. Carapace on some pliable.	Full, but exoskeleton may be pliable.	Dark gray to black.

The best place to estimate shell age king crabs is on the ventral side of the coxa of the walking legs (pereopods) and meri. Soft-shell crabs are rarely captured in pots since they would have had to molt in the pot; hence, no soft-shell crabs (noted as '0') should be recorded. Shell age descriptions for blue and red king crabs and hair crabs follows.

Soft-shell: Crab has molted within weeks. Exoskeleton is still soft and pliable from recent molt.

New-shell-pliable: Coxa and ventral surface of exoskeleton shiny, not scratched or pitted. Legs easily compressed when pinched (legs contain little meat at this time). Exoskeleton is fragile and subject to breakage when handled or dumped from the pot. If carapace is removed, the gills will be translucent-cream in color. Crabs estimated to have had new-pliable exoskeletons for approximately two weeks to three months after molting.

New-shell-hard: Coxa and ventral surface of exoskeleton dull white. Legs mostly full of meat, meri not easily compressed by pinching. If carapace is removed, the gills will be a light cream color. During August, this category includes most ovigerous blue king crab females and those with matted setae.

Old-shell: Distal portion of the ventral coxa is partially or totally covered with brown scratches or dots. Legs are full of meat, meri are not easily compressed when pinched. If carapace is removed, gills will be tan in color due to fouling by microorganisms. Rarely are females assessed in this category.

Very old-shell: Distal portion of ventral coxa densely covered with black scratches or dots. Legs full of meat, meri not easily compressed when pinched. Carapace is darkened by black spots at the base of spines on blue king crab males. Tips of dactyls are worn, rounded, and black. If carapace is removed, gills will be dark gray or gray-black in color due to fouling by microorganisms.

Hair Crabs

New-shell-pliable: Exoskeleton pink. Coxa and ventral surface of exoskeleton shiny, not scratched or pitted. Legs easily compressed when pinched (legs contain little meat at this time). Exoskeleton is fragile and subject to breakage when handled or dumped from the pot. Crabs estimated to have had new-pliable exoskeletons for approximately two weeks to 3 months after molting.

New-shell-hard: Exoskeleton pink. Legs mostly full of meat, meri not easily compressed by pinching.

Old-shell: Crabs with gray or tan cast to exoskeleton, sometimes fouled with marine life, e.g., barnacles.

Appendix C. Notes on female blue crabs from St. Matthew Island kept in captivity.

The following information and observations were made by Richard MacIntosh, fishery biologist, National Marine Fisheries Service, Kodiak.

Pete Cummiskey, NMFS biologist on the 1999 St. Matthew Island blue king crab nearshore survey, brought blue king crabs after the survey to the Kodiak Fisheries Research Center (KFRC) on August 16. Most of the crabs died in transit and others died shortly after being placed in a seawater tank. Once stability was achieved, the tank was held at a constant temperature of 2.0 °C. By September, the only crabs that had survived were four females. These crab were measured and assessed on 15 September as follows:

- 105 mm CL new-shell hard, barren with only matted setae in clutch.
- 110 mm CL new-shell hard, barren with only matted setae in clutch.
- 91 mm CL new-shell hard, barren with only matted setae in clutch.
- 72 mm CL new-shell hard, barren with only clean setae in clutch.

MOLTING EVENTS: All four crabs molted.

<u>PREMOLT</u> <u>CL - MM</u>	<u>POSTMOLT</u> <u>CL - MM</u>	<u>MOLT</u> <u>DATE</u>
110	114	~10-23-99
91	95	~11-27-99
105	108	12-23-99
72	???	1-27-00 (this crab was killed after it molted by the other crabs)

NOTES:

None of these females extruded eggs after molting, presumably because there were no males in the tank in which they were held. A large, dark colored, developed ovary could be seen through the abdominal membranes in all three of the mature females. The immature female had not extruded eggs when its still soft carcass was removed from the tank. Internal examination showed that she too contained a large, dark, pre-extrusion ovary. Her pre-molt size of 72 mm CL also suggests that she was a pubescent female that would have molted to maturity and extruded a clutch of eggs in the presence of a male.

Certainly one of the most interesting things about these crabs is that the mature females molted in the fall, rather than the following spring, when conventional wisdom would have told us they should have molted. In addition, the pubescent female molted AFTER the mature females! In the better known Pribilof Island blue king population, females molted and mated in the spring in the years studied, and pubescent females molted before mature females. The four St Matthew Is. females at the KFRC were held in 2° C water. While we don't know how similar this temperature regime was to ambient St Matthew Is. temperatures, the fact that the mature females molted before the pubescent female was a fundamental reversal of the "normal" pattern. Our observations of last fall can be added to other sketchy evidence that suggests adult females in the St. Matthew Island population molt and mate in the fall to early winter period.

Appendix D. Log of scuba dives and crab habitat explored during the August 1999 St. Matthew Island blue king crab nearshore survey conducted by ADF&G.

Dive No.	Day	Divers	Location	Time of Dive & Visibility	Depth	Habitat and Commercial Crabs Observed
1	4-Aug	Cummiskey Blau Wever	60 deg 31.57' N 173 deg 03.00' W NW side of St. Matthew Is.	18:01-18:48 6-12'	18-31'	Dove adjacent to rock cliffs several hundred feet high. Subtidal area from 18-27' dominated by large boulders, covered primarily by the kelp <i>Laminaria</i> sp. Scattered sponges, red algae (<i>Neoptilota aspleneriodes</i> and <i>Yendonia crassifolia</i>) limpets, snails, hermit crabs. Four ovigerous female blue king crabs spotted amongst kelp. Coarse sand occurred between 28-31'.
2	4-Aug	Cummiskey Blau	60 deg 31.09' N 173 deg 04.18' W NW side of St. Matthew Is.	19:13-19:48 6-12'	32-65'	No blue king crabs counted. Primarily coarse sand from 65'-53' inhabited by rock sole buried in the sand. Rock boulders/reefs with channels between them filled with coarse sand and small rocks. Reefs covered with a variety of marine life but not covering their surfaces densely. Kelps <i>Agarum cribrosum</i> and <i>Laminaria</i> sp., encrusting and a variety of red foliose algae; patches of sponges, large stalked and solitary tunicates.
3	8-Aug	Cummiskey Wever	60 deg 23.48' N 172 deg 32.55' W SE side of St. Matthew Is.	21:05-21:20 6'	48-55'	Dove offshore from a beach composed of rocks and cobbles. One hair crab was captured from its self-made pit in the sand. Substrate hard packed coarse sand.
4	10-Aug	Cummiskey Blau Wever	60 deg 23.56' N 172 deg 26.98' W SE side of St. Matthew Is.	21:00-21:25 8'	35-54'	Dove off of shore with rocky cliffs. Bottom was coarse hard packed sand. Sparse marine life; a hair crab, skate, rock sole, jellyfish, large flatworms, and <i>Okiopluera</i> .

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