UNITED STATES DEPARTMENT OF COMMERCE
Office of the Under Secretary for Oceans and Atmosphere
Washington, D.C. 20230

DEC - 6 2000

To All Interested Government Agencies and Public Groups:

Under the National Environmental Policy Act, an environmental review has been performed on the following action.

TITLE: Amendment 15 to the Fishery Management Plan for the King and Tanner Crab Fisheries of the Bering Sea and Aleutian Islands

LOCATION: Federal Waters of the Bering Sea and Aleutian Islands

SUMMARY: Amendment 15 is a rebuilding plan for the St. Matthew stock of blue king crab (Paralithodes platypus). On October 8, 1999, the stock was deemed overfished because the spawning stock was below the minimum stock size threshold established for this stock. The Magnuson-Stevens Fishery Conservation and Management Act requires a rebuilding plan to be prepared within 1 year from October 8, 1999. The North Pacific Fishery Management Council adopted this rebuilding plan, which has components of harvest strategy, bycatch controls, and habitat protection. The actions in this amendment are expected to allow the St. Matthew crab stock to rebuild with a 50% probability in 10 years.

RESPONSIBLE OFFICIAL:
James W. Balsiger
Administrator
Alaska Region
National Marine Fisheries Service
P.O. Box 21668
Juneau, AK 99802
Phone: 907-586-7221

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, Maryland 20910

NOV 29 2000

MEMORANDUM FOR: Susan B. Fruchter
NEPA Coordinator

FROM: for Penelope D. Dalton

SUBJECT: Transmittal of the Environmental Assessment for Amendment 15 to the Fishery Management Plan for King and Tanner Crab Fisheries of the Bering Sea and Aleutian Islands--DECISION MEMORANDUM

Based on the subject environmental assessment, I have determined that no significant environmental impacts will result from the proposed action. I request your concurrence in this determination by signing below. Please return this memorandum for our files.

1. I concur. Susan Fruchter 12/5/00
Date

2. I do not concur. ______________________
Date

Attachments

The environmental review process led us to conclude that this action will not have a significant impact on the environment. Therefore, an environmental impact statement was not prepared. A copy of the finding of no significant impact, including the environmental assessment, is enclosed for your information. Also, please send one copy of your comment to me in Room 5805, SP, U.S. Department of Commerce, Washington, D.C. 20230.

Sincerely,

Susan B. Fruchter

Susan B. Fruchter
NEPA Coordinator

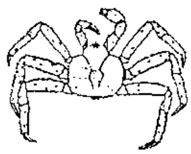
Enclosure

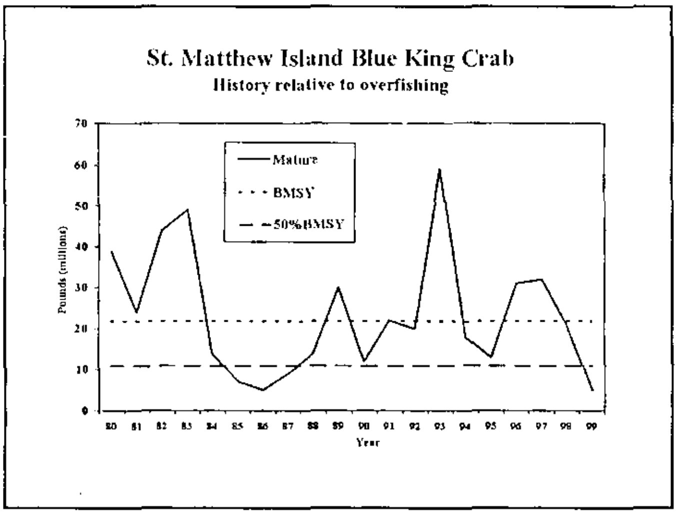
11-29-00 EA KTC 15

11/2000 73pp

ENVIRONMENTAL ASSESSMENT
for proposed
AMENDMENT 15
to the Fishery Management Plan for the
King and Tanner Crab Fisheries in the Bering Sea/Aleutian Islands

A Rebuilding Plan for the St. Matthew Blue King Crab Stock





Prepared by staff of the
North Pacific Fishery Management Council
Alaska Department of Fish and Game
National Marine Fisheries Service

November 2000

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Executive Summary

The 1999 NMFS Bering Sea survey indicated that the St. Matthew blue king crab (Paralithodes platypus) stock was below the minimum stock size threshold (MSST) established for this stock. The stock declined sharply from 1998 to 1999 and the current estimate of spawning biomass (4.8 million pounds) is considerably below the MSST (11.0 million pounds). Consequently no fishery was allowed in 1999, although the causes of the decline are environmental and not attributed to fishing. On September 24, 1999, NMFS informed the Council that this stocks was declared "overfished" pursuant to the Magnuson Act guidelines, which require a rebuilding plan to be developed within one year. This Environmental Assessment (EA) addresses alternatives for rebuilding the overfished St. Matthew blue king crab stock. The alternatives examined were the following:

Alternative 1: Status Quo. No rebuilding plan would be adopted for St. Matthew blue king crab.

Alternative 2: **(preferred)** Establish a rebuilding plan for St. Matthew blue king crab. The rebuilding plan may have three components: a harvest strategy, bycatch control measures, and habitat protection. Note that more than one option can be adopted for each component.

A. Harvest Strategy: In previous years when there was a directed fishery, harvest rates for St. Matthew blue king crab were established at 20% of the mature male abundance. This harvest strategy could be modified to reduce mortality on legal males.

Option 1: Status quo. Continue to establish harvest rates for St. Matthew blue king crab at 20% of the mature male abundance.

Option 2: **(preferred)** Adopt the Alaska Board of Fisheries new harvest strategy for St. Matthew blue king crab. The strategy, as detailed in Section 5.1 includes lower harvest rates at low biomass levels, and incorporates a threshold biomass.

B. Bycatch Controls: The main source of bycatch is the bycatch of females and sublegal males in the directed blue king crab fishery.

Option 1: Status quo. Maintain existing management regime.

Option 2: **(preferred)** Adopt the Board of Fisheries gear modifications measures and area closure (Figure 13) to reduce bycatch of blue king crabs in crab fisheries.

C. Habitat protection: Adequate habitat is essential for maintaining the productivity of fishery resources. Essential fish habitat (EFH) has been defined and potential threats have been identified. Additional measures could be implemented to further protect habitat.

Option 1: Status quo. No species habitat protection measures would be established for this stock.

Option 2: **(preferred)** For agency consultation purposes, highlight the importance of St. Matthew blue king crab EFH in maintaining stock productivity. To the extent feasible and practicable, this area should be protected from adverse impacts due to non-fishing activities.

<u>Option 3</u>: **(preferred)**Adopt the Alaska Board of Fisheries State waters habitat protection area for egg-bearing female blue king crab around St. Matthew Island, Hall Island, and Pinnacles Island (Figure 13).

Alternative 3: No Fishing. No fishing would be allowed in the directed St. Matthew blue king crab fishery until the stock is rebuilt.

The proposed actions contained in this amendment are intended to rebuild the St. Matthew blue king crab stock. The near-term outlook is not very promising based on recent poor recruitment, extremely low survey abundance in 1999, and poor in-season fishery performance in 1998.

Adoption of Alternative 2 (particularly Part A, Option 2) is expected to allow the St. Matthew blue king crab stock to rebuild, with a 50% probability, to the Bmsy level in less than 10 years. The projected rebuilding time period, with a 50% probability, is 6 years. Adoption of the revised harvest strategy should result in more spawning biomass as more larger male crab would be conserved and fewer juveniles and females would die due to discarding. This higher spawning biomass would be expected to produce good year-classes when environmental conditions are favorable. Protection of habitat and reduction of bycatch will reduce mortality on juvenile crabs, thus allowing a higher percentage of each year-class to contribute to spawning (and future landings). Any or all of these actions proposed under Alternative 2 would be expected to improve the status of this stock, while allowing some fishing under the conditions outline in the harvest strategy. No rebuilding benefits are provided by Alternative 1. The projected rebuilding time period, with a 50% probability, under status quo is 12 years. Under Alternative 3, no fishing, the projected rebuilding time period, with a 50% probability, is 5 years. Detailed analysis of the specification of the rebuilding time period is in section 6.0.

Reducing blue king crab bycatch in the groundfish fisheries was analyzed but not considered as an alternative. According to observer data, blue king crab is not a measurable component of bycatch in the trawl fisheries. Further, bottom trawling does not occur in areas identified as blue king crab habitat. This may be due to the fact that blue king crab are found in rocky habitat, which is destructive to non-pelagic trawl gear.

None of the alternatives are likely to significantly affect the quality of the human environment, and the preparation of an environmental impact statement for the proposed action is not required by Section 102(2)(C) of the National Environmental Policy Act or its implementing regulations. The rebuilding plan does not contain implementing regulations so a regulatory impact review under E.O. 12866 and initial regulatory flexibility analysis under the Regulatory Flexibility Act are not required.

1.0 Introduction

The king and Tanner crab fisheries in the Exclusive Economic Zone (EEZ) (3 to 200 miles offshore) of the Bering Sea and Aleutian Islands off Alaska are managed under the Fishery Management Plan for King and Tanner Crab Fisheries in the Bering Sea/Aleutian Islands (BSAI). This fishery management plan (FMP) was developed by the North Pacific Fishery Management Council (Council) under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). The BSAI King and Tanner crab FMP was approved by the Secretary of Commerce and became effective in 1989.

Actions taken to amend the FMPs or implement other regulations governing the BSAI crab and groundfish fisheries must meet the requirements of Federal laws and regulations. In addition to the Magnuson-Stevens Act, the most important of these are the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), Executive Order (E.O.) 12866, and the Regulatory Flexibility Act (RFA). NEPA requires a description of the purpose and need for the proposed action as well as a description of alternative actions which may address the problem. This information is included in Section 1through 6 of this document. Section 7 contains information on the biological and environmental impacts of the alternatives as required by NEPA. Impacts on endangered species and marine mammals are also addressed in this section. Section 8 contains information that addresses the economic and socioeconomic impacts of the alternatives and options considered by the Council.

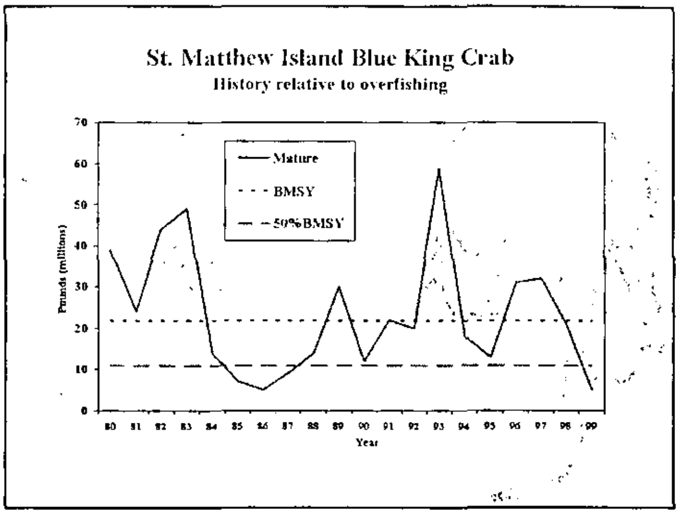
This Environmental Assessment (EA) addresses alternatives for rebuilding the St. Matthew blue king crab stock as required under the Magnuson-Stevens Act. The sections of the Magnuson-Stevens Act that must be satisfied are: National Standard 1 section 301(a)(1); Required provisions 303(a)(10) and 303(a)(14); Rebuilding overfished fisheries 304(e); and national standard guidelines 50 CFR 600.310. To the fullest extent possible, the rebuilding alternatives adhere to the NMFS Technical Guidance on Rebuilding (Restrepo et al 1998).

None of the alternatives are likely to significantly affect the quality of the human environment, and the preparation of an environmental impact statement for the proposed action is not required by Section 102(2)(C) of the National Environmental Policy Act or its implementing regulations. The rebuilding plan does not contain implementing regulations so a regulatory impact review under E.O. 12866 and initial regulatory flexibility analysis under the Regulatory Flexibility Act are not required.

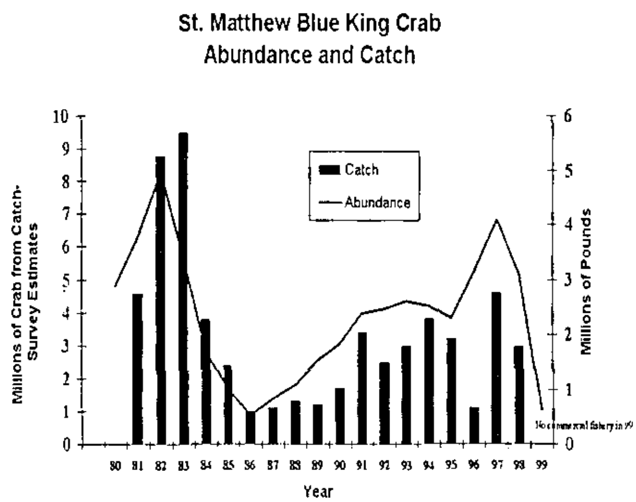
1.1 Purpose of and Need for the Action

The Magnuson-Stevens Act, in section 303(a)(10), requires that each FMP specify objective and measurable criteria (status determination criteria) for identifying when stocks or stock complexes covered by the FMP are overfished. To fulfill the intent of the Magnuson-Stevens Act, such status determination criteria are comprised of two components: A maximum fishing mortality threshold and a minimum stock size threshold (see Sec. 600.310(d)(2)).

Amendment 7 to the BSAI King and Tanner Crab FMP redefined overfishing, OY, and MSY, and updated the FMP with new information. The amendment established MSY point estimates, along with minimum stock size thresholds (MSST) for individual crab stocks based on prevailing environmental conditions (1983-1997 period). Overfishing is now defined as a fishing mortality rate in excess of natural mortality (M=0.2 for king crabs, M=0.3 for Tanner crabs). Overfished is defined as a biomass that falls below MSST, regardless of the causes of the stock decline. The 1999 NMFS Bering Sea survey indicated that the St. Matthew blue king crab stock was below the minimum stock size threshold (MSST) established for this stock. Abundance declined sharply this year, resulting in a spawning biomass value (4.8 million pounds) that falls below the MSST (11.0 million pounds). On September 24, 1999, NMFS informed the Council that this stock was declared "overfished" pursuant to the Magnuson Act guidelines, which require a rebuilding plan to be developed within one year.



This stock is currently near historical low abundance. The 1999 estimates of total stock abundance is the second lowest in the history of the NMFS bottom trawl survey (Table 1). The near-term outlook for this stock is bleak, as the 1999 survey encountered very few crab of any size. As a precautionary interim measure, no fishery was allowed in 1999. The 2000 abundance estimate increased slightly to 5.2 million pounds of spawning biomass.



Abundance and catch of legal male St. Matthew blue king crab, 1980-1999.

2.0 Description of Alternatives and Options

This EA addresses alternatives for rebuilding the overfished stock of St. Matthew blue king crab. Alternatives and options were developed by the Council at their October, 1999 meeting. The alternatives examined were the following:

Alternative 1: Status Quo. No rebuilding plan would be adopted for St. Matthew blue king crab.

Alternative 2: **(preferred)** Establish a rebuilding plan for St. Matthew blue king crab. The rebuilding plan may have three components: a harvest strategy, bycatch control measures, and habitat protection. Note that more than one option can be adopted for each component.

A. **Harvest Strategy**: In previous years when there was a directed fishery, harvest rates for St. Matthew blue king crab were established at 20% of the mature male abundance. This harvest strategy could be modified to reduce mortality on legal males.

Option 1: Status quo. Continue to establish harvest rates for St. Matthew blue king crab at 20% of the mature male abundance.

Option 2: **(preferred)** Adopt the Alaska Board of Fisheries new harvest strategy for St. Matthew blue king crab. The strategy, as detailed in Section 5.1 includes lower harvest rates at low biomass levels, and incorporates a threshold biomass.

B. Bycatch Controls: The main source of bycatch is the bycatch of females and sublegal males in the directed blue king crab fishery.

Option 1: Status quo. Maintain existing management regime.

Option 2: **(preferred)** Adopt the Board of Fisheries gear modifications measures and area closure (Figure 13) to reduce bycatch of blue king crabs in crab fisheries.

C. Habitat protection: Adequate habitat is essential for maintaining the productivity of fishery resources. Essential fish habitat (EFH) has been defined and potential threats have been identified. Additional measures could be implemented to further protect habitat.

Option 1: Status quo. No species habitat protection measures would be established for this stock.

Option 2: **(preferred)** For agency consultation purposes, highlight the importance of blue king crab EFH in maintaining stock productivity. To the extent feasible and practicable, this area should be protected from adverse impacts due to non-fishing activities.

Option 3: **(preferred)** Adopt the Alaska Board of Fisheries State waters habitat protection area for egg-bearing female blue king crab around St. Matthew Island, Hall Island, and Pinnacles Island (Figure 13).

Alternative 3: No Fishing. No fishing would be allowed in the directed St. Matthew blue king crab fishery until the stock is rebuilt.

3.0 Requirements for Stock Rebuilding

Stock rebuilding is required by the Magnuson Stevens Act, Section 304. The applicable section of the Act is provided below.

(e) REBUILDING OVERFISHED FISHERIES.--

(1) The Secretary shall report annually to the Congress and the Councils on the status of fisheries within each Council's geographical area of authority and identify those fisheries that are overfished or are approaching a condition of being overfished. For those fisheries managed under a fishery management plan or international agreement, the status shall be determined using the criteria for overfishing specified in such plan or agreement. A fishery shall be classified as approaching a condition of being overfished if, based on trends in fishing effort, fishery resource size, and other appropriate factors, the Secretary estimates that the fishery will become overfished within two years.

(2) If the Secretary determines at any time that a fishery is overfished, the Secretary shall immediately notify the appropriate Council and request that action be taken to end overfishing in the fishery and to implement conservation and management measures to rebuild affected stocks of fish. The Secretary shall publish each notice under this paragraph in the Federal Register.

(3) Within one year of an identification under paragraph (1) or notification under paragraphs (2) or (7), the appropriate Council (or the Secretary, for fisheries under section 302(a)(3)) shall prepare a fishery management plan, plan amendment, or proposed regulations for the fishery to which the identification or notice applies--

(A) to end overfishing in the fishery and to rebuild affected stocks of fish; or

(B) to prevent overfishing from occurring in the fishery whenever such fishery is identified as approaching an overfished condition.

(4) For a fishery that is overfished, any fishery management plan, amendment, or proposed regulations prepared pursuant to paragraph (3) or paragraph (5) for such fishery shall--

(A) specify a time period for ending overfishing and rebuilding the fishery that shall--

(i) be as short as possible, taking into account the status and biology of any overfished stocks of fish, the needs of fishing communities, recommendations by international organizations in which the United States participates, and the interaction of the overfished stock of fish within the marine ecosystem; and

(ii) not exceed 10 years, except in cases where the biology of the stock of fish, other environmental conditions, or management measures under an international agreement in which the United States participates dictate otherwise;

(B) allocate both overfishing restrictions and recovery benefits fairly and equitably among sectors of the fishery; and

(C) for fisheries managed under an international agreement, reflect traditional participation in the fishery, relative to other nations, by fishermen of the United States.

(5) If, within the one-year period beginning on the date of identification or notification that a fishery is overfished, the Council does not submit to the Secretary a fishery management plan, plan amendment, or proposed regulations required by paragraph (3)(A), the Secretary shall prepare a fishery management plan or plan amendment and any accompanying regulations to stop overfishing and rebuild affected stocks of fish within 9 months under subsection (c).

(6) During the development of a fishery management plan, a plan amendment, or proposed regulations required by this subsection, the Council may request the Secretary to implement interim measures to reduce overfishing under section 305(c) until such measures can be replaced by such plan, amendment, or regulations. Such measures, if otherwise in compliance with the provisions of this Act, may be implemented even though they are not sufficient by themselves to stop overfishing of a fishery.

(7) The Secretary shall review any fishery management plan, plan amendment, or regulations required by this subsection at routine intervals that may not exceed two years. If the Secretary finds as a result of the review that such plan, amendment, or regulations have not resulted in adequate progress toward ending overfishing and rebuilding affected fish stocks, the Secretary shall--

(A) in the case of a fishery to which section 302(a)(3) applies, immediately make revisions necessary to achieve adequate progress; or

(B) for all other fisheries, immediately notify the appropriate Council. Such notification shall recommend further conservation and management measures which the Council should consider under paragraph (3) to achieve adequate progress.

3.1 National Standard Guidelines

Below in this section (Section 3.1) is an excerpt from the Final Rule on National Standard Guidelines, published in the Federal Register on May 1, 1998.

Sec. 600.310 National Standard 1--Optimum Yield.

(e) Ending overfishing and rebuilding overfished stocks–(1) Definition. A threshold, either maximum fishing mortality or minimum stock size, is being ``approached'' whenever it is projected that the threshold will be breached within 2 years, based on trends in fishing effort, fishery resource size, and other appropriate factors.

(2) Notification. The Secretary will immediately notify a Council and request that remedial action be taken whenever the Secretary determines that:

(i) Overfishing is occurring;

(ii) A stock or stock complex is overfished;

(iii) The rate or level of fishing mortality for a stock or stock complex is approaching the maximum fishing mortality threshold;

(iv) A stock or stock complex is approaching its minimum stock size threshold; or

(v) Existing remedial action taken for the purpose of ending previously identified overfishing or rebuilding a previously identified overfished stock or stock complex has not resulted in adequate progress.

(3) Council action. Within 1 year of such time as the Secretary may identify that overfishing is occurring, that a stock or stock complex is overfished, or that a threshold is being approached, or such time as a Council may be notified of the same under paragraph (e)(2) of this section, the Council must take remedial action by preparing an FMP, FMP amendment, or proposed regulations. This remedial action must be designed to accomplish all of the following purposes that apply:

(i) If overfishing is occurring, the purpose of the action is to end overfishing.

(ii) If the stock or stock complex is overfished, the purpose of the action is to rebuild the stock or stock complex to the MSY level within an appropriate time frame.

(iii) If the rate or level of fishing mortality is approaching the maximum fishing mortality threshold (from below), the purpose of the action is to prevent this threshold from being reached.

(iv) If the stock or stock complex is approaching the minimum stock size threshold (from above), the purpose of the action is to prevent this threshold from being reached.

(4) Constraints on Council action.

(i) In cases where overfishing is occurring, Council action must be sufficient to end overfishing.

(ii) In cases where a stock or stock complex is overfished, Council action must specify a time period for rebuilding the stock or stock complex that satisfies the requirements of section 304(e)(4)(A) of the Magnuson-Stevens Act.

(A) A number of factors enter into the specification of the time period for rebuilding:

(1) The status and biology of the stock or stock complex;

(2) Interactions between the stock or stock complex and other components of the marine ecosystem (also referred to as ``other environmental conditions'');

(3) The needs of fishing communities;

(4) Recommendations by international organizations in which the United States participates; and

(5) Management measures under an international agreement in which the United States participates.

(B) These factors enter into the specification of the time period for rebuilding as follows:

(1) The lower limit of the specified time period for rebuilding is determined by the status and biology of the stock or stock complex and its interactions with other components of the marine ecosystem, and is defined as the amount of time that would be required for rebuilding if fishing mortality were eliminated entirely.

(2) If the lower limit is less than 10 years, then the specified time period for rebuilding may be adjusted upward to the extent warranted by the needs of fishing communities and recommendations by international organizations in which the United States participates, except that no such upward adjustment can result in the specified time period exceeding 10 years, unless management measures under an international agreement in which the United States participates dictate otherwise.

(3) If the lower limit is 10 years or greater, then the specified time period for rebuilding may be adjusted upward to the extent warranted by the needs of fishing communities and recommendations by international organizations in which the United States participates, except that no such upward adjustment can exceed the rebuilding period calculated in the absence of fishing mortality, plus one mean generation time or equivalent period based on the species' life-history characteristics. For example, suppose a stock could be rebuilt within 12 years in the absence of any fishing mortality, and has a mean generation time of 8 years. The rebuilding period, in this case, could be as long as 20 years.

(C) A rebuilding program undertaken after May 1, 1998 commences as soon as the first measures to rebuild the stock or stock complex are implemented.

(D) In the case of rebuilding plans that were already in place as of May 1, 1998, such rebuilding plans must be reviewed to determine whether they are in compliance with all requirements of the Magnuson- Stevens Act, as amended by the Sustainable Fisheries Act.

(5) Interim measures. The Secretary, on his/her own initiative or in response to a Council request, may implement interim measures to reduce overfishing under section 305(c) of the Magnuson-Stevens Act, until such measures can be replaced by an FMP, FMP amendment, or regulations taking remedial action.

(i) These measures may remain in effect for no more than 180 days, but may be extended for an additional 180 days if the public has had an opportunity to comment on the measures and, in the case of Council- recommended measures, the Council is actively preparing an FMP, FMP amendment, or proposed regulations to address overfishing on a permanent basis. Such measures, if otherwise in compliance with the provisions of the Magnuson-Stevens Act, may be implemented even though they are not sufficient by themselves to stop overfishing of a fishery.

(ii) If interim measures are made effective without prior notice and opportunity for comment, they should be reserved for exceptional situations, because they affect fishermen without providing the usual procedural safeguards. A Council recommendation for interim measures without notice-and-comment rulemaking will be considered favorably if the short-term benefits of the measures in reducing overfishing outweigh the value of advance notice, public comment, and deliberative consideration of the impacts on participants in the fishery.

3.2 Technical Guidance on Rebuilding

The National Standard 1 guidelines indicate that once biomass falls below the minimum stock size threshold (MSST), then remedial action is required "to rebuild the stock or stock complex to the MSY level within an appropriate time frame." Guidance for determining the adequacy and efficacy of rebuilding plans was prepared by Restrepo et al. (1998) "Technical Guidance on the Use of Precautionary Approaches to Implementing National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act". This guidance manual does not have the force of law, but instead provides technical details for stock assessment scientists.

3.3 Definitions from Crab FMP

The definition of optimum yield, MSY, and threshold levels were derived from definitions contained in the Magnuson-Stevens Act or on the guidelines. These definitions were adopted under Amendment 7.

Maximum sustainable yield (MSY) is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions. MSY is estimated from the best information available. Proxy stocks are used for BSAI crab stocks where insufficient scientific data exists to estimate biological reference points and stock dynamics are inadequately understood. MSY for crab species is computed on the basis of the estimated biomass of the mature portion of the male and female population or total mature biomass (MB) of a stock. A fraction [20% for St. Matthew blue king crab] of the MB is considered sustained yield (SY) for a given year and the average of the SYs over a suitable period of time is considered the MSY.

Overfishing: The term "overfishing" and "overfished" mean a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce MSY on a continuing basis. Overfishing is defined for king and Tanner crab stocks in the BSAI management area as any rate of fishing mortality in excess of the maximum fishing mortality threshold, Fmsy, for a period of 1 year or more. Should the actual size of the stock in a given year fall below the minimum stock size threshold, the stock is considered overfished. If a stock or stock complex is considered overfished or if overfishing is occurring, the Secretary will notify the Council to take action to rebuild the stock or stock complex.

MSY control rule means a harvest strategy which, if implemented, would be expected to result in a long-term average catch approximating MSY. The MSY control rule for king and Tanner crabs is the mature biomass of a stock under prevailing environmental conditions, or proxy thereof, exploited at a fishing mortality rate equal to a conservative estimate of natural mortality.

MSY stock size is the average size of the stock, measured in terms of mature biomass of a stock under prevailing environmental conditions, or a proxy thereof. It is the stock size that would be achieved under the MSY control rule. It is also the minimum standard for a rebuilding target when remedial management action is required. For king and Tanner crab, the MSY stock size is the average mature biomass observed over the past 15 years, from 1983 to 1997.

Maximum fishing mortality threshold (MFMT) is defined by the MSY control rule, and is expressed as the fishing mortality rate. The MSY fishing mortality rate Fmsy = M, is a conservative natural mortality value set equal to 0.20 for all species of king crab, and 0.30 for all Chionoecetes species.

Minimum stock size threshold (MSST) is whichever is greater: one half the MSY stock size, or the minimum stock size at which rebuilding to the MSY level would be expected to occur within 10 years if the stock or stock complex were exploited at the maximum fishing mortality threshold. The minimum stock size threshold is expressed in terms of mature biomass of a stock under prevailing environmental conditions, or a proxy thereof.

4.0 Current Crab Management Regime

4.1 Blue King Crab Biology and Fishery Management

King crab stocks off St. Matthew and Pribilof Islands are minor stocks that have supported small catches since fishery inception in the late 1970s. In 1998, combined red and blue king crab landings from the Pribilof Islands totaled just 1.2 million pounds worth $2.3 million. In the same year, landings of St. Matthew Island blue king crabs totaled $2.8 million pounds worth $5.6 million. In 1999, the abundance of Pribilof Islands blue king crabs continued an ongoing decline and fell below the threshold established for this fishery. On the other hand, estimates of red king crabs in the Pribilof Islands area increased significantly from 1998; however, most red king crabs were captured in a single tow, making the reliability of that estimate extremely low. Survey estimates for St. Matthew Island blue king crabs indicated dramatic declines of both male and female crabs in all size categories in 1999. Recruitment to this stock has been declining for several years, but the sharp decline in all sizes of crabs suggest large survey measurement errors, a large increase in natural mortality, or some combination of both. Owing to the low biomass of mature crabs, this stock was classified as "overfished" in 1999. King crab fisheries off St. Matthew and Pribilof Islands were closed in 1999 owing to low stock size and associated high degree of uncertainty.

4.1.1 Biology: Blue king crab (*Paralithodes platypus*) has a discontinuous distribution throughout their range (Hokkaido Japan to Southeast Alaska). In the Bering Sea, discrete populations exist around the Pribilof Islands, St. Matthew Island, and St. Lawrence Island. Smaller populations have been found around Nunivak and King Island. The 1999 survey distribution of large male blue king crabs in the Bering Sea is shown in Figure 1. Blue king crab molt multiple times as juveniles. Skip molting occurs with increasing probability for those males larger than 100 mm carapace length. Average molt increment for adult males is 14 mm. In the Pribilof area, 50% maturity of females is attained at 96 mm (about 3.8 inches) carapace length, which occurs at about 5 years of age. Blue king crab in the St. Matthew area mature at smaller sizes (50% maturity at 81 mm CL for females) and do not get as large overall. The 1999 survey length frequency distribution of blue king crabs in is shown in Figure 2. Blue king crab have a biennial ovarian cycle and a 12 to 19 month embryonic period. Female blue king crab are found in rocky habitat. According to ADF&G pot surveys and observer data, the majority of egg-baring females are found within depths of 30m, as shown in Figure 12. Females with out eggs are found in deeper waters, up to 70 m, as shown in Figures 9 and 10. Unlike red king crab, juvenile blue king crab do not form pods, instead relying on cryptic coloration for protection from predators. Adult male blue king crab occur at an average depth of 70 m and an average temperature of 0.6oC.

4.1.2 Management:

Blue king crab stocks in the Bering Sea are managed by the State of Alaska through a federal BSAI king and Tanner crab fishery management plan (FMP). Under the FMP, management measures fall into three categories: (1) those that are fixed in the FMP under Council control, (2) those that are frameworked so the State can change following criteria outlined in the FMP, and (3) those measures under complete discretion of the

Management measures implemented for the BSAI king and Tanner crab fisheries, as defined by the federal crab FMP, by category.

Category 1 (Fixed in FMP)	Category 2 (Frameworked in FMP)	Category 3 (Discretion of State)
* Legal Gear	* Minimum Size Limits	* Reporting Requirements
* Permit Requirements	* Guideline Harvest Levels	* Gear Placement and Removal
* Federal Observer Requirements	* Inseason Adjustments	* Gear Storage
* Limited Access	* Districts, Subdistricts and Sections	* Gear Modifications
* Norton Sound Superexclusive Registration Area	* Fishing Seasons	* Vessel Tank Inspections
	* Sex Restrictions	* State Observer Requirements
	* Closed Waters	* Bycatch Limits (in crab fisheries)
	* Pot Limits	* Other
	* Registration Areas	

State. In the past, the State set the pre-season guideline harvest levels for blue king crab based on a mature male harvest rate of 20%. Threshold levels were established for these stocks, below which a fishery will not occur. A threshold level of 0.77 million male crabs >119 mm CL has been established for the Pribilof stock; the St. Matthew threshold is 0.6 million males >104 mm CL. Current minimum legal size for the Pribilof District blue king crab is 6.5" in carapace width. Minimum legal size for blue king crab in the St. Matthew Island area is 5.5" carapace width. The ADF&G applied catch-survey analysis to St. Matthew Island and Pribilof Islands blue king crab stock beginning in 1996. It is particularly suited for blue king crabs that occupy untrawlable areas

In addition to minimum size and sex restrictions, the State has instituted numerous other regulations for BSAI crab fisheries. The State requires vessels to register with the state by obtaining licenses and permits, and register for each fishery and each area. Observers are required on all vessels processing king and Tanner crab in the BSAI. Season opening dates are set to maximize meat yield and minimize handling of softshell crabs. The season opening date for Pribilof District blue king crab fishery is September 15. In 1995, a combined GHL for red king and blue king crab fisheries in the Pribilof District was established. Pot limits have been established based on vessel size; the current pot limits are 50 for vessels > 125 feet, and 40 for vessels < 125 feet in the Pribilof District. In the St. Matthew area, the current pot limits are 75 for vessels > 125 feet, and 60 for vessels < 125 feet. Other gear restrictions include a requirement that crab pots be fitted with a degradable escape mechanism consisting of #30 cotton thread (max. diameter) or a 30-day galvanic timed release mechanism. Also, for the Pribilofs district, king crab pots must have 1/3 of one vertical surface comprised of 9" stretched-mesh webbing. There are no recreational fisheries for St. Matthew blue king crab.

Stock Structure: Two discrete stocks of blue king crab are actively managed in the BSAI region: the Pribilof Islands and St. Matthew Island stocks. Other smaller populations of blue king crab are found in the vicinity of St. Lawrence Island and Nunivak Island, as well as isolated populations in the Gulf of Alaska. Blue king crab stocks are managed separately to accommodate different life histories and fishery characteristics.

St. Matthew Stock: Abundance estimates for the St. Matthew blue king crab stock are obtained through the NMFS annual bottom trawl surveys using an area-swept method. Survey data indicated the presence of relatively high numbers of juvenile males in the late 1970s. These crabs recruited to fisheries in the early 1980s.

4.2 Overview of Blue King Crab Bycatch

4.2.1 Crab Fisheries Bycatch of crab in directed crab fisheries is another source of mortality to be considered in a rebuilding plan. Crab bycatch includes females of target species, sublegal males of target species, and non-target crab. Numbers of St. Matthew blue king crab taken as bycatch in recent major Bering Sea crab fisheries are listed in the adjacent table.

Some crabs taken as bycatch die due to handling mortality. Several laboratory and field studies have been conducted to determine mortality caused by handling juvenile and female crab taken in crab fisheries. There are a variety of effects caused by handling, ranging from sublegal (reduced growth rates, molting probabilities, decreased visual acuity from bright lights, and vigor) to lethal effects. Studies have shown a range of mortality due to handling based on gear type, species, molting stage, number of times handled, temperature, and exposure time (reviewed in Murphy and Kruse 1995). Handling mortality may have contributed to the high natural mortality levels observed for Bristol Bay red king crab in the early 1980's (65% for males and 82% for females), that along with high harvest rates, resulted in stock collapse (Zheng et al. 1995). However, another study concluded that handling mortality from deck and temperature impacts was not responsible for the decline on the red king crab fishery (Zhou and Shirley 1995, 1996).

Delayed mortality due to handling does not appear to be influenced by method of release. In an experiment done during a test fishery, red king crab thrown off the deck while the vessel was moving versus those gently placed back into the ocean showed no differences in tag return rates (Watson and Pengilly 1994). Handling methods on mortality have been shown to be non-significant in laboratory experiments with red king crab (Zhou and Shirley 1995, 1996) and Tanner crab (MacIntosh et al. 1996). Although handling did not cause mortality, injury rates were directly related to the number of times handled.

Byersdorfer and Watson (1992, 1993) examined red king crab and Tanner crab taken as bycatch during the 1991 and 1992 ADF&G red king crab test fisheries. Instantaneous handling mortality of red king crab was <1% in 1991, and 11.2% in 1992. Stevens and MacIntosh (1993) found average overall mortality of 5.2% for red king crabs and 11% for Tanner crabs on one commercial crab vessel. Authors recommend these results be viewed with caution, noting that experimental conditions were conservative. Mortality for red king crab held 48 hours was 8% (Stevens and MacIntosh 1993, as cited in Queirolo et al. 1995). A laboratory study that examined the effects of multiple handling indicated that mortality of discarded red king crabs was negligible (2%), although body damage increased with handling (Zhou and Shirley 1995).

Mortality of crabs is also related to time out of water and air temperature. A study of red king crabs and Tanner crabs found that crabs exposed to air exhibited reduced vigor and righting times, feeding rates (Tanner crabs), and growth (red king crabs) (Carls and Clair 1989). For surviving females, there was no impact on survival of eggs or larvae. Cold air resulted in leg loss or immediate mortality for Tanner crabs, whereas red king crabs exhibited delayed mortality that occurred during molting. A relationship was developed to predict mortality as the product of temperature and duration of exposure (measured as degree hours). Median lethal exposure was -8oC for red king crab and -4.3oC for Tanner crab. For example, if crabs were held on deck for 10 minutes and it was -23oC or 10 degrees below zero (Fahrenheit) outside, about 15% of the king crab and 50% of the Tanner crab would die of exposure. Zhou and Shirley (1995) observed that average time on deck was generally 2 to 3 minutes, and they concluded that handling mortality was not a significant source of mortality. Additionally, because the St. Matthew blue king crab fishery occurs in September, cold exposure is likely minimal, and thereby handling mortality is likely minimal.

Bycatch (numbers of crabs) of St. Matthew blue king crab in recent crab fisheries. ADF&G Observer Program data. Bycatch data from opilio fishery include blue king crab from Pribilof district and St. Matthew section of northern district.

Fishery	Legal	Sublegal	Females	Total
1992/93 *C. opilio*	9,487	20,028	3,162	32,677
1992 St. Matthew	0	1,393,098	3,420,452	4,813,550
1992 Total	**9,487**	**1,413,126**	**3,423,614**	**4,846,227**
1993/94 *C. opilio*	843	27,841	5,906	34,590
1993 St. Matthew	0	1,213,993	1,952,945	3,166,938
1993 Total	**843**	**1,241,843**	**1,958,851**	**3,201,528**
1994/95 *C. opilio*	1,700	11,000	1,200	13,900
1994 St. Matthew	0	1,582,360	2,251,820	3,834,180
1994 Total	**1,700**	**1,593,360**	**2,253,020**	**3,848,080**
1995/96 *C. opilio*	660	10,300	0	10,960
1995 St. Matthew		Confidential		
1996/97 *C. opilio*	17,381	6,952	0	24,333
1996 St. Matthew	603,000	627,000	445,000	1,675,000
1996 Total	**620,381**	**633,952**	**445,000**	**1,699,333**
1997 *C. opilio*	0	0	0	0
1997 St. Matthew		Confidential		
1998 *C. opilio*	1,254	5,017	3,762	10,033
1998 St. Matthew		Confidential		

Catching mortality is ascribed to those crabs that enter a pot and are eaten by other pot inhabitants before the pot is retrieved. Catching mortality likely occurs during the molting period, when crabs are more susceptible to cannibalism. Most crab fisheries are set to occur outside of the molting season, and catching mortality in these fisheries may be limited to octopus or large fish entering a pot. Because no evidence of crab is left in the pot, these mortalities remain unassessed.

Mortality is also caused by ghost fishing of lost crab pots and groundfish pots. Ghost fishing is the term used to describe continued fishing by lost or derelict gear. The impact of ghost fishing on crab stocks remains unknown. It has been estimated that 10-20% of crab pots are lost each year (Meyer 1971, Kruse and Kimker 1993). Based on skipper interviews, about 10,000 pots were estimated lost in the 1992 Bristol Bay red king, and Bering Sea Tanner and snow crab fisheries (Tracy 1994). Fewer pots are expected to be lost under pot limit regulations and shorter seasons. Bob Schofield, a major crab pot manufacturer, testified at the January 1996 Council meeting that he was making fewer pots since inception of the pot limit. He estimated that 6,461 pots were replaced in 1995. It is not known how long lost pots may persist and continue to fish, or just litter the bottom.

A sonar survey of inner Chiniak Bay (Kodiak, Alaska) found a high density of lost crab pots (190 pots) in an area of about 4.5 km2 (Vining et al 1997). Underwater observations indicated that crabs and fish were common residents of crab pots, whether or not the pot mesh was intact. Intact pots recovered from the Chiniak Bay study area often contained crabs (primarily Tanner crabs) and octopus. High (1985) and High and Worlund (1979) observed that 20% of legal sized male red king crab and 8% of the sublegals captured by lost pots failed to escape.

Crabs captured in lost pots may die of starvation or by predation. Captured crab are subject to cannibalism (Paul et al. 1993), and predation by octopus, halibut and Pacific cod (High 1976). Crabs also have limited abilities to withstand starvation. In a field study, 39% mortality of Tanner crabs was observed after 119 days of starvation (Kimker 1992). In a laboratory study, 10% of the Tanner crabs tested died of starvation in 90 days. Of the 90% that had survived 90 days, all later died even though they were freely fed (Paul et al. 1993). To reduce starvation mortality in lost pots, crab pots have been required be fitted with degradable escape mechanisms. Regulations required #120 cotton thread from 1977-1993. Beginning in 1993, regulations required #30 cotton thread or 30-day galvanic timed release mechanisms. A #30 cotton thread section is also required in groundfish pots. The average time for #30 cotton twine to degrade is 89 days, and the galvanic timed release about 30 days to degrade. Pots fitted with an escape mechanism of #72 cotton twine had a fishable life of 3-8 years and documented retention of up to 100 crabs per lost pot (Meyer 1971). High and Wolund (1979) estimated an effective fishing life of 15 years for king crab pots. Pots without escape mechanisms could continue to catch and kill crabs for many years, however testimony from crabbers and pot manufacturers indicate that all pots currently fished in Bering Sea crab fisheries contain escape mechanisms.

Mortality of crab caused by ghost fishing is difficult to estimate with precision given existing information. Mortality caused by continuous fishing of lost pots has not been estimated, but unbaited crab pots continue to catch crabs (Breen 1987, Meyer 1971), and pots are subject to rebaiting due to capture of Pacific cod, halibut, sablefish, and flatfish. In addition to mortality of trapped crab by ghost pots, and predation by octopus and fish, pot mesh itself can kill crabs. Lost pots retrieved by NMFS trawl surveys occasionally contain dead crabs trapped in loose webbing (Brad Stevens, NMFS, pers. comm). Pot limits and escape mechanisms may have greatly minimized ghost fishing due to pot loss in recent years.

Another very minor source of human induced crab mortality is direct gear impacts. Direct gear impacts result from a pot landing on the ocean floor when it is being set, presumably damaging any crab on which it lands. With reasonable assumptions, direct gear impacts is only a very minor source of mortality, however. An estimate of this impact can be derived by multiplying the number of pot lifts, the area they occupy, and relative crab density within areas fished in the Bering Sea. Assuming that pots land on different areas after each lift, and crab pots are set non-randomly over areas with relatively high density of crabs in directed fisheries, the total number of crab impacted can be roughly estimated. For 1993 the red king crab fishery, assuming a density of 5,000 red king crab of all sizes per square mile (density data from Stevens et al. 1994), a maximum of about two thousand red king crab were impacted (NPFMC 1996). Similarly, a maximum of 9,000 Tanner crabs (assuming 10,000 crab/mile2) and 110 thousand snow crabs (assuming 75,000 crab/mile2) were impacted by direct gear impacts in respective crab fisheries in 1993. It is not known what proportion of these crab die when a crab pot lands on them.

4.2.2 Trawl Fisheries

Bycatch of blue king crab in groundfish fisheries is small relative to total abundance. Bycatch due to groundfish fisheries has ranged from 195 crabs to 4,983 crabs during the 1994-99 period. On average, this equates to less than 0.06% of the total stock, assuming all "other king crabs" were blue king crabs. When adjusted for mortality, the numbers drop down to less than 2,200 crabs in any one year, equating to less than 0.02% of the population. From a mortality standpoint, this much lower than mortality associated with other groundfish fishery PSC species such as herring (1%), halibut (1.3% trawl and longline combined), chum salmon (<1%), red king crab (0.1%), C. opilio crab (0.1%), and chinook salmon (2%-4%) (Witherell et al., 2000).

Bycatch (numbers) of "other king crab" in groundfish fisheries in the St. Matthew area, 1994-1999 (through 10/30), and current years survey abundance estimate.

Year	Bycatch	Abundance (millions)	Bycatch as %
1994	1,199	5.95	0.02
1995	2,772	5.62	0.05
1996	732	9.96	0.01
1997	195	10.03	0.00
1998	774	8.36	0.01
1999	4,983	1.7	0.30

At first glance, the option to establish a blue king crab bycatch limit for groundfish fisheries would maintain tighter control on bycatch, particularly when the stock is at low levels. However, because bycatch mortality caused by trawl fisheries is extremely small relative to other sources of mortality, establishment of bycatch limits may not result in measurable improvements to crab stock abundance or promote the rebuilding of the stock.

Crab bycatch is estimated by the National Marine Fisheries Service through the groundfish Observer Program (Queirolo et al. 1995). Observer coverage depends on vessel length; 100% observers on vessels > 125 feet, 30% coverage on vessels 60-125 feet, and 0% coverage on vessels <60 feet. Shoreside processors have 100% coverage. 100% coverage means that an observer is always onboard; it does not mean that every haul or landing is observed. Bycatch numbers for blue king crab are combined with golden king crab and scarlet king crabs into an "other king crab" category.

Bycatch (numbers) of "other king crab" in statistical area 524 in groundfish trawl fisheries, 1993-1999. Reported by NMFS Blend estimates.

Year	
1994	1,193
1995	2,725
1996	168
1997	8
1998	0
1999	0

Bycatch of "other king crab" in recent trawl fisheries is shown in the adjacent table; more detailed information is found in Table 2. The adjacent table shows the bycatch of "other king crab" in area 524, which is the statistical area that encompasses St. Matthew Islands. Therefore, this table represent the our best estimates bycatch of St. Matthew's blue king crab in the groundfish trawl fisheries. As shown in the table, very few blue king crab are taken as bycatch in the trawl fisheries. When we look at the whole Bering

Sea, a total of 19,222 other king crabs were taken as bycatch in the 1999 BSAI groundfish fisheries. Most other king crabs bycatch is taken in the groundfish pot fisheries (about 62.9 %) and to a lesser extent in the trawl (31.6 %) and groundfish longline fisheries (5.5 %). Other king crabs are bycaught in the Pacific cod and flatfish fisheries (likely blue king crabs) and in the turbot and rockfish fisheries (likely golden king crabs). Bycatch has been highest in NMFS statistical areas 521 and 541.

Further, analysis of the observer data from 1973-96 show that almost no trawl effort occurs in the areas identified as St. Matthew blue king crab habitat and where the NMFS annual trawl survey finds areas of high St. Matthew blue king crab abundance (see Table 1). Please refer to the analysis of catch-per-unit-effort, length, and depth distributions of major groundfish and bycatch species in the Bering Sea contained in Fritz et al 1998.

Not all crabs in the path of a trawl are captured. Some crabs pass under the gear, or pass through the trawl meshes. Non-retained crabs may be subject to mortality from contact with trawl doors, bridles, footrope, or trawl mesh, as well as exposure to silt clouds produced by trawl and dredge gear. Limited studies have been conducted to estimate catchability of crabs by trawl gear.

Bycatch in groundfish fisheries has ranged between 195 and 4,983 St. Matthew blue king crabs during the 1994-99 period. This equates to less than 0.06% of the total stock, based on survey estimates (which are considered to be underestimated). From a mortality standpoint, this is extremely small relative to mortality associated with other groundfish fishery PSC species such as herring (1%), halibut (1.3% trawl and longline combined), chum salmon (<1%), red king crab (0.1%), Tanner crab (1 %) and chinook salmon (2%-4%) (Witherell et al., 2000).

An option to implement bycatch limit may help maintain control on the allowable bycatch, but it is probably not worth the costs associated with monitoring. Because bycatch mortality caused by trawl fisheries is extremely small relative to other sources of mortality on St. Matthew blue king crabs, reductions in bycatch limits most likely will not result in measurable improvements to crab stock abundance.

4.2.3 Other Fisheries

Some crabs are caught incidentally by non-trawl gear in pursuit of groundfish, and a portion of these crabs die. No field or laboratory studies have been made to estimate mortality of crab discarded in these fisheries. However, based on condition factor information from the trawl survey, mortality of crab bycatch has been estimated and used in previous analyses (NPFMC 1993).

Estimated bycatch mortality of St. Matthew blue king crabs (numbers of animals) in Bering Sea fisheries, 1994-1999.

Year	directed crab pot	groundfish trawl	groundfish fixed gear	Total
1994	307,846	954	2	308,803
1995	confidential	2,180	17	n/a
1996	135,947	134	212	136,293
1997	confidential	6	69	n/a
1998	confidential	0	286	n/a
1999	confidential	0	399	n/a

Discard mortality rates for red king crab were estimated at 37% in longline fisheries and 37% in pot fisheries. Estimated bycatch mortality rates for Tanner crab were 45% in longline fisheries and 30% in pot fisheries. In the analysis made for Amendment 37, a 37% mortality rate was assumed for red king crab taken in longline fisheries and an 8% rate for pot fisheries. Observer data on condition factors collected for crab during the 1991 domestic fisheries suggested lower mortality of red king crab taken in groundfish pot fisheries. Bycatch mortality rates used in the analysis of Amendment 37 (NPFMC 1996) for red king crabs were 37% in longline fisheries and 8% in pot fisheries. Because the scallop fishery does not take place anywhere near St. Matthew, this fishery has no bycatch of crabs from this stock.

Bycatch (numbers) of "other king crab" in statistical area 524 in groundfish fixed gear fisheries, 1993-1998. Reported by NMFS Blend estimates.

Year	Total
1994	6
1995	47
1996	574
1997	187
1998	774
1999	4,983

4.2.4 Total Bycatch Mortality Estimates (all fisheries)

Number of crab bycaught

Based on data discussed in previous sections, it is possible to estimate the impacts of bycatch on the St. Matthew blue king crab stock. A full data set for crab fisheries cannot be shown due to confidentiality restrictions (in many years, less than three observed vessels -- catcher processors -- participated in this fishery). Total bycatch has apparently declined from 3.8 million crab in 1994 to 1.7 million in 1996. Bycatch in fixed gear fisheries increased in 1999 due to a developing directed pot fishery for Pacific cod in the St. Matthew area.

Bycatch (numbers) of St. Matthew blue king crabs in Bering Sea fisheries, 1994-1999.

Year	directed crab pot	groundfish trawl	groundfish fixed gear	Total
1994	3,848,080	1,193	6	3,849,279
1995	confidential	2,725	47	n/a
1996	1,699,333	168	574	1,700,075
1997	confidential	8	187	n/a
1998	confidential	0	774	n/a
1999	confidential	0	4,983	n/a

Mortality of crab bycaught

These bycatch estimates can be converted into mortality estimates by applying bycatch mortality rates estimated from scientific observations, as summarized in previous sections. Discard mortality rates for *C. bairdi* used in previous analysis (NPFMC 1995) were: crab pot - 8%, trawl - 80%, longline- 37%, groundfish pot - 8%, scallop dredge - 40%. The discard mortality rate of 8% was applied to all crab taken in 1999 groundfish fixed gear category, because nearly all were taken with pot gear (all other years were longline bycatch). Applying discard mortality rates to bycatch data provides total discard mortality (in number of crabs) estimates that are useful in evaluating potential rebuilding scenarios.

Results indicate that in years when a GHL is established, the single largest source of human induced crab mortality is removals of legal males by directed crab fisheries and associated bycatch. These data indicate that reductions in crab quotas for crab fisheries may have relatively more impact on rebuilding than management actions to control bycatch in groundfish fisheries.

This analysis also indicates that establishing bycatch limits, such as PSC limits, for groundfish fisheries would not improve or rebuild crab stocks. Because bycatch mortality caused by trawl fisheries is minuscule relative to other sources of removals due to natural and fishing mortality, establishment of bycatch limits may not result in measurable improvements to crab stock abundance.

4.3 Temporal and Spatial Aspects of Blue King Crab Bycatch

4.3.1 Groundfish Fisheries

Observer data from groundfish fisheries indicated that very few 'other' king crab (golden king crab, scarlet king crab, and blue king crab combined) are taken in the vicinity of St. Matthew island. No additional analysis was performed to see where these crabs were taken (see Fritz et al 1998).

4.3.2 Crab Fisheries

Observers stationed on catcher-processor vessels have provided data on catch of non-retained blue king crab in the St. Matthew Island Section during the commercial snow crab and blue king crab fisheries. We summarize results of those data for the 1992 through the 1999 seasons (sources are: Tracy 1994, 1995a, 1995b; Boyle et al. 1996, 1997).

Bycatch of non-retained St. Matthew blue king crab has been observed in the St. Matthew blue king crab fishery and the eastern Bering Sea snow crab fishery. It is doubtful that the only other commercial crab fishery that is occasionally prosecuted in the St. Matthew Island Section, the St. Matthew Island Section golden king crab fishery, encounters any bycatch of blue king crab due to differences in distribution of blue and golden king crabs. The available observer data indicates that, unless the blue king crab fishery is closed for a season, the blue king crab fishery accounts for nearly 100% of the annual estimated number of blue king crabs that are captured and discarded during crab fisheries within the St. Matthew Island Section.

Estimated number of non-retained blue king crabs captured annually during the 1992 through 1998 St. Matthew blue king crab fisheries has ranged from 1.7 million to 4.8 million animals. Those estimates compare with 0.6 million to 0.9 million legal males that were annually harvested in the fishery over the same period. Either sublegal males or females dominate the bycatch blue king crabs depending on the fishery season. Annual ratios of sublegal males to legal males in potlifts sampled by observers have ranged from 1:1 to 2:1. Annual ratios of females to legal males in potlifts sampled by observers have ranged from 1:1 to over 3:1. Forty percent to 80% of the bycatch females examined annually are mature. Blue king crab are biennial spawners (Somerton and MacIntosh 1985, Jensen and Armstrong 1989), and observer samples indicate that ovigerous females are extremely rare in the bycatch. Over 15,000 bycatch mature female blue king crab have been examined by observers since the 1990 season, but only 18 (<1%) of those were ovigerous. The paucity of ovigerous females in the observer samples likely reflects differences in distribution of ovigerous and barren mature females relative to the distribution of fishery effort. Inspection of the geographic distribution of catch per pot of immature females, mature females, sublegal males, and legal males in pot samples from catcher-processor vessels during the St. Matthew blue king crab seasons of the 1990's reveals no consistent "hotspots" of high bycatch and low directed catch (Figures 3 - 8). Bycatch of immature females, mature females, and sublegal males apparently occurs throughout the distribution of observed effort (largely between 30 and 40 fms, 55 m to 74 m, in waters south of St. Matthew Island) within which local areas of high catch rates can change between seasons.

The plots for Figures 3 through 8 are derived from bycatch data collected by shellfish observers deployed on catcher-processor vessels during the 1991, 1992, 1993, 1994, 1996, and 1998 St. Matthew blue king crab fishery seasons. Plots for the 1990, 1995, and 1997 seasons are not shown due to confidentiality of data resulting from less than three catcher-processor vessels participating in those seasons. The area fished by all vessels participating in the fishery may be more extensive than the area fished by catcher-processor vessels that is displayed in these plots. Z-scores are used here as a relative index of harvest compared to the overall mean harvest within a single fishery season. The darker areas represent areas of higher than average catch per pot lift (CPUE). The surfaces from the St Matthew fishery are based on an underlying 5 x 5-km grid. The depth contours in increments of 50 m are shown.

4.4 Measures to Control Bycatch in the Crab Fisheries

Gear modifications

Under the FMP, legal fishing gear modifications are at the discretion of the state. A number of pot gear modifications designed to inhibit bycatch in the crab fisheries have been adopted by the Board and incorporated into regulatory definitions of allowable gear. All pots used in Bering Sea crab fisheries must have biodegradable twine woven into a side wall (or tunnel) to prevent "ghost fishing" whenever fished gear is lost (ADF&G 1999). Regulations for some BSAI crab fisheries also include minimum pot tunnel entrance dimensions and escape rings or mesh panels to allow egress of non-retainable crabs, including females and undersized males. Gear modification regulations for the Bering Sea snow crab fishery provide some protection against blue king crab bycatch. Regulations for the snow crab fisheries require that pots contain egress 5-inch (stretched) mesh or 3.75-in (inside diameter) rings, but additionally specify a maximum pot tunnel height opening of 3 inches to reduce bycatch of king crabs.

In March 2000, the Board adopted gear modification regulations to reduce bycatch in the directed blue king crab fishery. These regulations require pots to be fitted with escape rings or stretched mesh to allow female and sublegal male crabs to escape.

Area Closures

In March 2000, the Alaska Board of Fisheries also adopted a closed area that includes all State waters around St. Matthew Islands, Hall Islands, and Pinnacle Island. This was established to protect egg-bearing females and their habitat. Figure 13 illustrates the habitat protection area.

Bycatch limits

Non-target crab bycatch caps have not been established in state or federal regulations for Bering Sea crab fisheries. Monitoring of bycatch species and evaluation of catch rates is these fisheries is presently accomplished through varying levels of at-sea observer coverage.

Fishing Seasons

Crab fishing seasons established by the Board (including those for FMP crab stocks) are also scheduled to minimize the potential for excessive bycatch and associated handling mortality of molting and mating crabs. The current September 15 season opening for St. Matthew blue king crabs (ADF&G 1999) appears to safeguard against high bycatch mortality resulting from crabs in this condition, as annual NMFS surveys conducted prior to the fishery indicate that molting and reproductive activity of this stock typically occurs earlier in the year. Likewise, the current timing of the Bering Sea snow crab fishery avoids harvesting during the early to mid-summer stock molting and mating.

5.0 Evaluation of Alternatives and Options

5.1 Harvest Strategy

ADF&G developed the new harvest strategy for the St. Matthew Island blue king crab fishery that the Board adopted in March 2000. The harvest strategy includes four components: a stock threshold, a minimum guideline harvest level (GHL), variable mature harvest rates, and a cap on legal male harvest rate. A stock abundance threshold was set to prevent against future instances of stock declines to "overfished" status. A minimum GHL was chosen because small GHLs are not manageable given the current size of the fishing fleet. A maximum legal harvest rate cap was set to prevent high removal rates of legal crabs when most mature males are sublegal size such as would be the case when a strong year class has yet to recruit to the fishery. The harvest strategy is closely based on NMFS technical guidance for implementing precautionary harvest strategies and rebuilding plans of Restrepo et al. (1998). The harvest strategy is detailed in the ADF&G report "Overview of Stock Assessment and Recommended Harvest Strategy for St. Matthew Island Blue king Crabs" (Zheng and Kruse 2000).

The four components of the proposed harvest strategy are:

Minimum stock threshold: 2.9 million lbs of mature male (105 mm carapace length) biomass. This is 25% of the equivalent mature male biomass capable of producing maximum sustainable yield (Bmsy=11.6 million lbs).

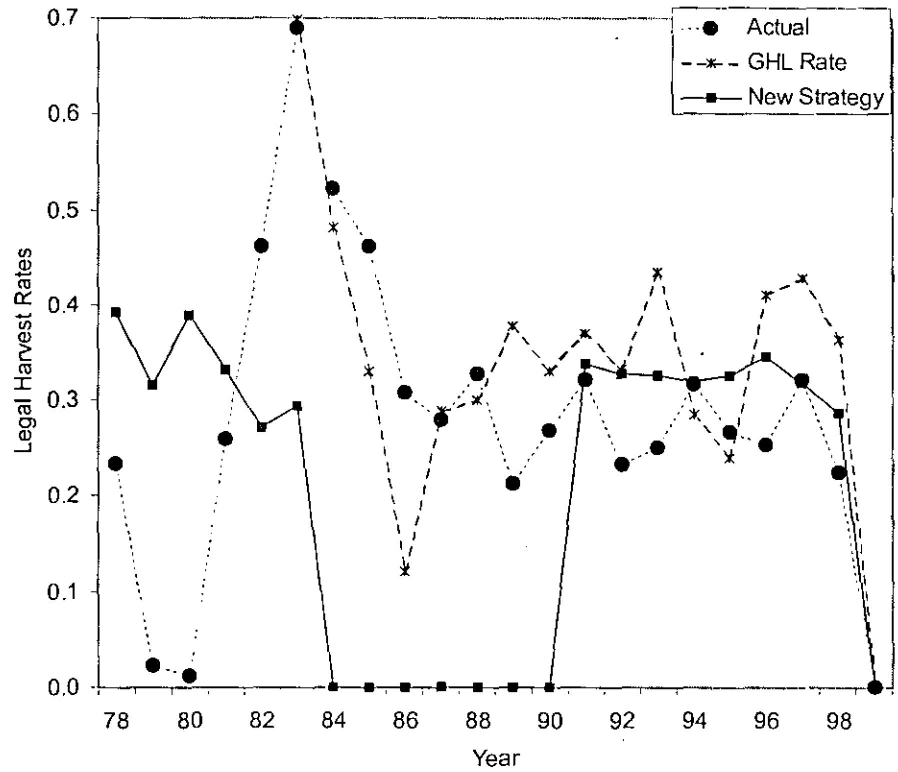
Minimum GHL: 2.5 million lbs.

Directed mature male harvest rates:

1. 0.0 when mature male biomass (B) < 2.9 million lbs,
2. $[(B-2.9)/8.7]*0.1+0.1$ when $11.6 > B \geq 2.9$ million lbs, and
3. 0.2 when $B \geq 11.6$ million lbs.

Cap of legal male harvest rate: 0.4.

Application of the proposed harvest strategy to historical population abundance from 1978 to 1999 resulted in legal harvest rates generally less than the historical rates associated with the GHLs (see adjacent Figure 5.1). All else being equal, the fishery would have been closed from 1984 to 1990 under the proposed harvest strategy due to the minimum GHL requirement in contrast to no historical closures during this period. However, GHL ranges were less than 2.5 million lbs during this period, and these would not have been manageable anyway under the current fleet size; thus, the difference in fishery closures between proposed and historical harvest strategies are overstated in Figure 5.1. Also, because of lower harvest rates, the population abundance would have been higher under the proposed harvest strategy than the actual historical abundance, so the number of years with fishery closure might have been less than indicated in Figure 5.1. That is, for purposes of Figure 5.1, we have not attempted to accumulate conservation benefits from the proposed strategy in one year in terms of improved stock conditions in the next year. We merely contrasted the proposed and the historical strategies given the historical stock assessment record.



Relative to the status quo, the new harvest strategy is much more conservative, particularly at low stock sizes, and would be expected to help maintain long term stock productivity, as well as increase the probability of stock rebuilding.

5.2 No Fishing

A no fishing alternative was analyzed in the development of the harvest strategy and in the estimations of the rebuilding time period. The no fishing alternative of the harvest strategy is detailed the ADF&G report "Overview of Stock Assessment and Recommended Harvest Strategy For St. Matthew Islands Blue King Crab" (Zheng and Kruse 2000). Under the specification of the rebuilding time period (section 6.0 of this document), the estimated rebuilding time period, with a 50% probability, is 5 years. This is one year less than the estimated rebuilding time period under the harvest strategy, which is 6 years.

5.3 Bycatch Controls

Mortality associated with crab bycatch may slow the recovery of the St. Matthew blue king crab stock to some extent. Based on 1994 and 1996 data, an estimated 136,000 to 308,000 St. Matthew blue king crabs were killed incidentally in Bering Sea fisheries. This equates to about 1.37% to 5.19% of the total abundance as measured by the NMFS trawl surveys.

Crab Fisheries

Bycatch in crab fisheries is a concern. As shown in the adjacent table, bycatch in crab fisheries accounts for a relatively high proportion of the stock (as measured by the trawl survey). For example, the 1994 St. Matthew crab fishery season resulted in 3.8 million crabs discarded and 3.8 million kept. In other words, for every legal crab retained during the 1994 season, one was thrown back. The 1992 season had even higher rates, with 4.8 million crabs discarded and only 2.5 million kept. In 1996, 1.7 million blue king crabs were discarded, and 3.1 million kept during the St. Matthew blue king crab fishery.

Given that bycatch rates of 1-to-3 females and 1-to-2 sublegal males for each captured legal male have been estimated from observer pot sample data in the St. Matthew blue king crab fishery, the Alaska Board of Fisheries (Board) considered options for reducing bycatch in the fishery.

Bycatch (numbers) of St. Matthew blue king crab in crab fisheries in the St. Matthew area, and current years survey abundance estimate.

Year	Bycatch	Abundance (millions)	Bycatch as %
1992	4,846,227	7.4	65.5
1993	3,201,528	14.6	21.9
1994	3,848,080	5.9	65.2
1995	conf.	5.6	n/a
1996	1,699,333	10.0	17.0

The Board's adopted a requirement for escape rings or escape mesh in pots used to fish St. Matthew blue king crab. The new regulations require each pot to be fitted with either 5.8-inch diameter escape rings (4 per side panel and 2-inch maximum distance for rings from bottom margin of side panel) or 8-inch stretch mesh on at least 1/3 of one vertical surface of the pot. These requirements will allow males <5.5 inches and females to escape. The minimum opening that a crab will be able to pass through is determined by "greatest length" of the crab as measured from the anterior tip of the rostrum to the posterior-most body margin (including protruding telsin spines). Morphometric analyses indicate that male St. Matthew blue king crabs at the minimum carapace width for legal retention (5.5 in or 140 mm) will have a greatest length of 5.8 in (148 mm; Tracy 2000). Hence, escape rings with a minimum inside diameter of 5.8-in or escape-mesh panels with webbing that provides a minimum opening of 5.8 in will allow passage of sublegal male crabs out of a pot. Most female St. Matthew blue king crab will also be able to pass through a 5.8-in opening.

It should be noted that pot-soak times used in the St. Matthew blue king crab fishery are typically very short -- 12 to 18 hours (ADF&G unpublished data). So, the effectiveness of escape rings or escape mesh for reducing bycatch in that fishery may be low without some means to extend the pot-soak times.

The Board also reduced bycatch of females during the St. Matthew blue king crab fishery by closing fishing in the areas in which egg-bearing females have been shown to occur at during historic preseason pot surveys and fisheries (Figure 13). This closure extends out to 3 n mi. Female St. Matthew blue king crabs tend to have a more limited distribution than do males (Blau 1996, Blau and Watson 1999, Vining et al. 1999) and are generally captured within 30 nm of the southern side of St. Matthew Island (Figures 9-12). Hence, the closed area was establish for the St. Matthew blue king crab fishery on the basis of female distribution in pot surveys and observer pot samples.

5.4 Habitat Protection

ADF&G identified the area within State waters around St. Matthew Islands, Hall Island, and Pinnacles Islands as habitat that is necessary for the long-term maintenance of the St. Matthew Island blue king crab stock. The Board closed these waters to crab fishing in March 2000 (Figure 13). ADF&G is working on a proposal to the Board to close these waters to all State managed fisheries.

Blue king crab have a biennial reproductive cycle with a 12-to-19-month period of embryonic development (Sasakawa 1975, Somerton and MacIntosh 1985, Jensen and Armstrong 1989) so that during any part of the year only a portion of the mature females are ovigerous. Analysis of NMFS trawl survey data, crab fishery observer data, and ADF&G pot survey data indicate that, at least during July through September, females carrying uneyed eggs (i.e., eggs that were extruded and fertilized the preceding spring) are concentrated in the shallow waters on the south shore of St. Matthew Island (Figures 9-12).

The annual NMFS eastern Bering Sea trawl survey visits the St. Matthew Island area in July. The trawl survey does not tow in waters shallower than 20 fm (37 m) and rarely in waters shallower than 30 fm (55 m) in the vicinity of St. Matthew Island. Of the 163 mature females (i.e., ovigerous or with empty egg cases) that have been captured the trawl survey during the last 8 survey years, only 14 (9%) were ovigerous with uneyed eggs, (R. MacIntosh, NMFS-Kodiak, pers. comm.). Likewise, ovigerous females with uneyed eggs have been rare in the two standardized pot surveys for St. Matthew blue king crab that have been performed by ADF&G. ADF&G performed pot surveys for St. Matthew blue king crab during August of 1995 (Blau 1996) and 1998 (Blau and Watson 1999). During the 1995 ADF&G pot survey (Figure 9), 2,383 mature females were captured, of which only 18 (<1%) were ovigerous with uneyed eggs (another 18 were ovigerous with eyed eggs); most of the ovigerous females captured were from the four shallowest (19 to 25 fm, or 35 to 46 m) fished. During the 1998 ADF&G pot survey (Figure 10) 1,775 mature females were captured, of which only 3 (<1%) were ovigerous with uneyed eggs (another 50 were ovigerous with eyed eggs). Additionally, ovigerous females have been rare among the many mature females that have been examined as bycatch during the St. Matthew blue king crab fishery by observers. The fishery occurs in the later half of September and most pot lifts sampled by observers are from depths of 30 fm (55 m) to 40 fm (73 m). During the 1990 through 1998 fisheries onboard observers examined over 15,000 female blue king crabs for clutch size and condition of which more than half were carrying empty egg cases and only 10 (<1%) were ovigerous with uneyed eggs (an additional 10 were ovigerous with eyed eggs).

Concentrations of ovigerous females with uneyed eggs were, however, identified by nearshore work (<20 fm) performed by ADF&G to supplement the standard pot survey. During the 1998 pot survey, four stations consisting of king crab pots or conical pots were set in the bight of the on the southeastern end of St. Matthew Island at depths of 4 fm (7 m) to 20 fm (37 fm) (Figure 11). A total of 1,462 females were captured in the nearshore pots during 1998, of which 1,436 (98%) were ovigerous with uneyed eggs. In 1999 ADF&G returned in August with cooperation from NMFS staff to survey the waters <20 fm (37 m) around St. Matthew Island with king crab and conical pots (Figure 12). A A total 1,585 mature females were captured during the 1999 nearshore work, of which 1,106 (70%) were ovigerous with uneyed eggs (S.F. Blau, ADF&G-Kodiak, pers. comm.). Highest densities of ovigerous females with uneyed eggs were observed on the southern side of St. Matthew Island, and there was a general increase in their densities with decreasing depth.

The results of the nearshore pot surveys as compared to standard surveys and fishery bycatch data clearly indicate the importance of the narrow band of waters < 20 fm (37 m) south of St. Matthew Island and adjacent to Pinnacle Island as habitat for ovigerous female blue king crabs.

At present, there are no indications that human activities in the BS/AI area have had any measurable effect on the existing habitats of blue king crabs. The present primary human use of the offshore area is commercial fishing. While the establishment of other activities could potentially generate user conflicts, pollution, and habitat deterioration, most scientists consider that the status of the habitat in this management area is generally unaffected by other human activities at this time. Activities that could adversely affect habitat in this area, as discussed in the crab FMP include: offshore petroleum production, coastal development and filling, marine mining, ocean discharge and dumping, litter, benthic habitat damage, and discharge of wastes.

Given the current status of blue king crab in the St. Matthew Island area, it seems reasonable that the importance of EFH in maintaining stock productivity should be a priority message contained in consultations on any proposed activities. To the extent feasible and practicable, this area should be protected from adverse impacts. The interim final rule for EFH states the following in the case of an overfished stock all habitats currently and historically used by the species should be considered essential. Therefore, EFH for St. Matthew blue king crab should be considered as all habitats used by this stock, at least until such a time as the stock is above MSST.

6.0 Specification of the Rebuilding Time Period

A four-stage catch-survey analysis was developed to assess the St. Matthew Island blue king crab stock (Zheng and Kruse 2000). The four-stage model extends the three-stage model by including pre-recruit-2 male crabs (90-104 mm CL), those two molts from becoming legal size. The three-stage analysis includes pre-recruit-1 (105-119 mm CL), recruit (newshell 120-133 mm CL), and post-recruit male (>133 mm CL and oldshell 120-133 mm CL) crabs. Unlike the three-stage version of Zheng and Kruse (1999) that was fitted to NMFS trawl survey data only, the new model was fitted to both NMFS trawl survey data from 1978 to 1999 and ADF&G pot survey data in 1995 and 1998. The additional data used in the new model are helpful for smoothing estimates of mature male crab abundance. Females are not modeled because too few are caught by the NMFS survey for analysis.

Because of uncertainty about instantaneous natural mortality (*M*) in 1999 (*M99*), we assumed that *M99* was either: (1) the same, (2) three times as high, or (3) five times as high as mean *M* from 1978 to 1998. Some model parameter values differ because of these three different assumptions (Table 6.1). Differences in parameter values among three scenarios are partially due to unavoidable confounding among parameters. Assumption (2) results in a measurement error in 1999 comparable to the measurement errors from 1978 to 1998 (Figure 6.1). Assumption (3) fits the survey data best because it assumes high natural mortality and small measurement error, whereas assumption (1) fits the data poorest because it assumes constant natural mortality and high measurement error in 1999. Thus, we used assumption (2) as the base model and assumptions (1) and (3) for sensitivity studies.

Recruitment to the model was assumed to enter the pre-recruit-2 size group. Based on a short time series from 1979 to 1999, model recruitment shows a semi-cyclic pattern with a low cycle for about 8 years (1981-88) and a period of high values for about 8 years (1989-96; Figure 6.2). This recruitment pattern is similar under three assumptions for natural mortality in 1999, although the absolute values of recruitment are different under different assumptions because of association among natural mortality, catchability, and selectivity parameters (Figure 6.2 and Table 6.1).

The four-stage model was used in computer simulations to estimate rebuilding time periods and rebuilding probabilities for St. Matthew Island blue king crabs. Similar to the "rebuilt" definition for eastern Bering Sea Tanner crabs (*Chionoecetes bairdi*), we define the stock to be "rebuilt" when mature biomass achieves a level (B_{msy}) capable of producing maximum sustainable yield in two consecutive years. This "rebuilt" definition reduces chances of rebuilding caused by survey measurement errors or a single strong year class. Model parameters for simulations are summarized in Table 6.1. All parameter values in Table 6.1 are estimated from the assessment model and observer data except that natural mortality rates used in the simulations are 4% lower than those estimated in the assessment model. Natural mortality estimated from the assessment model includes bycatch mortality from the directed pot fishery. In the simulation model we modeled natural mortality and handling mortality separately, so M was reduced accordingly.

The primary features of the simulation scenarios and options are as follows:

- The model was initialized with data on population status for 1999.

- Because of poor female data, only male crab data were used for stock assessment and simulation modeling. The current B_{msy} (22 million lbs, NPFMC 1998) is defined for both male and female blue king crabs. Based on the survey data from 1983 to 1997, we approximated the equivalent B_{msy} for mature male blue king crabs ≥105 mm CL as 11.6 million lbs.

- For each scenario and option, we simulated the population and fishery for 35 years with 1000 replicates. The average population status, rebuilding probability (the proportion of replicates at rebuilt status), loss of fishing opportunity (the proportion of replicates with fishery closure), and mean yield from the simulations were summarized to compare the alternative scenarios and options.

- Recruitment was modeled with three approaches: (1) randomly sampling from recruitment estimates from 1979 to 1999, (2) periodically semi-cyclic low recruitment (lasting randomly from 8 to 12 years) and high recruitment (lasting randomly from 6 to 10 years) with log-normally distributed noise, and (3) autocorrelated recruitment with recruitment equal to the mean level plus autocorrelated noise. We used assumption (1) as the base model and assumptions (2) and (3) for sensitivity studies.

- Handling mortality rate of captured but discarded sublegal males was assumed to be 20% for the directed crab fishery. We also examined the sensitivities of the results to handling mortality rates of 0 and 50%.

- Because few St. Matthew Island blue king crabs were caught as bycatch from groundfish fisheries, no bycatch from groundfish fisheries was included in the simulations.

- Standard deviation for log-normally distributed measurement error was assumed to be 0.2.

Four management options were compared in the simulations. We also examined the sensitivities of the results to minimum GHLs of 1.5 and 2.0 million lbs. The four management options are:

(1) Directed fishing mortality before the stock has been rebuilt and the proposed new harvest strategy described in section 5.1 after the stock has been rebuilt.

(2) Proposed new harvest strategy described in section 5.1.

(3) Fixed mature harvest rate of 20% with a threshold of 2.9 million lbs of mature male biomass, a minimum GHL of 2.5 million lbs, and a legal harvest rate cap of 40%.

(4) Fixed mature harvest rate of 20% with a fishery threshold of 0.6 millions of mature male crabs and without a minimum GHL. This is the status quo strategy.

Simulated results are illustrated in Figure 6.3 and summarized in Table 6.2. With the base model, the rebuilding time periods at 50% probability are 5 years without a fishery (T_{min}), 6 years with the new harvest strategy (option 2), 7 years with the fixed mature harvest rate of 0.2 (option 3), and 12 years with the status quo strategy (option 4). The rebuilding time periods at 90% probability are 8 years without a fishery, 12 years with management option 2, and 25 years with management option 4. Because T_{min} is less than 10 years, the maximum rebuilding time period, T_{max}, should be 10 years (Restrepo et al. 1998). Management option 3 has slightly higher mean yield than management option 2 but option 2 is more precautionary. The status quo strategy has highest fishing opportunity, produces highest mean yield, and requires longest time to rebuild the stock. However, with the current large fishing fleet, it may not be possible to manage the fishery with small GHLs.

Due to the minimum GHL, the fishery might be closed about 40% or more of the time within a 20-year horizon. High minimum GHL shortens rebuilding time periods, increases the proportion of years with fishery closures, and decreases mean yield. Because the mature male biomass that produces a GHL above the minimum level is much higher than the fishery threshold, the minimum GHL effectively functions as a higher fishery threshold. Small differences of the results among options 1-3 are primarily due to the minimum GHL. The current large fishing fleet may make it impossible to implement the status quo strategy when the population is low; thus, differences of the results between the status quo and proposed strategies in reality should be smaller than those simulated here. The minimum GHL is a manageability issue and is needed regardless what strategy will be used.

If the stock-recruitment relationship is density-dependent, the conservation benefits of management option 2 would be relatively higher than estimated because we assumed that recruitment is density-independent in this study. Furthermore, if the stock-recruitment relationship is depensatory, a conservative strategy such as the one we proposed will help prevent the stock from staying in the depressed condition for a long period of time. Many king crab stocks in the Gulf of Alaska have been depressed for more than two decades with little recruitment, indicating potential depensatory stock-recruitment relationships for these stocks. However, rebuilding time periods at 50% probability would not greatly be affected by the assumption of density-independent stock-recruitment relationship because any management actions taken now to protect the spawning stock will not have great effects on recruitment until 6 to 8 years later owing to the time from mating to recruitment. Unfortunately, data are not available to test for a stock-recruitment relationship for this crab stock.

Rebuilding time periods and probabilities also depend on assumptions on future recruitment and handling mortality rate (Table 6.2). As expected, at 50% rebuilding probability, rebuilding time periods are generally shortest for scenarios with randomly selected recruitment because recruitment has been high more than half of the time (Figure 6.2). Rebuilding time periods are longest for scenarios with autocorrelated recruitment because the stock recently entered a period of declining recruitment (Figure 6.2) and autocorrelation continues that trend. For high rebuilding probabilities, rebuilding time periods are shortest for scenarios with semi-cyclic recruitment because the cycle deterministically turns to high recruitment after a certain number of years. High handling mortality rates increase rebuilding time periods and decrease mean yield. Closing the fishery until the population is rebuilt considerably shortens time to rebuild with a high rebuilding probability. Assumptions about 1999 natural mortality slightly affect the rebuilding time periods, proportions of fishery closure, and mean yield.

One notable feature of our simulation model is that we modeled male crabs only. Because the fishery retains only legal male crabs, the impact of fishing is higher on mature male biomass than on total mature male and female biomass. Therefore, the difference of rebuilding time periods between management options 1-3 and option 4 would be smaller than estimated if the simulation model included crabs of both sexes. Under our base model, the difference of rebuilding time periods between the proposed and status quo strategies is 6 years (Table 6.2). Because overall mature male biomass is higher than mature female biomass, even without any impact on female abundance (no handling mortality), the difference of rebuilding time periods between the two options should still be 3 or 4 years. However, based on limited observer data, the bycatch of females is very high for this fishery, and depending on handling mortality rate, the fishery could have substantial impact on female mature biomass. Considering the bycatch mortality of females, rebuilding time periods for the status quo strategy should not be greatly different between the models with only males and with both males and females.

Overall, under our base model, T_{min} is 5 years, and T_{max} is 10 years. If the current trend of poor recruitment continues as would be the case under the autocorrelated recruitment scenario, T_{min} will be 8 years, and T_{max} will still be 10 years. Either way, the target rebuilding time periods (T_{target}) with the new proposed harvest strategy are within these T_{min} and T_{max} bounds as required by the Magnuson-Stevens Fishery Conservation and Management Act.

Table 6.1. Parameters for a four-stage model used to estimate rebuilding time periods and probabilities through computer simulations for St. Matthew blue king crabs. All parameters are estimated from the assessment model and observer data except that natural mortality rates are 4% lower than those estimated in the assessment model.

Parameter	Natural Mortality in 1999 3*M	1*M	5*M
Natural Mortality (M) during 1978-98	0.35	0.26	0.31
Trawl Catchability: Pre-recruit 2	0.38	0.53	0.41
Trawl Catchability: Pre-recruit 1	0.79	0.95	0.83
Trawl Catchability: Legals	1.00	1.00	1.00
Pot Selectivity: Pre-recruit 2	0.23	0.29	0.20
Pot Selectivity: Pre-recruit 1	0.61	0.71	0.58
Pot Selectivity: Legals	1.00	1.00	1.00
Molting Probability: Pre-recruit 2	1.00	1.00	1.00
Molting Probability: Pre-recruit 1	0.91	0.92	0.90
Autocorrelation Coefficient	0.70	0.70	0.70
Recruitment Deviate in 1999	-1.00	-1.00	-1.00
St. Dev. for Autocorrelated R	0.54	0.54	0.54
Low Recruitment Cycle Length (yr)	8-12	8-12	8-12
High Recruitment Cycle Length (yr)	6-10	6-10	6-10
Cycle Magnitude (ln scale)	0.82	0.82	0.82
St. Dev. for Cyclic Recruitment	0.28	0.28	0.28
St. Dev. for Mean Recruitment	0.24	0.24	0.24
Abundance in 1999 (millions of crabs)			
Pre-recruit 2	0.64	0.46	0.59
Pre-recruit 1	0.47	0.60	0.32
Recruits	0.41	0.63	0.27
Post-recruits	0.69	1.35	0.45

	Parameters for Three Scenarios Mean W(lbs)	Growth Matrix: From Pre-recruit 2	Pre-recruit 1
Pre-recruit 2	1.47	0.11	0.00
Pre-recruit 1	2.33	0.83	0.11
Recruits	3.51	0.06	0.83
Post-recruits	4.83	0.00	0.06

Table 6.2. Comparisons of mean number of years required to achieve ≥10%, 50% and 90% rebuilding probabilities (RP) and mean proportions of years with fishery closure and mean annual yields (million lbs) within 5, 10 and 20 years after the year 1999 under four management options with different levels of GHL threshold (TH, million lbs) and different assumptions of recruitment dynamics, natural mortality in 1999 (*M99*), and handling mortality rates (HM). The first four rows in bold font are the results from the base model.

Scenarios				Years at RP≥			Fishery Closure			Mean Annual Yield		
M99	**TH**	**HM**	**Option**	**10%**	**50%**	**90%**	**5yr**	**10yr**	**20yr**	**5yr**	**10yr**	**20yr**
					Randomly Selected Recruitment							
3*M	**2.5**	**0.2**	**1**	**4**	**5**	**8**	**0.82**	**0.57**	**0.44**	**0.681**	**1.564**	**1.959**
3*M	**2.5**	**0.2**	**2**	**4**	**6**	**12**	**0.66**	**0.50**	**0.42**	**1.148**	**1.711**	**2.009**
3*M	**2.5**	**0.2**	**3**	**4**	**7**	**13**	**0.64**	**0.48**	**0.40**	**1.195**	**1.755**	**2.051**
3*M	**0**	**0.2**	**4**	**6**	**12**	**25**	**<0.01**	**<0.01**	**<0.01**	**1.953**	**2.275**	**2.478**
1*M	2.5	0.2	1	2	4	6	0.69	0.50	0.42	1.134	1.751	1.997
1*M	2.5	0.2	2	3	6	12	0.53	0.45	0.41	1.553	1.871	2.039
1*M	2.5	0.2	3	3	6	14	0.50	0.42	0.38	1.619	1.916	2.078
5*M	2.5	0.2	1	4	5	7	0.83	0.55	0.41	0.647	1.653	2.095
5*M	2.5	0.2	2	4	6	11	0.67	0.49	0.39	1.113	1.783	2.140
5*M	2.5	0.2	3	4	6	12	0.65	0.47	0.37	1.156	1.826	2.177
3*M	2.5	0.0	1	4	5	8	0.82	0.55	0.41	0.691	1.643	2.109
3*M	2.5	0.0	2	4	6	11	0.65	0.47	0.39	1.190	1.838	2.176
3*M	2.5	0.0	3	4	6	12	0.63	0.45	0.36	1.243	1.884	2.226
3*M	2.5	0.5	1	4	5	8	0.82	0.60	0.49	0.668	1.441	1.757
3*M	2.5	0.5	2	4	7	14	0.68	0.54	0.48	1.076	1.545	1.788
3*M	2.5	0.5	3	4	8	16	0.66	0.52	0.45	1.119	1.582	1.824
3*M	1.5	0.2	1	4	5	8	0.81	0.46	0.25	0.709	1.732	2.188
3*M	1.5	0.2	2	4	8	17	0.42	0.27	0.20	1.481	1.984	2.256
3*M	1.5	0.2	3	4	9	20	0.30	0.18	0.11	1.669	2.122	2.375
3*M	2.0	0.2	1	4	5	8	0.81	0.50	0.33	0.704	1.675	2.108
3*M	2.0	0.2	2	4	7	14	0.56	0.40	0.32	1.310	1.855	2.144
3*M	2.0	0.2	3	4	8	17	0.49	0.33	0.25	1.452	1.972	2.250
					Semi-Cyclic Recruitment							
3*M	2.5	0.2	1	6	7	8	1.00	0.63	0.50	0.009	1.542	1.924
3*M	2.5	0.2	2	7	8	9	0.93	0.53	0.46	0.221	1.758	1.999
3*M	2.5	0.2	3	7	8	9	0.90	0.51	0.44	0.281	1.789	2.033
3*M	0	0.2	4	8	9	11	<0.01	<0.01	<0.01	1.325	2.226	2.496
					Autocorrelated Recruitment							
3*M	2.5	0.2	1	5	8	15	0.95	0.74	0.58	0.232	1.124	1.828
3*M	2.5	0.2	2	5	10	22	0.84	0.67	0.54	0.536	1.311	1.911
3*M	2.5	0.2	3	5	10	23	0.83	0.65	0.52	0.570	1.344	1.943
3*M	0	0.2	4	6	13	32	0.01	0.01	0.01	1.502	1.999	2.468

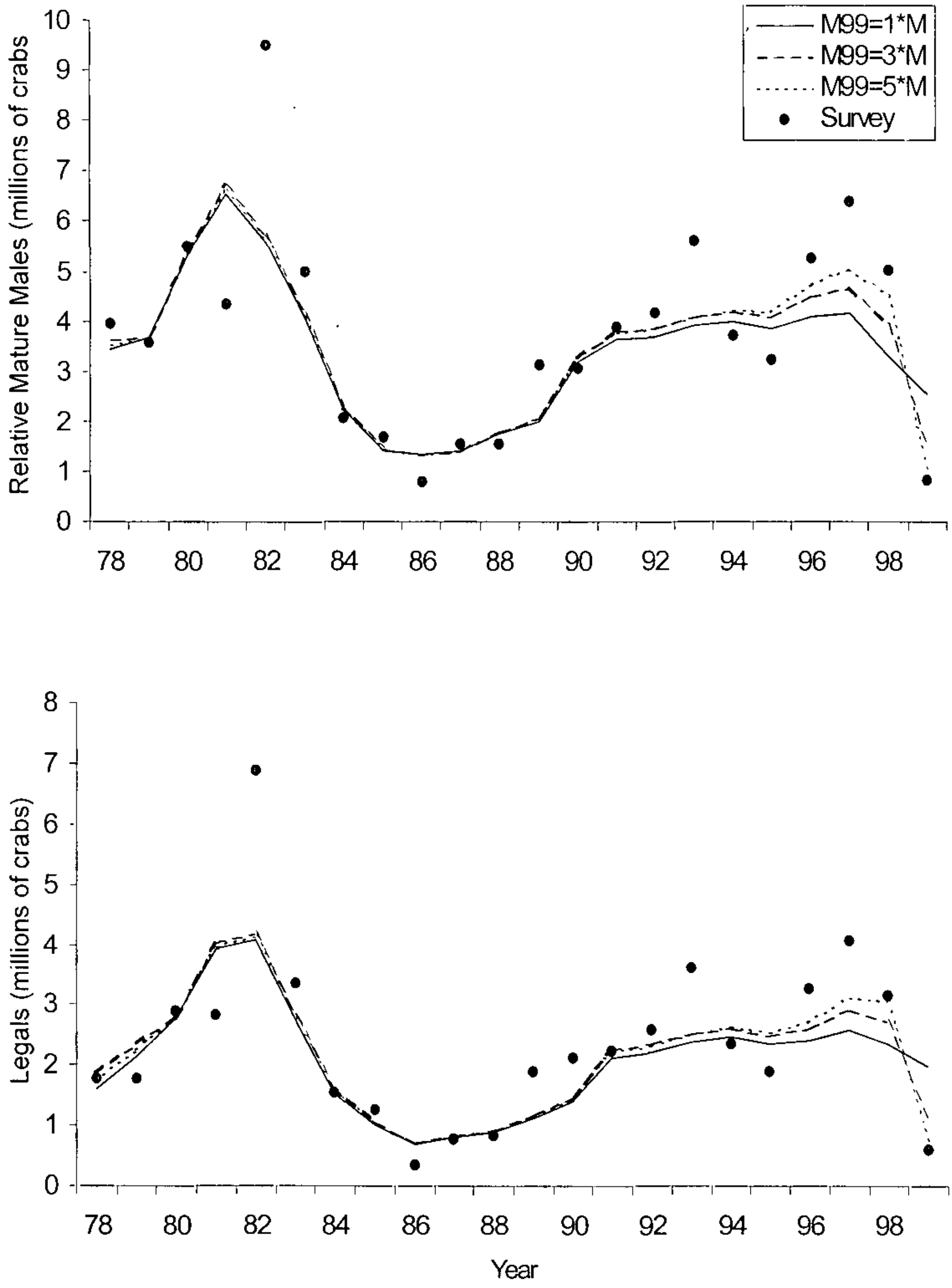


Figure 6.1. Comparison of abundance estimates of St. Matthew mature (top panel) and legal (bottom panel) male blue king crabs from area-swept estimates and catch-survey analysis. Three assumptions were made for instantaneous natural mortality in 1999 (*M99*).

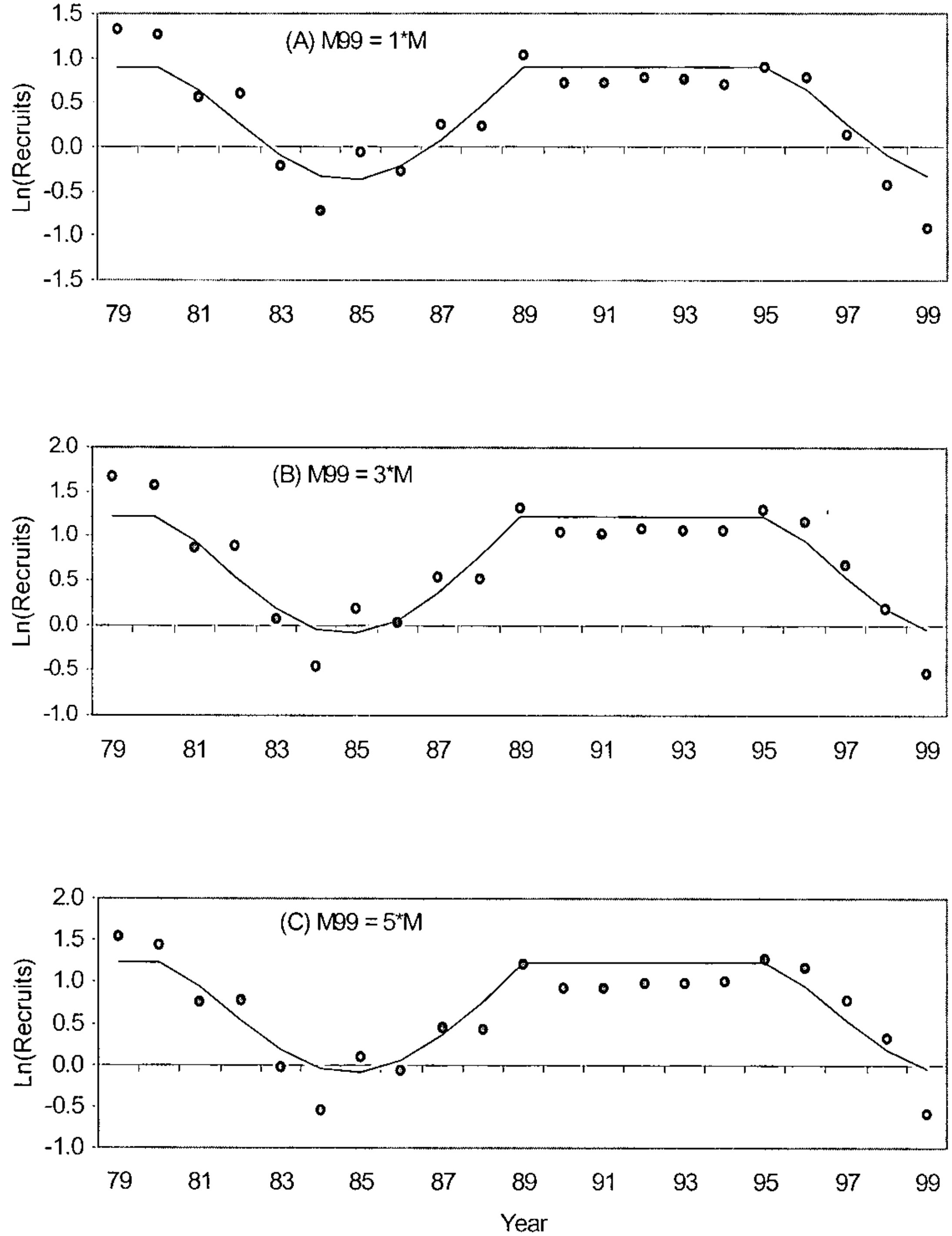
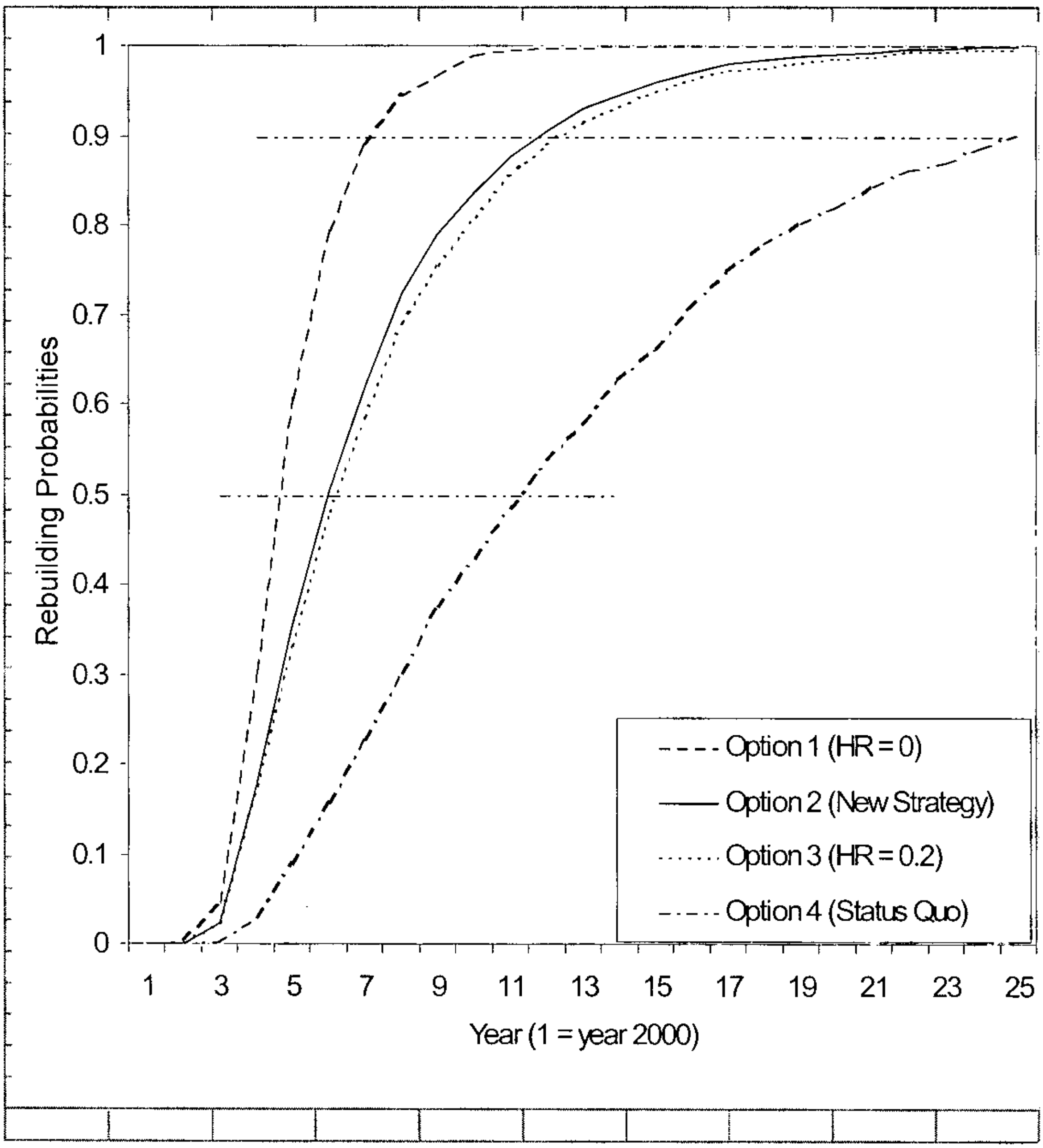


Figure 6.2. Logarithm of male recruitment to the model and the fit of semi-cyclic recruitment. Year is year of recruitment to the model as pre-recruit-2 males. Recruitment was estimated by a four-stage catch-survey analysis with three assumptions of natural mortality in 1999 (*M99*) shown in panels A, B, and C.

Figure 6.3. Estimated rebuilding probabilities for four harvest strategy options under the assumption of randomly selected recruitment for St. Matthew blue king crabs. Parameters used in the simulations were estimated with an assumption that natural mortality in 1999 was three times as high as the mean from 1978 to 1998. Year 1 corresponds to 2000.



6.1 Mechanisms for Monitoring Effectiveness of the Rebuilding Plan

Mechanisms are in place for monitoring the effectiveness of the rebuilding plan. The NMFS eastern Bering Sea bottom-trawl survey provides an annual assessment of the status of the St. Matthew blue king crab stock. ADF&G will use the results of that survey to determine openings and harvest. The annual survey will allow the BSAI Crab Plan Team to include an assessment of the stock status relative to the overfished level and its progress towards the rebuilt level in the Stock Assessment and Fishery Evaluation (SAFE) Report for the king and Tanner crab fisheries of the BSAI.

ADF&G also conducts a pot survey on a triennial basis for blue king crab in the St. Matthew area (Blau 1995, Blau and Watson 1998). Most of the pot survey effort is devoted to the area south of St. Matthew Island in the relatively shallow waters (25-55 fm) that supports much of the blue king crab commercial fishery and the mature female population. Use of pots allows for surveying areas that are not accessible to the NMFS EBS trawl survey. This survey is invaluable for providing population indices and indicators of crab distribution for large portions of the legal and mature female stock that are not represented in the annual NMFS trawl survey (Vining, et al 1999). Tagged crabs that are released during the pot survey are recovered during the commercial fishery to provide data for evaluating vulnerability of crabs to the commercial harvest as a function of preseason distribution.

Programs exist within ADF&G and NMFS to contain levels of catch and bycatch at those prescribed in the rebuilding plan. Any catch or bycatch level that departs from that prescribed by the rebuilding plan can be assessed and will be reported in the SAFE. ADF&G will monitor catch and bycatch from the directed crab fishery and NMFS and ADF&G will monitor bycatch of blue king crabs in other fisheries. There currently exist programs for reporting catch to ADF&G fishery managers during the directed crab fishery so that the harvest can be capped at the level prescribed by the harvest strategy. ADF&G currently has a dockside sampling program for monitoring landings during the commercial fishery to shoreside processors and an observer program for monitoring landings by floater-processor vessels and catcher-processor vessels. ADF&G reports the total harvest from the commercial fishery and that report will be included annually in the SAFE. The NMFS observer program provides the means by which bycatch of crabs can be monitored inseason during the BSAI trawl groundfish fisheries.

The Board passed regulations in 1999 that allow for expansion of the state observer program for crab fisheries into the catcher-only vessel component effective July 2000. Coupled with the existing state program that provides for observer coverage on catcher-processor vessels, the expanded crab-fishery observer program will provide improved estimates of the bycatch of crabs that occurs during the crab fisheries. Estimates of bycatch in the groundfish pot and longline fisheries will be provided by the existing NMFS observer program. Estimates of crab bycatch from all commercial fisheries will be reported annually in the SAFE and the BSAI Crab Plan Team will assess that bycatch relative to the expectations and assumptions of the rebuilding plan.

7.0 Environmental Consequences

The St. Matthew Island blue king crab fishery occurs in that portion of the Bering Sea north of the latitude of Cape Newenham at 58 39'N. lat. and south of the latitude of Cape Romanzof at 61 49'N. lat. Descriptions of the affected environment are given in the FSEIS for the groundfish fisheries (NMFS 1998). Substrate is described at section 3.1.1, water column at 3.1.3, temperature and nutrient regimes at 3.1.4, currents at 3.1.5, marine mammals at 3.4, seabirds at 3.5, benthic infauna and epifauna at 3.6, prohibited species at 3.7, and the socioeconomic environment at 3.10. The projections for fishing year 1999, as well as the status of the stocks and history of the fishery, are contained in the 1999 BSAI crab SAFE report (NPFMC 1999).

An environmental assessment (EA) is required by the National Environmental Policy Act of 1969 (NEPA) to determine whether the action considered will result in significant impact on the human environment. If the action is determined not to be significant based on an analysis of relevant considerations, the EA and resulting finding of no significant impact (FONSI) would be the final environmental documents required by NEPA. An environmental impact statement (EIS) must be prepared for major Federal actions significantly affecting the human environment. This section contains the discussion of the environmental impacts of the alternatives including impacts on threatened and endangered species and marine mammals.

The environmental impacts generally associated with crab fishery management actions are effects resulting from (1) harvest of crab stocks which may result in changes in food availability to predators and scavengers, changes in the population structure of target stocks, and changes in the marine ecosystem community structure; (2) changes in the physical and biological structure of the marine environment as a result of fishing practices, e.g., effects of pot gear use; and (3) entanglement/entrapment of non-target organisms in active or inactive fishing gear.

The rebuilding plan will reduce the environmental consequences of the blue king crab fishery by 1) prohibiting fishing some years, 2) allowing fishing at a reduced harvest rate during other years, and 3) protecting egg-barring females and their habitat with a closed area (Figure 13). For the rebuilding plan, the Council may adopt the harvest strategy for blue king crab developed by ADF&G and adopted by the Board. The harvest strategy is intended to improve management of the blue king crab fishery and improve long term stock productivity, as well as increase the probability of stock rebuilding. The harvest strategy will be implemented by ADF&G. The harvest strategy will close the blue king crab fishery when abundance is low, allow a fishery at a reduced harvest level when abundance has increased, and a establish sustainable harvest rate, which is less that the status quo, when the stock is rebuild.

7.1 Trophic Interactions

The marine food-web of North Pacific marine fishes are complex (Livingston and Goiney 1983). Numerous species of plankton, phytoplankton, invertebrates, mollusks, crustaceans, forage fish, demersal, mid-water, and pelagic fish, marine mammals, seabirds, and humans combine to comprise the food-web present in the BSAI and GOA. Environmental changes as well as human exploitation patterns can effect changes to trophic interactions. Fishing causes direct changes in the structure of benthic communities by reducing the abundance of target or by-catch species, then these reductions may lead to responses in non-target species through changes in competitive interactions and predator prey relationships. Indirect effects of fishing on trophic interactions in marine ecosystems may also occur. Current debates on these topics include comparing relative roles of "top down" (predator) or "bottom up" (environmental and prey) control in ecosystems and the relative significance of "donor controlled" dynamics (in which victim populations influence enemy dynamics but enemies have no significant effect on victim populations) in the food webs (Jennings and Kaiser 1998.)

Minimal research has been conducted on the trophic interactions of St. Matthew's blue king crab. We can assume that blue king crab have similar trophic interactions as red king crab, however, blue king crab are predominantly distributed around the Pribilof Islands and St. Matthew's Island. A number of fish species are known to feed on larval red king crab, including Pollock, Pacific herring, sockeye salmon, and yellowfin sole. Once the crab settle on the sea floor, they are prey to a number of commercial and non-commercial fish species such as most flatfish species, halibut, sablefish, skates, sculpins, and other benthic invertebrates, such as sea stars. A high rate of cannibalism by juvenile red king crab on younger crab also exists. Studies have documented that Pacific cod consume soft-shelled female adult red king crab.

7.2 Impacts on Habitat

Inclusively all the marine waters and benthic substrates in the management areas comprise the habitat of all marine species. Additionally the adjacent marine waters outside the EEZ, adjacent State waters inside the EEZ, shoreline, freshwater inflows, and atmosphere above the waters, constitutes habitat for prey species, other life stages, and species that move in and out of, or interact with, the fisheries' target species, marine mammals, seabirds, and the ESA listed species. Fishery impacts on habitat are further reduced by the closure of State waters around St. Matthew Island, Hall Islands, and Pinnacle Island, which is discussed in detail in section 5.4.

Blue king crab rely on habitat in a number of ways. Young of the year blue king crab require nearshore shallow habitat with significant cover that offers protection (e.g. sea stars, anemones, macroalgae, shell hash, cobble, shale) to this frequently molting life stage. The juvenile stages of blue king crab require high relief habitat nearshore with extensive biogenic assemblages.

This section contains analyses of potential fishing gear impacts on benthic substrate attributable to crab fisheries. The habitat impacts of the crab fishery will not increase due to this proposed action because the proposed action does not increase the amount of crab harvested or change the location of the fishery. In fact, under the rebuilding plan harvest strategy, the fishery will have no habitat impacts in the years that the fishery is closed and will have a decreased habitat impacts when the harvest level is reduced. Further, once the stock is rebuilt, the new harvest strategy will ensure that the harvest rate remains below the status quo harvest rate. Summaries and assessments of habitat information for BSAI king and Tanner crab are provided in the "Essential Fish Habitat Assessment Report for the Bering Sea and Aleutian Islands King and Tanner Crabs" dated March 31, 1998 (available from the NPFMC).

7.2.1 Direct Impacts of Fishing Gear on Habitat

The blue king crab fishery uses pot gear. This gear type likely affects habitat during setting and retrieval of pots; however, no research quantifying the impacts has been conducted to date. Whatever the direct effects of setting and pulling pot gear on the benthic environment, they appear to be small in comparison to the potentially large-scale effects of "ghost-fishing" by derelict pots. Lost by the fishery, these pots may continue to entrap animals until their netting or escape panels disintegrate. Inasmuch as they are unbated, the primary attraction of derelict pots is their physical structure, which adds complexity and vertical relief to a generally featureless environment. No additional pot loss is expected under the proposed action. Under the rebuilding plan, no pot loss will occur in years when the fishery is closed.

Like other fisheries, pot fisheries incur some bycatch of incidental fish and crab. Bycatch in crab pot fisheries includes crabs, octopus, Pacific cod, halibut, and other flatfish (Tracy 1994). Crab bycatch in the blue king crab fishery includes females of target species, sublegal males of target species, and non-target crabs, primarily C. opilio crab. Section 3.1.2.3 of the groundfish FSEIS (NMFS 1998) provides a detailed description of the impacts of pot gear on the seas floor. Section 1.5.2 of this document provides a detailed description of bycatch in the blue king crab fishery and bycatch of blue king crab in other fisheries.

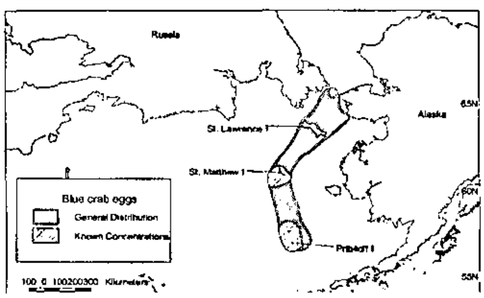
The rebuilding plan reduces direct impacts of trawl gear on near-shore habitat by closing State waters to crab fishing (Figure 13). The State identified near-shore habitat as important for egg-bearing female and juvenile blue king crab.

7.2.2 Impacts on Essential Fish Habitat

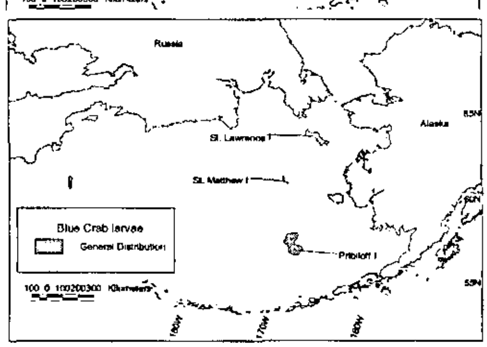
Section 303(a)(7) of the Magnuson-Stevens Act requires all FMPs to describe and identify EFH , which it defines as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." In addition, FMPs must minimize effects on EFH caused by fishing and identify other actions to conserve and enhance EFH. Groundfish and blue king crab fisheries occur within essential fish habitat (EFH) for a number of fish and invertebrate species. In the Bering Sea, EFH includes those identified for pollock, Pacific cod, many flatfish species, other groundfish species, red king crab, Tanner crab, and snow crab. Additional information on EFH can be found in the EA for Amendments 55/55/8/5/5 (NPFMC 1999 - copies of this document can be obtained from the Council office upon request). The interim final rule for EFH states the following in the case of an overfished stock:

"If a species is overfished, and habitat loss or degradation may be contributing to the species being identified as overfished, all habitats currently used by the species should be considered essential in addition to certain historic habitats that are necessary to support rebuilding the fishery and for which restoration is technologically and economically feasible. Once the fishery is no longer considered overfished, the EFH identification should be reviewed, and the FMP amended, if appropriate."

On January 20, 1999, the Council's five FMPs (BSAI and GOA groundfish, salmon, crab, and scallops) were amended to incorporate EFH provisions. These provisions included identification and description of EFH including habitat areas of particular concern, identification of research and information needs, and identification of potential adverse effects on EFH due to fishing and non-fishing activities. Additional information on EFH can be found in the EA for Amendments 55/55/8/5/5 (NPFMC 1999 - copies of this document can be obtained from the Council office upon request). The EFH definitions adopted for blue king crab life stages are listed below.



Egg - Level 0b, Level 1 and Level 2
Same as Mature. Essential habitat for eggs is known for the stock of blue king crab in the Pribilof Islands based on general distribution (level 1) and density (level 2) of egg bearing female crabs. Essential habitat for eggs of the St. Matthew Island blue king crab stock is based on general distribution (level 1) of the egg bearing females. Essential habitat for eggs of the St. Lawrence Island blue king crab stock is inferred from incidental catch of mature female crab.

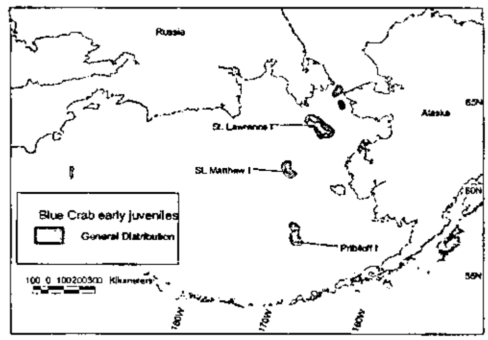


Larvae - Level 0c and Level 1
No EFH definition determined for the St. Matthew Island and St. Lawrence stocks.
Blue king crab larvae spend 3.5 to 4 months in pelagic larval stages before settling to the benthic life stage. Larvae are found in waters of depths between 40 to 60 m. Essential habitat of larval blue king crab of the Pribilof Islands stock is defined using the

general distribution (level 1) of larvae in the water column. Information to define essential habitat is not available for the St. Matthew Island and St. Lawrence Island stocks of larval blue king crab.

Early Juvenile - Level 0c and Level 2

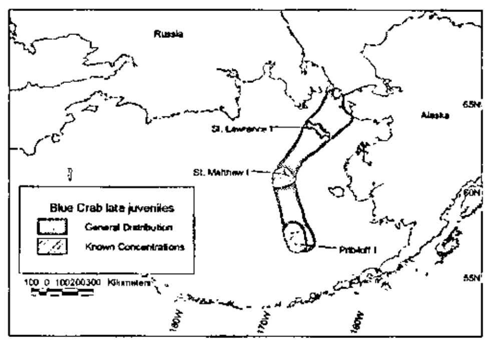
No EFH definition determined for the St. Matthew and St. Lawrence Island stocks. Early juvenile blue king crabs require refuge substrate characterized by gravel and cobble overlaid with shell hash, and sponge, hydroid and barnacle assemblages. These habitat areas have been found at 40-60 m around the Pribilof Islands. Essential habitat of early juvenile blue king crabs is based on general distribution (level 1) and density (level 2) of this life stage in the Pribilof Island stock. Information to define essential habitat for early juvenile blue king crabs in the St. Matthew Island and St. Lawrence Island stocks is not available.



Late Juvenile - Level 0c, Level 1 and Level 2

NO EFH definition determined for the St. Lawrence Island stock.

Late juvenile blue king crab require nearshore rocky habitat with shell hash. Essential habitat is based on general distribution (level 1) and density (level 2) of late juvenile blue king crab of the Pribilof Islands stock. General distribution (level 1) of the late juvenile blue king crabs is used to identify essential habitat for the St. Matthew Island stock. Information is not available to define essential habitat for the St. Lawrence Island stock of late juvenile blue king crab.



Mature - Level 1 and Level 2

Mature blue king crabs occur most often between 45-75 m depth on mud-sand substrate adjacent to gravel rocky bottom. Female crabs are found in a habitat with a high percentage of shell hash. Mating occurs in mid-spring. Larger older females reproduce biennially while small females tend to reproduce annually. Fecundity of females range from 50,000-200,000 eggs per female. It has been suggested that spawning may depend on availability of nearshore rocky-cobble substrate for protection of females. Larger older crabs disperse farther offshore and are thought to migrate inshore for molting and mating. General distribution (level 1) and density (level 2) of mature blue king crab are used to identify essential habitat for the Pribilof Islands and St. Matthew Island stocks. Essential habitat of mature blue king crab is based on distribution (level 1) data for the St. Lawrence Island stock.

Given the current status of St. Matthew's blue king crab, it seems reasonable that the importance of blue king crab EFH in maintaining stock productivity should be a priority message contained in consultations on any proposed activities. To the extent feasible and practicable, this area should be protected from adverse impacts. The interim final rule for EFH states the following in the case of an overfished stock: "If a species is overfished, and habitat loss or degradation may be contributing to the species being identified as overfished, all habitats currently used by the species should be considered essential in addition to certain historic habitats that are necessary to support rebuilding the fishery and for which restoration is technologically and economically feasible. Once the fishery is no longer considered overfished, the EFH identification should be reviewed, and the FMP amended, if appropriate." Therefore, EFH for St. Matthew's blue king crab should be considered as all habitats used by this stock, at least until such a time as the stock is above MSST. Additional and updated information on blue king crab habitat was provided in this analysis.

Additionally, the results of the nearshore pot surveys as compared to standard surveys and fishery bycatch data clearly indicate the importance of the narrow band of waters < 20 fm (37 m) south of St. Matthew Island and adjacent to Pinnacle Island as habitat for ovigerous female blue king crabs. This area should be identified and protected as habitat that is necessary for the long-term maintenance of the St. Matthew Island blue king crab stock. Actions taken to protect blue king crab habitat could potentially benefit groundfish and other crab stocks in the area.

The blue king crab fishery occurs around St. Matthew's Island in the Bering Sea, concentrating in the south of the St. Matthew's Island. According to the EA for Amendment 8 to Crab FMP, it is reasonable to assume that the blue king crab fishery may impact the EFH of the following species: yellowfin sole, rock sole, flathead sole, skates, sculpins, golden king crab, scarlet king crab, C. opilio crab, and Triangle Tanner crab. Insufficient data exists to determine the extent of the impacts on EFH, beyond the fact that the blue king crab fishery occurs in the species general distribution. No evidence suggests that the blue king crab fishery impacts the EFH of salmon. The blue king crab fishery does not occur on any areas designated as Habitat Areas of Particular Concern (HAPC). This proposed action will not change the location of the blue king crab fishery.

The rebuilding plan reduces the harvest rate from status quo and provides for decreased harvest if the stock is below the minimum stock size threshold and provides for no fishing when the stock is at very low levels of abundance. The action proposed by this regulatory amendment will not increase the amount of harvest, the intensity of harvest, or the location of harvest, therefore, this action is presumed not to increase the impacts of the fishery to EFH. Based on the above, this action, in the context of the fishery as a whole, will not adversely affect EFH for species managed under the four North Pacific FMPs. As a result of this determination, an EFH consultation is not required.

7.3 *Biological Diversity*

The concept of biological diversity is generally used to denote the variety of living things in an ecosystem. The definition of biological diversity considers three levels: genetic, species, and ecosystem diversity. There is potential for other ecological impacts of this proposal. Reduced bottom trawl and crab pot effort may result in reduced unobserved mortality on fish, crabs, and other benthic organisms. This issue, and other potential ecological effects of trawling and pot fishing, has been thoroughly discussed in previous analyses (e.g., EFH amendment analyses; NPFMC 1999).

Adoption of Alternative 2 is expected to allow the St. Matthew's blue king crab stock to rebuild to the Bmsy level within 10 years. Adoption of the revised harvest strategy should result in more spawning biomass as more larger male crab would be conserved. This higher spawning biomass would be expected to produce good year-classes when environmental conditions are favorable. Protection of habitat and/or reduction of bycatch would reduce mortality on juvenile crabs, allowing a higher percentage of each year-class to contribute to spawning (and future landings). Any or all of these actions proposed under Alternative 2 would be expected to improve the status of this stock, thus promoting biological diversity.

7.4 Endangered Species Act Considerations

The Endangered Species Act of 1973 as amended (16 U.S.C. 1531 et seq; ESA), provides for the conservation of endangered and threatened species of fish, wildlife, and plants. The program is administered jointly by the NMFS for most marine mammal species, marine and anadromous fish species, and marine plants species and by the USFWS for bird species, and terrestrial and freshwater wildlife and plant species.

The designation of an ESA listed species is based on the biological health of that species. The status determination is either threatened or endangered. Threatened species are those likely to become endangered in the foreseeable future [16 U.S.C. § 1532(20)]. Endangered species are those in danger of becoming extinct throughout all or a significant portion of their range [16 U.S.C. § 1532(20)]. Species can be listed as endangered without first being listed as threatened. The Secretary of Commerce, acting through NMFS, is authorized to list marine fish, plants, and mammals (except for walrus and sea otter) and anadromous fish species. The Secretary of the Interior, acting through the USFWS, is authorized to list walrus and sea otter, seabirds, terrestrial plants and wildlife, and freshwater fish and plant species.

In addition to listing species under the ESA, the critical habitat of a newly listed species must be designated concurrent with its listing to the "maximum extent prudent and determinable" [16 U.S.C. § 1533(b)(1)(A)]. The ESA defines critical habitat as those specific areas that are essential to the conservation of a listed species and that may be in need of special consideration. Federal agencies are prohibited from undertaking actions that destroy or adversely modify designated critical habitat. Some species, primarily the cetaceans, which were listed in 1969 under the Endangered Species Conservation Act and carried forward as endangered under the ESA, have not received critical habitat designations.

Federal agencies have an affirmative mandate to conserve listed species. One assurance of this is Federal actions, activities or authorizations (hereafter referred to as Federal action) must be in compliance with the provisions of the ESA. Section 7 of the Act provides a mechanism for consultation by the Federal action agency with the appropriate expert agency (NMFS or USFWS). Informal consultations, resulting in letters of concurrence, are conducted for Federal actions that have no adverse affects on the listed species. Formal consultations, resulting in biological opinions, are conducted for Federal actions that may have an adverse affect on the listed species. Through the biological opinion, a determination is made as to whether the proposed action poses "jeopardy" or "no jeopardy" of extinction to the listed species. If the determination is that the action proposed (or ongoing) will cause jeopardy, reasonable and prudent alternatives may be suggested which, if implemented, would modify the action to no longer pose the jeopardy of extinction to the listed species. These reasonable and prudent alternatives must be incorporated into the Federal action if it is to proceed. A biological opinion with the conclusion of no jeopardy may contain a series of management measures intended to further reduce the negative impacts to the listed species. These management alternatives are advisory to the action agency [50 CFR. 402.24(j)]. If a likelihood exists of any taking occurring during promulgation of the action, an incidental take statement may be appended to a biological opinion to provide for the amount of take that is expected to occur from normal promulgation of the action. An incidental take statement is not the equivalent of a permit to take.

Ten species occurring in the BSAI crab management areas are currently listed as endangered or threatened under the ESA. The group includes seven great whales, one pinniped, two seabirds, and one albatross. In summary, species listed under the ESA are present in the action area and, as detailed below. The NMFS is the expert agency for ESA listed marine mammals. The USFWS is the expert agency for ESA listed seabirds.

Listed Species. The following species are currently listed as endangered or threatened under the ESA and occur in the BSAI:

	Endangered
Northern Right Whale	*Balaena glacialis*
Bowhead Whale	*Balaena mysticetus*
Sei Whale	*Balaenoptera borealis*
Blue Whale	*Balaenoptera musculus*
Fin Whale	*Balaenoptera physalus*

Humpback Whale	*Megaptera novaeangliae*
Sperm Whale	*Physeter macrocephalus*
Short-tailed Albatross	*Diomedia albatrus*
Steller Sea Lion	*Eumetopias jubatus*
	Threatened
Spectacled Eider	*Somateria fishcheri*
Steller's Eider	*Polysticta stelleri*

Section 7 Consultations. Because crab fisheries are federally regulated activities, any negative effects of the fisheries on listed species or critical habitat and any takings that may occur are subject to ESA section 7 consultation.

Seabirds: In 1994, NMFS prepared a Biological Assessment for the king and Tanner crab FMP, which analyses the potential takes of listed seabirds in these fisheries and conducted an informal Section 7 consultations with USFWS (NMFS 1994). According to the Biological Assessment, the blue king crab fishery is not known to result in any significant impact to the short-tailed albatross, Steller's eider, or Spectacled eider. Nor does the fishery compete for any crab species commonly preyed upon by marine birds. NMFS determined that the crab fisheries will have no adverse impact on any listed seabird nor will they delay in any way the recovery of those species, except the C. opilio fishery which may adversely impact the Spectacled Eider. The outcome of the Biological Assessment and informal consultations with FWS was the initiation of formal section 7 consultation on the impacts of the C. opilio fishery on Spectacled Eider. The conclusion of which was that USFWS concurred with NMFS's determination that the C. opilio crab fishery is not likely to adversely affect threatened or endangered species under the jurisdiction of the USFWS, including the threatened spectacled eider (FWS 1998). No new information has become available which indicates that the crab fisheries may affect a listed species of seabird.

None of the alternatives under consideration would affect the prosecution of the crab fisheries of the BSAI in a way not previously considered in the above consultations. The proposed alternatives are designed to improve the effectiveness of the management of BSAI crab fisheries. None of the alternatives would affect takes of listed species. Therefore, none of the alternatives are expected to have a significant impact on endangered or threatened species.

7.5 Marine Mammal Protection Act

The king and Tanner crab fisheries in the BSAI are classified as Category III fisheries under the Marine Mammal Protection Act. A fishery that interacts only with non-strategic stocks and whose level of take has an insignificant impact on the stocks is placed in Category III. An observer program has been in existence since 1988 for the Alaskan crustacean pot fisheries. No marine mammal species have been recorded as taken incidentally in the fisheries according to records that date back to 1990.

7.6 Coastal Zone Management Act

Implementation of each of the alternatives would be conducted in a manner consistent, to the maximum extent practicable, with the Alaska Coastal Management Program within the meaning of Section 30(c)(1) of the Coastal Zone Management Act of 1972 and its implementing regulations.

7.7 Conclusions or Finding of No Significant Impact

None of the alternatives for Amendment 15 are likely to significantly affect the quality of the human environment, and the preparation of an environmental impact statement for the proposed action is not required by Section 102(2)(C) of the National Environmental Policy Act or its implementing regulations.

for William T. Hogarth 11/29/00
Assistant Administrator for Fisheries, NOAA Date

8.0 Economic and Social Impacts of Alternatives

This section provides information about the economic and socioeconomic impacts of the alternatives including identification of the individuals or groups that may be affected by the action, the nature of these impacts, quantification of the economic impacts if possible, and discussion of the trade offs between qualitative and quantitative benefits and costs. The objective of this amendment is to rebuild the St. Matthew blue king crab stock to sustainable levels.

Catch, effort, and economic data from the St. Matthew king crab fishery, 1989-1999. Catch (millions of lbs) includes deadloss.

Year	Catch	# of vessels	# of days	# of pots	price per lb	total value
1989	1.17	69	3	30,853	2.90	$ 3,500,000
1990	1.73	31	6	26,264	3.35	$ 5,700,000
1991	3.37	68	4	37,104	2.80	$ 9,000,000
1992	2.47	174	3	56,630	3.00	$ 7,400,000
1993	3.00	92	6	58,647	3.23	$ 9,700,000
1994	3.76	87	7	60,860	4.00	$ 15,000,000
1995	3.17	90	5	48,560	2.32	$ 7,100,000
1996	3.08	122	8	91,205	2.20	$ 6,700,000
1997	4.65	117	7	81,117	2.21	$ 9,800,000
1998	2.87	131	11	89,500	1.87	$ 5,340,000
1999	0	0		0	0	$ 0

The alternatives were discussed in section 2.0.

8.1 Description of Fleet, Fishery, & Industry

A description of the crab fishery and fishing industry is provided in the Crab FMP, the Crab Stock Assessment and Fishery Evaluation (SAFE) report (e.g., NPFMC 1999), and the annual area management reports produced by ADF&G. Copies of these documents are available on request from the Council office. All crab catcher vessels could be considered small businesses, with annual receipts of less than $3 million. Under proposed Amendment 10 to the Crab FMP, a total of 170 catcher vessels would receive endorsements to participate in the St Matthew blue king crab and red king crab fishery. No catcher vessels depend solely on this crab fisheries, as most catcher vessels also fish for other crab species. The rebuilding plan would allow some fishing during the rebuilding period. This is expected to occur in some years after the rebuilding plan is implemented. In addition, an unknown number of the 8 catcher-processor vessels endorsed for the St. Matthew blue king crab fishery also could be considered small entities.

The St. Matthew Island blue king crab fishery occurs in that portion of the Bering Sea north of the latitude of Cape Newenham at 58° 39' N. lat. and south of the latitude of Cape Romanzof at 61° 49' N. lat. This area, along with the rest of the Bering Sea, was fished by Japanese, Russian and other foreign vessels beginning in 1930. The last foreign fishing operations in this area concluded in 1974. The St. Matthew area was first exploited commercially by domestic fishers in 1977, when 10 vessels harvested 1.3 million pounds. Catch and effort continued to increase with a peak harvest of 9.5 million pounds taken in 1983 by 164 vessels. The annual harvest since that time has not exceeded 5.0 million pounds; in 1998 the harvest was 2.9 million pounds taken by 131 vessels. Significant declines in all components of the stock, including legal males, which fell below the minimum stock size threshold, prompted a complete fishery closure for the 1999 season.

In 1995, a total of 90 vessels (1 catcher-processor, 89 catcher vessels) participated in the St. Matthew blue king crab fishery. The season began on September 15 and lasted 5 days, during which time 3.2 million pounds were landed. Blue king crab fetched $2.32 per pound exvessel, making the total fishery worth $7.1 million. The average crab size was 4.8 pounds and the fishery had an average catch-per-unit-effort (CPUE) of 14 crabs per pot. In 1997, 117 vessels participated and harvested 4.6 million pounds in 7 days. Crab averaged 4.9 pounds each and brought $2.21 per pound exvessel, making the total fishery worth $9.8 million.

The 1998 fishery opened with a GHL of 4 million pounds, and an additional 99,500 lbs allocated as community development quota, CDQ. A total of 2.87 million pounds were harvested before the regular commercial fishery was closed due to poor fishery performance. The CPUE of the regular commercial fishery of 7 crabs per pot was one of the worst ever observed. The CPUE of the CDQ fishery was a little better at 10 crabs per pot for the two vessels participating. The GHL for the 1999 fishery was set at zero due to the "overfished" status of this stock. In addition to low spawning biomass, the survey found very little sign of young crab, thereby necessitating a conservative approach.

Economic data from the St. Matthew king crab fishery, 1989-1999. Catch (millions of lbs) includes deadloss.

Year	Catch	# of vessels	# of days	# of pots	price per lb	total value
1989	1.17	69	3	30,853	2.90	$ 3,500,000
1990	1.73	31	6	26,264	3.35	$ 5,700,000
1991	3.37	68	4	37,104	2.80	$ 9,000,000
1992	2.47	174	3	56,630	3.00	$ 7,400,000
1993	3.00	92	6	58,647	3.23	$ 9,700,000
1994	3.76	87	7	60,860	4.00	$ 15,000,000
1995	3.17	90	5	48,560	2.32	$ 7,100,000
1996	3.08	122	8	91,205	2.20	$ 6,700,000
1997	4.65	117	7	81,117	2.21	$ 9,800,000
1998	2.87	131	11	89,500	1.87	$ 5,340,000
1999	0	0		0	0	$ 0

The St. Matthew Island blue king crab fleet is made up of vessels ranging in size from 58 to 180 feet in overall length. Approximately 62% are less than 125 feet in length. From 1995 to 1999, fleet size ranged from 91 to 133 vessels, including five catcher processors. In addition, five floating processors also participated in this fishery during this five year period.

Additional information on the economics of BSAI crab fisheries can be found in the ADF&G's Annual Area Management Reports (e.g., Morrison 1996). Total value of the three major Bering Sea crab fisheries in recent years is about $180 million to $260 million per year. Most vessels that participate in the St. Matthew blue king crab fisheries also participate in the Tanner crab, snow crab, Pribilof king crab, and Bristol Bay red king crab fisheries. Since 1982, the snow crab fishery has generated much higher values than the other crab fisheries. Although snow crab landings had dropped drastically since the peak in 1991 (325 million lbs.), price increased such that average gross ex-vessel value increased to over $710,000 per vessel in the 1995 snow crab fishery.

Abundance of legal males (millions of crab from catch-survey estimates), pre-season guideline harvest levels (GHL, in millions of pounds), and total catches (millions of pounds, including deadloss) of St. Matthew blue king crab, 1980-1997.

Year	Abundance	GHL	Catch
1980	2.50	na	na
1981	3.10	1.5 - 3.0	4.6
1982	6.80	5.6	8.8
1983	3.50	8.0	9.5
1984	1.60	2.0 - 4.0	3.8
1985	1.08	0.9 - 1.9	2.4
1986	0.38	0.2 - 0.5	1.0
1987	0.74	0.6 - 1.3	1.1
1988	0.83	0.7 - 1.5	1.3
1989	1.48	1.7	1.2
1990	1.66	1.9	1.7
1991	2.17	3.2	3.4
1992	2.30	3.1	2.5
1993	3.60	4.4	3.0
1994	2.47	3.0	3.8
1995	1.93	2.4	3.2
1996	3.40	2.4	3.1
1997	3.94	5.0	4.6
1998	3.11	4.1	2.9
1999	0.63	0	0

Several crab fisheries have been closed in recent years, adding to the economic situation currently faced by crab fishermen. In 1999, the king crab fisheries of St. Matthew and the Pribilof Islands were closed, as was the Bering Sea Tanner crab fishery, which had been closed since 1997. In 2000, the snow crab GHL was drastically reduced.

The following tables present data summarizing the number of vessels by gear and area that harvested Alaska crab in 1996. More recent data were not readily available. However, the number of vessels participating in

1999 would expected to be less than, but not significantly different from the number of vessels participating in 1996. More detailed information on projected fleet size can be found in the License Limitation Program analysis (NPFMC 1998).

Number of vessels that caught crab in the BSAI area in 1996, by vessel length class (measured by length overall (LOA) in feet), catcher type, and gear.

	Catcher vessels			Catcher/
	<60'	60-124'	>125'	proc.s
Bristol Bay red king	0	130	62	4
Bering Sea Tanner	0	102	40	4
Bering Sea Snow crab	0	154	70	15
Norton Sound red king	41	0	0	0

Number of vessels that caught groundfish in the BSAI area in 1996, by vessel length class (measured by length overall (LOA) in feet), catcher type, and gear.

	<60'	60-124'	>125'	Total
Catcher vessels				
Fixed gear	64	125	17	206
Trawl gear	6	91	31	128
Catcher/processors				
Fixed gear	1	21	32	54
Trawl gear	0	7	55	62
Total all vessels	71	244	135	450

The Crab Vessel License Limitation Program (LLP)

The NPFMC approved LLPs for its Groundfish and Crab FMPs on June 17, 1995. The Secretary approved the proposed rule implementing the Groundfish and Crab LLPs on September 12, 1997. The final rule was approved on October 1, 1998. Fishing under the final LLPs is expected to begin in January 2000. In 1998, the Crab LLP was further amended to include changes in the basic eligibility criteria for crab, in the form of additional recent participation criteria. These changes were adopted by the Council as Amendment 10 to the Crab FMP in October, 1998.

Under the original qualifying criteria, 365 vessels are projected to qualify for crab licenses in areas excluding Norton Sound. Of the total projected qualifiers, Alaskans currently own 125 vessels and 240 are currently owned by residents of other states. Participation declined from 349 vessels in 1995 to 299 in 1996 and 282 in 1997. Through February 7, 1998, 219 vessels had participated. The lower number in 1998 probably reflects the fact that only a few weeks of the fishing year had passed. Throughout the recent period a total of 410 unique vessels have participated: 19 vessels as catcher processors and 391 as catcher vessels. The largest decline appears for seine combination catcher vessels. The number of participants reported in the data dropped from 70 in 1995 to 7 in 1997. The numbers of participants in other vessel classes varied within a much narrower range. The number of Alaskan residents participating in the crab fisheries has declined throughout the period, while the number of participating residents of other states fell in 1996 and then rose in 1997. The number of crab vessels with endorsements for the BSAI Tanner crab fishery under the original LLP was 323 vessels.

In 1998 the Council adopted Amendment 10 to the Crab FMP, which would require recent participation in the BSA king and tanner crab fisheries in order to qualify for a license under the Crab LLP. The recent participation requirement would apply to the general license only; if a vessel satisfies the recent participation criteria chosen, it would receive its original license and all of the species/area endorsements for which it qualified under the original criteria. No new species/area endorsements could be earned during the recent qualification. The specific alternative adopted by the Council in October, 1998, was Alternative 9, which required participation at least once between 1996 and February 7, 1998. The Council also included the following four exemptions to this requirement:

1. Vessels with only a Norton Sound Endorsement

2. All vessels that are < 60' LOA and are qualified under the original LLP

3. Vessels that made landings in the Bering Sea and Aleutian Islands crab fishery in 1998, on or before February 7, 1998, and for which the owner acquires license limitation rights from a vessel that meets the general qualification period (GQP) and endorsement qualification period (EQP) landings requirements. The owner must have acquired these rights or entered into a contract to acquire the rights by 8:36 a.m. Pacific time on October 10, 1998.

4. A vessel that was lost or destroyed and which made a landing (or its replacement vessel) in the Bering Sea and Aleutian Islands crab fishery from the time it left the fishery and January 1, 2000, would be deemed to have met the recent participation criteria and would be issued the general license and all species/area endorsements earned under the original crab LLP.

The table below shows the endorsements for crab vessels that qualified under proposed Amendment 10. A total of 178 vessels will be endorsed for the St. Matthew blue and red king crab fishery, if the Secretary adopts this amendment.

Table. Endorsements for crab fishing licenses under the crab license limitation program, adopted by the Council as Amendment 10, October 1998.

	BSAI Tanner	Adak Brown	Adak Red	Bristol Bay Red	Dutch H. Brown	Pribilofs Blue/Red	St. Matt. Blue/Red
Factory Trawlers	6		1	5		2	2
Other Fixed-gear Cps	28	5	2	28	3	14	20
Pot CVs 125'+	42	5	5	42	5	22	35
Pot CVs 60'-124'	132	10	16	132	8	84	96
Seine Combination Cvs	1			1		2	
Trawl CVs 125'+	13	1	1	12	1	5	5
Trawl CVs 60'-124'	43		2	43		14	20
CV / CP Licenses							
Catcher Vessels	249	18	26	248	15	136	170
Catcher Processors	16	3	1	15	2	7	8
Grand Total	**265**	**21**	**27**	**263**	**17**	**143**	**178**

8.2 Expected Effects of Alternatives

The crab fisheries would be impacted under all the alternatives. It is important to remember that the crab fleet suffers negative economic impacts from the depressed stock, as seen in 1998 when the GHL was 4.1 million pounds but the fleet was only able to harvest 2.9 million pounds due to the low abundance of crab. When abundance is low, CPUE is low and it is difficult for vessels to earn a profit. The preferred alternatives in this rebuilding plan attempt to rebuild the stock size to a level that supports healthy fisheries, although the fleet may experience a short term economic loss. Since, as explained above, no vessels rely solely on the St. Matthew blue king crab fishery, the closure of this fishery will compound the economic losses suffered by the closure or reduced GHL in other, more lucrative crab fisheries. A cumulative effects analysis would need to be done to determine the economic consequences of depressed crab stocks on the crab fleet. Positive benefits to the crab fleet would be realized when the blue king crab stock rebuilds to a level that can produce MSY. Proposed actions that reduce crab harvests would be expected to result in short term losses to the fleet. However, it should be noted that the fishery has been closed since 1999, so no additional costs would be incurred. The new harvest strategy adopted by the Board of Fisheries is expected to result in lower harvests during the rebuilding period, but is expected to provide sustainable yields in future years.

8.3 Impacts on Communities

National Standard 8 of the Magnuson-Stevens Act mandates that conservation and management shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to provide for the sustained participation of such communities, and to the extent practicable, minimize adverse economic impacts on such communities.

Many of the coastal communities participate in the crab and groundfish fisheries is one way or another, whether it be processing, support businesses, have a harbor, or are home to fishermen and processing workers. Major groundfish and crab ports in Alaska that process catch from the Bering Sea include Dutch Harbor, St. Paul, Akutan, Sand Point, King Cove, and Kodiak. Additionally, Seattle, Washington is home port to many catcher and catcher-processor vessels.

Shore-based processing plants which purchase, process and sell blue king crabs harvested from the St. Matthew Island area are located in the ports of Dutch Harbor (7), Akutan (1), King Cove (1) and St. Paul, on the Pribilof Islands (3). Additional processors in the port of Kodiak occasionally purchase and process St. Matthew Island blue king crabs.

The 1998 CDQ for St. Matthew blue king crab was 99,512 pounds, which is 3.5% of the GHL. Two vessels participated in the fishery, catching 99.4% of the quota. One of the vessels fished for APICDA (Aleutian Pribilof Island Community Development Association), which was allocated 50% of the CDQ reserve. The other vessels fished the remaining 50% of the CDQ reserve as a cooperative among the four other CDQ groups. The ex-vessel value for the CDQ fishery was $164 thousand, with an average price per pound of $1.67. The CDQ price was lower than the regular commercial fishery price of $1.84 per pound.

In 1999, CDQ was 5% of Bering Sea crab stocks; this increased to 7.5% beginning in 2000 per Magnuson-Stevens Act. In years of low GHLs, the CDQ quotas for St. Matthew blue king crab would be very small, even with a 7.5% allocation. Nevertheless, harvest of the blue king crabs will generate much higher incomes for CDQ groups when the stock is rebuilt and GHLs are increased. Because it receives are higher quota, APICDA, based in the Pribilof Islands, suffers the greatest economic loss when the stocks are depressed and would have the most to gain from a rebuild stock. And again, the economic effects of the closure of the St. Matthew blue king crab fishery are not great when viewed in isolation, they compound the economic losses suffered from closed or reduced fisheries on other depressed stocks, like Tanner crab and snow crab.

The economic impact to communities where St. Matthew blue king crabs are landed, is in most cases of minor significance. In the most recent four year period, from 1995 to 1998 (the fishery remained closed in 1999), the floating processor component of the fleet processed approximately 65% of the annual harvest with an average annual value of 4.1 million dollars. Shore-based processors in Dutch harbor purchased and processed an average of 18.8% of the annual St. Matthew blue king crab harvest, with an average value of 1.4 million dollars. Processors in St. Paul received 11.7% of the annual average harvest, valued at 85 thousand dollars. All other processors combined, including catcher processors, received on an annual basis, less than 5% of the St. Matthew blue crab harvest, worth just over one million dollars.

Summary information on these communities is provided below; more detailed information about these communities is provided in the "Faces of the Fisheries" (NPFMC 1994).

St. Paul -St. Paul is a supply and processing port for a portion of the Bering Sea groundfish and crab fleets. Major improvements to the harbor, including a dock expansion and breakwater, have allowed continual development of this community as a shipping and fishing town. There are fish processing plants, along with cold storage and warehouse facilities. The local fleet fishes primarily for halibut; local processor produce crab and several species of groundfish.

In addition to seafood harvesting and processing, employment on St. Paul includes government administration, education, native corporation, and other service related jobs. The community is also developing tourism; visitors come from all over to see fur seals and sea bird rookeries. Subsistence hunting, fishing and gathering has always been an important part of life on the Pribilof Islands.

Dutch Harbor/Unalaska -Dutch Harbor/Unalaska has been called "... the most prosperous stretch of coastline in Alaska." With 27 miles of ports and harbors and several hundred local businesses, most of them servicing, supporting, or relying on the seafood industry, this city is the heart of the Bering Sea fisheries. Dutch Harbor is not only the top ranked fishing port in terms of the tonnage of fish landed in Alaska, but has held that distinction for the Nation, as a whole, each year since 1989, and ranked at or near the top in terms of value of fish landed over the same period.

Historically, Dutch Harbor was principally dependent upon non-groundfish (primarily king and Tanner crab) landings and processing for the bulk of its economic activity. These non-groundfish species continue to be important components of a diverse processing complex in Dutch Harbor. In 1997, for example, nearly 2 million pounds of salmon, more than 1.7 million pounds of herring, and 34 million pounds of crabs were reportedly processed in this port. Since the mid-1980s, groundfish and particularly pollock has accounted for the vast majority of landings in Dutch Harbor/Unalaska. Again, utilizing 1997 catch data, over 93.5% of total pounds landed and processed in this port were groundfish, 83% of which were pollock.

The facilities and related infrastructure in Dutch Harbor/Unalaska support fishing operations in the eastern Bering Sea, Aleutian Islands and GOA management areas. At least eight shore-based processors in this port receive and process fish caught in all three areas, and the wider community is linked to, and substantially dependent upon, serving both the inshore and at-sea sectors of the fishing industry. While Dutch Harbor has been characterized as one of the world's best natural harbors, it offers few alternative opportunities for economic activity beyond fisheries and fisheries support. Its remote location, limited and specialized infrastructure and transportation facilities, and high cost make attracting non-fishery related industrial and/or commercial investment doubtful, at least in the short-run.

Akutan -Akutan ranks as the second most significant landings port for groundfish, most of which is pollock, on the basis of tons delivered and has been characterized as a unique community in terms of its relationship to the BSAI fisheries. According to a recent social impact assessment, prepared for the Council, while Akutan is the site of one of the largest of the onshore pollock processing plants in the region, the community is geographically and socially separate from the plant facility.

While the community of Akutan derives economic benefits from its proximity to the large Trident Seafoods shore plant (and a smaller permanently moored processing vessel, operated by Deep Sea Fisheries, which handles only crab), the entities have not been integrated in the same manner as other landings ports and communities. The community derives some economic benefits from the fisheries, including a 1% raw fish tax from the nearby plant. Alternative economic opportunities of any kind are extremely limited.

Kodiak -Kodiak supports at least nine processing operations which receive groundfish from the GOA and, to a lesser extent, the BSAI, and four more which process exclusively non-groundfish species. The port also supports several hundred commercial fishing vessels, ranging in size from small skiffs to large catcher/processors and everything in between. According to data supplied by the City, "The Port of Kodiak is 'home port' to 770 commercial fishing vessels. Not only is Kodiak the state's largest fishing port, it is also home to some of Alaska's largest trawl, longline, and crab vessels."

Kodiak has a diversified seafood processing sector. The port historically was very active in the crab fisheries and, although these fisheries have declined from their peaks in the late-1970s and early-1980s, Kodiak continues to support shellfish fisheries, as well as significant harvesting and processing operations for groundfish (particularly flatfish and pollock) Pacific halibut, herring, sablefish, and the five Pacific salmon species.

Kodiak often ranks near the top of the list of U.S. fishing ports, on the basis of landed value, and is frequently regarded as being involved in a wider variety of fisheries than any other community on the North Pacific coast. In 1997, for example, the port recorded salmon landings of just under 44 million pounds, with an estimated exvessel value of over $12 million. Approximately 4.3 million pounds of Pacific herring were landed in Kodiak with an exvessel value of more than $713,000. Crab landings exceeded 1.1 million pounds and were valued exvessel at more than $2.7 million.

In addition to seafood harvesting and processing, the Kodiak economy includes sectors such as transportation (being regarded as the transportation hub for southwest Alaska), federal/state/local government, tourism, and timber (the forest products industry, based upon Sitka spruce, is an important and growing segment of the Kodiak economy). The community is also home to the largest Coast Guard base in the U.S.

Sand Point and King Cove - Sand Point and King Cove, like Akutan, are part of the Aleutians East Borough. Both Sand Point and King Cove have had extensive historical linkages to commercial fishing and fish processing, and currently support resident commercial fleets delivering catch to local plants. These local catches are substantially supplemented by deliveries from large, highly mobile vessels, based outside of the two small Gulf of Alaska communities. King Cove possesses a deep water harbor which provides moorage for approximately 90 vessels of various sizes, in an ice-free port. Sand Point, with a 25 acre/144 slip boat harbor and marine travel-lift, is home port to what some have called " the largest fishing fleet in the Aleutians" (NPFMC, 1994).

For decades, each of these the two communities has concentrated principally on salmon fisheries. For example, in 1997, both Sand Point and King Cove recorded salmon landings of several million pounds. In addition, King Cove had significant landings of Pacific herring and crabs. Recently, each community has actively sought to diversify its fishing and processing capabilities. Few employment alternatives to commercial fishing and fish processing exist, within the cash-economy, in these communities. However, subsistence harvesting is an important source of food, as well as a social activity, for local residents in both Sand Point and King Cove.

Summary of Impacts on Communities

Changes to BSAI crab fishery regulations to rebuild St. Matthew blue king crab may impact communities in the North Pacific region. Changes to the harvest strategy would effect the crab fishermen from Seattle, Dutch Harbor, Kodiak, Homer, and other communities. However, these impacts would be expected to be short lived, as some fishing on the stock will be allowed during the rebuilding period. This fishery generated $5 million to $15 million (exvessel) annually during the last decade (1990-1998). The costs of reduced fishing opportunities during the rebuilding period may be more than offset by benefits gained from rebuilding the stock to its MSY level. Note that ADF&G does not allow directed fisheries for St. Matthew blue king crab when the stock is at low abundance (e.g., 1999), so exvessel value is $0. Once rebuilt, these coastal communities would once again have expanded opportunities (both fishing and processing) in this potentially lucrative fishery.

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10.0 AGENCIES AND INDIVIDUALS CONSULTED

NMFS-AKRO: Mary Furuness
ADF&G: Wayne Donaldson
UAF: Tom Shirley

Public: John Gauvin, Arni Thomson, Simeon Swetzoff, Mateo Paz-Soldan, Dorothy Childers

Advisory Groups: BSAI Crab Plan Team, Alaska Board of Fisheries, NPFMC Scientific and Statistical Committee, NPFMC Advisory Panel

11.0 LIST OF PREPARERS

NPFMC: Dave Witherell
ADF&G: Rance Morrison, Gordon Kruse, Doug Pengilly, Jie Zheng, Shareef Siddeek, Leslie Watson, Donn Tracy, and Larry Byrne.
NMFS: Bob Otto, Jack Turnock, Gretchen Harrington

12.0 TABLES

Table 1. Annual abundance estimates (millions of crabs) for St. Matthew blue king crabs from NMFS bottom trawl surveys, 1976-1999.

Table 2. Bycatch of crab in 1999 BSAI groundfish fisheries by species, gear type, target, and regulatory area. Note that the "other king crab" category includes blue king crab, scarlet king crab, and golden king crab.

Table 1 Annual abundance estimates (millions of crabs) for St. Matthew blue king crabs from NMFS bottom trawl surveys, 1976-1999.

Northern District

	Males				Females			
	Small	Pre-rec	Legal		Small	Large		
Carapace Length(mm)	<105	105-119	≥120		<80	≥80		Grand
Width(in)	<4.3	4.3-5.5	≥5.5	Total	<3.8	≥3.8	Total	Total
1980	3.4	2.2	2.5	8.1	0.8	2.2	3.0	11.1
1981	1.2	1.8	3.1	6.3	<0.1	0.5	0.5	6.8
1982	3.2	2.6	6.8	12.5	0.4	0.7	1.1	13.6
1983	1.8	1.6	3.5	6.9	0.2	2.4	2.7	9.6
1984	1.4	0.6	1.6	3.6	0.2	0.5	0.7	4.3
1985	0.5	0.4	1.1	1.9	0.1	0.1	0.2	2.1
1986	0.6	0.4	0.4	1.4	0.3	0.1	0.3	1.7
1987	1.1	0.7	0.7	2.5	0.5	0.2	0.7	3.2
1988	1.4	0.7	0.8	2.9	0.9	0.8	1.7	4.6
1989	4.8	1.0	1.5	7.3	1.6	1.7	3.3	10.5
1990	1.4	0.8	1.7	3.9	0.4	0.2	0.6	4.50
1991	2.9	1.5	2.2	6.6	0.8	0.7	1.5	8.1
1992	2.3	1.5	2.3	6.0	0.9	0.4	1.3	7.4
1993	4.6	2.0	3.6	10.2	1.4	3.0	4.4	14.6
1994	1.5	1.4	2.5	5.4	0.1	0.4	0.5	5.9
1995	1.9	1.1	1.9	4.9	0.6	0.1[1]	0.7	5.6
1996	2.6	2.0	3.4	8.0	1.1	0.9	2.0	10.0
1997	2.4	2.3	3.9	8.6	0.6	0.8	1.4	10.0
1998	2.3	1.8	3.1	7.2	0.6	0.5	1.1	8.4
1999	0.5	0.2	0.6	1.4	0.3	<0.1[1]	0.3	1.7
Limits[2]								
Lower	0.0	0.1	0.4	0.7	0.0	0.0	0.0	0.5
Upper	1.1	0.4	0.9	2.1	0.7	0.1	0.8	2.9
±%	108	61	42	51	152	200	141	68

[1] These estimates considered unreliable because few crabs caught.

[2] Mean ± 2 standard errors for most recent year.

Table 2 Bycatch of crab in 1999 BSAI groundfish fisheries by species, gear type, target, and regulatory area. Note that the "other king crab" category includes blue king crab, scarlet king crab, and golden king crab.

1999 crab bycatch data		red king	bairdi	o.Tanner	o. king
by gear and target					
Hook and Line					
	P. cod	7,981	2,782	90,582	1,624
	other	8	18	756	1,724
	Total all targets	7,989	2,800	91,338	3,348
Groundfish pot					
	P. cod	979	40,402	177,673	14,511
	other	0	18	767	23,761
	Total all targets	979	40,420	178,440	38,272
Trawl					
	Greenland turbot	0	5,828	3,032	1,811
	P. cod	7,697	127,242	278,899	4,066
	rock sole	*62,619*	*306,775*	*451,338*	3,075
	yellowfin sole	14,304	455,527	739,812	2,890
	other targets	89	6,247	71,666	7,380
	Total all targets	84,709	901,619	1,544,747	19,222
Total all gears/targets		93,677	944,839	1,814,525	60,842

1999 crab bycatch data		red king	bairdi	o.Tanner	o. king
by area (all gears/targets)					
Regulatory area					
	509	48,032	291,353	450,943	1,843
	512	2,420	46	45	14
	513	915	284,478	855,019	3,447
	514	895	4,589	78,317	1,963
	516	40,623	81,718	11,655	2,864
	517	66	214,088	234,937	4,690
	518	4	4,741	210	923
	519	34	18,344	41,511	438
	521	405	31,661	126,322	11,517
	523	5	327	5,654	8
	524	77	7,740	9,212	4,985
	541	196	5,497	677	19,693
	542	5	245	22	4,438
	543	0	10	0	4,018

13.0 FIGURES

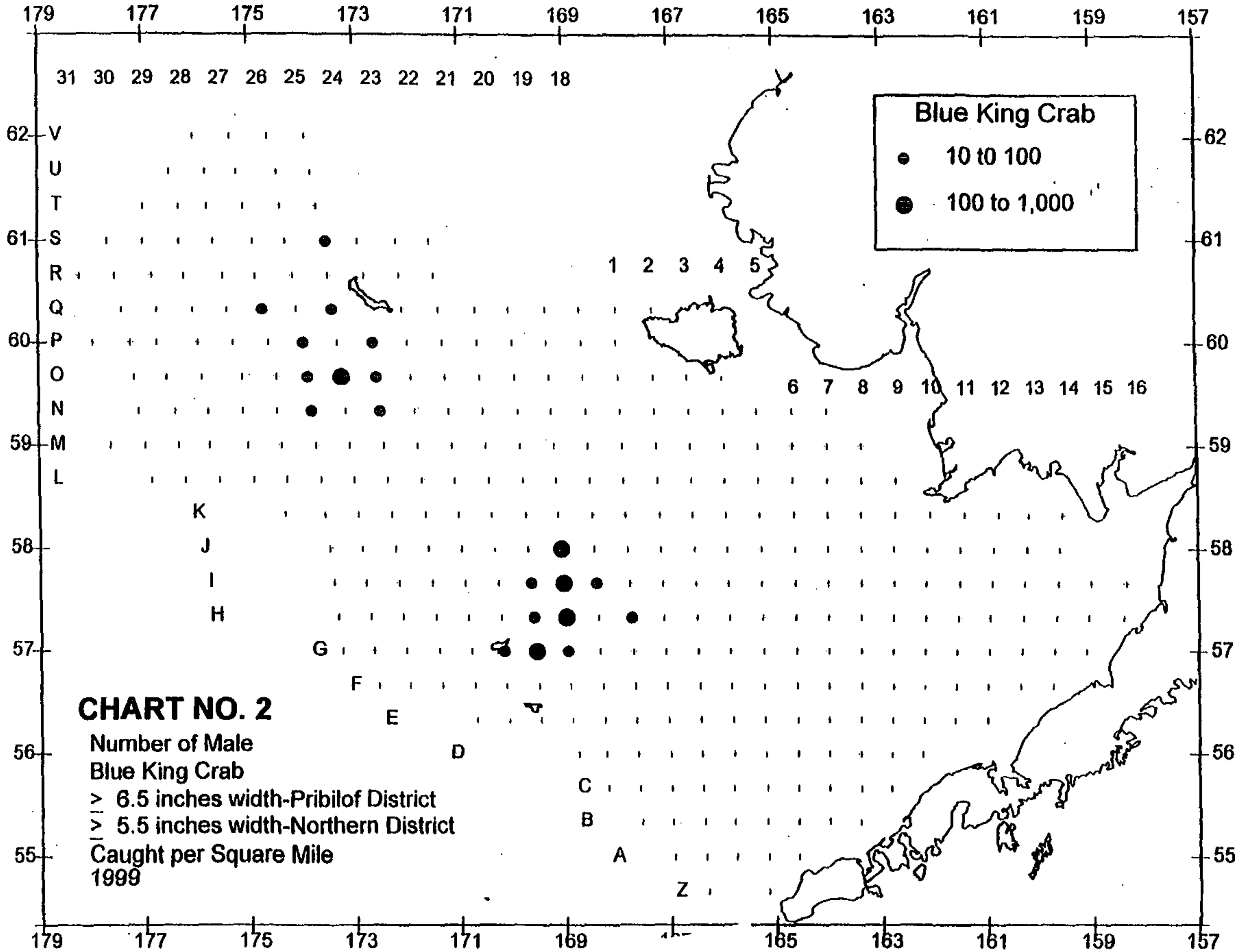

Figure 1 Distribution of large male St. Matthew blue king crab from the 1999 NMFS summer trawl survey.

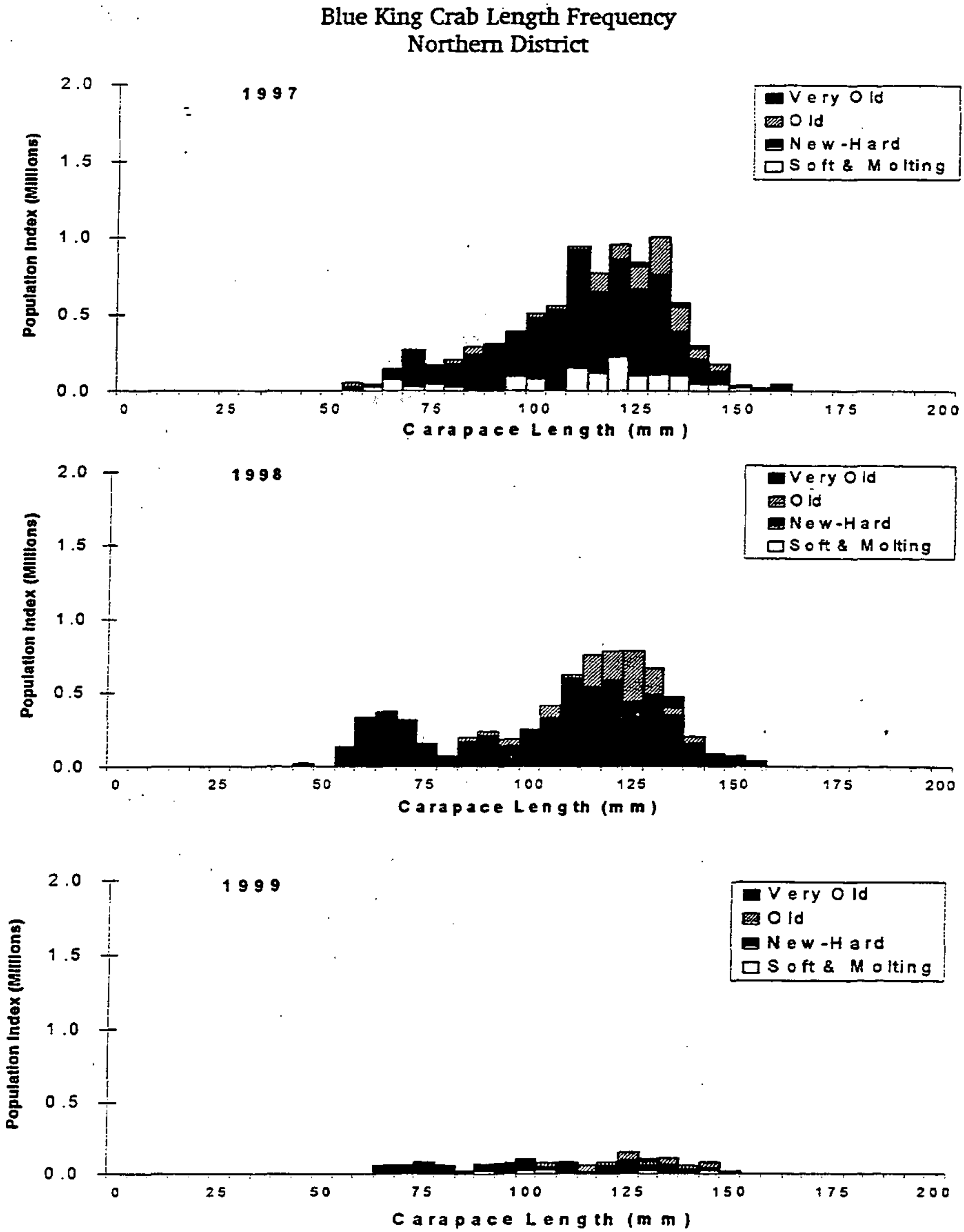

Figure 2 Size-frequency of Northern District (St. Matthew Island) male blue king crab (*P. platypus*), by 5 mm length classes, 1997-1999.

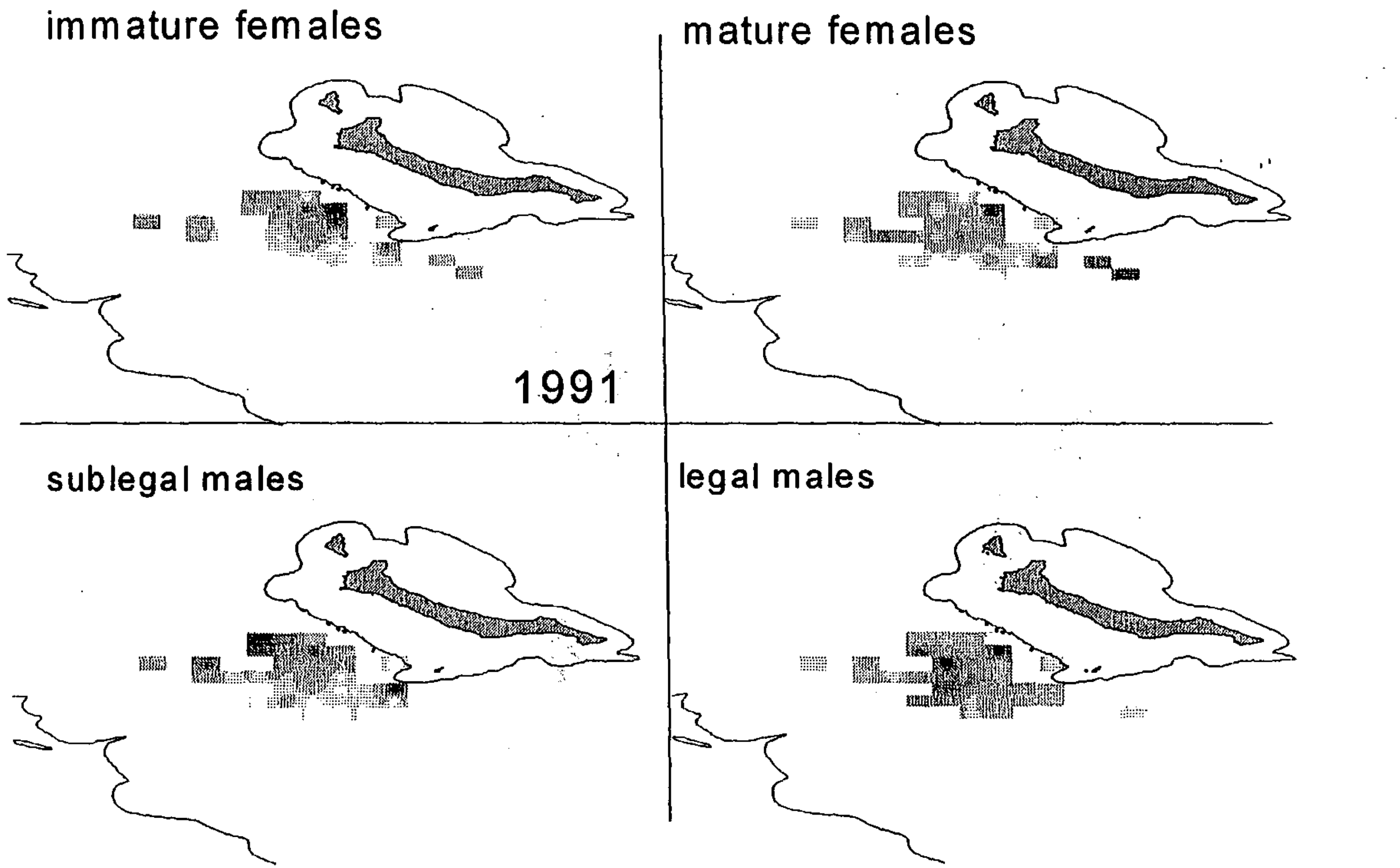

Figure 3 Z-score surfaces of mean CPUE for blue king crabs from the 1991 St. Matthew Island blue king crab fishery. Data is from 124 pots sampled by observers on 9 catcher-processor vessels that participated in the fishery.

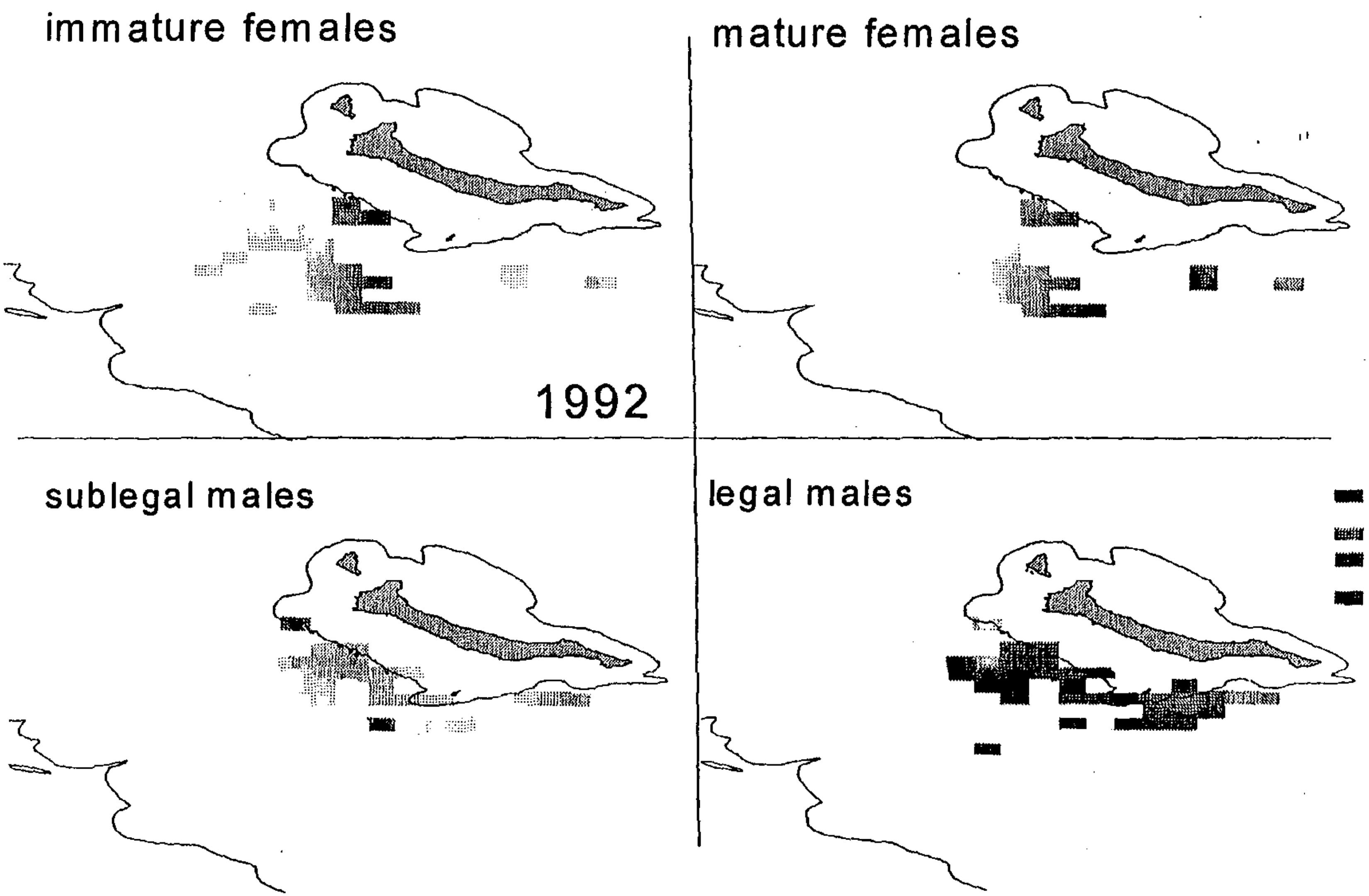

Figure 4 Z-score surfaces of mean CPUE for blue king crabs from the 1992 St. Matthew Island blue king crab fishery. Data is from 71 pots sampled by observers on 8 catcher-processor vessels that participated in the fishery.

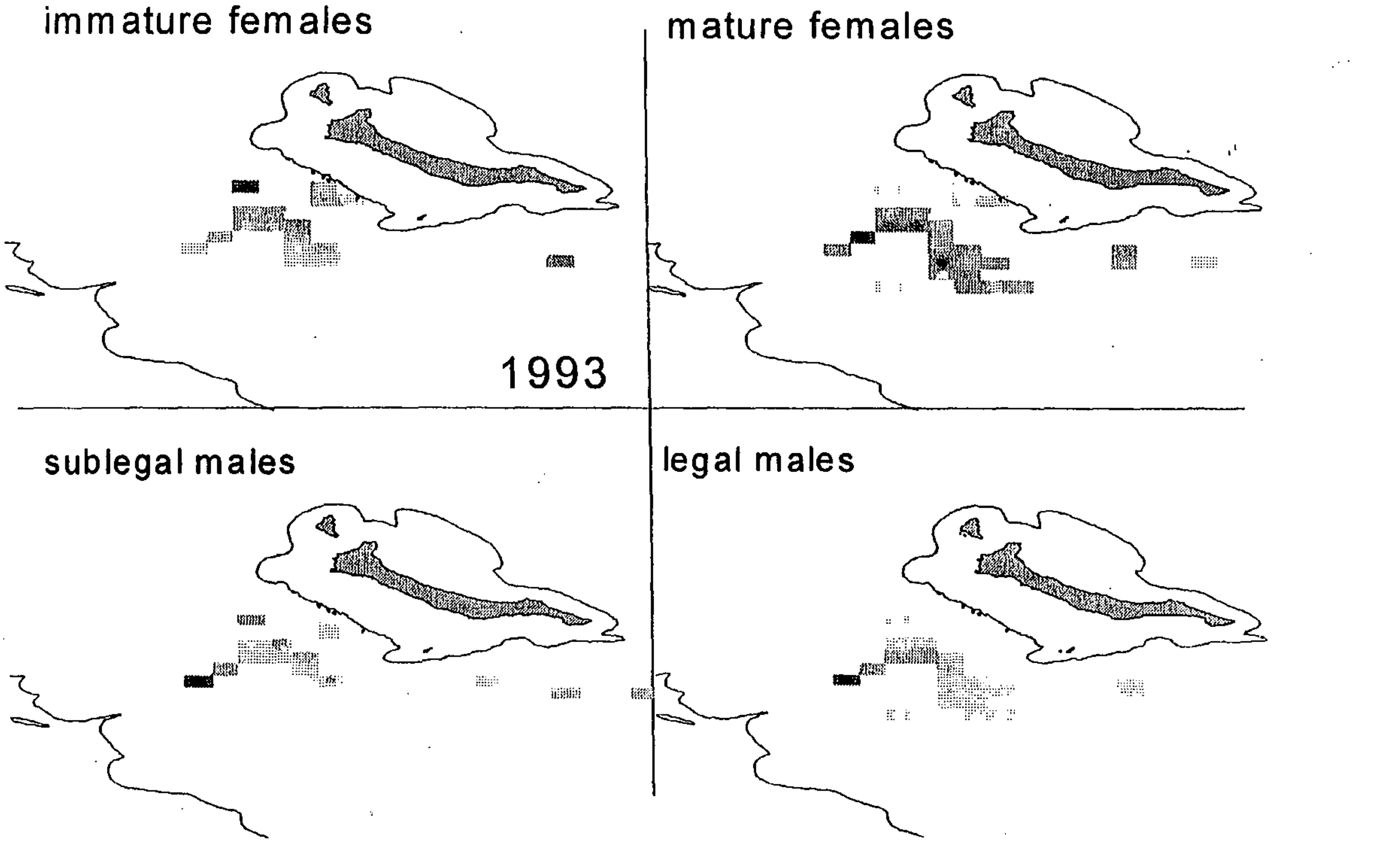

Figure 5 Z-score surfaces of mean CPUE for blue king crabs from the 1993 St. Matthew Island blue king crab fishery. Data is from 84 pots sampled by observers on 3 catcher-processor vessels that participated in the fishery.

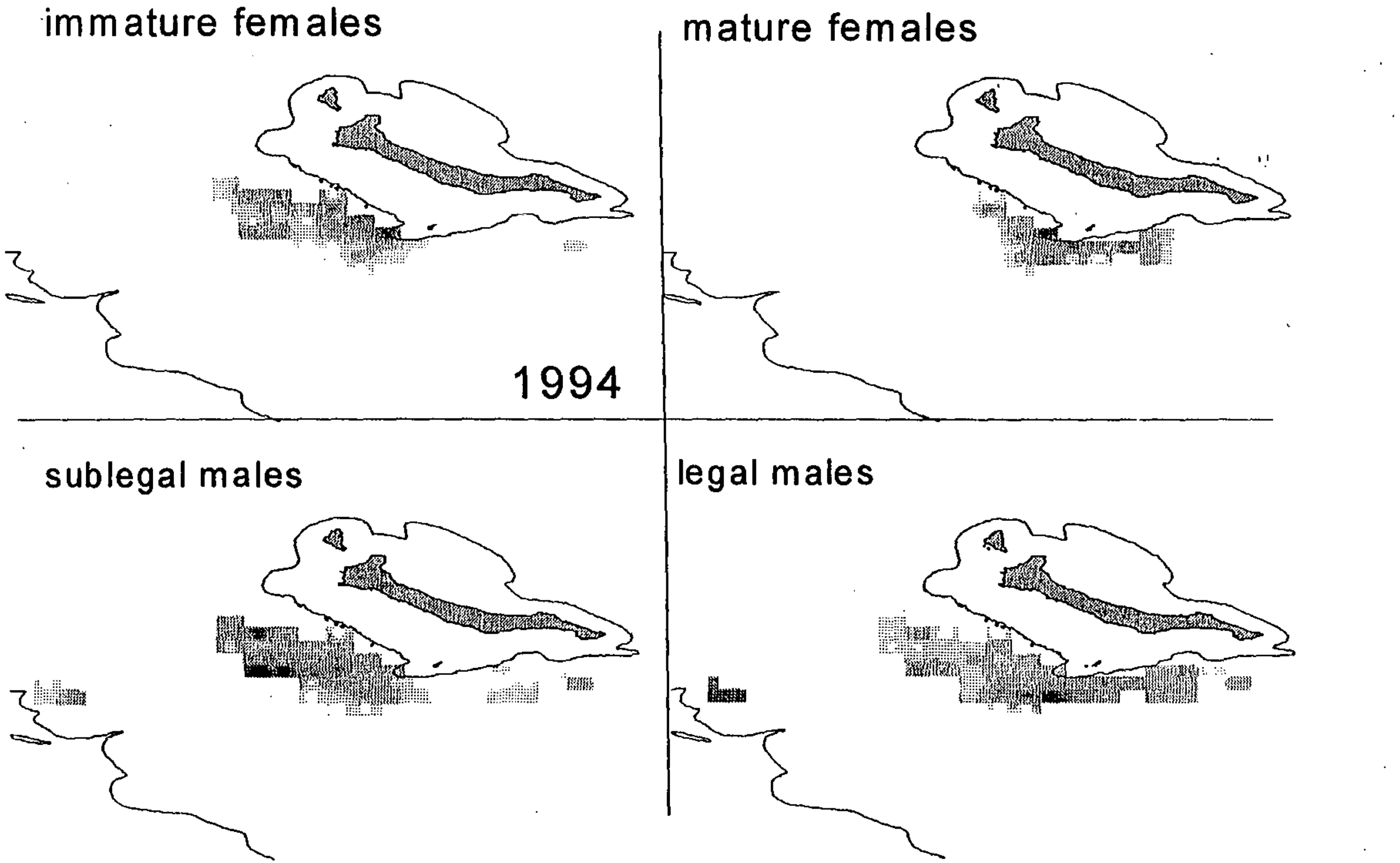

Figure 6 **Z-score surfaces of mean CPUE for blue king crabs from the 1994 St. Matthew Island blue king crab fishery. Data is from 203 pots sampled by observers on 6 catcher-processor vessels that participated in the fishery.**

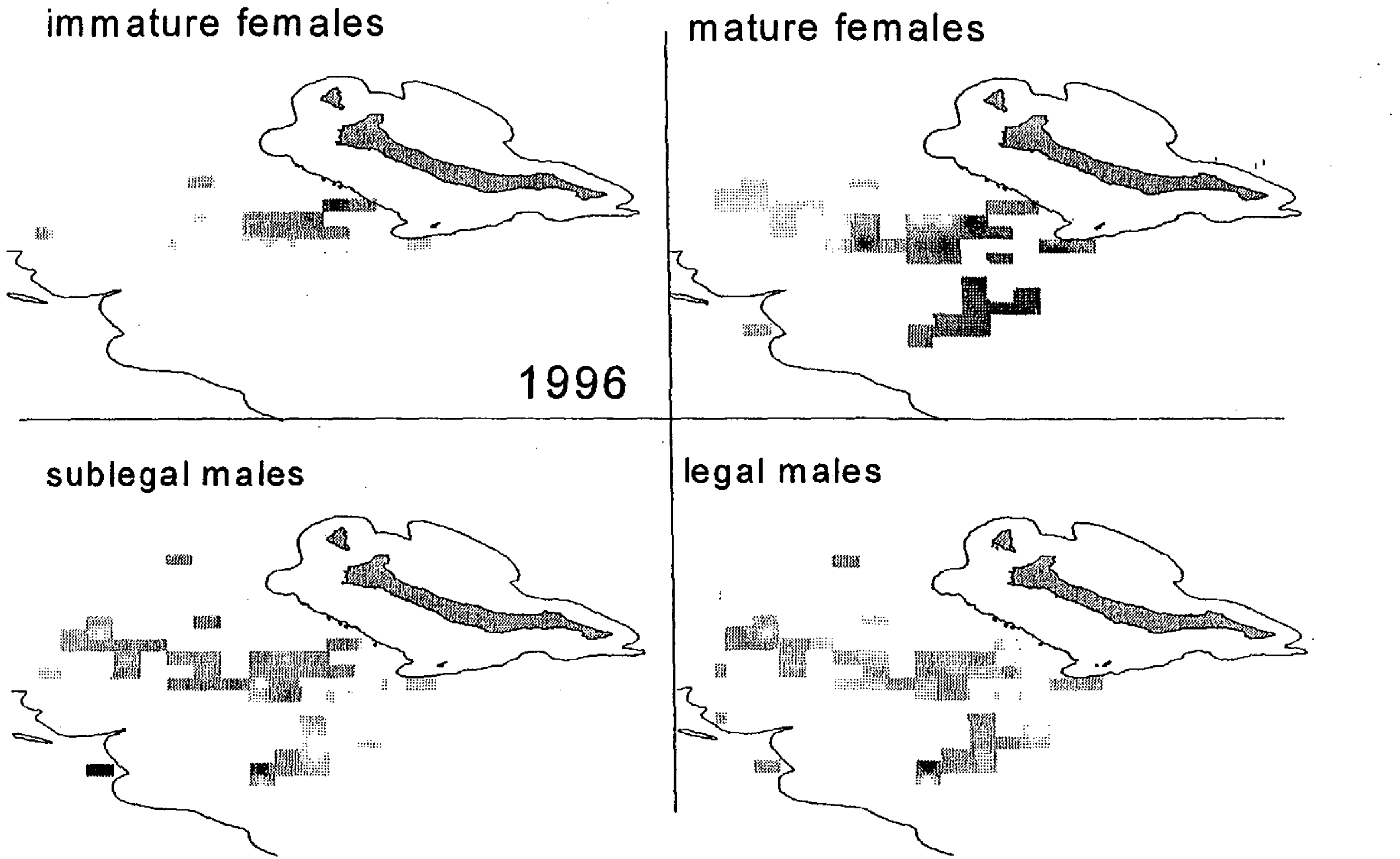

Figure 7 Z-score surfaces of mean CPUE for blue king crabs from the 1996 St. Matthew Island blue king crab fishery. Data is from 96 pots sampled by observers on 3 catcher-processor vessels that participated in the fishery.

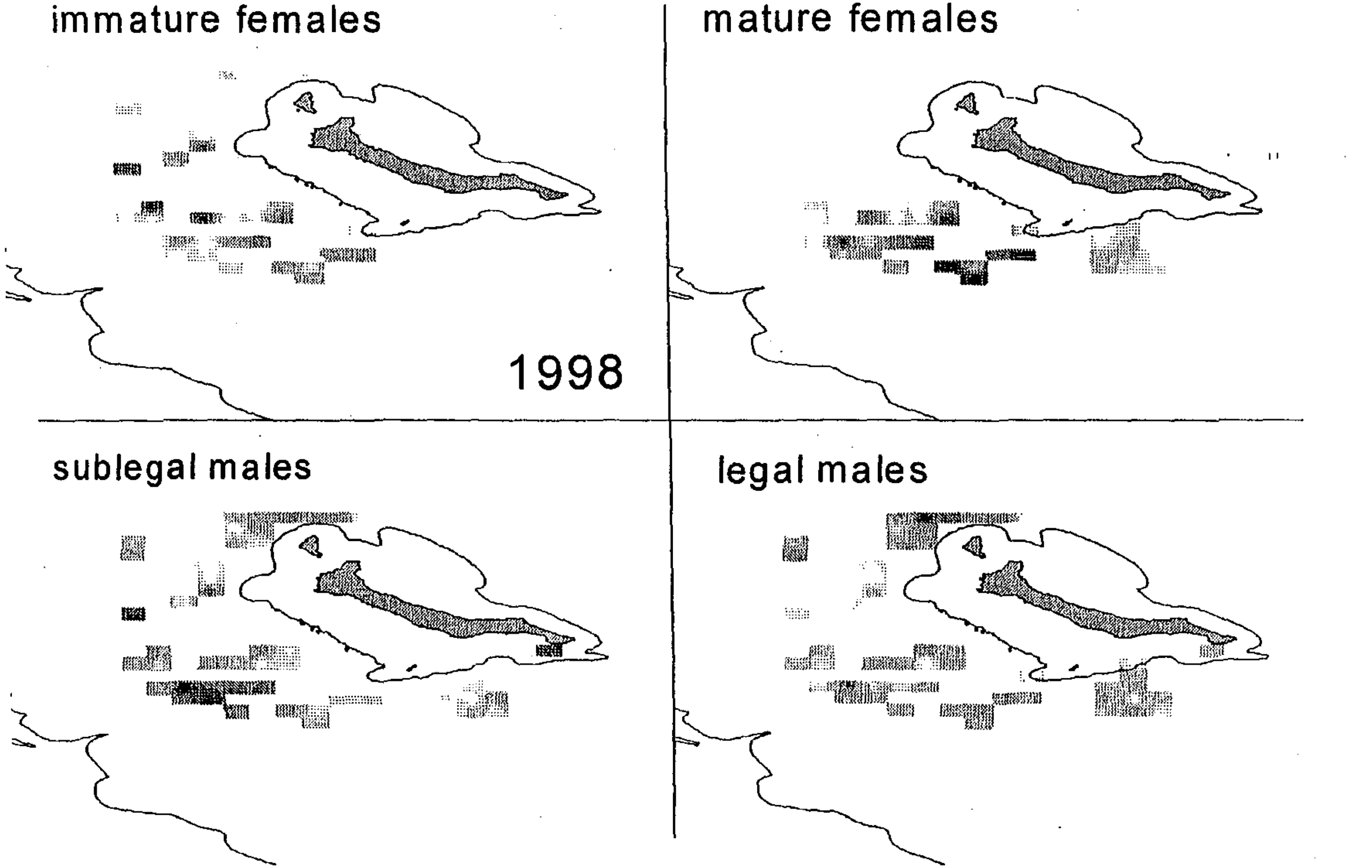

Figure 8 Z-score surfaces of mean CPUE for blue king crabs from the 1998 St. Matthew Island blue king crab fishery. Data is from 135 pots sampled by observers on 3 catcher-processor vessels that participated in the fishery.

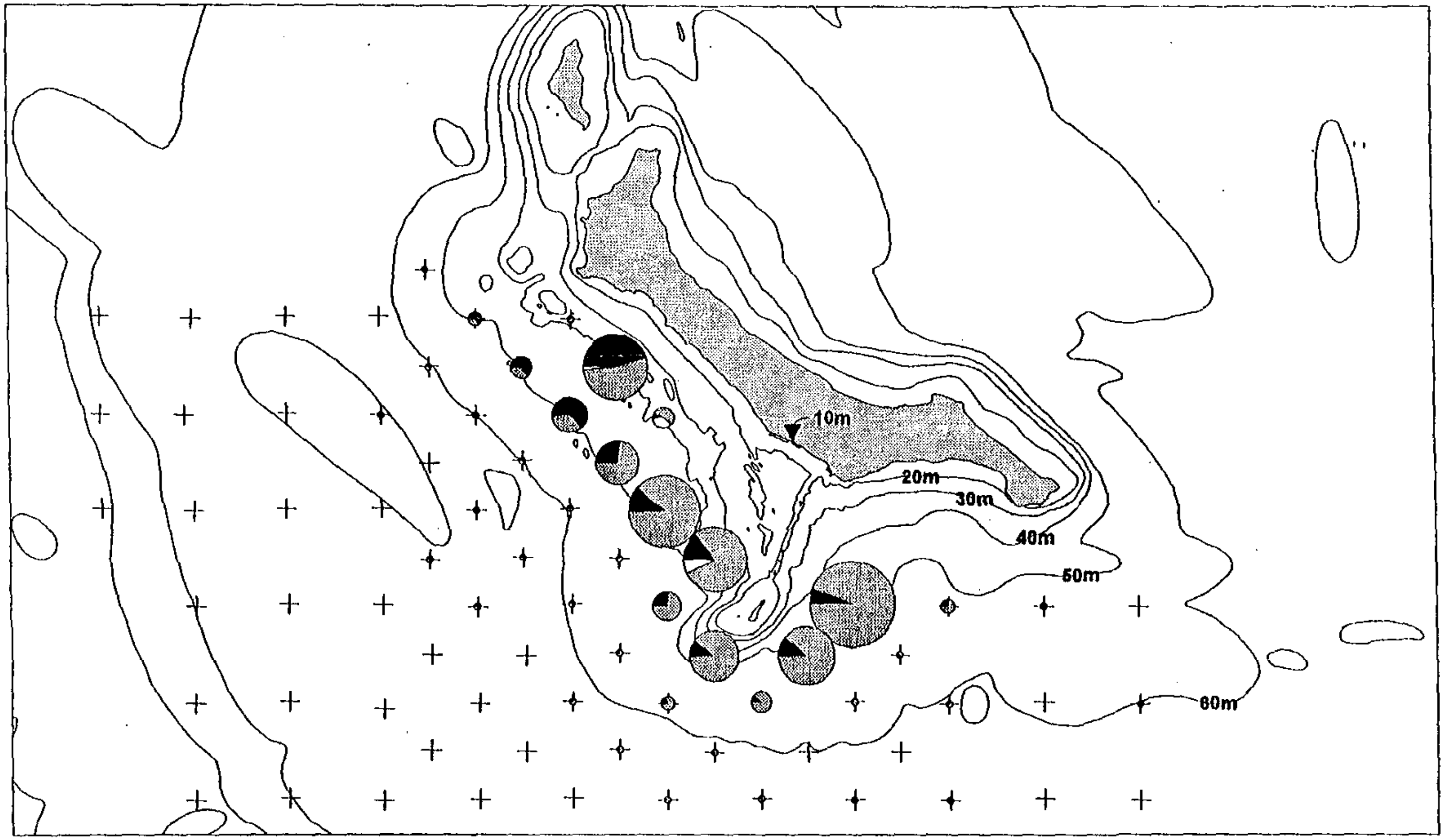

Figure 9 Catch per pot by station of female blue king crab by reproductive status in the 1995 ADF&G St. Matthew I. pot survey. Black = barren, clean setae females, gray = barren, matted setae; white = ovigerous. Largest circle = 150 females. Each station consists of four king crab pots arrayed north-to-south and spaced 0.125 nmi. Ten-meter depth contours are shown.

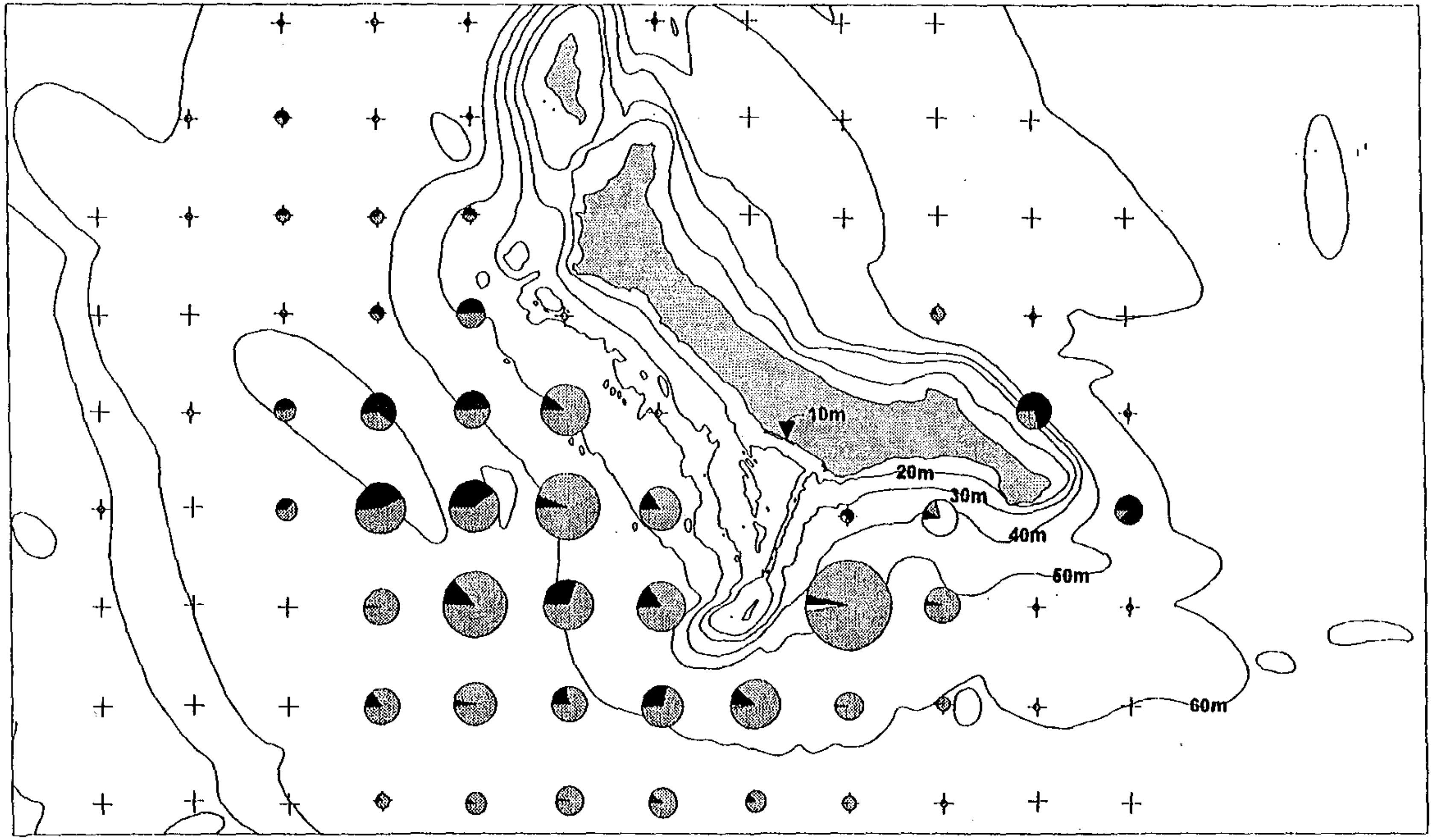

Figure 10 Catch per pot by station of female blue king crab by reproductive status in the 1998 ADF&G St. Matthew I. pot survey. Black = barren, clean setae females, gray = barren, matted setae; white = ovigerous. Largest circle = 60 females. Each station consists of four king crab pots arrayed north-to-south and spaced 0.125 nmi. Ten-meter depth contours are shown.

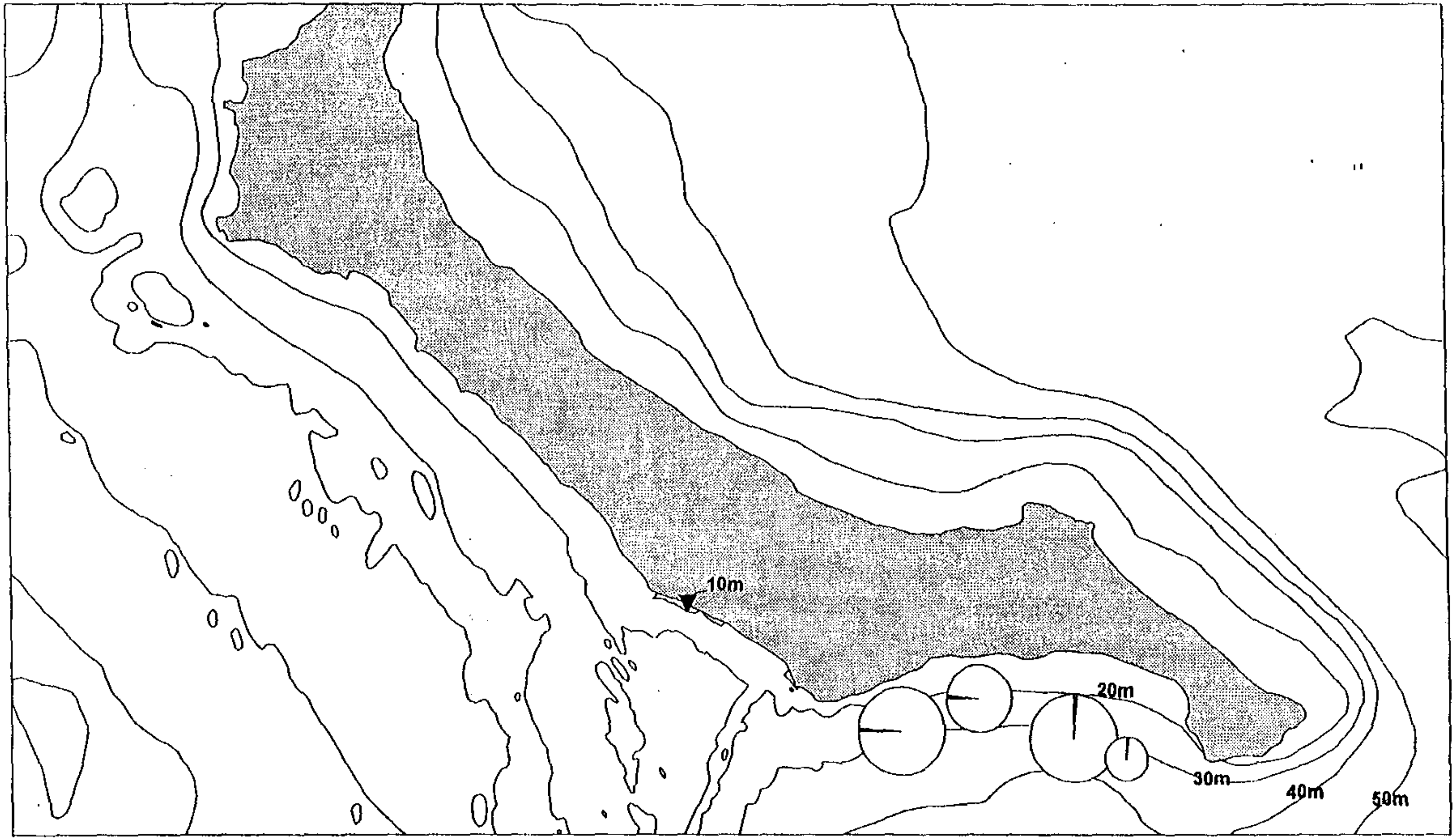

Figure 11 Catch per pot (C/P) by station of female blue king crab by reproductive status in the 1998 ADF&G nearshore St. Matthew I. pot survey. Conical pot C/P shown with horizontal slice: largest circle = 16 crabs. King crab pot C/P shown with vertical slice: largest circle = 97 crabs. Black = barren, clean setae, gray = barren, matted setae; white = ovigerous. Conical pot stations consist of 5 or 11 pots placed perpendicular to the shoreline and spaced at one fathom depth increments; king crab pot stations consist of 7 or 10 pots placed perpendicular to the shoreline and spaced at one fathom depth increments. Ten-meter depth contours are shown.

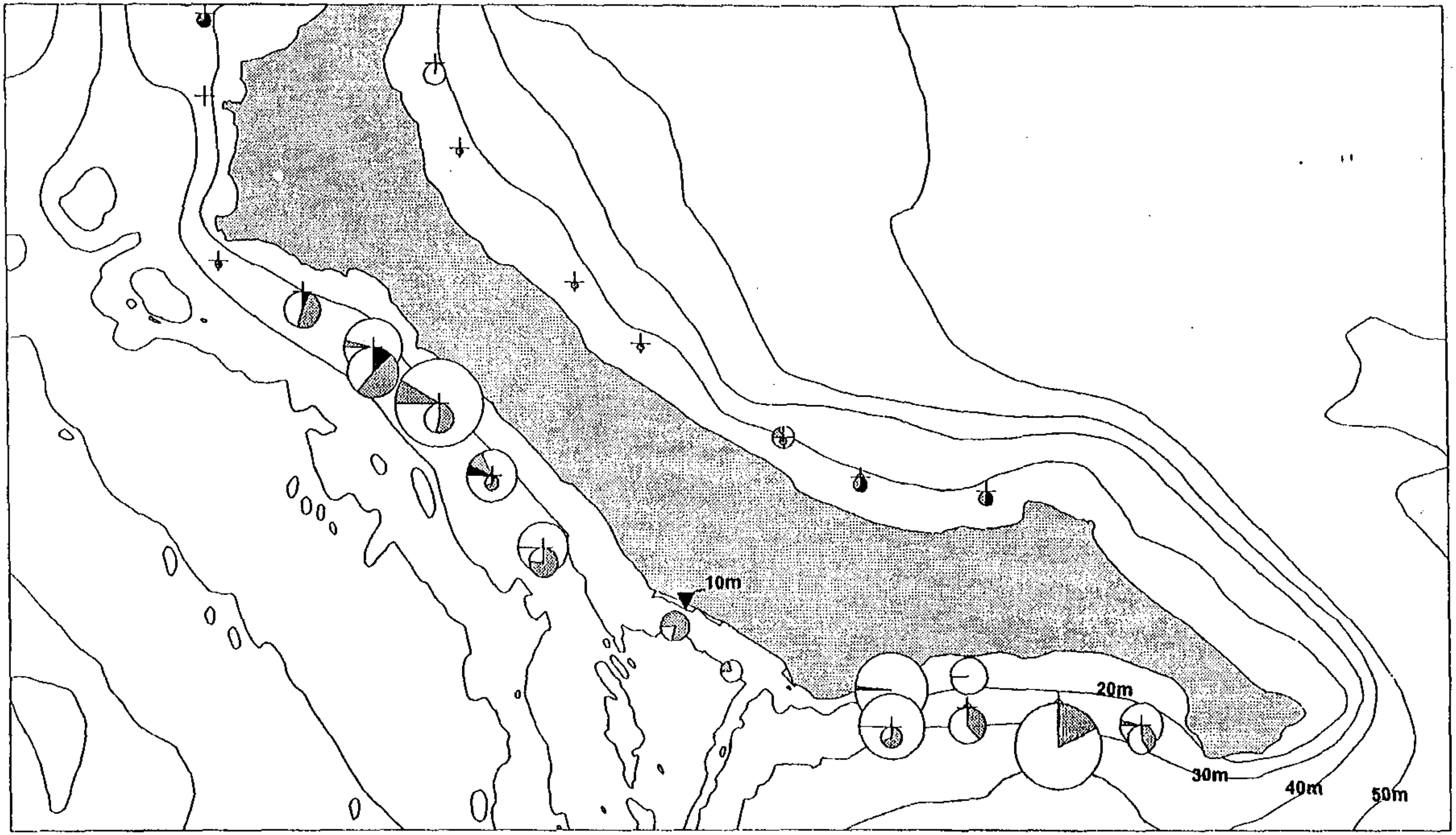

Figure 12 Catch per pot (C/P) by station of female blue king crab by reproductive status in the 1999 ADF&G nearshore St. Matthew I. pot survey. Conical pot C/P shown with horizontal slice: largest circle = 15 crabs. King crab pot C/P shown with vertical slice: largest circle = 44 crabs. Black = barren, clean setae, gray = barren, matted setae; white = ovigerous. Conical pot stations consist of 1 to 7 pots placed perpendicular to the shoreline and spaced at one fathom depth increments; king crab pot stations consist of 9 or 10 pots placed perpendicular to the shoreline and spaced at one fathom depth increments. Ten-meter depth contours are shown.

St. Matthew blue king crab Rebuilding Plans: Habitat Protection

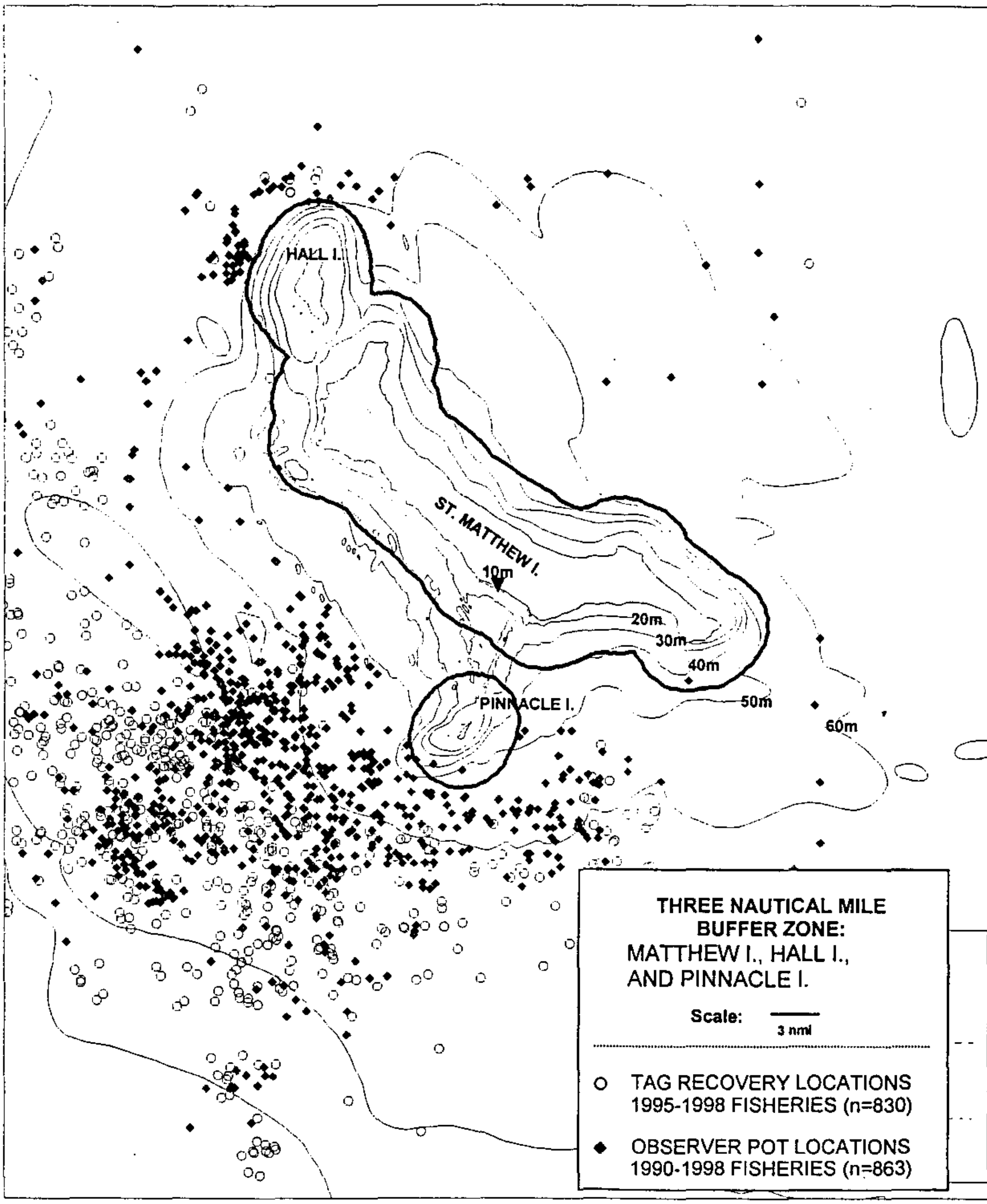

Figure 13

Three nautical mile buffer zone around St. Matthew I., Hall I. and Pinnacle I. to protect ovigerous female blue king crabs.

is 'home port' to 770 commercial fishing vessels. Not only is Kodiak the state's largest fishing port, it is also home to some of Alaska's largest trawl, longline, and crab vessels."

Kodiak has a diversified seafood processing sector. The port historically was very active in the crab fisheries and, although these fisheries have declined from their peaks in the late-1970s and early-1980s, Kodiak continues to support shellfish fisheries, as well as significant harvesting and processing operations for groundfish (particularly flatfish and pollock) Pacific halibut, herring, sablefish, and the five Pacific salmon species.

Kodiak often ranks near the top of the list of U.S. fishing ports, on the basis of landed value, and is frequently regarded as being involved in a wider variety of fisheries than any other community on the North Pacific coast. In 1997, for example, the port recorded salmon landings of just under 44 million pounds, with an estimated exvessel value of over $12 million. Approximately 4.3 million pounds of Pacific herring were landed in Kodiak with an exvessel value of more than $713,000. Crab landings exceeded 1.1 million pounds and were valued exvessel at more than $2.7 million.

In addition to seafood harvesting and processing, the Kodiak economy includes sectors such as transportation (being regarded as the transportation hub for southwest Alaska), federal/state/local government, tourism, and timber (the forest products industry, based upon Sitka spruce, is an important and growing segment of the Kodiak economy). The community is also home to the largest Coast Guard base in the U.S.

Sand Point and King Cove - Sand Point and King Cove, like Akutan, are part of the Aleutians East Borough. Both Sand Point and King Cove have had extensive historical linkages to commercial fishing and fish processing, and currently support resident commercial fleets delivering catch to local plants. These local catches are substantially supplemented by deliveries from large, highly mobile vessels, based outside of the two small Gulf of Alaska communities. King Cove possesses a deep water harbor which provides moorage for approximately 90 vessels of various sizes, in an ice-free port. Sand Point, with a 25 acre/144 slip boat harbor and marine travel-lift, is home port to what some have called " the largest fishing fleet in the Aleutians" (NPFMC, 1994).

For decades, each of these the two communities has concentrated principally on salmon fisheries. For example, in 1997, both Sand Point and King Cove recorded salmon landings of several million pounds. In addition, King Cove had significant landings of Pacific herring and crabs. Recently, each community has actively sought to diversify its fishing and processing capabilities. Few employment alternatives to commercial fishing and fish processing exist, within the cash-economy, in these communities. However, subsistence harvesting is an important source of food, as well as a social activity, for local residents in both Sand Point and King Cove.

Summary of Impacts on Communities

Changes to BSAI crab fishery regulations to rebuild St. Matthew blue king crab may impact communities in the North Pacific region. Changes to the harvest strategy would effect the crab fishermen from Seattle, Dutch Harbor, Kodiak, Homer, and other communities. However, these impacts would be expected to be short lived, as some fishing on the stock will be allowed during the rebuilding period. This fishery generated $5 million to $15 million (exvessel) annually during the last decade (1990-1998). The costs of reduced fishing opportunities during the rebuilding period may be more than offset by benefits gained from rebuilding the stock to its MSY level. Note that ADF&G does not allow directed fisheries for St. Matthew blue king crab when the stock is at low abundance (e.g., 1999), so exvessel value is $0. Once rebuilt, these coastal communities would once again have expanded opportunities (both fishing and processing) in this potentially lucrative fishery.

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10.0 AGENCIES AND INDIVIDUALS CONSULTED

NMFS-AKRO: Mary Furuness
ADF&G: Wayne Donaldson
UAF: Tom Shirley

Public: John Gauvin, Arni Thomson, Simeon Swetzoff, Mateo Paz-Soldan, Dorothy Childers

Advisory Groups: BSAI Crab Plan Team, Alaska Board of Fisheries, NPFMC Scientific and Statistical Committee, NPFMC Advisory Panel

11.0 LIST OF PREPARERS

NPFMC: Dave Witherell
ADF&G: Rance Morrison, Gordon Kruse, Doug Pengilly, Jie Zheng, Shareef Siddeek, Leslie Watson, Donn Tracy, and Larry Byrne.
NMFS: Bob Otto, Jack Turnock, Gretchen Harrington

12.0 TABLES

Table 1. Annual abundance estimates (millions of crabs) for St. Matthew blue king crabs from NMFS bottom trawl surveys, 1976-1999.

Table 2. Bycatch of crab in 1999 BSAI groundfish fisheries by species, gear type, target, and regulatory area. Note that the "other king crab" category includes blue king crab, scarlet king crab, and golden king crab.

Table 1 Annual abundance estimates (millions of crabs) for St. Matthew blue king crabs from NMFS bottom trawl surveys, 1976-1999.

Northern District

Carapace	Males: Small	Males: Pre-rec	Males: Legal	Males: Total	Females: Small	Females: Large	Females: Total	Grand Total
Length(mm)	<105	105-119	≥120		<80	≥80		
Width(in)	<4.3	4.3-5.5	≥5.5		<3.8	≥3.8		
1980	3.4	2.2	2.5	8.1	0.8	2.2	3.0	11.1
1981	1.2	1.8	3.1	6.3	<0.1	0.5	0.5	6.8
1982	3.2	2.6	6.8	12.5	0.4	0.7	1.1	13.6
1983	1.8	1.6	3.5	6.9	0.2	2.4	2.7	9.6
1984	1.4	0.6	1.6	3.6	0.2	0.5	0.7	4.3
1985	0.5	0.4	1.1	1.9	0.1	0.1	0.2	2.1
1986	0.6	0.4	0.4	1.4	0.3	0.1	0.3	1.7
1987	1.1	0.7	0.7	2.5	0.5	0.2	0.7	3.2
1988	1.4	0.7	0.8	2.9	0.9	0.8	1.7	4.6
1989	4.8	1.0	1.5	7.3	1.6	1.7	3.3	10.5
1990	1.4	0.8	1.7	3.9	0.4	0.2	0.6	4.50
1991	2.9	1.5	2.2	6.6	0.8	0.7	1.5	8.1
1992	2.3	1.5	2.3	6.0	0.9	0.4	1.3	7.4
1993	4.6	2.0	3.6	10.2	1.4	3.0	4.4	14.6
1994	1.5	1.4	2.5	5.4	0.1	0.4	0.5	5.9
1995	1.9	1.1	1.9	4.9	0.6	0.1[1]	0.7	5.6
1996	2.6	2.0	3.4	8.0	1.1	0.9	2.0	10.0
1997	2.4	2.3	3.9	8.6	0.6	0.8	1.4	10.0
1998	2.3	1.8	3.1	7.2	0.6	0.5	1.1	8.4
1999	0.5	0.2	0.6	1.4	0.3	<0.1[1]	0.3	1.7
Limits[2]								
Lower	0.0	0.1	0.4	0.7	0.0	0.0	0.0	0.5
Upper	1.1	0.4	0.9	2.1	0.7	0.1	0.8	2.9
±%	108	61	42	51	152	200	141	68

[1] These estimates considered unreliable because few crabs caught.

[2] Mean ± 2 standard errors for most recent year.

Table 2 Bycatch of crab in 1999 BSAI groundfish fisheries by species, gear type, target, and regulatory area. Note that the "other king crab" category includes blue king crab, scarlet king crab, and golden king crab.

1999 crab bycatch data		red king	bairdi	o.Tanner	o. king
by gear and target					
Hook and Line					
	P. cod	7,981	2,782	90,582	1,624
	other	8	18	756	1,724
	Total all targets	7,989	2,800	91,338	3,348
Groundfish pot					
	P. cod	979	40,402	177,673	14,511
	other	0	18	767	23,761
	Total all targets	979	40,420	178,440	38,272
Trawl					
	Greenland turbot	0	5,828	3,032	1,811
	P. cod	7,697	127,242	278,899	4,066
	rock sole	62,619	306,775	451,338	3,075
	yellowfin sole	14,304	455,527	739,812	2,890
	other targets	89	6,247	71,666	7,380
	Total all targets	84,709	901,619	1,544,747	19,222
Total all gears/targets		93,677	944,839	1,814,525	60,842

1999 crab bycatch data		red king	bairdi	o.Tanner	o. king
by area (all gears/targets)					
Regulatory area					
	509	48,032	291,353	450,943	1,843
	512	2,420	46	45	14
	513	915	284,478	855,019	3,447
	514	895	4,589	78,317	1,963
	516	40,623	81,718	11,655	2,864
	517	66	214,088	234,937	4,690
	518	4	4,741	210	923
	519	34	18,344	41,511	438
	521	405	31,661	126,322	11,517
	523	5	327	5,654	8
	524	77	7,740	9,212	4,985
	541	196	5,497	677	19,693
	542	5	245	22	4,438
	543	0	10	0	4,018

13.0 FIGURES

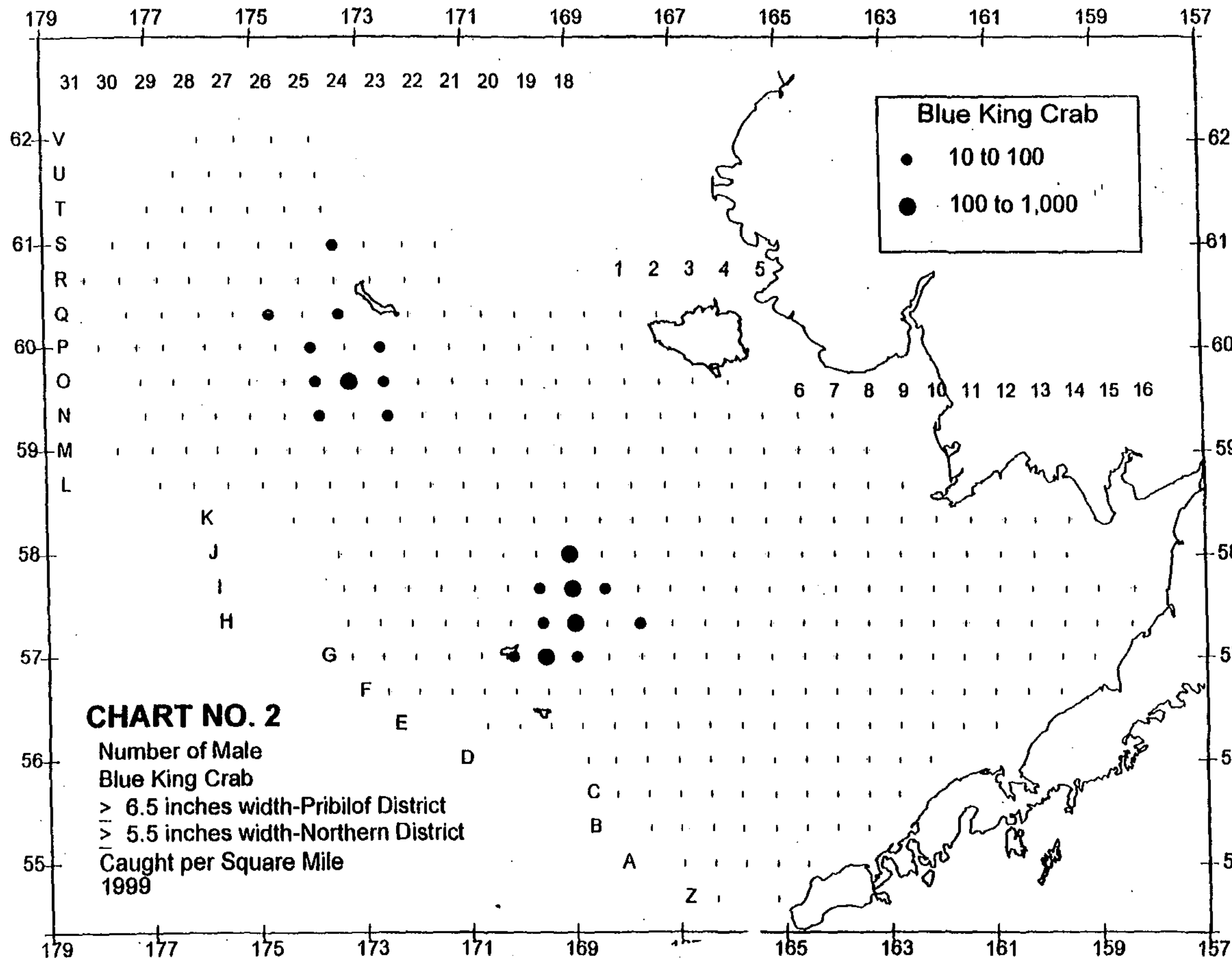


Figure 1 Distribution of large male St. Matthew blue king crab from the 1999 NMFS summer trawl survey.

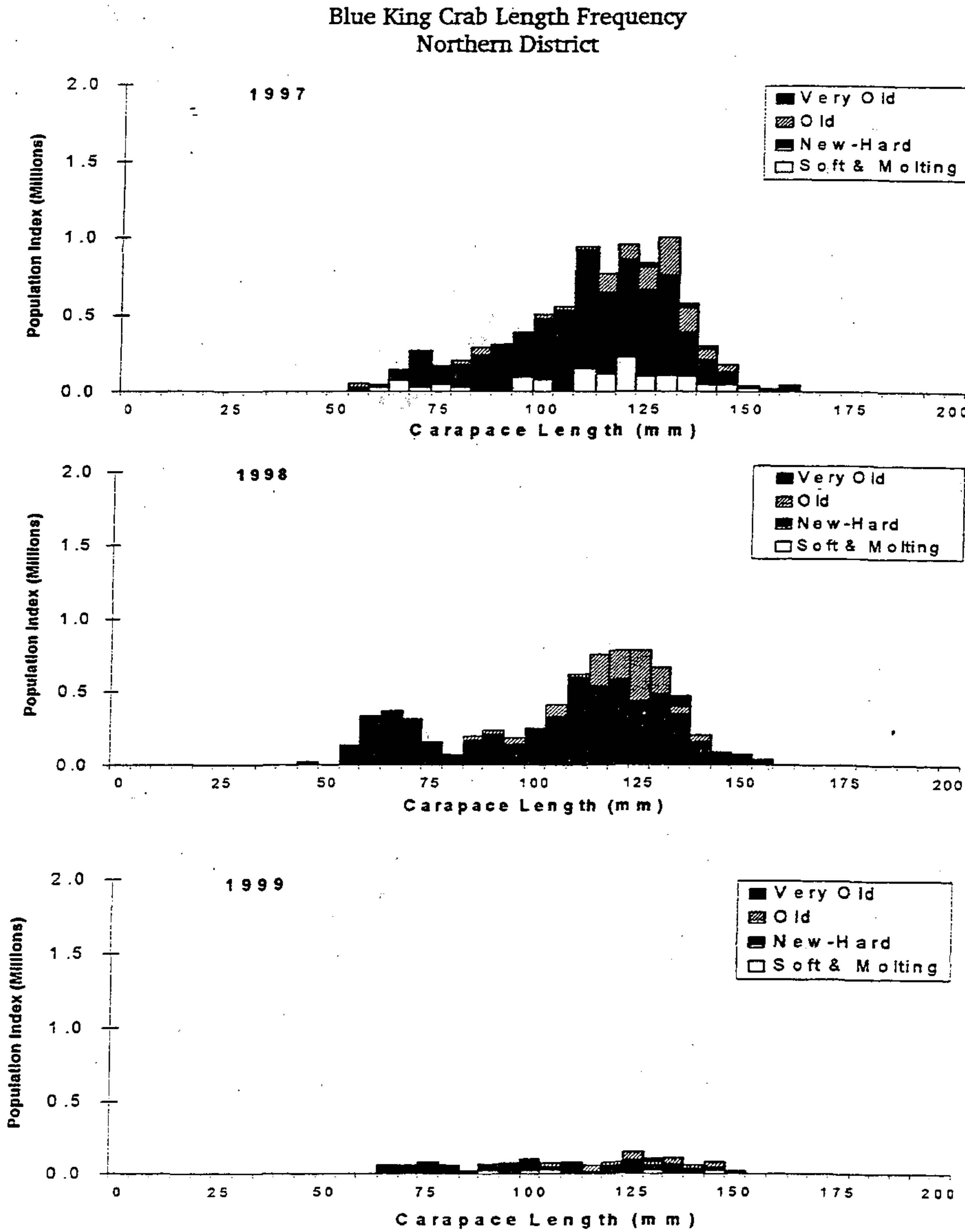


Figure 2 *Size-frequency of Northern District (St. Matthew Island) male blue king crab (P. platypus), by 5 mm length classes, 1997-1999.*

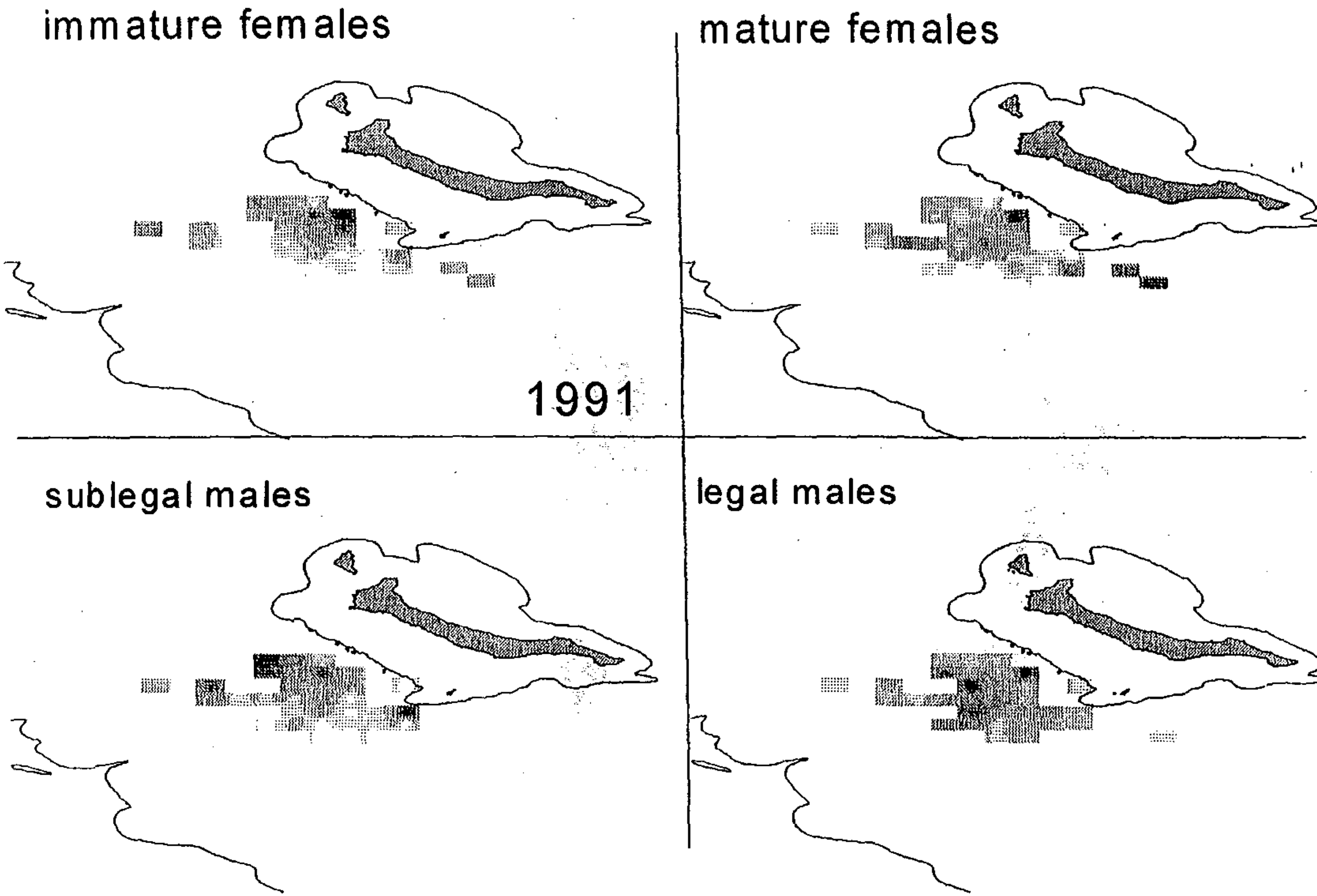


Figure 3 Z-score surfaces of mean CPUE for blue king crabs from the 1991 St. Matthew Island blue king crab fishery. Data is from 124 pots sampled by observers on 9 catcher-processor vessels that participated in the fishery.

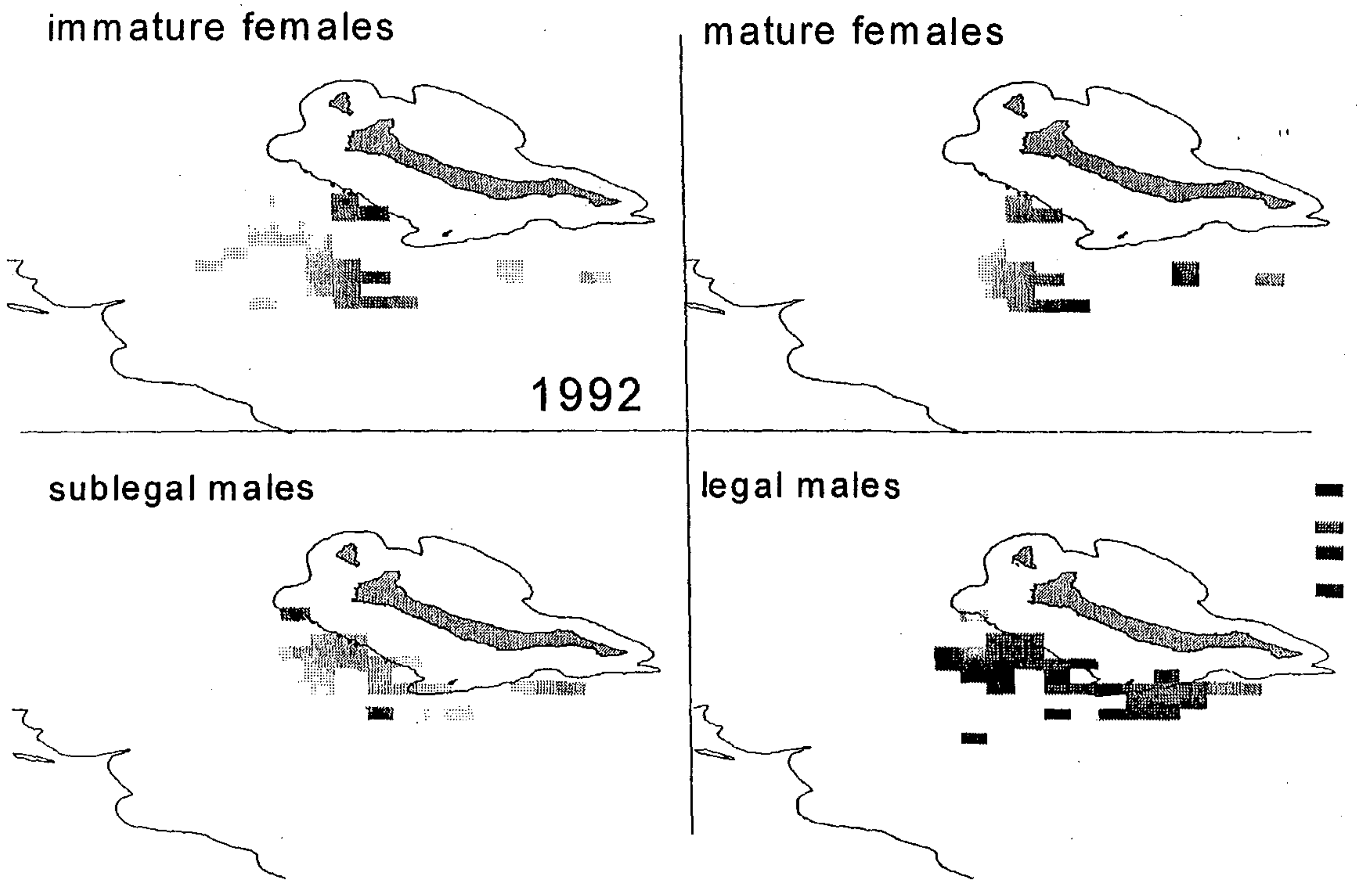


Figure 4 Z-score surfaces of mean CPUE for blue king crabs from the 1992 St. Matthew Island blue king crab fishery. Data is from 71 pots sampled by observers on 8 catcher-processor vessels that participated in the fishery.

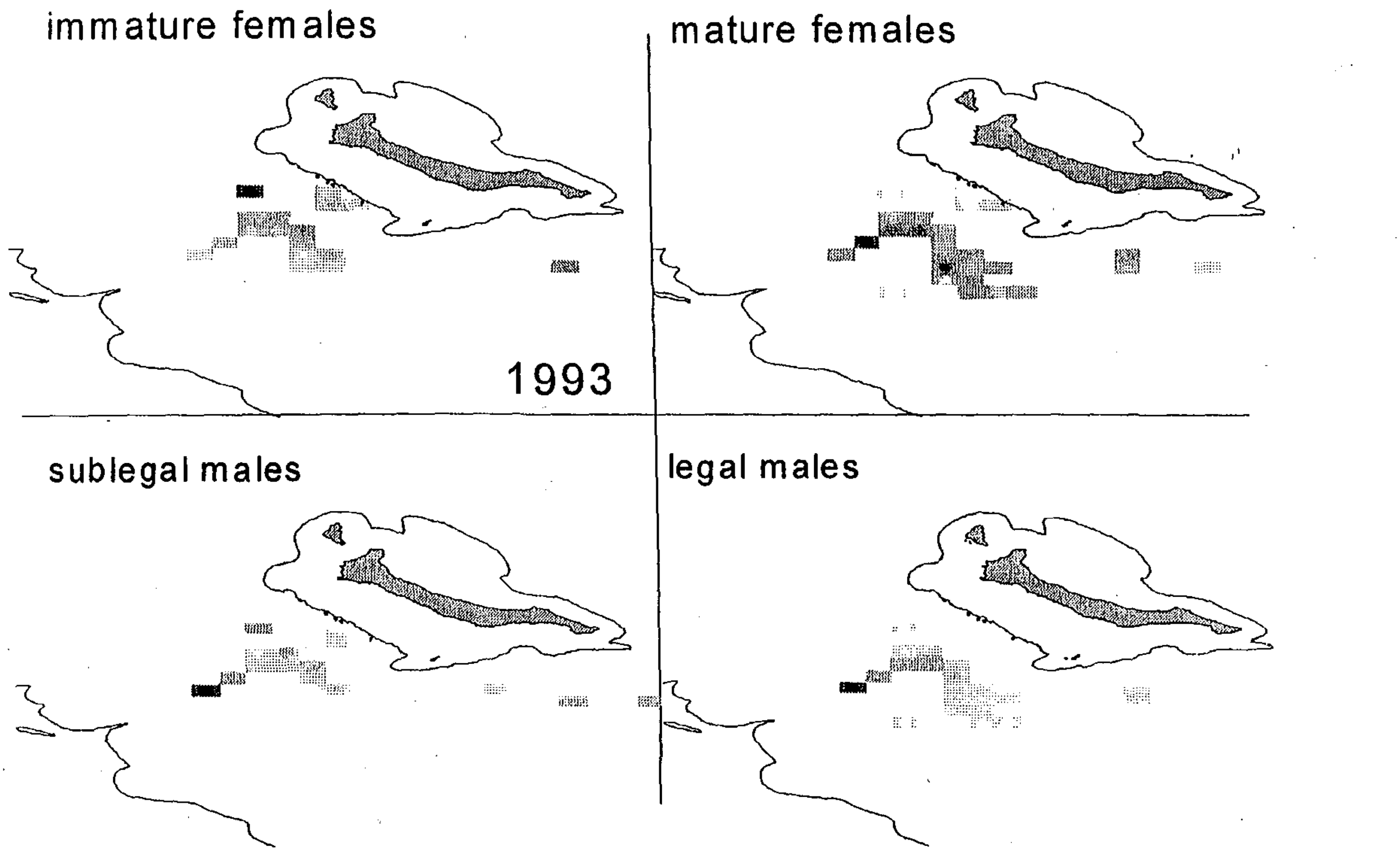


Figure 5 Z-score surfaces of mean CPUE for blue king crabs from the 1993 St. Matthew Island blue king crab fishery. Data is from 84 pots sampled by observers on 3 catcher-processor vessels that participated in the fishery.

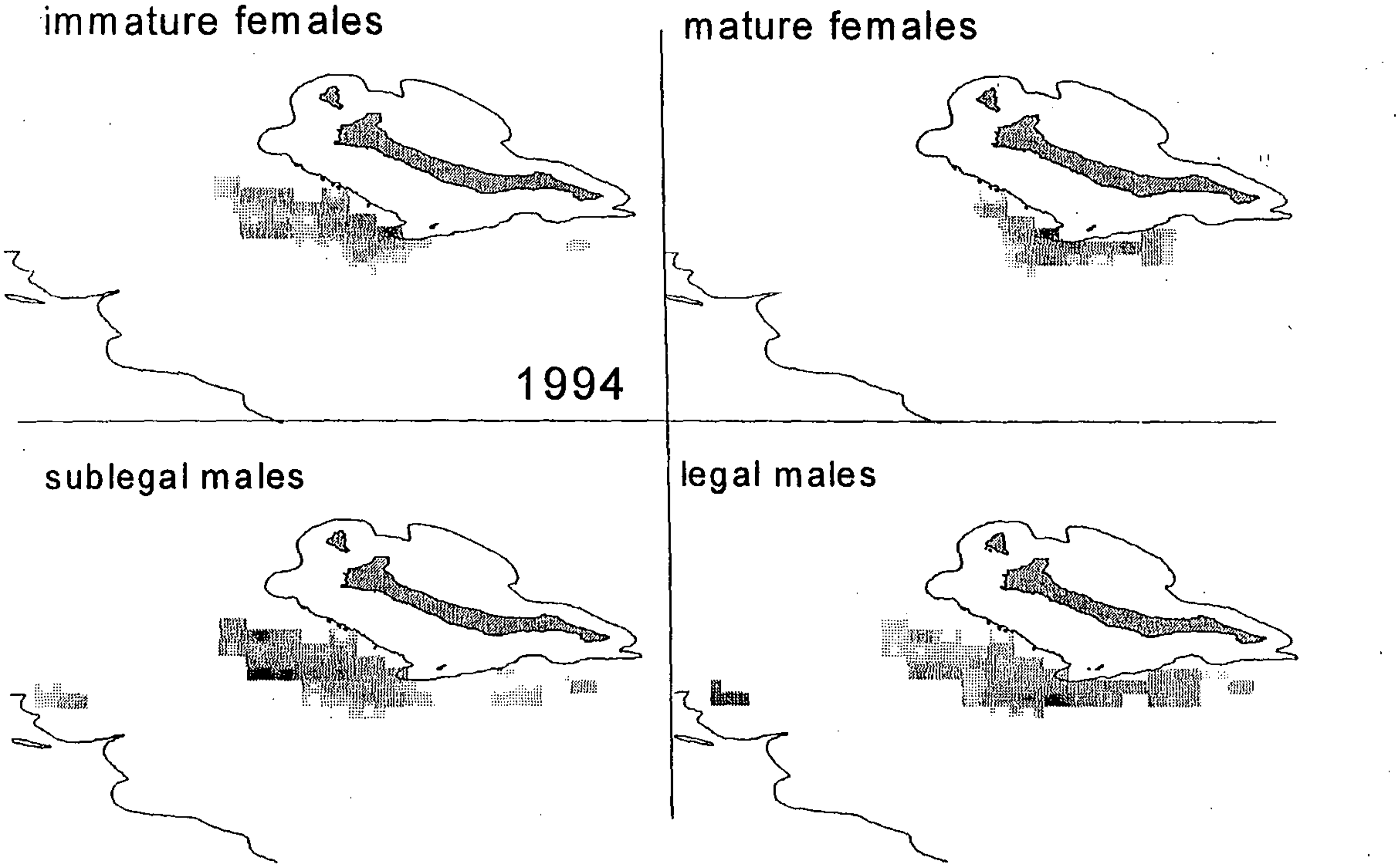


Figure 6 **Z-score surfaces of mean CPUE for blue king crabs from the 1994 St. Matthew Island blue king crab fishery. Data is from 203 pots sampled by observers on 6 catcher-processor vessels that participated in the fishery.**

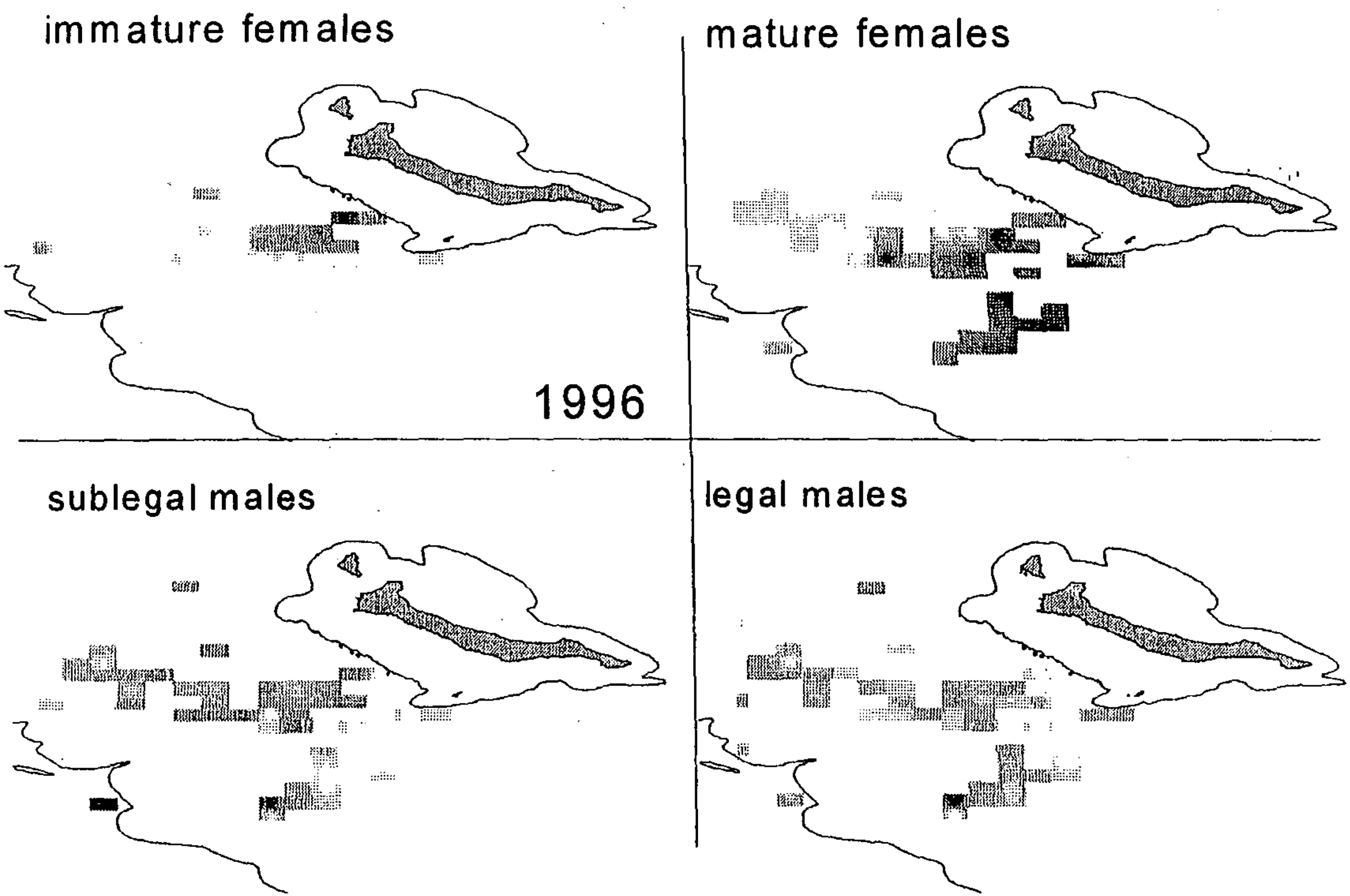


Figure 7 Z-score surfaces of mean CPUE for blue king crabs from the 1996 St. Matthew Island blue king crab fishery. Data is from 96 pots sampled by observers on 3 catcher-processor vessels that participated in the fishery.

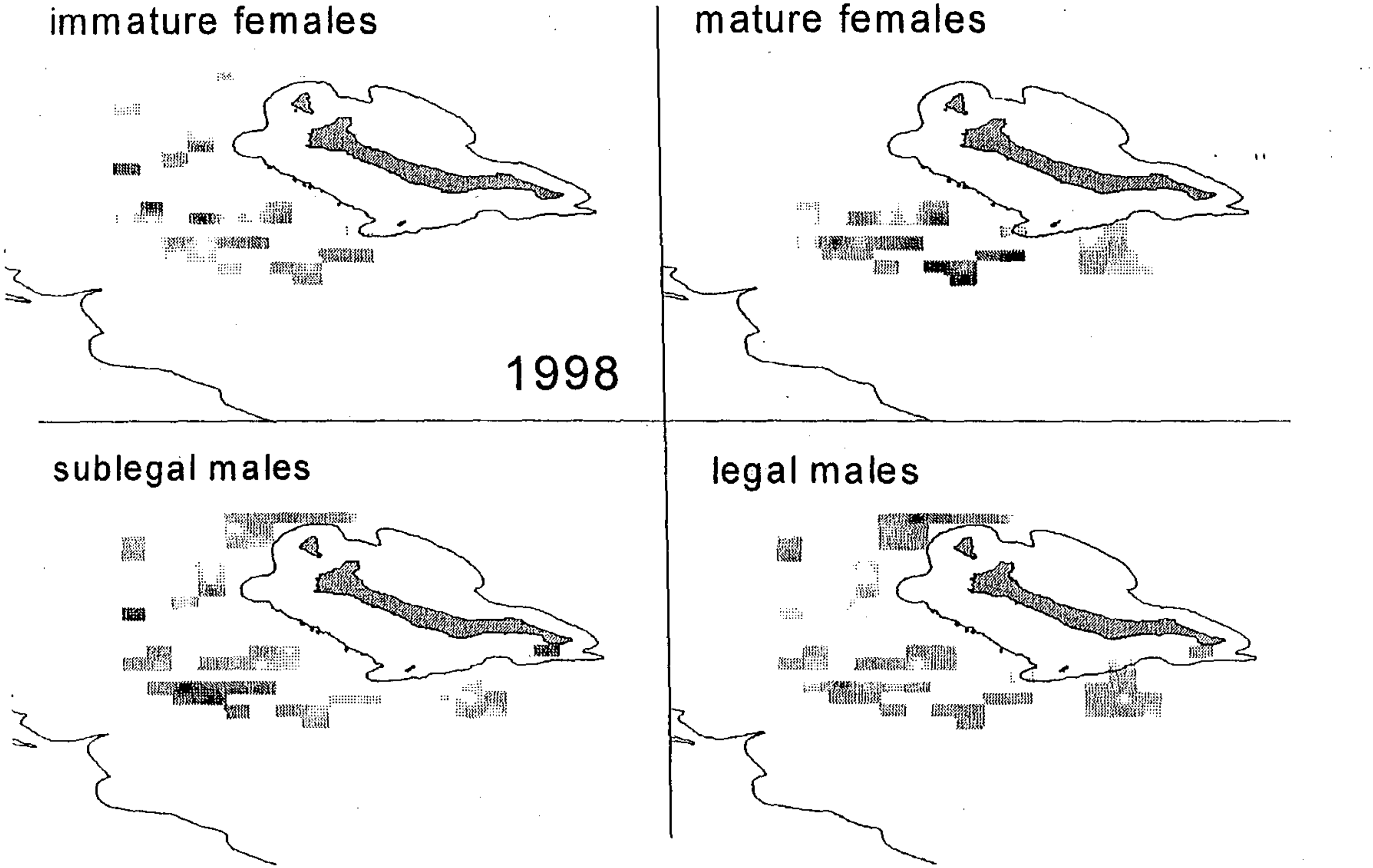


Figure 8 Z-score surfaces of mean CPUE for blue king crabs from the 1998 St. Matthew Island blue king crab fishery. Data is from 135 pots sampled by observers on 3 catcher-processor vessels that participated in the fishery.

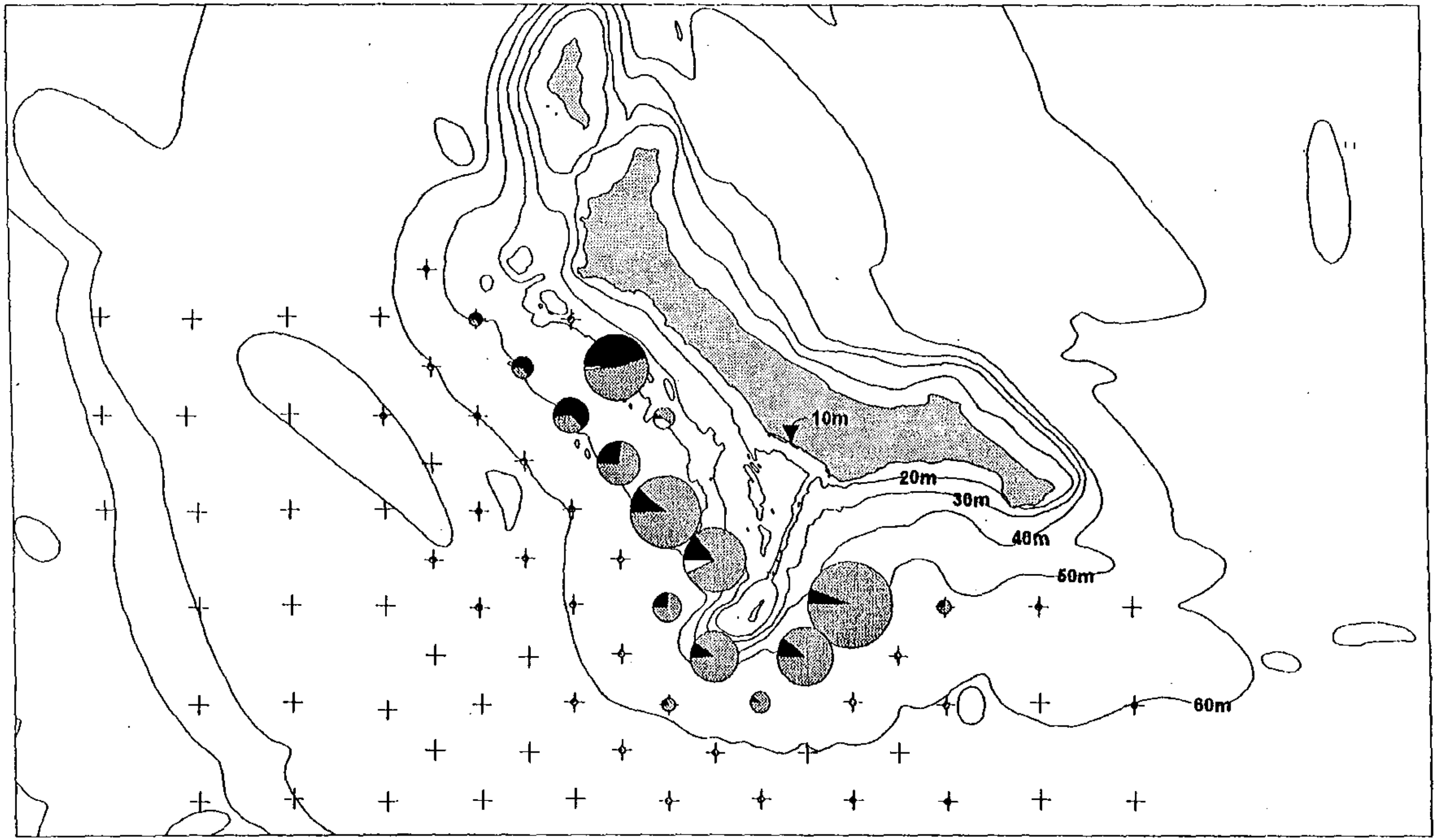


Figure 9 Catch per pot by station of female blue king crab by reproductive status in the 1995 ADF&G St. Matthew I. pot survey. Black = barren, clean setae females, gray = barren, matted setae; white = ovigerous. Largest circle = 150 females. Each station consists of four king crab pots arrayed north-to-south and spaced 0.125 nmi. Ten-meter depth contours are shown.

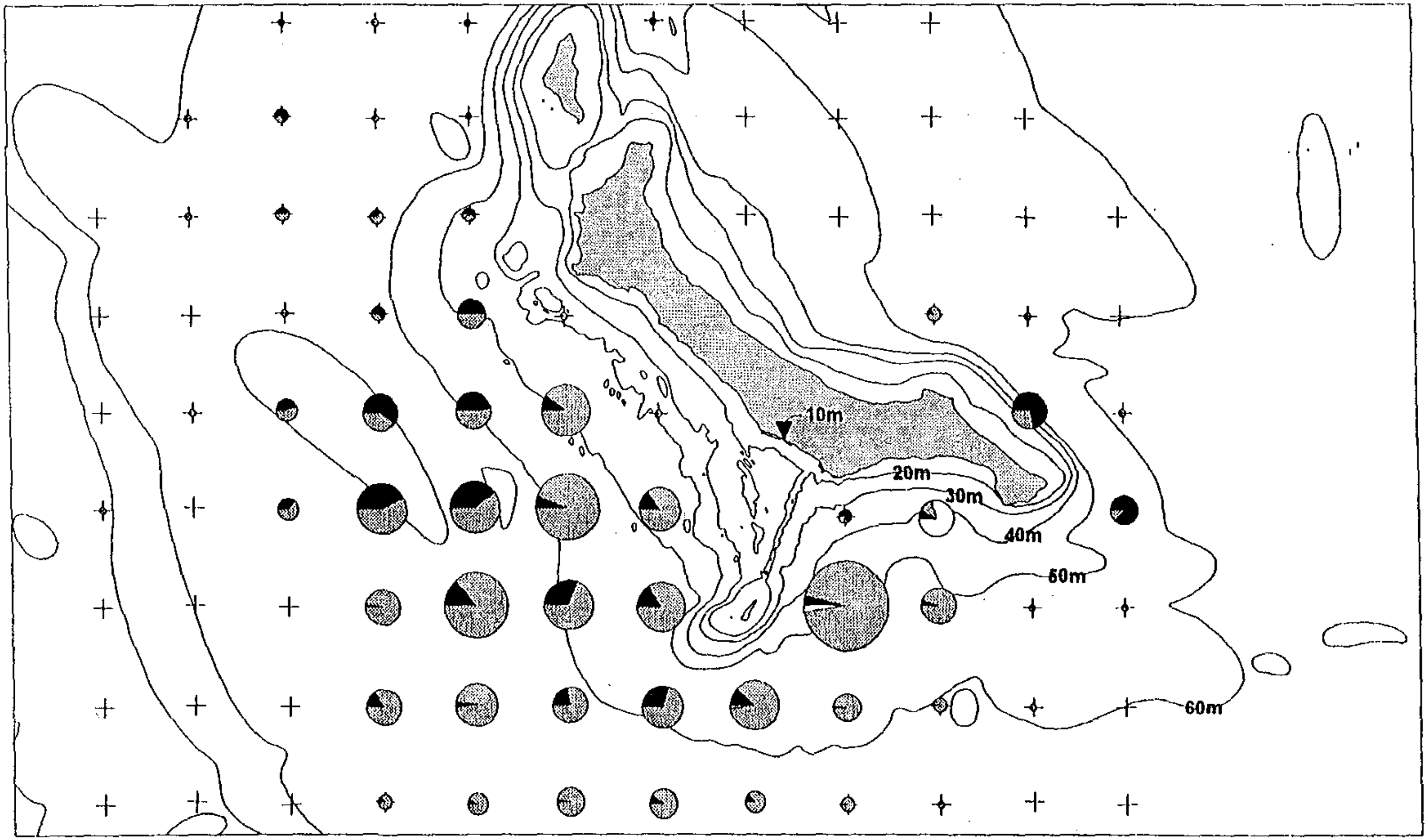


Figure 10 Catch per pot by station of female blue king crab by reproductive status in the 1998 ADF&G St. Matthew I. pot survey. Black = barren, clean setae females, gray = barren, matted setae; white = ovigerous. Largest circle = 60 females. Each station consists of four king crab pots arrayed north-to-south and spaced 0.125 nmi. Ten-meter depth contours are shown.

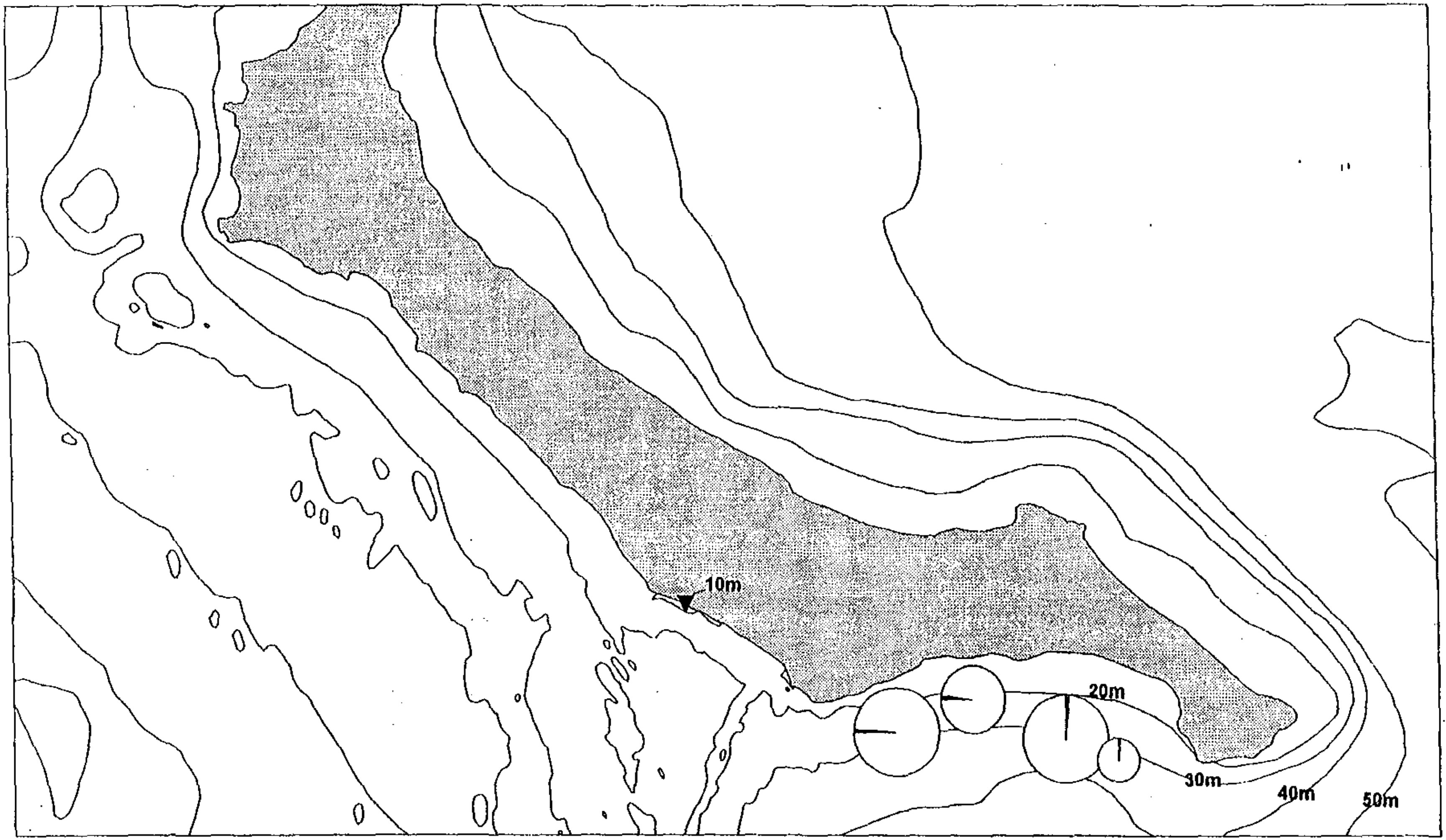


Figure 11 Catch per pot (C/P) by station of female blue king crab by reproductive status in the 1998 ADF&G nearshore St. Matthew I. pot survey. Conical pot C/P shown with horizontal slice: largest circle = 16 crabs. King crab pot C/P shown with vertical slice: largest circle = 97 crabs. Black = barren, clean setae, gray = barren, matted setae; white = ovigerous. Conical pot stations consist of 5 or 11 pots placed perpendicular to the shoreline and spaced at one fathom depth increments; king crab pot stations consist of 7 or 10 pots placed perpendicular to the shoreline and spaced at one fathom depth increments. Ten-meter depth contours are shown.

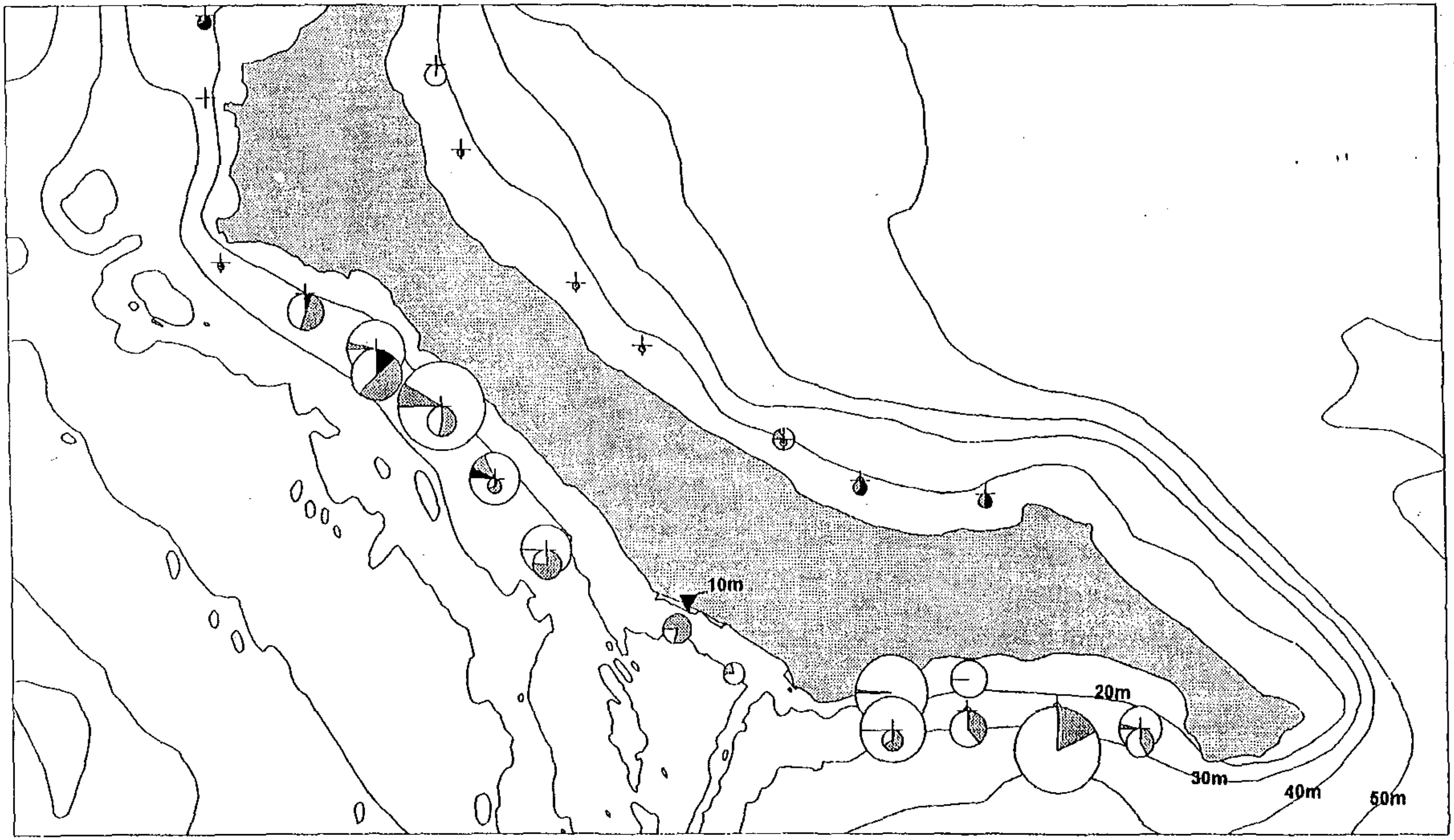


Figure 12 Catch per pot (C/P) by station of female blue king crab by reproductive status in the 1999 ADF&G nearshore St. Matthew I. pot survey. Conical pot C/P shown with horizontal slice: largest circle = 15 crabs. King crab pot C/P shown with vertical slice: largest circle = 44 crabs. Black = barren, clean setae, gray = barren, matted setae; white = ovigerous. Conical pot stations consist of 1 to 7 pots placed perpendicular to the shoreline and spaced at one fathom depth increments; king crab pot stations consist of 9 or 10 pots placed perpendicular to the shoreline and spaced at one fathom depth increments. Ten-meter depth contours are shown.

St. Matthew blue king crab Rebuilding Plans: Habitat Protection

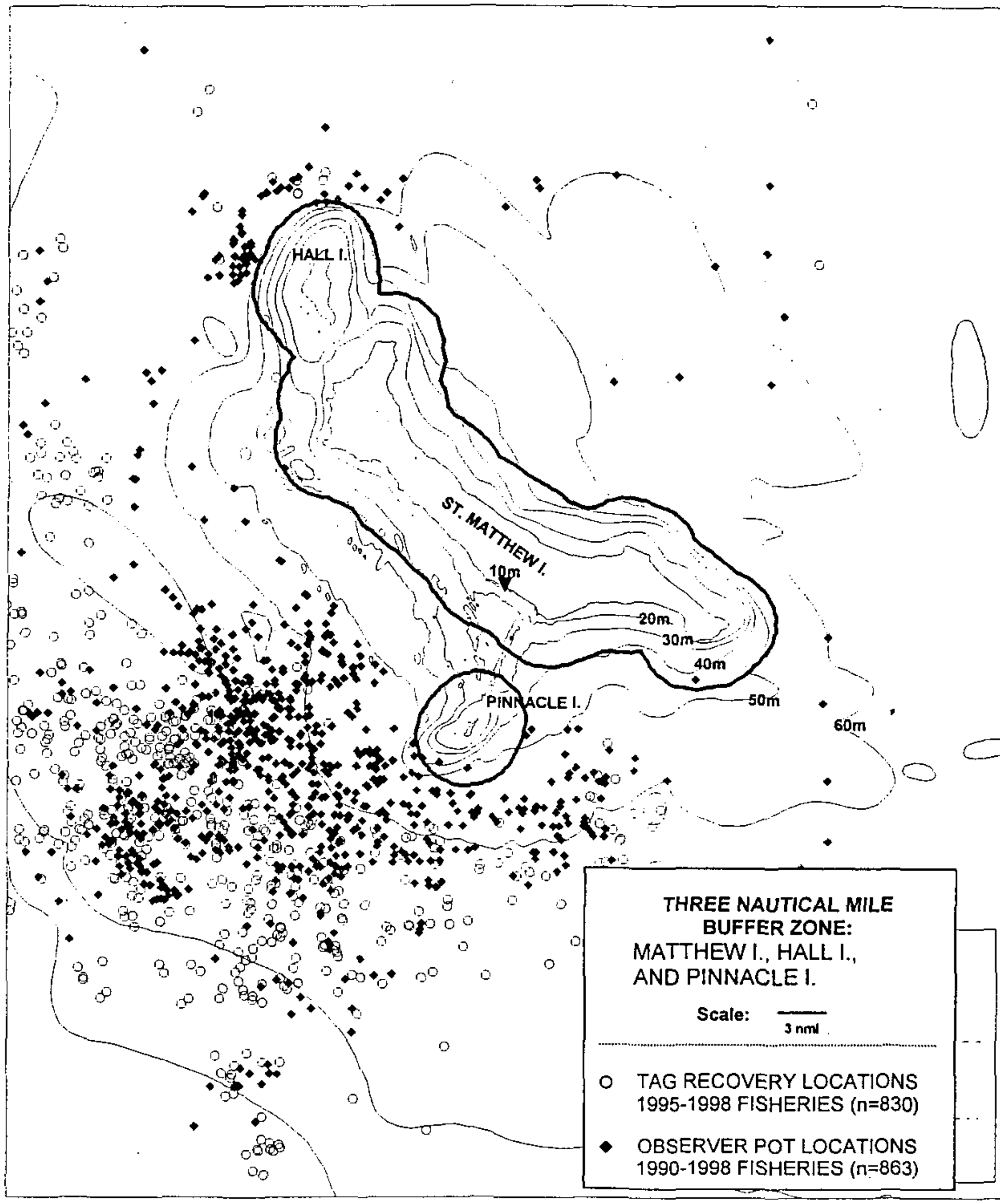
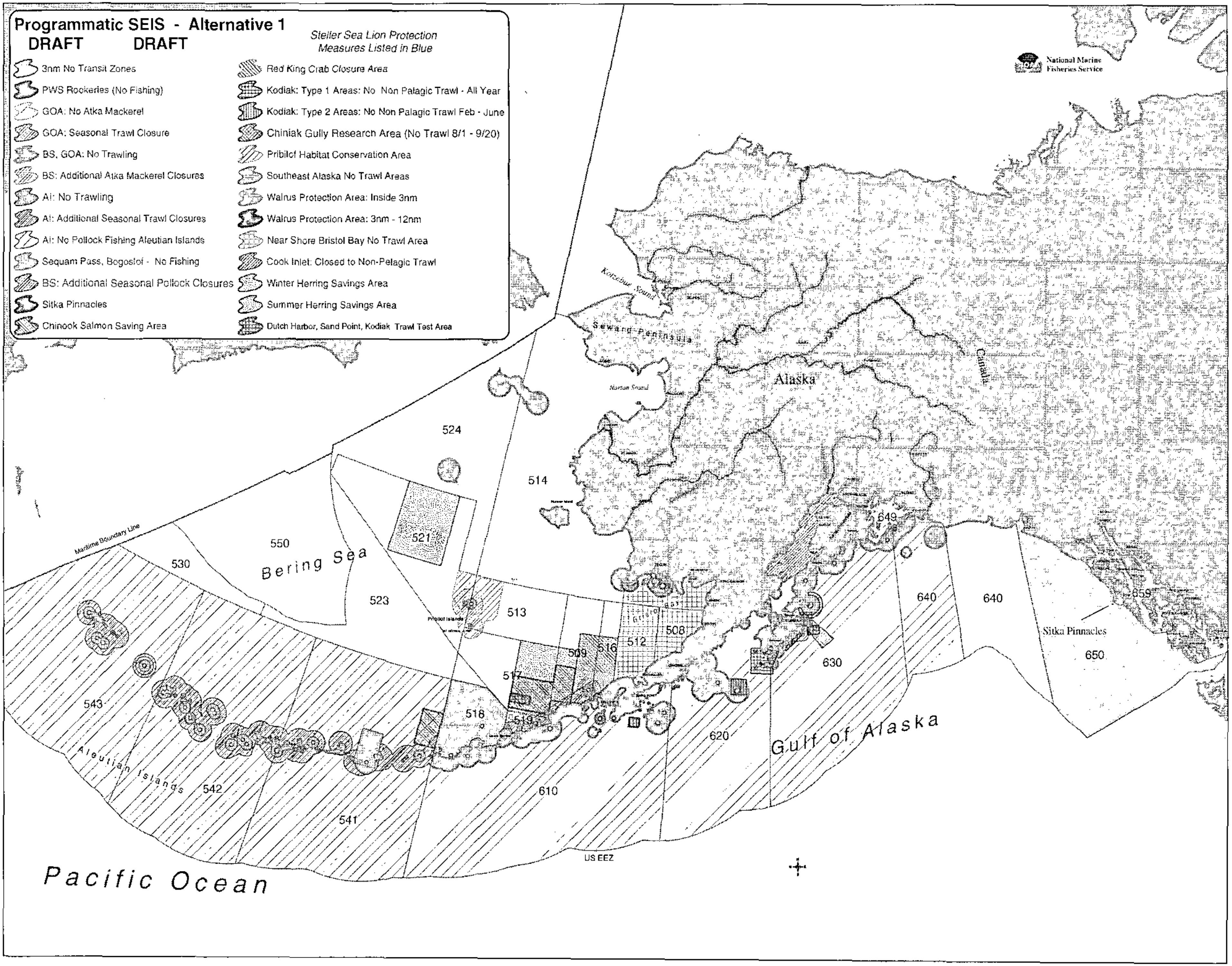
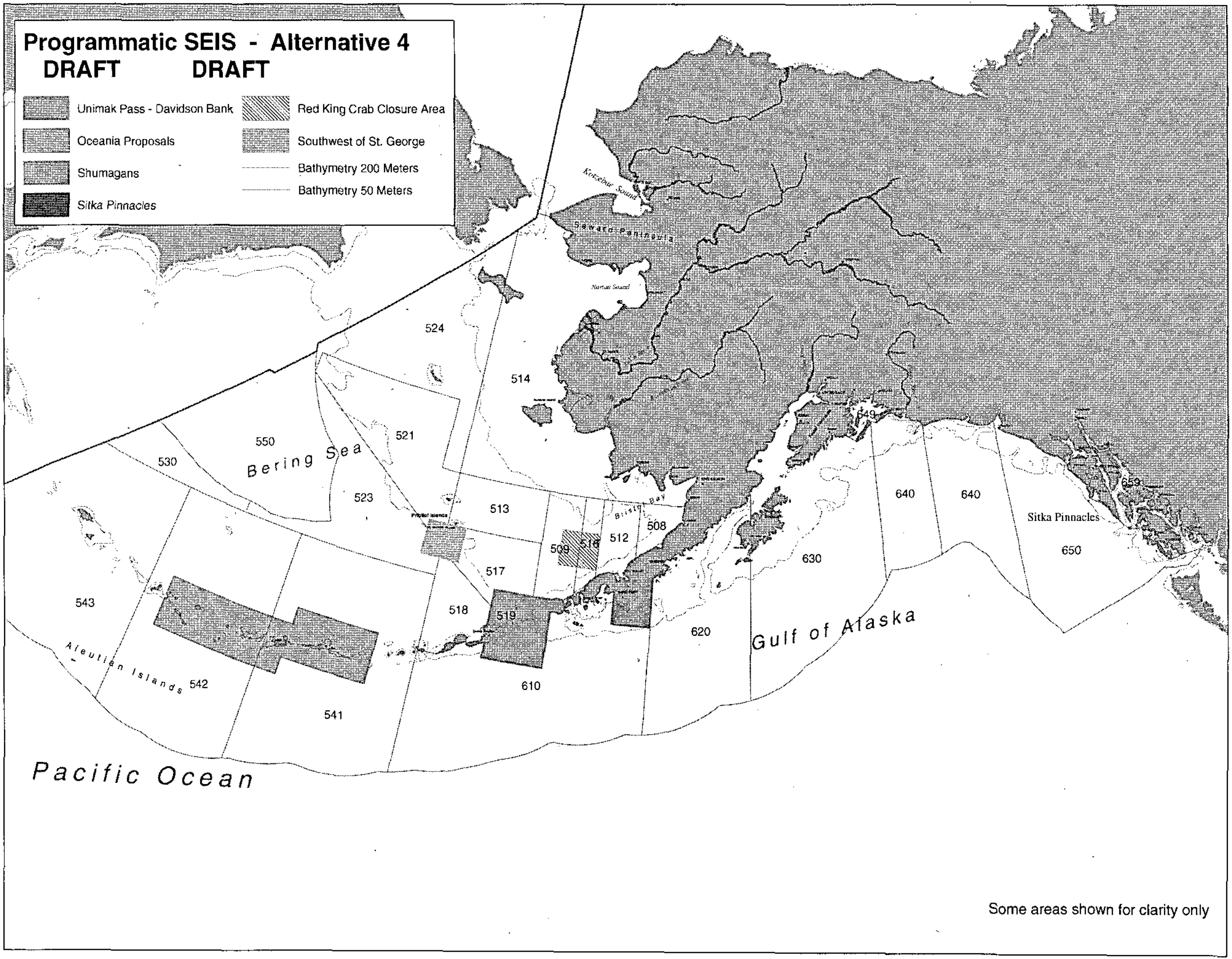


Figure 13

Three nautical mile buffer zone around St. Matthew I., Hall I. and Pinnacle I. to protect ovigerous female blue king crabs.



Programmatic SEIS - Alternative 1
DRAFT DRAFT
Steller Sea Lion Protection Measures Listed in Blue
3nm No Transit Zones
PWS Rookeries (No Fishing)
GOA: No Atka Mackerel
GOA: Seasonal Trawl Closure
BS, GOA: No Trawling
BS: Additional Atka Mackerel Closures
AI: No Trawling
AI: Additional Seasonal Trawl Closures
AI: No Pollock Fishing Aleutian Islands
Sequam Pass, Bogoslof - No Fishing
BS: Additional Seasonal Pollock Closures
Sitka Pinnacles
Chinook Salmon Saving Area
Red King Crab Closure Area
Kodiak: Type 1 Areas: No Non Palagic Trawl - All Year
Kodiak: Type 2 Areas: No Non Palagic Trawl Feb - June
Chiniak Gully Research Area (No Trawl 8/1 - 9/20)
Pribilof Habitat Conservation Area
Southeast Alaska No Trawl Areas
Walrus Protection Area: Inside 3nm
Walrus Protection Area: 3nm - 12nm
Near Shore Bristol Bay No Trawl Area
Cook Inlet: Closed to Non-Pelagic Trawl
Winter Herring Savings Area
Summer Herring Savings Area
Dutch Harbor, Sand Point, Kodiak Trawl Test Area
National Marine Fisheries Service
Kotzebue Sound
Seward Peninsula
Norton Sound
Alaska
Canada
Maritime Boundary Line
Bering Sea
Pribilof Islands
Bristol Bay
Sitka Pinnacles
Gulf of Alaska
Aleutian Islands
Pacific Ocean
US EEZ
524
514
550
530
521
523
513
508
512
509
516
517
518
519
543
542
541
610
620
630
640
640
649
650
659



Programmatic SEIS - Alternative 4
DRAFT DRAFT
Unimak Pass - Davidson Bank
Oceania Proposals
Shumagans
Sitka Pinnacles
Red King Crab Closure Area
Southwest of St. George
Bathymetry 200 Meters
Bathymetry 50 Meters
Kotzebue Sound
Seward Peninsula
Norton Sound
Bering Sea
Bristol Bay
Pribilof Islands
Aleutian Islands
Gulf of Alaska
Pacific Ocean
Sitka Pinnacles
524
514
550
521
530
523
513
509
516
512
508
517
518
519
543
542
541
610
620
630
640
640
649
650
659
Some areas shown for clarity only