

Regional Information Report No. 4K05-11

**Project Operational Plan for the 2005 Bering Sea
Snow Crab *Chionoectes opilio* Tagging Survey**

by

Leslie J. Watson,

Kirsten A. Gravel,

and

Douglas Pengilly

November 2005

Alaska Department of Fish and Game

Division of Commercial Fisheries



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211 Mission Road, Kodiak, AK 99615 -

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FOREWORD

The 2005 Bering Sea Snow Crab *Chionoecetes opilio* survey is funded in part by NOAA Cooperative Agreement NA04NMF4370175 (Bering Sea Crab Research IV). The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its subagencies.

ABSTRACT

This report describes the project operational plan for the 2005 Bering Sea snow crab *Chionoecetes opilio* tagging survey and provides an overview of the mark-recapture study. A description of the objectives, survey area, sampling methodologies, and reporting are given. The tagging survey will be conducted by Alaska Department of Fish and Game (ADF&G) biologists aboard the chartered 39.6-m vessel, FV *Bella K* from 20 July to 19 August 2005. The survey sampling grid is composed of two areas; the southern sampling grid and the northern sampling grid. The southern sampling grid consists of 42 stations northwest of the Pribilof Islands. The northern sampling grid consists of 8 stations northwest of St. Matthew Island. Both areas will be sampled using a series of nine-pot stations. Up to 15,000 tags will be placed on legal-sized male crabs at a rate of 300 tags per station. Although the legal size for snow crab is 3.1-in (79-mm) carapace width, only crabs that meet the industry standard of 4.0-in (102-mm) carapace width will be tagged. The recovery rate of morphometrically-mature, legal-sized male snow crabs as a function of release location will be determined during the winter 2005/2006 and subsequent fisheries. Shell condition classification protocols used during the summer NMFS eastern Bering Sea trawl survey will be compared to those used by shellfish observers and ADF&G dockside samplers during the winter commercial fishery.

Key words: snow crab; *Chionoecetes opilio*; Bering Sea; tagging; mark-recapture; shell condition

INTRODUCTION

The eastern Bering Sea (EBS) snow crab *Chionoecetes opilio* stock has supported the most valuable crab fishery in the state of Alaska, with annual landings and ex-vessel values averaging 187-million pounds and \$144-million, respectively, over the period 1990-1999 (Bowers et al. 2004). In 1999, that same stock was declared “overfished” by the National Marine Fisheries Service (NMFS) when estimated mature biomass fell below the “minimum stock size threshold” (MSST) as defined in the Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs (FMP; NPFMC 1998). Following the overfished declaration annual harvests have been considerably reduced, ranging from 23.9-million pounds to 33.3-million pounds during 2000-2004. Under the State/Federal cooperative management regime established by the FMP, the fishery is managed by the Alaska Department of Fish and Game (ADF&G) with Federal oversight.

Snow crab distribution in the EBS extends from the shallow waters of the north and northeast to the deeper waters of the middle and outer continental shelves, but is concentrated in the middle continental shelf, which is characterized by low circulation and cold bottom water temperatures in the summer (Otto 1998). The fishery occurs in the Bering Sea District of Tanner crab Registration Area J, which includes all the waters of the Bering Sea north of Cape Sarichef at 54°36' N latitude and east of the U.S.-Russia Maritime Boundary Line of 1991. This district is divided into the Eastern and Western Subdistricts at 173° W longitude. The eastern Subdistrict is further divided at the latitude of Cape Romanzof and 168° W longitude into the Norton Sound Section to the east and the General Section to the south and west (Bowers et al. 2004). Prior to 1986, the fishery was concentrated on the middle continental shelf between the 50-m and 100-m isobaths. Since that time, the fishery has been concentrated in the outer continental shelf between the 100-m isobath and the shelf edge (Armstrong et al. 2004).

In an analysis of historic summer survey and winter fishery data through the winter 2002/2003 fishery, Armstrong et al. (2004) noted an apparent spatial mismatch between the distribution of large males (≥ 102 -mm carapace width, CW) during summer stock assessment surveys and their distribution in the winter fishery. Data on EBS snow crab distribution collected in the summer during the NMFS annual trawl survey show that the centroids of distribution of large males are always in the middle continental shelf. Conversely, the data collected during the winter fishery clearly show large males are harvested to the south of the centroids of the summer distribution and predominantly within the outer edges of the continental shelf. Moreover, within those areas where the fishery is concentrated, the number of large males harvested during the winter fishery was greater than the number estimated to have been present during the trawl survey of the preceding summer. The spatial mismatch between summer distribution of large males and winter fishery distribution persisted through the 2004 and 2005 fisheries (Figures 1 and 2). Those findings suggest the need for investigations on: 1) the existence of a migration, either seasonal or ontogenetic, by large males during the period between the summer survey and winter fishery; 2) the ability of the currently-used area-swept estimation methods applied to the NMFS trawl survey to adequately estimate the abundance of large male snow crabs on the fishing grounds; and, 3) the need to control harvest rates spatially to avoid localized overfishing.

The unrealistic estimated local harvest rates (e.g., $>100\%$ of pre-season abundance estimates; Armstrong et al. 2003) computed from summer survey and winter fishery data could be explained by a combination of migration to the fishing grounds and survey selectivity less than the assumed 1.0. Data from the annual NMFS trawl survey strongly suggest an ontogenetic migration by males from the north and northeast to the deeper waters of the outer continental shelf (Armstrong et al. 2004, Otto 1998, Zheng et al. 2001). Although the distribution of fishery effort and catch may not necessarily be coincident with stock distribution, the trend in comparisons between the survey and subsequent fisheries is consistent with the hypothesis that the large males migrate in that direction between summer and winter. If such migrations occur between summer surveys and winter fisheries, localized harvest rates estimated from the summer survey and winter fishery would overestimate the true local harvest rates. Additionally, the survey selectivity for snow crab is assumed to be 1.0 for area-swept estimates of abundance during the summer survey (Rugolo et al. 2003), whereas survey selectivity for snow crabs has been estimated to be less than 1.0 even for large males (Somerton and Otto 1999, Turnock 2004). Hence the area-swept estimates may underestimate local abundance, which would result in overestimates of local harvest rates.

The mismatch between summer survey distribution and winter fishery distribution, coupled with a trend towards increased spatial concentration of fishery removals, has raised concerns over the possible effects of the high local harvest rates on the reproductive output of the EBS snow crab stock. The Crab Plan Team (CPT) of the North Pacific Fishery Management Council (NPFMC) noted that, whereas only 26% of the total large males in the EBS were estimated to exist south of 58°30' N latitude during the summer 2003 NMFS trawl survey, 66% of the catch during the fishery of the following winter occurred south of 58°30' N latitude (Draft BSAI King and Tanner Crab Plan Team Minutes, September 20-22, 2004. NPFMC, Anchorage). The CPT also noted that 40% of the catch during the winter 2003/2004 fishery came from a single ADF&G statistical area (735800) of approximately 900 nmi². Noting that the disproportionately high harvest from areas south of 58°30' N latitude coincided with incidence of empty clutches and low clutch fullness in that area, the CPT recommended that,

“...an immediate analysis of the issues surrounding the differential harvest rates be developed to address the conservation issues and to also develop appropriate alternatives to protect the viability and reproductive strength of this stock. The analysis should be directed towards ensuring that the distribution of fishing effort be managed to ensure the equalization of exploitation rates over the range of the exploitable stock.”

Tagging studies of EBS snow crab have been suggested as a means to better understand the role of migration by large males in effecting the spatial mismatch between summer survey distribution and winter fishery distribution of large male snow crabs (Armstrong et al. 2004, Turnock 2004). By tagging and releasing large male snow crabs during the summer for their recovery during the winter fishery, information can be acquired for estimating the probability that large males present in the shallower middle shelf domain during the summer are harvested during the following winter in the deeper outer shelf domain where the fishery is concentrated. Data can also be acquired on the direction and distance between summer release location and winter fishery capture location, which may be a consideration for developing management measures that utilize summer distribution and abundance data for distributing catch and effort during the winter fishery. A tagging study can also provide information useful to developers of stock assessment models for EBS snow crab by providing information on comparability of shell conditions (Jadamec et al. 1999) recorded during summer surveys with shell conditions recorded during subsequent fisheries and on the number of fishing seasons that a large male snow crab may live through prior to capture by the fishery.

This report documents the plans for capturing, tagging, and releasing morphometrically-mature male snow crabs ≥ 102 -mm CW in the Bering Sea during summer 2005. This project is coupled with a tag recovery program that will take place during the winter 2005/2006 fishery and subsequent fisheries. A description of the project data analysis and tag recovery will be documented in a companion report.

OBJECTIVES

Prioritized objectives for the 2005 Bering Sea snow crab tagging survey are as follows:

1. - Determine recovery rate as a function of release location during the winter 2005/2006 fishery.
2. - Determine recovery rate by statistical area as a function of release location during the winter 2005/2006 fishery and subsequent fisheries.
3. - Compare shell condition classifications determined during the summer using NMFS shell condition classification protocols with shell condition classifications determined by fishery observers and ADF&G dockside samplers during the winter 2005/2006 fishery and subsequent fisheries.
4. - Estimate the maximum numbers of fishery seasons that a morphometrically-mature male snow crab ≥ 102 -mm CW is available to the commercial fishery.

TERMS

Snow Crabs

- Sublegal males: < 79 -mm (< 3.1 -in) CW **inside** lateral spines.

- Small legal males: ≥ 79 -mm and < 102 -mm (≥ 3.1 -in and < 4 -in) CW **inside** lateral spines.
- Large legal males: ≥ 102 -mm (4-in) CW **inside** lateral spines. *This size group of legal males is the tagging target for the survey.*
- Immature females: abdominal flap covers only $\frac{2}{3}$ of ventral surface (Jadamec et al. 1999).
- Primiparous females: mature, exoskeleton in clean soft, clean hard, or intermediate condition (NMFS shell codes 2 or 3); no mating scars on pereiopods (Sainte-Marie 1993).
- Multiparous females: mature, exoskeleton in intermediate, dirty hard, or dirty soft condition (NMFS shell codes 3, 4 or 5); generally with mating scars on pereiopods.

Tanner Crabs

- Sublegal males: < 140 -mm (5.5-in) CW outside lateral spines.
- Legal males: ≥ 140 -mm (5.5-in) CW outside lateral spines.
- Females: Immature and mature as identified by shape of the abdominal flap (Jadamec et al. 1999).

Hair Crabs

- Sublegal males: < 83 -mm (3.25-in) CW.
- Legal males: ≥ 83 -mm (3.25-in) CW.
- Females: Immature (no external evidence of ovigerity); mature (external embryos or empty egg cases present).

Blue King Crabs

- Sublegal males: < 140 -mm (5.5-in) CW outside lateral spines in the St. Matthew Island Section; < 165.1 -mm (6.5-in) CW outside lateral spines in the Pribilof District.
- Legal males: ≥ 140 -mm (5.5-in) CW outside lateral spines in the St. Matthew Island District; ≥ 165.1 -mm (6.5-in) CW outside lateral spines in the Pribilof District.
- Females: Immature (no external evidence of ovigerity); mature (external embryos or empty egg cases present).

Golden King Crabs

- Sublegal males: < 140 -mm (5.5-in) CW outside lateral spines in the St. Matthew Island Section and the Pribilof District.
- Legal males: ≥ 140 -mm (5.5-in) CW outside lateral spines in the St. Matthew Island Section and the Pribilof District.
- Females: Immature (no external evidence of ovigerity); mature (external embryos or empty egg cases present).

Red King Crabs

- Sublegal males: < 165.1 -mm (6.5-in) CW outside lateral spines in the Pribilof District.
- Legal males: ≥ 165.1 -mm (6.5-in) CW outside lateral spines in the Pribilof District.

- Females: Immature (no external evidence of ovigerity); mature (external embryos or empty egg cases present).

METHODS

The snow crab tagging survey will be conducted in the Bering Sea aboard the chartered 39.6-m (130-ft) vessel, FV *Bella K* from approximately 20 July to 19 August 2005. The southern sampling grid encompasses the area between 58°00' - 59°20' N latitude and 170°20' - 173°43' W longitude (Figure 3). The northern sampling grid encompasses the area between 60°40' - 61°20' N latitude and 174°49' - 175°41' W longitude (Figure 3). Details on methods are provided in the Shipboard Instructions (Appendix A1). The 30-day charter will begin and end in Dutch Harbor with a captain, engineer, three crewmen, and four ADF&G biologists aboard. Approximately four of the 30 days allotted will be necessary for travel to and from the survey grounds and two more days will be required for travel between the southern and the northern sampling grids (Appendix B).

SURVEY DESIGN

Southern Area

The southern sampling grid is based on (1) historic geographic distribution and high densities of large male snow crab catch during the NMFS annual trawl survey, and (2) statistical catch areas with the largest catch per unit effort (CPUE) in recent fisheries (Figures 1 and 2). The southern sampling area also straddles the 58°30' N latitude line, which is the line that separates the two areas that the NPFMC CPT suggested be considered for separate management. A total of 42 stations have been identified in the southern sampling area. Twenty-six of these stations have been identified based on regularly trawled stations during the NMFS annual trawl survey in which stations are spaced 20 nmi north-to-south and east-to-west (see dark squares in Figure 4). The other sixteen stations are also based on a 20 nmi X 20 nmi grid but are offset from the regularly surveyed NMFS stations by 10 nmi north-to-south and east-to-west (see open circles in Figure 4).

Northern Area

The northern sampling grid is based on locations where high abundance estimates for large males have consistently been obtained during the NMFS survey (Figures 1 and 2). Tagging of large legal males from this area will allow us to determine if these crabs migrate to the fishing grounds. Eight stations have been identified in the northern sampling area. Six of the 8 stations are spaced 20 nmi north-to-south and east-to-west; two of the eight stations are central and spaced 20 nmi apart north-to-south and are offset from the others by 10 nmi north-to-south and east-to-west; all stations are based on regularly trawled NMFS trawl survey stations (Figure 4).

All stations will be sampled using a string of nine crab pots set 0.125 nmi apart and set in such a way as to have the fifth pot set directly on the midpoint of the station. The survey crab pots will be supplied by the FV *Bella K* and are used in commercial Bering Sea crab fisheries. Each pot measures 7 ft x 7 ft x 34 in, is fitted with 4½ in stretch mesh on all webbing, and has two opposing tunnel eye entrances each measuring 3 in x 36 in. Each pot is fitted with 4-in escape rings. Each pot will be baited with chopped Pacific herring and Pacific cod as hanging bait with no restriction on the amount of bait used. The target soak time for each pot is 16 hours. A maximum of 300 'large' legal, morphometrically mature male snow crabs ≥ 102 -mm CW will be tagged and released at each of the 50 stations.

All stations will be sampled during the survey. A minimum of 2 stations will be set and pulled each day as shown in Appendix B2. Mid-point station coordinates are listed in Appendices B3 and B4. Fishing parameters such as station, sequential pot number, set and pull date and time, latitude, longitude, gear performance, and water temperature will be recorded by the vessel captain on the Pilot House Log (Appendix C1.) Biological data for sampled crabs will be recorded on the appropriate data forms as instructed in Appendices C4 – C6. All necessary equipment for the survey is listed in Appendix D1.

CATCH SAMPLING

The snow crab catch from each pot will be sorted first by sex. Females will be sorted by maturity category and enumerated. Males will be sorted into sublegals and legals, and legals will be divided into ‘small’ and ‘large’ subgroups and enumerated. Male crabs will be sampled randomly with regard to shell age and size, measured, and if they are ‘large’ legal (≥ 102 -mm CW) morphometrically mature, will be tagged. The contents of the last pot at each station will be sampled entirely to determine species composition at each station (Appendix C7). Snow crabs will be sampled in the same manner described above. All captured king, Tanner and hair crabs will be measured and enumerated from all pots during the survey.

TAG RECOVERY

A tag recovery program during the 2005/2006 Bering Sea snow crab fishery will be conducted. Prior to the fishery and during vessel tank inspections, ADF&G personnel will contact vessel crews and processing facilities to explain the tagged crab recovery effort and attendant tag reward program. A news release was issued to the Bering Sea crab industry outlining the tag recovery effort (Appendix H1). At-sea shellfish observers from the ADF&G mandatory observer program and ADF&G dockside samplers will monitor catches for tagged crabs. Observers and dockside samplers will be briefed prior to the onset of the fishery and equipped with instructions, forms and necessary equipment for tag recovery documentation (Appendix H2). All recovered, tagged crabs will be measured and assessed for shell age, with complete capture location and depth information to be obtained from vessel captains. Observers will also be asked to take dorsal and ventral digital photographs of each tagged crab recovered for shell age assessment.

SCHEDULES AND PERSONNEL

Date	Activity	Personnel
4/05-5/05	Project planning, solicit vessel charter bids, prepare PR’s for major purchases	Watson, Gravel, Pengilly
5/05-7/05	Prepare POP, shipboard instructions, survey gear	Watson, Gravel, Pengilly
7/20/05-8/19/05	Conduct 30-day survey in Bering Sea	Gravel, Alinsunurin, Renfro, Bon
9/05	Edit and enter survey data, write memo	Gravel
10/05-06/06	Conduct tag recovery effort during the 2005/2006 commercial fishery	ADF&G observers and dockside samplers
06/06	Edit and enter tag recovery data	Gravel
07/06-09/06	Compile, analyze, and write final report	Gravel

REPORTS

A post-survey memo will be written documenting the number of crabs caught, measured, and tagged per station and sampling area. Semi-annual progress reports and a final report for NOAA grant NA04NMF4370175: Project 1: Bering Sea *opilio* Tagging Project will also be written. The schedule for the semi-annual reports and final report pertaining to this project, including this Project Operational Plan, is given below.

Date	Report	Author(s)
6/05	Project Operational Plan	Watson, Gravel, Pengilly
9/05	Post-survey memo	Gravel
1/06	Semi-annual progress report	Pengilly, Gravel, Watson
7/06	Semi-annual progress report	Pengilly, Gravel, Watson
9/06	Final comprehensive report	Pengilly, Gravel, Watson

REFERENCES CITED

- Armstrong, A., L. Orensanz, and B. Ernst. 2004. Project 2 - Reproductive dynamics of female snow crab and Tanner crab populations in the eastern Bering Sea. *In*: Final Comprehensive Performance Report for NOAA Cooperative Agreement NA16FN1275 – Bering Sea Crab Research (I). Submitted to National Oceanic Atmospheric Administration – National Marine Fisheries Service May 13, 2004. Alaska Department of Fish and Game, Division of Commercial Fisheries, Juneau.
- Bowers, F., B. Failor-Rounds, and A. Gilson. 2004. Annual management report for the commercial shellfish fisheries of the Bering Sea, 2003. Pages 65 - 184 in Annual management report for the commercial and subsistence shellfish fisheries of the Aleutian Islands, Bering Sea and the Westward Region's shellfish observer program, 2003. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 4K04-43, Kodiak.
- Jadamec, L.S., W.E. Donaldson, and P. Cullenberg. 1999. Biological field techniques for *Chionoecetes* crabs. Alaska Sea Grant College Program AK-SG-99-02, Univ. of Alaska Fairbanks.
- North Pacific Fishery Management Council (NPFMC). 1998. Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs. North Pacific Fishery Management Council, Anchorage.
- Otto, R. 1998. Assessment of the eastern Bering Sea snow crab, *Chionoecetes opilio*, stock under the terminal molt hypothesis. Pages 109 – 124 *in* G.S. Jamieson and A. Campbell (eds.). Proceedings of the North Pacific symposium on invertebrate stock assessment and management. Canadian Special Publication of Fisheries and Aquatic Sciences 125.
- Rugolo, L.J., R.A. MacIntosh, C.E. Armistead, J.A. Haaga, and R.S. Otto. 2003. Report to Industry on the 2003 Eastern Bering Sea Crab Trawl Survey. AFSC Processed Report 2003-11, National Marine Fisheries Service, Alaska Fisheries Science Center, Kodiak Fisheries Research Center, Kodiak.
- Sainte-Marie, B. 1993. Reproductive cycle and fecundity of primiparous and multiparous female snow crab, *Chionoecetes opilio*, in the northwest Gulf of Saint Lawrence. *Can. J. Fish. Aquat. Sci.* 50:2147-2156.
- Somerton, D.A., and R.S. Otto. 1999. Net efficiency of a survey trawl for snow crab, *Chionoecetes opilio*, and Tanner crab, *C. bairdi*. *Fish. Bull.* 97:617-625.
- Turnock, B.J. 2004. Stock assessment of eastern Bering Sea snow crab. Appendix A *in*: Stock Assessment and Fishery Evaluation Report for the King and Tanner Crab Fisheries of the Bering Sea and Aleutian Islands Regions – 2004 Crab SAFE. North Pacific Fishery Management Council, Anchorage.

Zheng, J., G. H. Kruse, and D. R. Ackley. 2001. Spatial distribution and recruitment patterns of snow crabs in the eastern Bering Sea. Pages 233 – 255 in G.H. Kruse, N. Bez, A. Booth, M.W. Dorn, S. Hills, R.N. Lipcius, D. Pelletier, C. Roy, S.J. Smith, and D. Witherell (eds.). 2001. Spatial processes and management of marine populations. University of Alaska Sea Grant, AK-SG-01-02, Fairbanks.

FIGURES

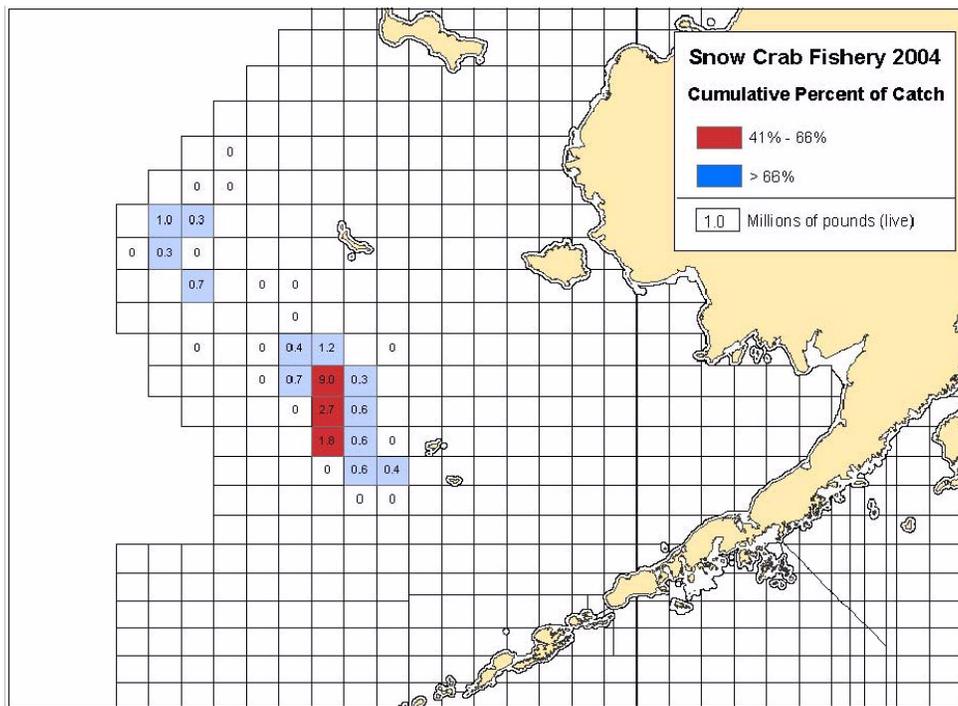
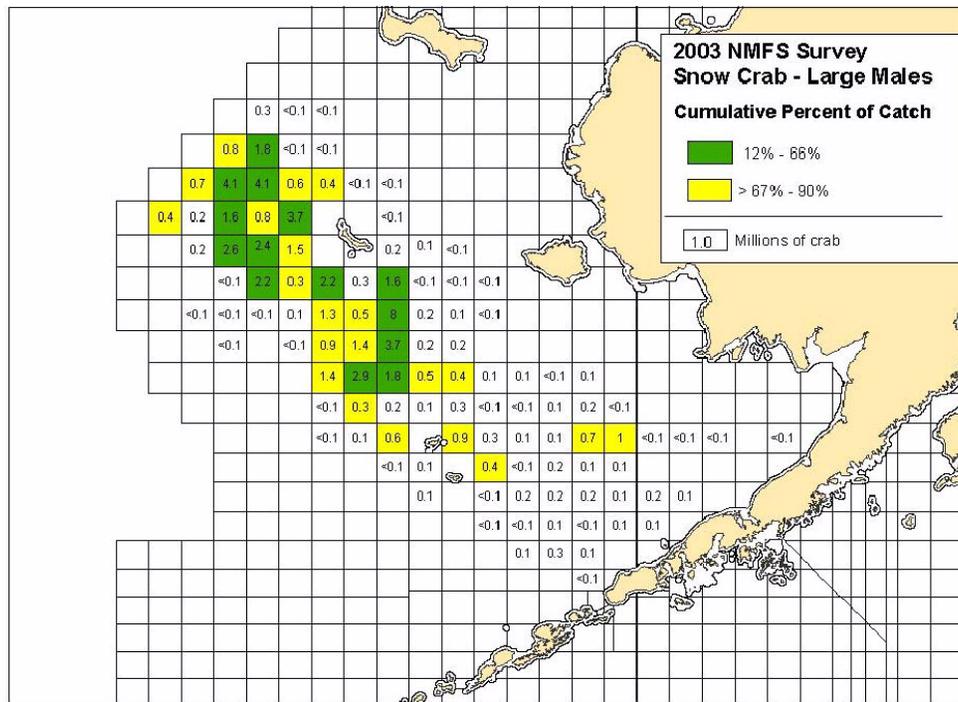


Figure 1.-Estimated number of male snow crabs ≥ 102 -mm carapace width (CW) captured during the 2003 NMFS eastern Bering Sea trawl survey, by ADF&G statistical area (top panel); harvest of male snow crabs in the 2004 commercial fishery, by ADF&G statistical area (bottom panel). Source: NMFS-AFSC, Kodiak Laboratory; http://www.fakr.noaa.gov/npfmc/membership/planteams/CPT/505crab_survey_maps.pdf.

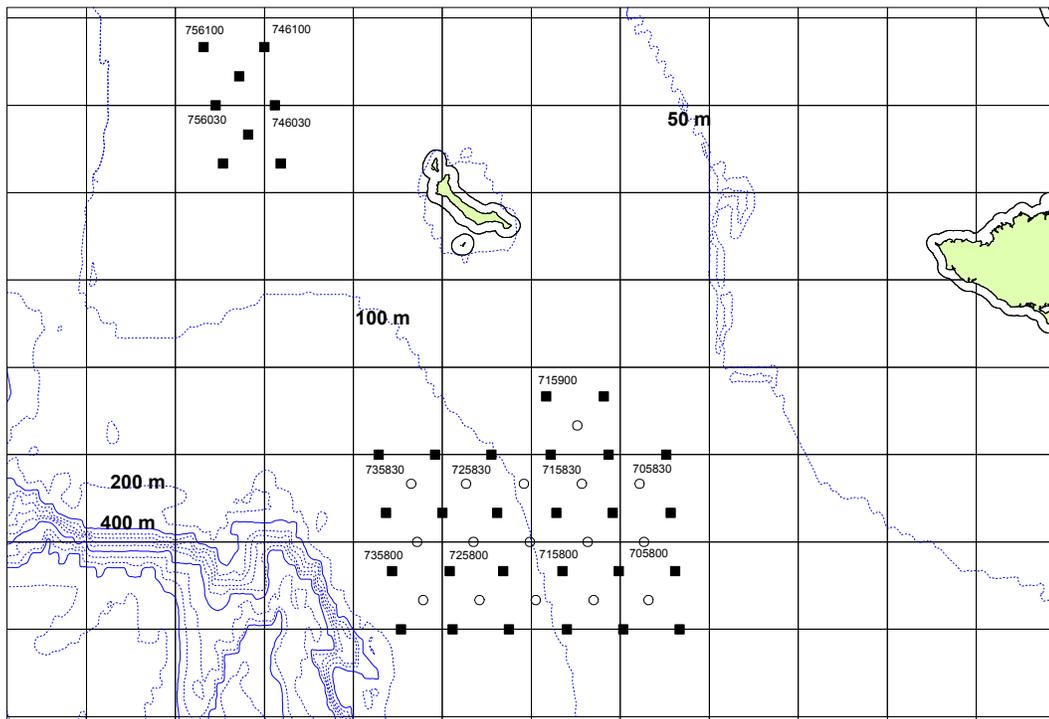
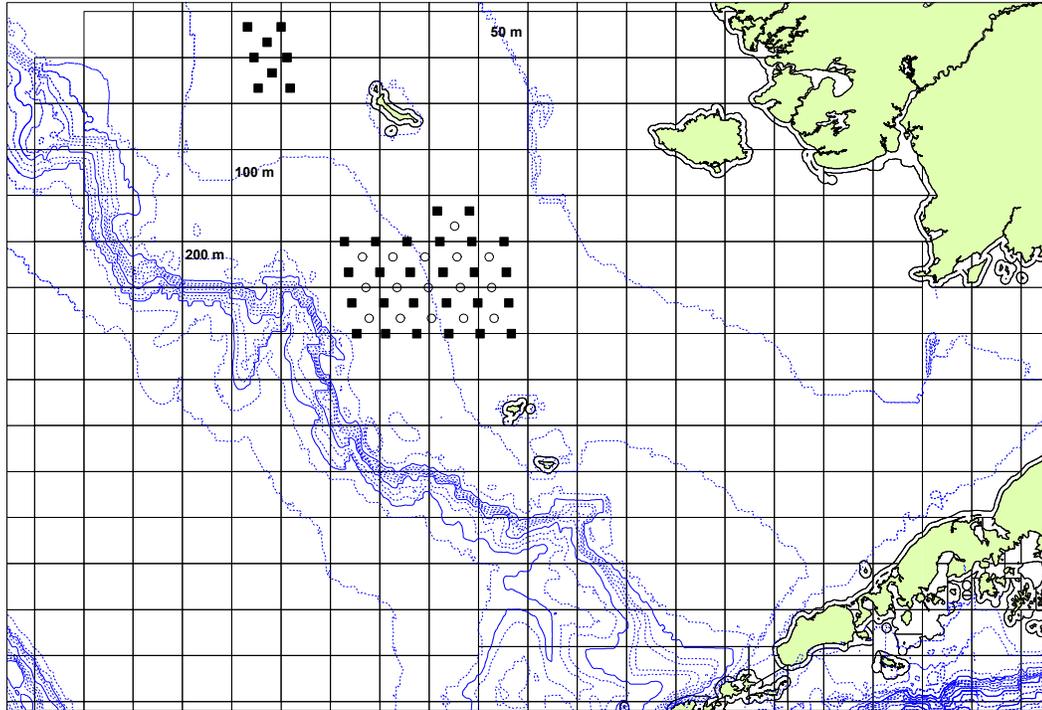


Figure 3.-Tagging station layout of the 34 ‘regularly trawled NMFS’ (black squares) stations and 16 ‘offset’ (open circles) stations to be fished during the 2005 Bering Sea snow crab tagging survey (top panel); location of tagging stations within ADF&G statistical areas (bottom panel).

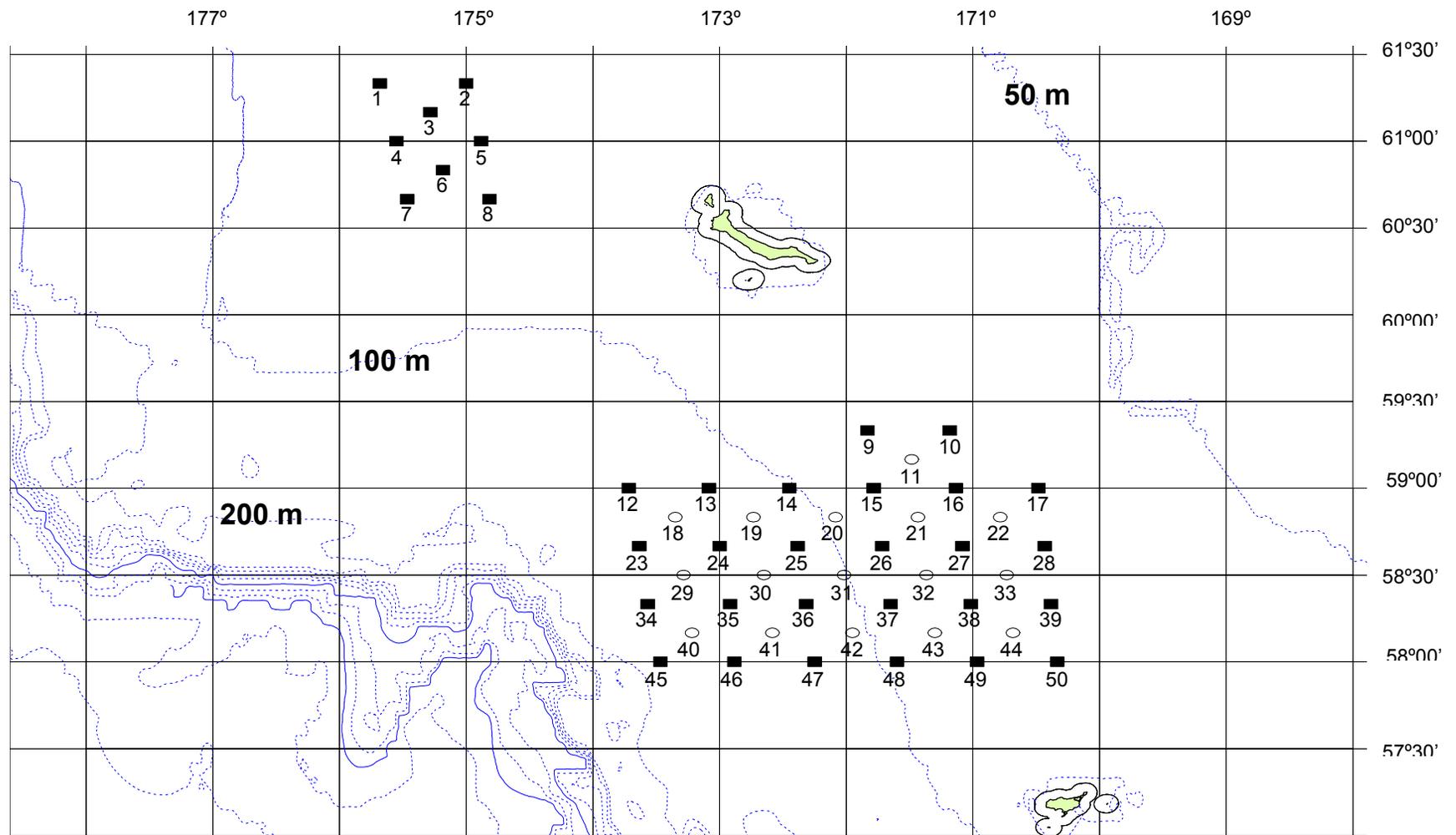


Figure 4.-Station location and numbers of the 50 stations to be fished on the 2005 Bering Sea snow crab tagging survey. *Black squares denote stations based on regularly trawled stations during the NMFS annual trawl survey; open circles denote stations that are offset 10 nmi from regularly trawled stations during NMFS annual trawl survey.*

**APPENDIX A. SHIPBOARD INSTRUCTIONS FOR THE 2005
BERING SEA SNOW CRAB TAGGING SURVEY**

APPENDIX A.
SHIPBOARD INSTRUCTIONS FOR THE
2005 BERING SEA SNOW CRAB TAGGING SURVEY

by: -

Leslie J. Watson -

June 22, 2005 -

SURVEY ORIENTATION

*****THE PURPOSE OF THE SURVEY IS TO SAFELY COMPLETE THE OBJECTIVES
DETAILED BELOW*****

The 2005 FV *Bella K* survey vessel crew consists of Captain Anders Rogers, engineer Michael Nickerson, and deckhands Brent Peterson, Tristan Roach, and Mathew Clancy. Biological staff includes crew leader Kirsten Gravel and biologists Rachel Alinsunurin, Kevin Renfro, and Myke Bon.

SAFETY BRIEFING

Prior to departure from Dutch Harbor, both vessel and ADF&G crews are required by terms of the charter contract (ITB 2006-1100-5494) to go through the following safety briefings and vessel orientations. The captain will specify all safety features and answer all questions related to these topics.

1. - Shipboard Safety Drill: You will be instructed regarding the location(s) to report to and what to do in emergency situations. Specific items include: 1) where to go when the general alarm is pulled; location of life raft(s), skiff(s), survival suits, and EPIRBs 2) safe locations on deck when gear is being set or pulled, dangerous locations on deck during active gear working. A safety drill will be held at an unspecified time to test the ability of all crewmembers and ADF&G personnel to don their survival suits and help others don theirs.
2. - General Vessel Orientation: Vessel tour including, but not limited to, fire stations, location of medical supplies, and engine room.

Safety of all personnel and the vessel is the primary concern during the charter. Under international law, the captain is responsible for the safety of the vessel and all souls aboard. Obey the captain in regards to your safety and the safety of others. If you have any doubt at all about where you should be at any time, ask the captain. Avoid running, be careful, and watch out for your own safety and the safety of others. Do not go on deck alone or anywhere outside when seas are extremely rough or conditions are otherwise unsafe; no photos or video are worth the risk. Make sure all deck gear is secured so that the temptation to save gear when it gets wicked out can be precluded. When the gear is being worked, pay attention to the location of lines, buoy trains, boom hooks and other flying objects. Stand in safe locations specified by the captain or deck boss when pots are being set, retrieved, moved or stacked.

Prior to departure, preferably several days before the vessel is scheduled to depart, each ADF&G crew member shall check his/her survival suit, and will wax the zipper and ensure that it works properly throughout it's entire length. Place one large plastic bag at the entrance to each leg hole to ensure a quick donning of your suit if the need arises. Call the U.S. Coast Guard in Dutch Harbor (581-3466) or Kodiak (487-5750) for protocols to test personal EPIRBs. Once tested, secure the EPIRB to your suit. Test the strobe light, make sure it has fresh batteries, and secure it to your suit.

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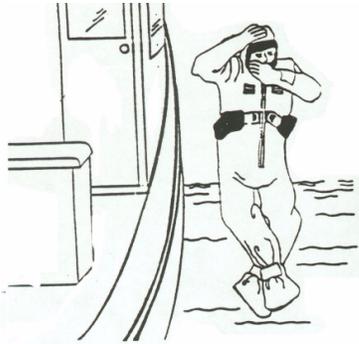
Practice donning your survival suit with a partner while clothed in full rain gear and boots. It is highly advisable that you also practice getting into the suit at a swimming pool prior to going to sea. Your peace of mind at sea will improve immensely if you have practiced and can get into your suit quickly, either on deck or in the water. With adequate practice, you should be able to don your suit in less than 3 minutes. Properly pack and stow your suit.

If you must abandon ship, work with a buddy when getting into your survival suit; ensure that you and your buddy's zippers are up. If possible, secure a line between you and your buddy once you are in the water, but do not tie yourselves together prior to leaving the vessel. Generally, do not abandon ship until the last possible minute, as many boats that appear to be sinking remain afloat. Don't jump into the water unless there is no other option. The approved protocol for jumping off of vessels is described below.

The primary factor controlling your safety at sea is self-preparedness

Protocol for Jumping Off of Vessels (reprinted from Alaska Marine Safety Education Association)

Immersion suit wearers who jump in the water incorrectly can damage their eardrums when air inside a suit rushes into the hood. In addition, damage to one's neck, back, or the suit's zipper can occur when jumping with an inflated air bladder. The diagram below shows the proper way to jump from a height while wearing an immersion suit.



To avoid injury, place the hand farthest from the vessel being abandoned inside the hood or neck of the suit before jumping. This creates a gap between the hood and face that will allow the air in the suit to escape. Once the wearer enters the water, the hydrostatic squeeze of water

pressure rapidly forces air from the legs and body of the suit into the hood. The more bulky and loose-fitting the suit, the more likely air will rush into the hood. Without a path for the air to escape, the pressure inside the head can be painful and even damaging to eardrums. This same hand can be used to cover and protect the airway so the jumper does not involuntarily suck in any water through the gasping reflex.

Also, the immersion suit's air bladder should not be inflated if a jump is necessary. If it is, the jumper will come to a sudden and stressful stop once the inflated bladder with all its buoyancy hits the surface of the water. This can result in damage to wearer's neck or back. Damage to the suit's zipper and air bladder can also occur. On some suits the bladder is attached to the zipper, and the force of impact can rip the zipper apart. This damage has occurred even when jumping into the water from a standing position on a dock.

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In addition to these two precautions, the jumper should place the hand nearest the vessel atop the hood. This does two things. It protects the side of the head near the vessel from hitting the vessel's side. Also, it keeps the hood in place while entering the water. It is easy for the hood to slip off during entry, especially if the immersion suit is large for the wearer. A well-anchored hood is

critically important in preventing water from entering the airway, and in keeping the immersion suit wearer warm while in the water.

Enter the water correctly during training or drills. Learning the correct technique during the nonemergency situation can prevent unnecessary injury during an actual emergency.

INSTRUCTIONS TO THE CAPTAIN

Consult with the crew leader prior to planning the fishing order of the stations and when pots are first picked in the morning and when setting should begin for the following day's pick. Each station consists of a straight string of 9 pots set 0.125 nmi apart and arrayed so that the fifth pot is set at the station center. The target soak time for each pot is 16 hours. An itinerary for completion of survey sampling is in Appendix B1; stations will be set in 'blocks' of 2 per day as depicted in Appendix B2. Changes can be made if bad weather slows or prohibits setting or picking gear, or if crab catches are great. Midpoint locations for each station in the southern and northern sampling grids are listed in Appendices B3 and B4, respectively.

SETTING AND RETRIEVING GEAR

When setting or retrieving gear use the Pilot House Log to report all required data for each pot (Appendix C1). Unique, sequential pot numbers will be assigned for each pot in successive stations beginning with the numeral 1. Record the latitude and longitude to the nearest one-hundredth of a minute; this information must be recorded at the time each pot is set, not at the time it is pulled. Pilot house logs must be accurately completed each day. Please use pencils to record all necessary data. We will deploy submersible temperature recorders (STRs) in the fifth pot at each station fished. Please make sure the crew tells you which STR (numbered 1 –5) is put in that pot. If the STR is placed in a pot other than the fifth one, the crew must identify which pot contains the STR.

We will try to stay on a schedule of retrieving the first pot by 0700 hours each day. Notify the ADF&G crew at least 30 minutes before the first pot is pulled in the morning so that we are ready for sampling. As each pot comes aboard, you must tell the ADF&G deck crew what the sequential pot number is for that pot. If a pot is lost, set without bait, or did not fish properly, note that on the Pilot House Log, and inform the ADF&G deck crew. Do not erase the sequential pot number of any lost pot or pot that had a poor performance.

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RADIO AND EMAIL SCHEDULES

You will maintain a daily radio schedule between the vessel and it's primary shoreside contact specifying the vessel location. The daily catch log will be reported via email through *Stratos* to the Kodiak and/or Dutch Harbor office, and is the responsibility of the crew leader. That record will contain dates and station numbers fished. State email use will be limited to necessary communications and the vessel shall be reimbursed for costs associated with State use.

MISCELLANEOUS SHIPBOARD RULES AND REMINDERS

- The captain is responsible for the safety of the vessel and all crew aboard; in such matters, the captain has the authority to halt fishing operations in unsafe or dangerous conditions.
- The crew leader has the authority to delay or halt the charter at any time and for any reason deemed necessary, including but not limited to: unsafe working conditions or insubordination by any person on board.
- Vessel and ADF&G crews will work as a team particularly when sorting the catch. Any personality conflicts will be resolved by the captain and crew leader; should situations arise that could escalate, notify them immediately.
- ADF&G crew must maintain all sampling equipment and ensure that calipers and other sampling equipment are cleaned daily. Store calipers, clipboards, tags, etc., inside the vessel at the end of each sampling day. All sampling gear should be in a designated area out of the mainstream traffic pattern. Ensure that laptop computer(s) and other peripherals are secured at all times. Prior to the end of each day, ADF&G crewmembers will check with the crew leader to ensure that all tasks are completed. Each ADF&G crewmember will be assigned a data checking or tag preparation activity each evening.
- Be considerate of others, maintain a sense of humor, and be patient while onboard the vessel. Keep your living quarters, work areas, and common areas neat. Please wash up thoroughly before meals. Extend offers to assist in meal preparation and dish washing.
- ADF&G crew will be briefed on basic vessel rules, including: 1) where to hang rain gear and gloves, 2) water conservation issues and policies (showers-how often & how long, laundry, dishes, bathroom), 3) galley manners, 4) personnel issues (who's the deck boss, etc.), and other items as noted by the vessel crew.
- Ensure that all equipment needed for the successful completion of the survey is functional and aboard the vessel prior to departure. Equipment needs are detailed in Appendix C.
- Work hard, play hard. We're going to have a great time in one of the most fantastic places in the Bering Sea. Above all, BE SAFE AND HAVE FUN!

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SURVEY DESIGN

AREA COVERAGE, STATION ARRAY, AND POT DEPLOYMENT

The 2005 survey area is between 58°00' - 61°30' N. latitude and 172°00' - 173°55' W. longitude and is composed of 50 stations. Stations 49 and 50 will be set first, followed by stations 44 and 39. Each station consists of a straight string of 9 pots set 0.125 nmi apart and arrayed so that the fifth pot is set at the station center. The target soak time for each pot is 16 hours. An itinerary for completion of survey sampling is in Appendix B1; stations will be set in 'blocks' of 2 per day as depicted in Appendix B2. Changes can be made if bad weather slows or prohibits setting or picking gear, or if crab catches are great. Midpoint locations for each of the 42 southern and 8 northern stations are listed in Appendices B3 and B4.

Each pot will be baited with frozen chopped Pacific herring *Clupea pallasii* and Pacific cod *Gadus macrocephalus* (hanging bait), with no restriction on the amount of bait used. Pots will be pulled in the sequential order that they are set. Fishing parameters such as station and sequential pot number, set date and time, lift date and time, bottom type (rock, sand, silt, mud, or gravel), latitude and longitude, and gear performance will be reported on the **Pilot House Log** (Appendix C1).

GEAR DESCRIPTION

Seventy-five identical king crab pots measuring 7 ft x 7 ft x 34 in supplied by the FV *Bella K* will be used. Each pot is webbed with #92 nylon twine with a stretch mesh of 4 1/2" and has two opposing 3" x 36" tunnel eye openings. Each pot is fitted with one 18" length #30 cotton twine (ADF&G 2003; Escape mechanism for shellfish and bottomfish pots) and 4-in escape rings.

CATCH SAMPLING

SORTING AND RECORDING POT CATCHES

The contents of each pot fished will be enumerated for snow crabs *Chionoecetes opilio*, Tanner crabs *C. bairdi*, blue king crabs *Paralithodes platypus*, red king crabs *P. camtschaticus*, golden king crabs *Lithodes aequispinus*, and hair crabs *Erimacrus*

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isenbeckii by sex and size. Male and female snow crab data will be tabulated during sampling and at the end of each day on the **Catch by Subgroup** forms (Appendices C2 and C3). All crabs will be handled carefully during sorting and measuring and will be released immediately after sampling is completed. When tagging occurs, the vessel will remain on station, not moving until all tagged crabs have been released so that they are returned as close to the original capture location as is feasible.

Snow crabs may be subsampled prior to measuring when pot catches are large enough to delay overall survey progress. All snow crab data will be recorded on either the **Male Snow Crab** (Appendix C4) or the **Female Snow Crab** form (Appendix C5). Prior to subsampling, snow crabs will be sorted by sex and subgroup as follows:

- | | |
|---|--|
| <ul style="list-style-type: none">• Males<ul style="list-style-type: none">• Sublegals: <3.1” CW (<79 mm CW)• Small Legals: ≥3.1” and <4.0” CW (≥79 mm and <102 mm CW)• Large Legals: ≥4.0” CW (≥102 mm CW) | <ul style="list-style-type: none">• Females<ul style="list-style-type: none">• Immature• Mature-Primiparous: new and old shell crabs; no mating scars on pereiopods.• Mature-Multiparous: old, very old, and very, very old shell crabs; mating scars on pereiopods. |
|---|--|

For the categories listed above, record the total number of crabs in each subgroup, the total number measured, and for large legal-sized male snow crabs, the number that were tagged on either the **Male Snow Crab Catch By Subgroup** (Appendix C2) or the **Female Snow Crab Catch By Subgroup** (Appendix C3) form.

All blue, red, and golden king, Tanner, and hair crabs will be sexed, measured and assessed for shell condition (age) and data recorded on the **‘Other’ Crab** form (Appendix C6). Blue, golden, and red king crabs and hair crab carapace lengths (CL) will be measured in millimeters (mm) from the posterior margin of the right eye orbit to the midpoint of the rear margin of the carapace as in Wallace et al. (1949). Snow crab carapace width (CW) will be measured to the nearest 0.1 mm across the carapace at the widest part perpendicular to the medial line from the anterior to the posterior of the carapace, with the tips of the calipers reaching inside the lateral spines as shown in Jadamec et al. (1999). Tanner crabs will be measured the same way, but recorded only to the nearest 1 mm. Legal size of snow crabs (3.1” CW; ≥79 mm CW) will be determined by measuring the carapace width **inside** the lateral spines. Legal size of blue king (5.5”), golden king (5.5”), red king (6.5”), Tanner (5.5”), and hair (3.25”) crabs will be determined by measuring the carapace width **outside** the lateral spines.

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For male snow crabs, chela height will be measured as in Jadamec et al. (1999) to the nearest 0.1 mm at the greatest height of the right chela, excluding spines to determine whether the crab is a large-clawed (morphometrically mature) or a small-clawed legal-sized male. Determination of small- or large-claw crabs can be confirmed by comparison of paired carapace width (CW) and chela height (CH) values as noted in Appendix E1.

SHELL AGING

Snow and Tanner Crabs

Shell age will be determined using the parameters outlined in Jadamec et al. (1999), using codes equivalent to that of the NMFS coding structure as follows:

Shell Age Category	ADF&G Code	NMFS Code
Soft	0	1
New-pliable	9	-
New-hard	1	2
Old	2	3
Very Old	3	4
Very, Very Old	4	5

Blue and Red King Crabs

The best place to estimate shell age is on the ventral side of the coxa of the walking legs (pereopods) and meri. Soft-shell crabs are rarely captured in survey pots since they would have had to molt in the pot.

- *Soft-shell*: Crab has molted within weeks. Exoskeleton is still soft 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 3 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.
- *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.

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- *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. 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.

Golden King Crabs

Shell age characteristics are similar to those itemized for red and blue king crabs except that the undersides of golden kings are golden in color instead of white.

Hair Crabs

Shell age characteristics for hair crabs are as follows:

- *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.

FEMALE REPRODUCTIVE CONDITION

Female reproductive condition will be characterized for all species of crabs that are sampled, including clutch fullness, egg color, development and presence/absence of dead eggs in the clutch (Appendices C5 and C6).

Clutch fullness categories for female snow, Tanner, and king crabs have been modified from the guidelines used on previous pot surveys. Changes described below reflect a move towards standardizing clutch fullness categories using photographic and other descriptive measures. Clutch scores are defined as follows:

Immature

0-Barren, with clean pleopodal setae.

Mature

1-Barren, with matted pleopodal setae.

2-Clutch trace to 1/8 full. -

3-Clutch 1/4 full. -

4-Clutch 1/2 full. -

5-Clutch 3/4 full. -

6-Clutch 100% full. -

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Primiparous and multiparous female snow crabs will be identified as described earlier in this section. Snow and Tanner crab clutch categories and codes are depicted in Appendix F1. King crab clutch scoring and coding is shown in Appendix F2.

SPECIES COMPOSITION

Species composition of pot catches will be enumerated for each pot at each station. Only crab species will be accounted for; any species of fish or other invertebrates will be ignored. Total counts and measurements of snow, Tanner, blue, red, or golden king, and hair crabs will be recorded either on the **Male Snow Crab Survey Data** form (Appendix C4), the **Female Snow Crab Survey Data** form (Appendix C5), or the **‘Other’ Crab Survey Data** form (Appendix C6) for each sampled pot.

TAGGING STRATEGY AND METHOD

A maximum of 300 legal-sized, large-clawed, healthy male snow crabs will be tagged and released at each 9-pot station in the Northern and Southern Areas. The station tagging goal was obtained by apportioning 300 crabs to each of the 50 survey stations (300 tags x 50 stations = 15,000 tags). Each crab will be healthy, with no severe new or old injuries or parasitic infestations. There is no maximum or minimum number of crabs to be tagged at each pot in a station; only that the station total is 300.

The Floy® poly ‘spaghetti’ tags are fluorescent pink with fluorescent green tabs and are numbered ‘N’ 00,001 through ‘N’ 15,000. Eligible crabs will be tagged by looping the tag between the 2nd and 3rd walking legs (3rd and 4th pereopods) on the left and right lateral margins, tying it on the dorsal surface of the carapace with a ‘double knot’ as illustrated in Appendix G1, and securing it with an overhand knot. The green tab is to be positioned on the tag so that it lies next to the knot on the dorsal surface of the carapace (Appendix G2).

DAILY DATA CHECKING

Each day data is collected it will be checked for accuracy by cross-checking recorded data by a person other than the recorder. This includes all forms that have been used that day (e.g., Pilot House Log, Crab Survey Data form).

OTHER SHIPBOARD PROJECTS

OCEAN TEMPERATURE DATA

Ocean bottom temperature data (°C) will be collected from the fifth pot at each station to sample the depth range fished within the survey grids. Three Brancker® model XR-420

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conductivity-temperature-depth (CTD) and two Brancker® model TR-1000 submersible temperature recorder (STR) data loggers will be deployed daily to obtain temperature data concurrent to snow crab catch per pot data. Temperature data from sampled pots will be recorded on the Pilot House Log after the logger is retrieved and the data are downloaded. All logger deployments will be documented on the **Pilot House Log** (Appendix C1) and the **Male Snow Crab Catch By Subgroup** (Appendix C2) forms.

ACKNOWLEDGEMENTS

We thank Forest Bowers and Mary Schwenzfeier of the Dutch Harbor ADF&G office and David Jackson of the Kodiak office for their editorial help in the completion of this report. We especially thank Lucinda Neel for guiding us through the vagaries of a new reporting format.

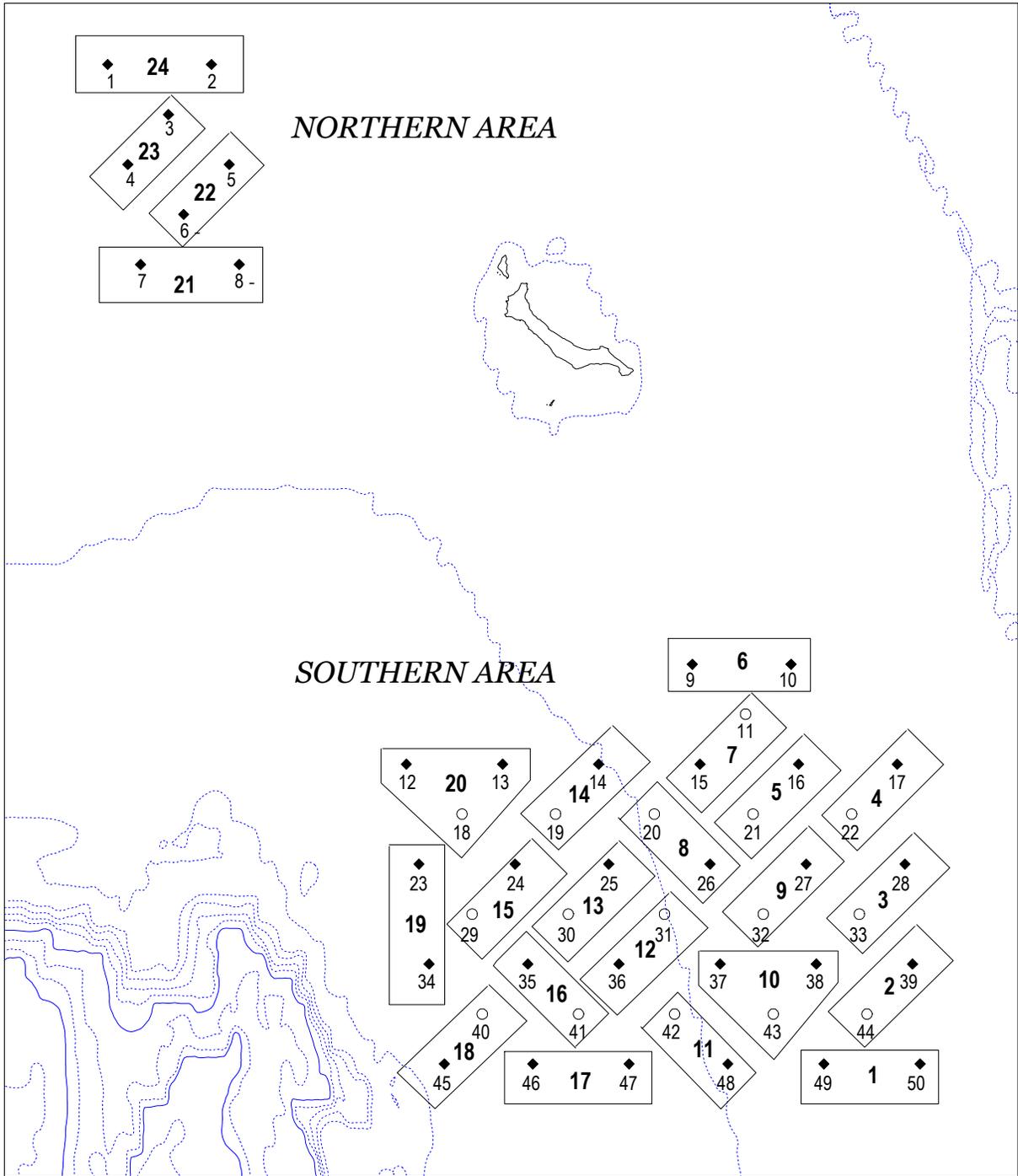
REFERENCES CITED

- Alaska Department of Fish and Game (ADF&G). 2003. Regulations of the Alaska Board of Fisheries for statewide commercial shellfish fishing in Alaska, 2003 – 2005 edition, Juneau, 230 pp.
- Jadamec, L.S., W.E. Donaldson, and P. Cullenberg. 1999. Biological field techniques for Chionoecetes crabs. University of Alaska Sea Grant College Program Report AK-SG-99-02, Fairbanks.
- Wallace, M.M., C.J. Pertuit, and A.R. Hvatum. 1949. Contribution to the biology of the king crab (*Paralithodes camtschatica*) Tilesius. U. S. Department of the Interior, Fish and Wildlife Service, Fishery Leaflet No. 340.

APPENDIX B. SURVEY ITINERARY AND LOCATION

Appendix B1.-Itinerary for the 2005 Bering Sea snow crab tagging survey. -

Day No.	Date	Activity		Stations Set
July				
1	20	Load survey gear; depart 12:00 travel to Southern Area	-	-
2	21	Travel to Southern Area	-	-
3	22	Set Block 1 (sta. 49, 50)	-	2
4	23	Set Block 2 (sta. 39, 44)	Pick Block 1	2
5	24	Set Block 3 (sta. 28, 33)	Pick Block 2	2
6	25	Set Block 4 (sta.17, 22)	Pick Block 3	2
7	26	Set Block 5 (sta. 16, 21)	Pick Block 4	2
8	27	Set Block 6 (sta. 9, 10)	Pick Block 5	2
9	28	Set Block 7(sta.11,15)	Pick Block 6	2
10	29	Set Block 8 (sta. 20,26)	Pick Block 7	2
11	30	Set Block 9 (sta. 27, 32)	Pick Block 8	2
12	31	Set Block 10 (sta. 37, 38, 43)	Pick Block 9	3
August				
13	1	Set Block 11 (sta. 42, 48)	Pick Block 10	2
14	2	Set Block 12 (sta. 31, 36)	Pick Block 11	2
15	3	Set Block 13 (sta. 25, 30)	Pick Block 12	2
16	4	Set Block 14 (sta. 14, 19)	Pick Block 13	2
17	5	Set Block 15 (sta. 24, 29)	Pick Block 14	2
18	6	Set Block 16 (sta. 35, 41)	Pick Block 15	2
19	7	Set Block 17 (sta. 46, 47)	Pick Block 16	2
20	8	Set Block 18 (sta. 40, 45)	Pick Block 17	2
21	9	Set Block 19 (sta. 23, 34))	Pick Block 18	2
22	10	Set Block 20 (sta. 12, 13, 18)	Pick Block 20	3
23	11	Pick Block 20; travel to Northern Area		
24	12	Set Block 21 (sta. 7, 8)	-	2
25	13	Set Block 22 (sta. 5, 6)	Pick Block 21	2
26	14	Set Block 23 (sta. 3, 4)	Pick Block 22	2
27	15	Set Block 24 (sta. 1, 2)	Pick Block 23	2
28	16	Pick Block 24; travel to Dutch Harbor	Pick Block 24	-
29	17	Travel to Dutch Harbor		
30	18	Arrive Dutch Harbor and offload survey gear		



Appendix B2.-Layout of the 24 station blocks to be fished during the 2005 Bering Sea snow crab tagging survey.

Appendix B3.-Midpoint locations of the 42 southern stations to be fished during the 2005 Bering Sea snow crab tagging survey.

Survey Station	Corresponding NMFS Station	N. Latitude		W. Longitude	
		Degrees	Minutes	Degrees	Minutes
9	N23	59	20	171	50
10	N22	59	20	171	11
11	MN22-23	59	10	171	29
12	M26	59	00	173	43
13	M25	59	00	173	5
14	M24	59	00	172	27
15	M23	59	00	171	47
16	M22	59	00	171	08
17	M21	59	00	170	29
18	LM25-26	58	50	173	21
19	LM24-25	58	50	172	44
20	LM23-24	58	50	172	05
21	LM22-23	58	50	171	26
22	LM21-22	58	50	170	47
23	L26	58	40	173	38
24	L25	58	40	173	00
25	L24	58	40	172	23
26	L23	58	40	171	43
27	L22	58	40	171	05
28	L21	58	40	170	26
29	KL25-26	58	30	173	17
30	KL25-26	58	30	172	39
31	KL25-26	58	30	172	01
32	KL25-26	58	30	171	22
33	KL25-26	58	30	170	44
34	K26	58	20	173	34
35	K25	58	20	172	55
36	K24	58	20	172	19
37	K23	58	20	171	39
38	K22	58	20	171	01
39	K21	58	20	170	23
40	JK25-26	58	10	173	13
41	JK25-26	58	10	172	35
42	JK25-26	58	10	171	57
43	JK25-26	58	10	171	18
44	JK25-26	58	10	170	41
45	J26	58	00	173	28
46	J25	58	00	172	53
47	J24	58	00	172	15
48	J23	58	00	171	36
49	J22	58	00	170	58
50	J21	58	00	170	20

Appendix B4.-Midpoint locations of the 8 northern stations to be fished during the 2005 Bering Sea snow crab tagging survey.

Survey Station	Corresponding NMFS Station	N. Latitude		W. Longitude	
		Degrees	Minutes	Degrees	Minutes
1	T28	61	20	175	41
2	T27	61	20	175	00
3	ST27-28	61	10	175	17
4	S28	61	00	175	33
5	S27	61	00	174	53
6	RS27-28	60	50	175	11
7	R28	60	40	175	28
8	R27	60	40	174	49

APPENDIX C. SURVEY DATA FORMS

INSTRUCTIONS FOR PILOT HOUSE LOG

This form is used to record fishing parameters for every pot that is set during the survey. It is the definitive table in the survey database and must be accurately completed. -

STATION – The station number of the pots set as identified from Appendix B2. -

SET GEAR – Record the month, day, and military time (24-hour) the pot is set. -

DEPTH – Record pot depth in fathoms. -

BOTTOM TYPE – Record the bottom type according to vessel echo sounder readings using the codes on the Pilot House Log form. -

SEQUENTIAL POT NUMBER – Enter each sequentially numbered survey pot at the time it is set, beginning with the number 1. Sequential pot numbering will not change if a pot is lost, if it is unbaited or malfunctions in any way.

BUOY NUMBER – Record the buoy number of each pot set. In addition to standard fishing practice, the buoy number is used to identify pots during sampling by the scientific crew on deck. *This field is not entered in the database.*

LIFT GEAR - Record the month, day, and military time (24-hour) the pot is retrieved. If a pot is lost, write 'LOST POT' across this row.

N. LATITUDE AND W. LONGITUDE – Record each pot location at the time it is set, in degrees, minutes and hundredths of minutes, e.g. 59°32.86 N. latitude, 172°57.23' W. longitude.

GEAR PERFORMANCE – Leave blank if pot performance is satisfactory. Record appropriate gear performance codes as noted on the Pilot House Log.

TEMPERATURE – Temperature recorders will be placed in select pots to measure ocean floor temperatures across the depth range of surveyed stations. Temperature data (°C) will be entered in the Pilot House log when recorders are retrieved and downloaded.

INSTRUCTIONS FOR MALE SNOW CRAB CATCH BY SUBGROUP FORM

STATION – The station number of the pots set as identified from Appendix B2.

SEQUENTIAL POT NUMBER – Enter each sequentially numbered survey pot at the time it is set, beginning with the number 1. Sequential pot numbering will not change if a pot is lost, if it is unbaited or malfunctions in any way.

SUBLEGAL – Male crabs <79-mm CW. Count the number in the subsample, if any, and record the total number from the pot.

SMALL LEGAL – Legal male crabs ≥ 79 mm and ≤ 102 -mm CW. Count the number in the subsample, if any, and record the total number from the pot.

LARGE LEGAL – Legal male crabs ≥ 102 -mm CW. Count the number in the subsample, if any, and record the total number from the pot.

NUMBER OF LARGE LEGALS TAGGED – Count and record the number tagged, if any, in the pot.

INSTRUCTIONS FOR FEMALE SNOW CRAB CATCH BY SUBGROUP FORM

STATION – The station number of the pots set as identified from Appendix B2.

SEQUENTIAL POT NUMBER – Enter each sequentially numbered survey pot at the time it is set, beginning with the number 1. Sequential pot numbering will not change if a pot is lost, if it is unbaited or malfunctions in any way.

IMMATURE – Count the number in the subsample, if any, and record the total number from the pot.

MATURE-PRIMIPAROUS – New- and old-shell mature females with no scars on pereiopods. Count the number in the subsample, if any, and record the total number from the pot.

MATURE-MULTIPAROUS – Old-, very old-, and very, very old-shell mature females with scars on pereiopods. Count the number in the subsample, if any, and record the total number from the pot.

Appendix C4.-Male snow crab survey data form. -

SAMPLING DATE: 0 5 ADF&G 2005 BERING SEA MALE SNOW CRAB PG ____ OF ____

SURVEY DATA FORM

STATION NUMBER: SAMPLING FRACTION: MEASURERS: _____

RECORDER: _____

Booy	SEQUENTIAL POT NUMBER		SPECIES	SEX	SIZE (MM)	CHELA HEIGHT (MM)	LEGAL	SIZE CAT.	SHELL	OTHER	SERIES	TAG NUMBER		COMMENTS
	1	2										1	2	
1											N			
2											N			
3											N			
4											N			
5											N			
6											N			
7											N			
8											N			
9											N			
10											N			
11											N			
12											N			
13											N			
14											N			
15											N			
16											N			
17											N			
18											N			
19											N			
20											N			
21											N			
22											N			
23											N			
24											N			
25											N			

[E:\OPI\SHAPE_SHIFT\FORMS.XLS: MALECRABFORM05 6.4.05]

Crab Species	Legal	Size Categories for Legal Crabs	Shell
1-L.aequispinus 7-C.opilio	1-Legal	1-Small	0-soft
2-P.camtschaticus 8-C. angulatus	2-Sublegal	≥79 mm and <102 mm CW	9-new/pliable
3-P.platypus 9-C. magister		2-Large	1-new/hard
4-E.isenbeckii 10-L. couesi	Sex	≥102 mm CW	2-old
5-Tanner hybrid 11-C. tanneri	1-male		3-very old
6-C.bairdi 12-P. multispinus	2-female		4-v. very old
	3-hermaphrodite		
	blank-sex unknown		
			Other
			1-dead
			3-nemertean in clutch
			4-turbellarians in clutch
			5-black mat
			6-bitter crab disease
			7-"cottage cheese" disease
			8-shell disease ('torch'/rust)
			9-B. callosus
			10-snailfish eggs in gills
			11-deformed carapace or gills
			0-leatherback

-continued-

INSTRUCTIONS FOR MALE SNOW CRAB SURVEY DATA FORM

This form is used to record all sampled male snow crabs captured on the survey. Leading zeroes are only used in date entries. Do not record sequential pot numbers for pots that have no crab catch. If a sampled crab is unmeasurable (deformed or broken carapace), pick another crab to sample. Collect, label, and freeze any hermaphroditic crabs for later analysis.

SAMPLING DATE – Enter in dd/mm/yr format on the date pot is pulled.

STATION NUMBER – Same number as recorded on the Pilot House Log.

SAMPLING FRACTION – The numerator is the number of crabs sampled, denominator is the number of crabs caught. Leave blank if no subsampling is done. Ensure that when subsampling, only subsampled crabs are recorded on data sheets that contain a sampling fraction.

BUOY NUMBER – Record the buoy number of each sampled pot. In addition to standard fishing practice, the buoy number is used to confirm pot identity with the vessel captain during sampling. *This field is not entered in the database.*

SEQUENTIAL POT NUMBER – Same number as recorded on the Pilot House Log. -

SPECIES – Enter code **7**. -

SEX – Enter code **1**.

SIZE (MM) – Biological carapace width, measured inside the lateral spines to the nearest 0.1 mm - (e.g., 123.7 mm). -

CHELA HEIGHT (MM) - Measured to the nearest 0.1 mm at the greatest height of the right - chela, excluding spines. -

LEGAL – Legal-sized males: enter code **1**. Sublegal-sized males enter code **2**. -

SIZE CATEGORIES – Record for legal-sized crabs only: -

SMALL - >79 mm and <102 mm CL: enter code **1**.

LARGE - \geq 102 mm CL: enter code **2**.

SHELL – Shell condition (age) – enter codes listed at the bottom of the form. See text for explanation. *Note the addition of code 4 = very, very old-shell.*

OTHER CONDITIONS - Enter codes listed at the bottom of the form; if more than one condition - is noted, record additional conditions in the Comments section.

TAG SERIES and NUMBER – The series letter ‘N’ has been preprinted, enter the 1-to-5 digit tag - number. Only ‘large’ legal-sized males will be tagged. -

INSTRUCTIONS FOR FEMALE SNOW CRAB SURVEY DATA FORM

This form is used to record all sampled female snow crabs captured on the survey. Leading zeroes are only used in date entries. Do not record sequential pot numbers for pots that have no crab catch. If a sampled crab is unmeasurable (deformed or broken carapace), pick another crab to sample. Collect, label, and freeze any hermaphroditic crabs for later analysis.

SAMPLING DATE – Enter in dd/mm/yr format on the date pot is pulled.

STATION NUMBER – Same number as recorded on the Pilot House Log.

SAMPLING FRACTION – The numerator is the number of crabs sampled, denominator is the number of crabs caught. Leave blank if no subsampling is done. Ensure that when subsampling, only subsampled crabs are recorded on data sheets that contain a sampling fraction.

BUOY NUMBER – Record the buoy number of each sampled pot. In addition to standard fishing practice, the buoy number is used to confirm pot identity with the vessel captain during sampling. *This field is not entered in the database.*

SEQUENTIAL POT NUMBER – Same number as recorded on the Pilot House Log. -

SPECIES – Enter code **7**. -

SEX – Enter code **2**.

SIZE (MM) – Biological carapace width, inside the lateral spines to the nearest 0.1 mm - (e.g., 123.7 mm). -

MATURITY – Immature females: enter code **3**. Mature females; enter code **4**. -

MATURITY CATEGORY – Record for mature females only: -

PRIMIPAROUS – Enter code **1**.

MULTIPAROUS – Enter code **2**.

SHELL – Shell condition (age) – enter codes listed at the bottom of the form. See text for explanation. *Note the addition of code 4 = very, very old-shell.*

EMBRYOS - Enter codes listed at the bottom of the form. -

OTHER CONDITIONS - Enter codes listed at the bottom of the form; if more than one condition - is noted, record additional conditions in the Comments section.

INSTRUCTIONS FOR 'OTHER' CRAB SURVEY DATA FORM

This form is used to record all sampled blue, golden, and red king crabs, hair, and Tanner crabs captured on the survey. Leading zeroes are only used in date entries. Do not record sequential pot numbers for pots that have no crab catch. Generally, all of these species will be sampled. Collect, label, and freeze any hermaphroditic crabs or in the case of blue king crabs, those with snailfish egg infestations in the branchial chambers for later analysis.

SAMPLING DATE – Enter in dd/mm/yr format on the date pot is pulled.

STATION NUMBER – Same number as recorded on the Pilot House Log.

SAMPLING FRACTION – The numerator is the number of crabs sampled, denominator is the number of crabs caught. Leave blank if no subsampling is done. Ensure that when subsampling, only subsampled crabs are recorded on data sheets that contain a sampling fraction.

BUOY NUMBER – Record the buoy number of each sampled pot. In addition to standard fishing practice, the buoy number is used to confirm pot identity with the vessel captain during sampling. *This field is not entered in the database.*

SEQUENTIAL POT NUMBER – Same number as recorded on the Pilot House Log. -

SPECIES – Enter the 1 or 2 digit code from the codes listed at the bottom of the form. -

SEX – Enter codes listed at the bottom of the form; leave blank if unknown.

SIZE (MM) – Biological carapace length (lithodid and hair crabs) or carapace width - (*Chionoecetes* and *Dungeness* crabs). -

LEGAL – Record codes as follows: **1** = legal-sized crab [male blue king (5.5”), hair (3.25”), - Tanner (5.5”)]; **2** = sublegal-sized crab; **3**= immature female; **4** = mature female. -

SHELL – Shell condition (age) – enter codes listed at the bottom of the form. See text for - explanation. *Note the addition of code 4 = very, very old-shell.*

EMBRYOS - Enter codes listed at the bottom of the form. -

OTHER CONDITIONS - Enter codes listed at the bottom of the form; if more than one condition - is noted, record additional conditions in the Comments section.

APPENDIX D. EQUIPMENT LIST

Appendix D1.-Equipment list. -

EQUIPMENT FOR EACH ADFG CREWMEMBER

1. Survival suit with attached EPIRB, strobe and water-activated light
2. Rain gear, boots, gloves
3. Stormy Seas jacket
4. SOSpenders

DECK AND SAMPLING EQUIPMENT

1. One 4'x8' aluminum sorting table with 6 stands
2. (12) thin, 3" hex head bolts and appropriate sized socket wrench for table assembly
3. (4) regular size clipboards
4. (4) covered clipboards (aluminum or plastic)
5. (6) pair calipers, large size with millimeter scale
6. (2) 5.5" measuring sticks; (2) 3.1"; 2 4.0"; (1) 6.5"
7. (3) tape measures – in cms (halibut and other fish)
8. (1) fish measuring board
9. (2) cans WD-40
10. (4) dump totes
11. (15) fish baskets
12. (4) plastic Rubbermaid dishpans
13. Assorted plastic bags: gallon & quart zip-locks
14. (10) rolls electric tape
15. (1) liters of 100% formalin w/ mixing jar
16. (1) gallon alcohol
17. (10) specimen jars
18. (1 or 2?) dissecting kit
19. (6) Victorinox knives
20. Plastic toolbox for crab sampling equipment
21. (2 or 3?) assorted magnifying glasses
22. (2) rolls biodegradable cotton twine
23. 5 lbs #96 tarred seine twine
24. 5 lbs 5mm poly orange twine

TAGGING SUPPLIES

1. 15,000 Floy tags-(New series 'N' 00,001 – 'N' 15,000)
2. Tagging needles & sharpening file
3. (10) tagging rods

FORMS

1. 40 pilot house log forms
2. 40 male snow crab catch by subgroup forms
3. 40 female snow crab catch by subgroup forms
4. 4000 male snow crab survey data forms (rite-in-rain paper)
5. 1500 female snow crab survey data forms (rite-in-rain paper)
6. 1000 'other' crab survey data forms (rite-in-rain paper)
7. 150 species composition forms (rite-in-rain paper)
8. 5 temperature recorder set-up forms

-continued-

CHARTS AND BOOKS

1. 2003-2005 Commercial Shellfish Fishing Regulations (1; Watson)
2. 2005 NMFS Species Codebook (1; Watson)
3. 2004 NMFS EBS survey report (1; Watson)
4. Ranked species list for NMFS 2003 EBS trawl survey (1; Watson)
5. Checklist of Alaskan Crabs, Stevens 2002 (1; Watson)
6. Review of the Family Lithodidae, Zaklan 2002 (1; Watson)
7. Biological Field Techniques for Chionoecetes Crabs, Jadamec et al. 1999 (1; Watson)
8. Laminated shell age guide for *P. platypus* (1; Dutch Harbor)
9. Laminated NMFS clutch fullness guide for *C. opilio* (1; Gravel)
10. Laminated EZ Lookup table for male snow crab (3; Gravel)
11. Alaska Saltwater Fishes and Other Sea Life, Kessler 1985 (2; Dutch Harbor)
12. Under Alaskan Seas, Barr and Barr 1983 (2; Dutch Harbor)
13. NMFS Invert guide *Eastern Bering Sea*, Clark (undated) (1; Watson)
14. Guide to the Identification of some Common eastern Bering Sea Snails, MacIntosh 1976 (1; Watson)
15. Pribilof Field Guide, Byersdorfer 2004 (1; Dutch Harbor)
16. Illustrated Key to west North American Pelecypod genera, Keen & Frizzel 1946 (1; Watson)
17. Illustrated Key to west North American Gastropod genera, Keen & Pearson 1952 (1; Watson)
18. Names of Decapod Crustaceans AFS #17, Williams et al. 1989 (1; Watson)
19. Names of Mollusks AFS #16, Turgeon et al. 1988 (1; Watson)
20. Pacific Fishes of Canada, Hart 1973 (1; Watson)
21. Fishes of Alaska, Mecklenburg et al. date (1; Dutch Harbor)
22. Guide to northeast Pacific Flatfishes, Kramer et al. 1995 (1; Watson)
23. Guide to northeast Pacific Rockfishes, Kramer & O'Connell 1986 (1; Watson)
24. A Field Guide to Alaskan Corals, Wing and Barnard 2004 (1; Gravel)

OFFICE AND MISC. SUPPLIES

1. (2) crew leader notebooks (3-ring binders)
2. (2) calculators
3. (10) mechanical pencils
4. Pkg. Number 2 regular pencils
5. (5) ink pens
6. Permanent markers
7. Highlighting markers
8. (100) sheets plain paper
9. (50) sheets Rite-in-Rain paper
10. (4) rite-in-rain field notebooks
11. (20) earplugs
12. 3-ring hole punch
13. Ass't. rubber bands (large for clipboards)
14. (1) roll Scotch & (2) rolls duct tape
15. Ass't. paper & binder clips
16. (15) envelopes (data form filing)
17. North Star medical kit (updated)
18. (1) 25-ft power cord

-continued-

COMPUTERS, CAMERAS, AND PERIPHERALS

1. - (2) notebook computers with power cords
2. - (2) Buss bars
3. - (5) zip disks
4. - Olympus digital camera
 - computer hookup cable
 - (2) 128 mg cards
 - charger and rechargeable batteries (type?)

TEMPERATURE RECORDERS

Conductivity-Temperature-Depth Recorders (CTDs) Brancker Model XR-420 (large, titanium housing)

1. - Three units:
 - S/N 9616
 - S/N 9641
 - S/N 9643
2. - (2) RS232 cables (telephone plug on one end, serial port connector on the other end)
3. - (1) software disk (version 4.10 or 4.18)
4. - (1) operations manual
5. - (3) fresh sets of batteries: each CTD uses four (4), 3V lithium cells (e.g. Energizer EL123A, Duracell DL123A)

Submersible Temperature Recorders (STRs) Brancker Model TR-1000 (small, yellow housing)

STRs will be programmed in Kodiak by R. Shepard prior to deployment on the 2005 survey. The programming software for the STRs uses Windows95; that version is not compatible with the survey laptops therefore these recorders cannot be programmed or downloaded at sea.

1. - Two units:
 - S/N 7209
 - S/N 8429
 2. - (2) fresh sets of batteries: each STR uses one (1) "D" cell
-

**APPENDIX E. MALE SNOW CRAB CARAPACE WIDTH-
CHELA HEIGHT RELATIONSHIP**

Appendix E1.-Paired chela height (CH) and chela width (CW) values for determining maturity of male snow crabs. (Source: Otto 1998 and J. Zheng, pers. comm. 1992)

Carapace Width ^a (mm CW)	Chela Height (mm CH)	Carapace Width (mm CW)	Chela Height (mm CH)	Carapace Width (mm CW)	Chela Height (mm CH)
40	6.7	80	16.3	120	27.5
41	6.9	81	16.5	121	27.8
42	7.1	82	16.8	122	28.0
43	7.3	83	17.1	123	28.3
44	7.5	84	17.3	124	28.6
45	7.7	85	17.6	125	28.9
46	8.0	86	17.9	126	29.2
47	8.2	87	18.1	127	29.5
48	8.4	88	18.4	128	29.8
49	8.6	89	18.7	129	30.1
50	8.9	90	18.9	130	30.4
51	9.1	91	19.2	131	30.7
52	9.3	92	19.5	132	31.0
53	9.6	93	19.8	133	31.4
54	9.8	94	20.0	134	31.7
55	10.0	95	20.3	135	32.0
56	10.3	96	20.6	136	32.3
57	10.5	97	20.9	137	32.6
58	10.7	98	21.1	138	32.9
59	11.0	99	21.4	139	33.2
60	11.2	100	21.7	140	33.5
61	11.5	101	22.0	141	33.8
62	11.7	102	22.3	142	34.1
63	12.0	103	22.5	143	34.4
64	12.2	104	22.8	144	34.7
65	12.5	105	23.1	145	35.0
66	12.7	106	23.4	146	35.4
67	12.9	107	23.7	147	35.7
68	13.2	108	24.0	148	36.0
69	13.4	109	24.3	149	36.3
70	13.7	110	24.5	150	36.6
71	14.0	111	24.8		
72	14.2	112	25.1		
73	14.5	113	25.4		
74	14.7	114	25.7		
75	15.0	115	26.0		
76	15.2	116	26.3		
77	15.5	117	26.6		
78	15.8	118	26.9		
79	16.0	119	27.2		

^a For a given carapace width, a mature male crab will have a corresponding chela height value greater than the reference value; an immature male crab will have a lower chela height value.

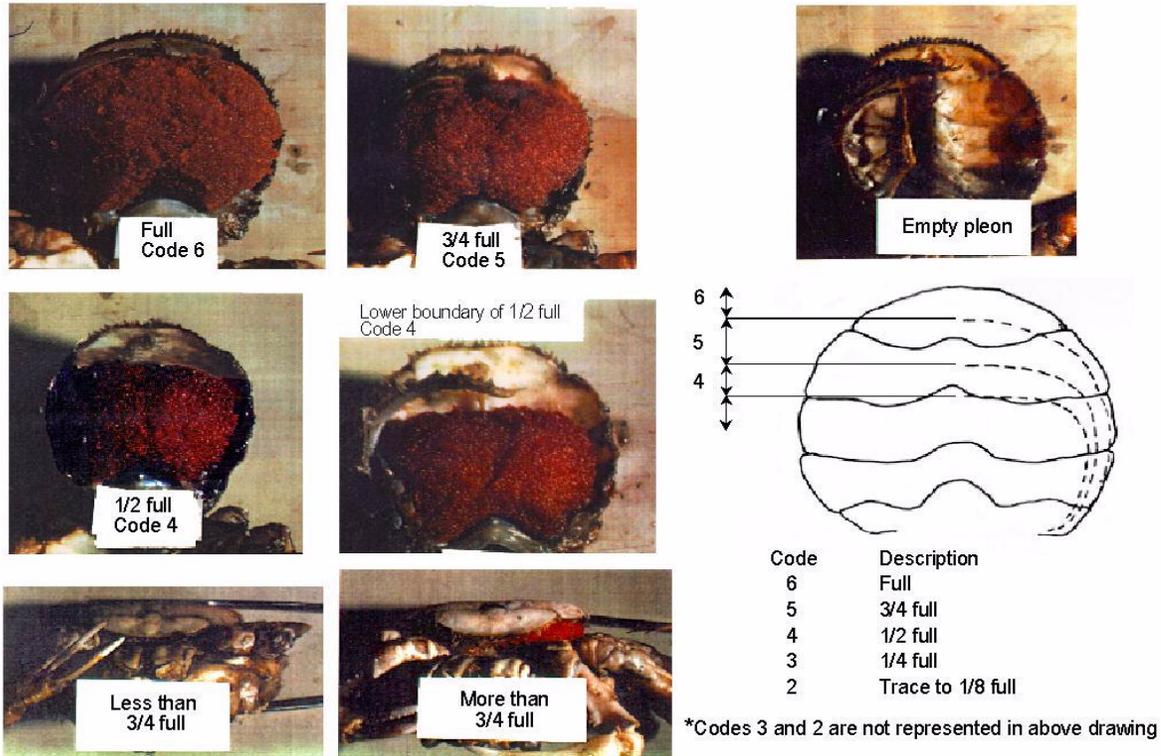
EZLOOK-UP TABLE											
CW ^a	CH	CW	CH	CW	CH	CW	CH	CW	CH	CW	CH
40	7	60	12	80	17	100	22	120	28	140	34
45	8	65	13	85	18	105	24	125	29	145	36
50	9	70	14	90	19	110	25	130	31	150	37
55	11	75	15	95	21	115	26	135	32		

^a Carapace width in 5-mm groupings; chela height rounded to the nearest 1 mm.

**APPENDIX F. SNOW AND KING CRAB CLUTCH FULLNESS
CATEGORIES**

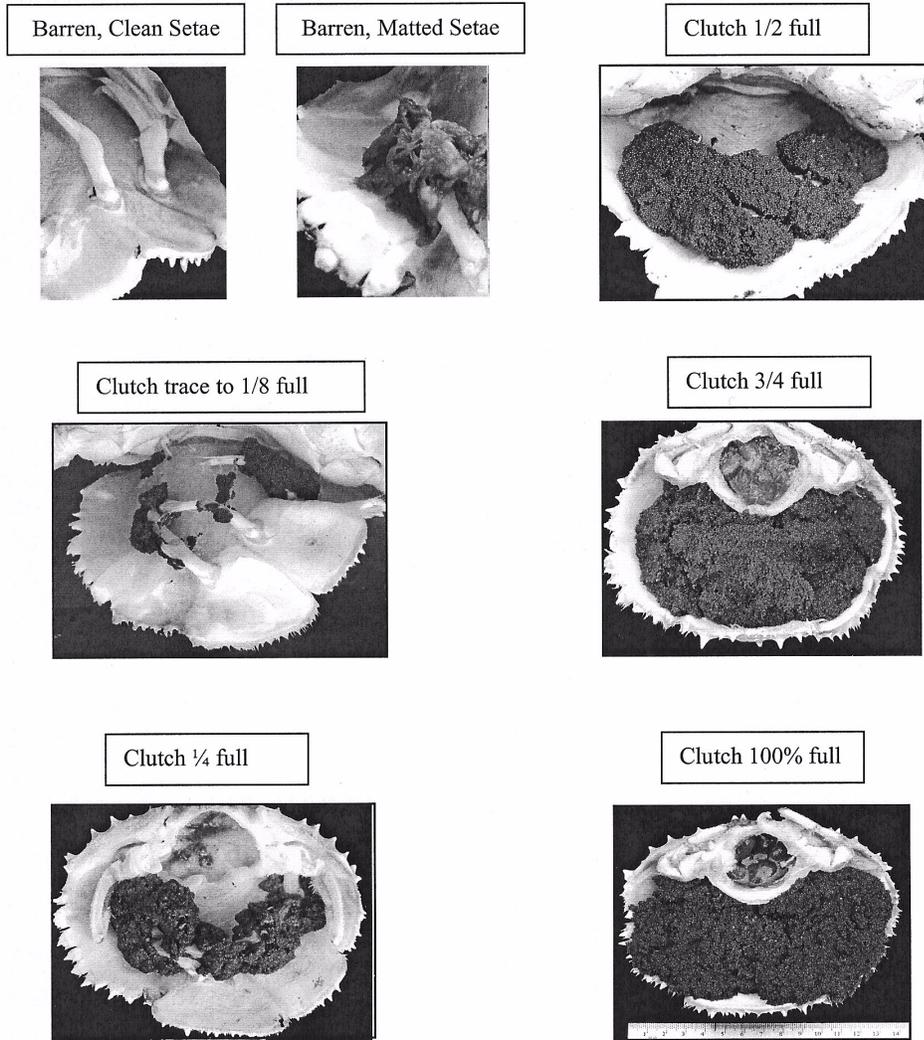
Appendix F1.-Snow Crab Clutch Fullness Categories. (Source: K. Gravel, ADF&G – Kodiak, pers. comm.)

NMFS clutch size codes - *Chionoecetes*



Code	Clutch Description
0	Barren, clean setae. No eggs or empty egg cases. Immature female.
1	Barren, matted setae. Empty egg cases present. Mature female.
2	Trace to 1/8 full.
3	Clutch 1/4 full.
4	Clutch 1/2 full.
5	Clutch 3/4 full.
6	Clutch 100% full.

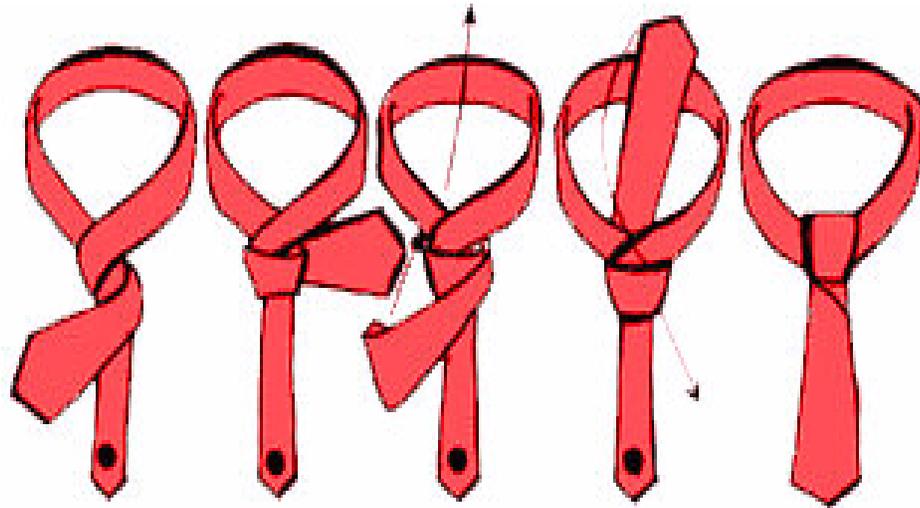
Appendix F2.-King Crab Clutch Fullness Categories. (Source: S. Byersdorfer, ADF&G-Kodiak, pers. comm.)



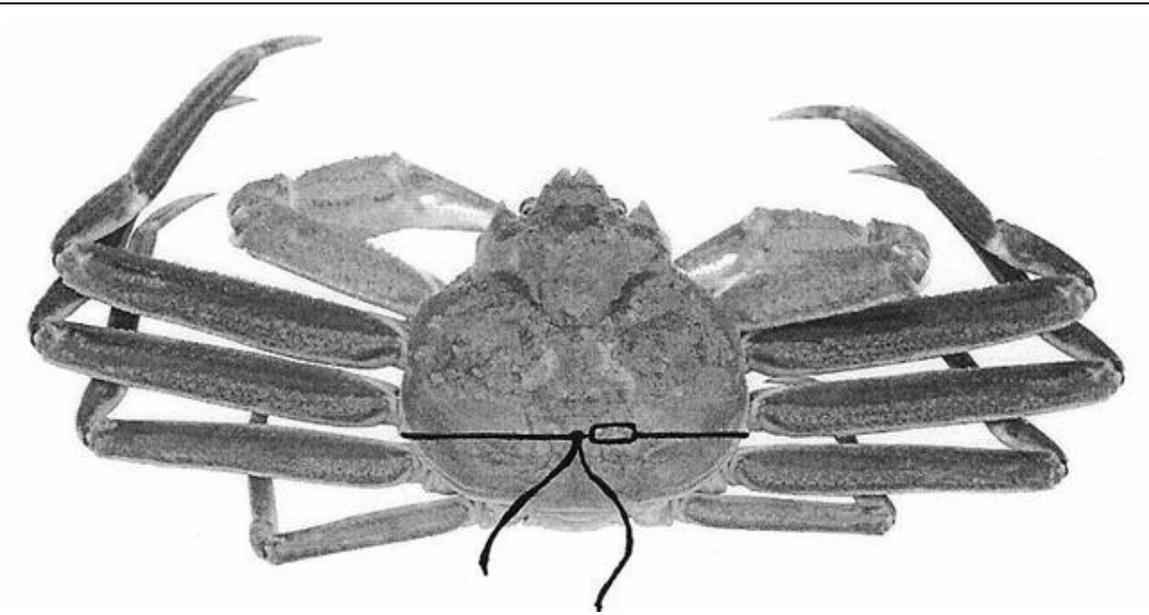
Code	Clutch Description
0	Barren, clean setae. No eggs or empty egg cases. Immature female. -
1	Barren, matted setae. Empty egg cases present. - Mature female.
2	Trace to 1/8 full.
3	Clutch 1/4 full.
4	Clutch 1/2 full.
5	Clutch 3/4 full.
6	Clutch 100% full.

**APPENDIX G. MALE SNOW CRAB TAGGING KNOT AND
PLACEMENT**

Appendix G1.-Diagram depicting the method of tying a double knot for tagging male snow crabs during the 2005 Bering Sea snow crab tagging survey. (Source: <http://www.jules.fr/vetements-homme/cravate/noeud-double-cravate.html>).



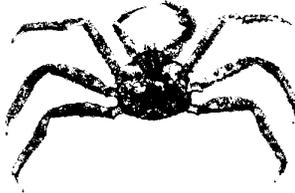
Appendix G2.-Placement of the tag and tab on the dorsal surface of a male snow crab. -



**APPENDIX H. 2005/2006 BERING SEA MALE SNOW CRAB
TAG RECOVERY PROGRAM**

Appendix H1.-News release for the 2005/2006 Bering Sea snow crab tag recovery and reward program.

ALASKA DEPARTMENT OF FISH AND GAME
COMMERCIAL FISHERIES
NEWS RELEASE



McKie Campbell, Commissioner
Denby S. Lloyd, Director
Division of Commercial Fisheries
Juneau



Contact: Ryan Burt, Rachel Alinsunurin
Fishery Biologists
Dutch Harbor

Westward Region
211 Mission Road
Kodiak, AK 99615

Phone: (907) 581-1239
Fax: (907) 581-1572

Date: September 21, 2005

2005 BERING SEA SNOW CRAB TAG RECOVERY EFFORT

The Alaska Department of Fish and Game (ADF&G) is asking for help in the recovery of tagged male snow crabs. All vessel crews should look for tagged crabs while sorting the catch during the 2005 Bering Sea snow crab commercial fishery.

During the summer of 2005, approximately 8,500 male snow crabs were tagged. The documentation of re-captured tagged crabs during the commercial fishery provides ADF&G with information on the biology, relative abundance and migration patterns of the snow crab population. The tags are fluorescent pink and each has a tab with a 5-digit tag number printed on one side and the inscription "LEAVE TAG ON CRAB - NOTIFY ADF&G" printed on the other side. Please do not remove the tag from any crab.

If you are carrying an observer, notify him/her immediately so that the crab can be sampled. Unless otherwise instructed by the vessel captain, the observer will credit the tag reward to the individual who presents the tagged crab to him/her for sampling.

If you are **not** carrying an observer, please use the attached tag recovery form to document capture information. At the top of the form, record the skipper and vessel name and vessel ADF&G number. For each tagged crab encountered, record the tag number, sex, legal status (for males only), fate, capture date, location, depth and statistical area. At the time of offload, please notify ADF&G personnel if you have any tagged crab recovery information or if there are any legal-sized tagged crab in the hold so they can be sampled.

Appendix H1.-(page 2 of 3) -

Please forward all tags and/or tagged crab recapture information not collected by observers or ADF&G personnel to the Dutch Harbor office:

Ryan Burt -or- Rachel Alinsunurin
Alaska Department of Fish and Game
P.O. Box 920587
Dutch Harbor, AK 99692
Phone: (907) 581-1239
Fax: (907) 581-1572
Email: ryan_burt@fishgame.state.ak.us
-or-
rachel_alinsunurin@fishgame.state.ak.us

Thank you for your participation in the tag recovery program.

- end -

2005 Bering Sea Snow Crab Tag Recovery Form

Skipper Name: _____ Vessel Name: _____ ADF&G Number: _____

Capture Information

	Tag Letter	Tag Number	Fate	Capture Date (mm/dd/yy)	N Latitude (dd°mm.mm)	W Longitude (ddd°mm.mm)	Depth (fathoms)	Statistical Area
1	N							
2	N							
3	N							
4	N							
5	N							
6	N							
7	N							
8	N							
9	N							
10	N							

<p align="center">Fate</p> <p>1 = Retained for sale</p> <p>2 = Released alive</p>
--

Reward Information

	Name	Address	Phone Number
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Appendix H2.-2005 Bering Sea tagged snow crab recovery instructions for shellfish observers.

Introduction

ADF&G has completed a 28 day tagging survey of legal, morphometrically-mature (large-clawed), male snow crab in two areas of the Bering Sea onboard the F/V *Bella K*. The two sampling areas were based on historic geographic distribution of legal males, high densities during the NMFS annual trawl survey, and the highest catch per unit effort (CPUE) in recent fisheries. The sampling areas were northwest of the Pribilof Islands and northwest of St. Matthew Island. This survey was conducted between July 20 and August 16 of this year, during which approximately 8,500 morphometrically-mature legal males were tagged and released. Onboard observers are the primary means of recovering tagged crabs from this survey. Observers have the unique opportunity to monitor pot catches for tagged crabs. This data is necessary for estimation of the fishing mortality of legal males, and enhances existing information on distribution, shell condition classification and survivorship of snow crabs that to-date, remains poorly understood.

The tags used during the 2005 survey are fluorescent pink. Each tag has a tab labeled with the letter ‘N’ followed by a 5-digit tag number. Printed on the other side of this tab is the inscription “**LEAVE TAG ON CRAB - NOTIFY ADF&G**”. Tags should be easily visible as they are looped between the 2nd and 3rd walking legs (3rd and 4th pereiopods) on the left and right lateral margins.

General Instructions

A news release has been issued to Bering Sea fishermen requesting their help in the recovery of tagged crabs. Observers assigned to floating processors should ask for forms and recovered tags from captains and crews of all delivering catcher vessels. Observers assigned to catcher-processors should inform the captain, crew, and processing workers to be on the look-out for tagged crabs, and to set them aside and immediately contact

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the observer so that (s)he may sample the crab(s). Stress to the captain, crew, and processing personnel that the crabs should not be damaged or processed, and that the tags should be left on the crabs until the observer samples them. If you are given a tag with no other recovery information, note that fact on the recovery form and record the fate of the crab as dead. After tagged crab sampling has been completed, crabs will be returned as follows:

Legal male snow crabs will be returned to the processing line after all required data is recorded and the tag has been removed.

All tagged crab recoveries should be fully documented as shown on the attached two-page form. All tags and tag recovery forms, including those collected from vessel captains should be returned to ADF&G in Dutch Harbor at the time of your debriefing.

Tag Reward Program

Tags and tagged crabs may come from the observer, vessel crews, captains, or processing workers whereas recovery information may only come from the observer or the captain or his relief skipper. Tag reward decks of cards will be given to individuals who present either a tagged crab or a tag to the observer. Tag rewards will be issued by observers and provided to them during briefings. If unavailable at the time tags are returned, rewards will be given directly or mailed to the tag finder at a later date. Be sure to credit tag returns appropriately.

**Observer and dockside sampler instructions for completing the ADF&G Westward
Region Tagged Crab Recovery Form**

SIDE 1: Tag Recovery Information

SPECIES: Snow crab.

FISHERY CODE: QO06.

OBSERVER/DOCKSIDE SAMPLER: Your name.

SEQUENTIAL POT NUMBER: For observer use only. Record the sequential pot number when tagged crabs are recovered from pots selected for **Bycatch sampling** (Do not record sequential pot numbers for tagged crabs recovered during any other type of sampling). If tagged crabs are found within the 600-crab Legal tally, note this fact in the 'Comments' section on Side 2 of this form.

FLOY TAG SERIES & NUMBER: See tag description above. **2005** tags are fluorescent pink with a fluorescent green tab, and are imprinted with the tag series 'N' followed by a 5-digit number. Accordingly, please be sure to attach tags to the form even if you can't read the tag number.

SIZE: Record the carapace width in millimeters (mm). Measure the crab twice before recording, as any size information is extremely important, and 1-2 mm variation in measurement due to sampling error is relatively common.

LEGAL: Identify measured male crabs as either 1=sublegal, or 2=legal. Legal crabs are 3.1" (79 mm) or greater in carapace width outside the spines.

SEX: Male=1, Female=2.

SHELL: Soft=0; 9=New-Pliable; New=1; Old=2; Very Old=3.

FATE: 1=Retained for sale; 2=Released alive; 3=Dead (not retained for sale; e.g., found in the deadloss pile or frozen for ADF&G/Observer sampling, etc.).

CAPTURE DATE: Use month-day-year format.

CAPTURE LOCATION: Latitude and longitude coordinates from the captain, in degrees and minutes, with minutes to the hundredths (convert seconds to hundredths of minutes). If lat/long information is not available, write "N/A" across the lat/long data columns.
Note E/W longitude.

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DEPTH: In fathoms.

STATISTICAL AREA: Determine from statistical area charts unless identified as capture location by captain in absence of lat/long coordinates.

ADF&G VESSEL NUMBER: The ADF&G number of the vessel that landed the tagged crab.

RECEIVED TAG OR TAGGED CRAB FROM: Record full name, address and phone number of the individual who gave you the tag or tagged crab. Check the “Needs reward” box. When the reward has been given to the tag finder, check the “issued” box.

RECEIVED RECOVERY LOCATION DATA FROM: Record full name, address and phone number.

VESSEL NAME: The vessel that landed the tagged crab.

PROCESSOR NAME: The processor the tagged crab was delivered to.

SAMPLING DATE: Date the tag or tagged crab was received and/or sampled.

SIDE 2: Female Reproductive Data and Comments Section

Use this side of the tag recovery form to record female reproductive data and general comments on tagged crabs. Refer to codes on the bottom of the form for appropriate assignment of embryo color and development, clutch condition and percent clutch fullness, disease/parasites, etc. Record males with shell rust, *B. callosus*, or ‘leatherback’ condition in the ‘Other’ column. If male crabs have more than one ‘Other’ code, record the additional codes in the ‘Comments’ section. **For shellfish observers only:** Record sequential pot number. Remember that codes used for clutch condition, percent clutch, and ‘Other’ categories are different than those used on the Crab and Fish Measurement form. If tagged crabs are found within the 600-crab Legal tally, note this fact in the ‘Comments’ section.

ADF&G WESTWARD REGION TAGGED CRAB RECOVERY FORM

SPECIES -----

FISHERY CODE -----

OBSERVER/ -----
DOCKSIDE SAMPLER

SEQ. POT.NO.	FLOY TAG SERIES & NUMBER	SIZE (mm)		LEGAL	SEX	SHELL	FATE	CAPTURE DATE			CAPTURE LOCATION (Note E longitude if applicable)				DEPTH (FM)	STATISTICAL AREA	ADF&G VESSEL NO.
		KING - CL	TANNER - CW					MO.	DAY	YEAR	N LATITUDE		W LONGITUDE				
		(a)	(b)					(c)	(d)								
1																	
2																	
3																	
4																	
5																	

(a) **LEGAL**: 1=Sublegal; 2=Legal. (b) **SEX**: 1=Male; 2=Female. (c) **SHELL AGE**: 0=Soft; 9=new-pliable; 1=New; 2=Old; 3= Very Old.
 (d) **FATE**: 1=Retained for sale; 2=Released alive; 3=Dead (legal male deadloss; or tag received only because sublegal male/female inadvertently retained).
NOTE: If a tagged female crab, record additional information on the back of this form. Record comments for males and females on the back of this form.

	Received Tag or Tagged Crab From: Name, Address & Phone	Received Recovery Location Data From: Name, Address & Phone	Vessel Name	Processor Name	Sampling Date		
					Mo.	Day	Year
1	Need reward <input type="checkbox"/> Issued <input type="checkbox"/>						
2	Need reward <input type="checkbox"/> Issued <input type="checkbox"/>						
3	Need reward <input type="checkbox"/> Issued <input type="checkbox"/>						
4	Need reward <input type="checkbox"/> Issued <input type="checkbox"/>						
5	Need reward <input type="checkbox"/> Issued <input type="checkbox"/>						

Edited by: _____ Date: _____ Entered by: _____ Date: _____ source: shellfish research 06/00

ADF&G WESTWARD REGION TAGGED CRAB RECOVERY FORM
(REVERSE SIDE)

* SEQ. POT NO.	EMBRYOS				OTHER	COMMENTS
	COLOR	DEVELOPMENT	CONDITION	% CLUTCH		
1						
2						
3						
4						
5						

LIVE EMBRYO COLOR

- 1-Tan
- 2-Purple
- 3-Brown
- 4-Orange
- 5-Purple-brown
- 6-Pink
- 7-Reddish
- 0-Other; describe in Comments.

EMBRYO DEVELOPMENT

- 1-Uneyed
 - 2-Eyed
- CLUTCH CONDITION**
- 1-Dead embryos not apparent
 - 2-Dead embryos <20 %
 - 3-Dead embryos >20%

PERCENT CLUTCH

- 1-Barren, clean pleopods
- 2-Barren, with empty embryo cases and/or stalks
- 3-Clutch 1-29% full
- 4-Clutch 30-59% full
- 5-Clutch 60-89% full
- 6-Clutch 90-100% full

OTHER

- 3-Nemertean in clutch
- 4-Turbellarians in clutch
- 5-Black mat syndrome
- 6-Bitter crab syndrome
- 7-"Cottage cheese" disease
- 8-Shell rust
- 9-*Briarosaccus callosus* (sac-like parasitic barnacle on king crab abdomens)
- 0-Leatherback: male brown king crab w/soft carapace & is old or very old shell

SPECIES	CHANGES IN EMBRYO COLOR		COMMENTS
	UNEYED	EYED-WELL DEVELOPED	
Red King	purple brown/tan	reddish-purple brown/grayish	
Blue King	purple	pinkish-red	
Golden (brown) king	light orange	tan	
Tanner (<i>C. bairdi</i>)	bright orange	dull colored; orange, brown-tan, orange-purple	
Snow (<i>C. opilio</i>)	bright orange	dull colored; orange, brown-tan, orange-purple	

source: shellfish research 06/00