MEMORANDUM

TO: Council, AP and SSC Members

FROM: Clarence G. Pautzke
Executive Director

DATE: September 19, 1990

SUBJECT: Bering Sea/Aleutian Islands King and Tanner Crab Plan

ACTION REQUIRED

(a) Final consideration of overfishing definition.
(b) Receive report on 1990 Bering Sea/Aleutian Islands Crab Survey.
(c) Review State crab observer program and consider request for federal observer program.

BACKGROUND

(a) Overfishing Definition

In August, the Council released for public review Amendment 1 to the Crab FMP which presented alternatives for the overfishing definition as requested by the Secretary of Commerce. The Secretary has given all Regional Councils until November 25, 1990 to submit a definition of overfishing for each of their FMPs. The four alternatives for an overfishing definition provided in Amendment 1 are:

Alternative 1: Status quo.

As the existing FMP contains neither an overfishing definition nor measurable criteria for establishing such, it fails to satisfy NOAA guidelines.

Alternative 2: Constant fishing mortality rate with threshold.

Under this approach, the Council would define overfishing for each crab stock for which sufficient data exist, as the commercial harvest resulting in an exploitation rate which exceeds the rate which would provide Maximum Sustainable Yield (MSY) when stocks are above threshold. When stocks are determined to be at or below threshold, overfishing would be defined as any commercial harvest.

Alternative 3: Constant fishing mortality rate.

Overfishing would be defined for each crab stock as any exploitation rate which exceeds the rate that produces MSY.

Alternative 4: Variable fishing mortality rate.

Overfishing is defined for each crab stock as any exploitation rate which exceeds a specified maximum level based on stock size.

Alternatives 2, 3 and 4 all require biological data which, depending on availability, will determine the precision and utility of the definition. A Plan Team review of these alternatives is available. A copy of Amendment 1, which was sent to public review on August 14, is enclosed as item D-2(a). The public comment period ended on September 17. Two letters received during the comment period are provided as items D-2(b) and D-2(c).

(b) 1990 Bering Sea Crab Survey Results

The 1990 Bering Sea Crab Stock Assessment Survey has recently been completed by NMFS. A preliminary report on the findings is included in your supplementary folder. An oral summary is also available.

(c) Review State Crab Observer Program and Consider Need for Federal Observer Program

Earlier this year the Council was requested to consider expanding the federal domestic observer program to include the Bering Sea/Aleutian Islands king and Tanner crab fisheries. A letter requesting Council consideration is provided as item D-2(d). Currently the State of Alaska operates an observer program as a Category 3 measure outlined in the Crab FMP. State observers are required on all catcher/processor and floating processor vessels. Shoreside observers, or port samplers, obtain data routinely from shore processing plants which receive deliveries from crab catcher vessels. Crab catcher vessels are also observed directly when observers are available.

The State's observer program was initially implemented in 1988 following a review of significant differences in catch rates between catcher vessels and catcher/processor vessels. The program was intended to learn why these differences exist, obtain other biological and fishery information, and in itself serve as a deterrent to the harvest of sublegal size crabs. Results indicate little difference in catch rates between the two vessel categories and suggest that the presence of observers does deter undersize processing. A report summarizing this analysis is provided as item D-2(e).

Since 1988, administrative problems have arisen with the program. The Alaska Board of Fisheries and Alaska Department of Fish and Game have attempted to respond to these problems as the program evolves. The issue now is whether the crab catcher vessel sector should be incorporated into the observer program. Groundfish industry representatives note that the groundfish fisheries participate in the federal program, results of which are often used by the crab industry. Costs associated with the observer program are paid by the vessels required to take observers. Crab catcher vessels are not required to take observers or pay the costs of administering the State or federal observer programs. Bycatch and other fishery information from this sector of the fleet are also limited.

In August the Council requested a report on the State's observer program at this meeting. A report is available from ADFG staff. The Council also requested the opinion of the Crab Plan Team on the adequacy of the current crab observer program. Their opinion is provided as item D-2(f). The Plan Team recommends that ADFG expand its existing program by gathering additional bycatch information and conducting an analysis of existing observer data to confirm whether sampling only catcher processor vessels provides a representative source of information on the crab fleet as a whole. If the additional analysis shows the catch of catcher/processor vessels is not representative of catcher vessels, sampling aboard catchers would be necessary to obtain a representative description of the fleet-wide bycatch.

(d) For Information Only

The Pacific Northwest Crab Industry Advisory Committee has scheduled a meeting for 9:00 a.m., Wednesday, October 3, in Room 2039, Alaska Fisheries Science Center, Seattle. The purpose of the meeting is to provide a forum for industry members to voice their concerns about season opening dates, quotas, and gear regulations. Members of ADFG, NMFS, and the Alaska Board of Fisheries have been invited to attend.

DRAFT

ENVIRONMENTAL ASSESSMENT

FOR

AMENDMENT 1 TO THE

FISHERY MANAGEMENT PLAN FOR THE COMMERCIAL

KING AND TANNER CRAB FISHERIES

IN THE BERING SEA/ALEUTIAN ISLANDS

Prepared by the
King and Tanner Crab Plan Team
of the
North Pacific Fishery Management Council

August 1990

North Pacific Fishery Management Council
P.O. Box 103136
Anchorage, Alaska 99510

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Description of the problem and statement of action

The Magnuson Fishery Conservation and Management Act (MFCMA) contains seven "national standards" [see Appendix B of Fishery Management Plan for the Commercial King and Tanner Crab Fisheries in the Bering Sea/Aleutian Islands (crab FMP)] with which all fishery management plans (FMP) and implementing regulations must be consistent. The first national standard states "Conservation and management measures shall prevent overfishing while achieving, on a continuous basis, the optimum yield from each fishery for the United States fishing industry."

The MFCMA places a high priority on preventing overfishing. However, the MFCMA does not define overfishing. In the revised guidelines at 50 CFR Part 602, the National Oceanic and Atmospheric Administration (NOAA) presented the following general definition "Overfishing is a level or rate of fishing mortality that jeopardizes the long-term capacity of a stock or stock complex to produce maximum sustainable yield (MSY) on a continuing basis." The 602 guidelines make a clear distinction between the prevention of overfishing and the achievement of optimum yield. Therefore, the task of specifying an overfishing definition should not be confused with an attempt to articulate an optimal harvest strategy. The overfishing definition is to be used as a constraint and not a target.

The Scientific and Statistical Committee (SSC) of the North Pacific Fishery Management Council (Council) has recommended a more conventional definition of overfishing as "fishing so hard that average long-term yield is reduced." The SSC believes that this definition is consistent with the 602 guidelines and with the Council's demonstrated preference for avoiding resource depletion. This definition is more conservative than a definition based on stock collapse.

Because of the generality of its overfishing definition, NOAA felt that it would be difficult to apply unambiguously. Therefore, the 602 guidelines contain the following directive: "Each FMP must specify, to the maximum extent possible, an objective and measurable definition of overfishing for each stock or stock complex covered by the FMP, and provide an analysis of how the definition was determined and how it relates to reproductive potential." The objective and measurable definition is not intended to take the place of the general definition, but is to constitute a specific method of implementing the general definition. Whereas the general definition is qualitative, the implementing definitions are quantitative.

The crab FMP was written as a cooperative state-federal FMP in an attempt to avoid state-federal coordination problems that were encountered in previous king and Tanner crab FMP's. It contains a general management goal to maximize the overall long-term benefit to the nation of Bering Sea/Aleutian Island stocks of king and Tanner crabs by coordinated federal and state management, consistent with responsible stewardship for conservation of the crab resources and their habitats. Within the scope of this management goal, there are seven specific objectives. These objectives relate to stock condition, economic and social objectives of the fishery, gear conflicts, habitat, weather and ocean conditions affecting safe access to the fishery, access of all interested parties to the process of revising the crab FMP, and necessary research and management. However, the crab FMP contains only the following qualitative definition of overfishing: "Recruitment overfishing is the condition that occurs when the spawning stock is reduced by fishing to too low a level to ensure adequate production of young crabs--the recruits to the future fishery." Since the crab FMP contains no objective or measurable criteria for implementing a definition, the crab FMP must be amended. The deadline for submission of the crab FMP amendment is November 23, 1990.

1.2 Current stock conditions

The stocks of king crab and Chionoecetes bairdi Tanner crab in the Bering Sea/Aleutian Islands area have been low. Overfishing, however, does not appear to have been the cause. Both male and female king crab and C. bairdi Tanner crab have declined in parallel even though the fisheries only harvest male crab. An alternative explanation is that handling incurred during fishing may influence survival in females to the same degree that the fishery effects males. Abundance of C. bairdi has increased from 1988 to 1989. Chionoecetes opilio Tanner crab have not been low in abundance; in fact, the 1989 estimate of abundance is in excess of 9,500 million crab.

Available information indicates that recruitment to the adult segments of the king and Tanner crab populations can vary naturally by three orders of magnitude, and typically varies by one or two orders of magnitude on an inter-annual basis. This variability most likely comes from fluctuations in survival. The abundance of known predators and the apparent incidence of diseases, have been higher during the 1980s than during the 1970s.

Directed commercial crab fisheries in the Bering Sea/Aleutian Islands area are regulated by restrictions on size, sex, fishing season, guideline harvest level (quota), and area fished. These restrictions, in combination, form a conservative biological management regime. Incidental catch of non-target species of crab in crab fisheries is regulated by the State of Alaska (state) emergency order authority.

Incidental catch of crab in non-directed fisheries is stringently controlled through time and area closures (including permanent closures) and quotas specified in Amendment 12a of the Bering Sea/Aleutian Islands Groundfish Fisheries Management Plan. Bottom trawl fisheries are responsible in part for incidental catch of king and Tanner crab in the Bering Sea. These fisheries include Joint Venture and Domestic Annual Production of flatfish and other fisheries. Estimates of the joint venture bycatch rates of C. bairdi Tanner crab and red king crab in the Bering Sea (see Tables 2.1, 2.2, 2.5, and 2.6 in Chapter 2 of the May 16, 1990 EA/RIR for amendment 21 and 16 for the groundfish FMP) indicate 0.01 and 0.39 percent, respectively, of the population were caught incidentally in 1989. For comparison, the 1989 directed commercial harvest of C. bairdi Tanner crab in the Bering Sea was 0.31 percent of the population. Directed commercial harvest of red king crab in the 1989 Bering sea fishery was 3.3 percent of the population.

Three other types of fisheries occur on the crab stocks in the Bering Sea/Aleutian Islands management area besides commercial fisheries: subsistence, sport, and personal use fisheries. Should any crab stock decline below threshold, the state's emergency order authority will be used to insure conservation of the resource and meet the requirements of these fisheries as specified by law.

1.3 Alternatives

The crab FMP team met in Kodiak on May 7 and 8, 1990 and discussed possible options for a quantitative overfishing definition for the king and Tanner crab stocks managed by the crab FMP. On June 26, 1990, the SSC reviewed the crab FMP team's first draft EA and later on August 6, 1990, a subcommittee of the SSC reviewed a revised draft. On August 8, 1990, the SSC recommended that the Council ask for public comments on the draft EA for amendment 1 to the FMP for the commercial king and Tanner crab fisheries in the Bering Sea/Aleutian Islands.

The consensus of the crab FMP team members was that under the current cooperative state-federal management system overfishing should not occur. However, it is possible that crab stocks could reach

a threshold level due to natural fluctuations. The threshold concept is pertinent to management in this event, since harvest at subthreshold levels may retard stock recovery. The crab FMP team therefore felt that it was necessary to establish threshold levels and maximum allowable fishing mortality rates for the crab stocks.

Fishing mortality (F) is defined as the total fishing mortality from directed (pot) and non-directed (trawl and pot) fisheries. Alternative fishing mortality definitions of crab overfishing are determined in terms of F on mature crab or F on legal crab. However, trawl fisheries tend to catch smaller crabs than pot fisheries (see Figures 2.4, 2.5, 2.6 and 2.7 in Chapter 2 of the May 16, 1990, EA/RIR for amendment 21 and 16 for the groundfish FMP) so adjustment would be necessary to convert small trawl-caught crab into mature or legal equivalents. No adjustment would be made to mature or legal crab caught in trawls. Non-directed fishing mortality would be added to directed catch to estimate the total fishing mortality. Total fishing mortality would be used in determinations of overfishing.

In the event a stock reached threshold, the rate of fishing mortality exceeded that defined as overfishing or allocation of fishing mortality to commercial user groups was necessary, the Council may request a risk analysis be performed to determine whether or not the multispecies exemption clause (section 602.11(c)(8)) should be invoked.

As previously noted, the amount of information available for alternate definition of overfishing is variable. Each of the alternatives presented here are divided into separate approaches to establish the same definition based on the type of data available. The crab FMP team will monitor and reassess the data available for determining overfishing for the Bering Sea/Aleutian Islands crab stocks through preparation of the Stock Assessment and Fishery Evaluation (SAFE) report or annual report as required by the FMP. New information may change the definition of overfishing for a stock.

In addition to the proposal preferred by the crab FMP team, other alternative means of defining overfishing are also examined. Specifically, the following alternatives are considered:

1.3.1 Alternative 1: Status quo.

Recruitment overfishing is the condition that occurs when the spawning stock is reduced by fishing to too low a level to ensure adequate production of young crabs--the recruits to the future fishery.

1.3.2 Alternative 2: Constant fishing mortality rate with threshold (Preferred).

Overfishing is defined for each crab stock in the Bering Sea/Aleutian Islands, for which sufficient data exist, as the level of commercial harvest resulting in an F value exceeding F_{msy} in any year when stock size is above threshold or any level of commercial harvest when the stock is at or below threshold.

Three information levels were characterized for Alternative 2 definition of overfishing according to the data available to quantify threshold and fishing mortality rate. Each of the 17 stocks in the Bering Sea/Aleutian Islands management area is assigned to one of the levels (Table 1).

(1) Data available: Historical catch, sporadic inseason catch and effort data, and mortality. Overfishing for stocks with level 1 data is defined as a fishing mortality rate exceeding the natural mortality rate of mature male crab. Threshold cannot be defined with level 1 data because the discontinuous time series of fishery data precludes estimation of population

abundance. For years in which sufficient catch and effort data are available, inseason fishing mortality rate may be based on a change in the inseason ratio of catch per unit effort (CPUE) of legal to mature male crab or a proportionate reduction in average weekly CPUE.

(2) Data available: Historical catch, continuous inseason catch and effort data, and mortality. Overfishing for stocks with level 2 data is defined as fishing in excess of the maximum allowable fishing mortality rate estimated to equal the natural mortality rate of mature male crab or any commercial harvest when the stock is at or below threshold where the threshold is equal to 10 percent of the long-term average catch (MSY) estimate (see Table 6 of the crab FMP). Inseason fishing mortality rate may be based on inseason CPUE and cumulative catch of legal male crab.

(3) Data available: Historical catch, continuous inseason catch and effort data, stock assessment, stock-recruitment, growth, maturity, and mortality parameters. Overfishing for stocks with level 3 data is defined as fishing in excess of the maximum allowable fishing mortality rate estimated as F_{msy} which is approximated by $F_{0.1}$, based on the size of first maturity for male crabs or any commercial harvest when the stock is at or below threshold where threshold is equal to 20 percent of the pristine exploitable biomass defined as the best estimate of the equilibrium level of spawning stock. Guideline harvest levels are estimated annually for level 3 stocks, therefore the fishing mortality rate is established prior to a fishery.

1.3.3 Alternative 3: Constant fishing mortality rate.

Overfishing is defined as any rate of fishing mortality in excess of F_{msy} for king and Tanner crab stocks in the Bering Sea/Aleutian Islands management area.

Three information levels were characterized for Alternative 3 definition of overfishing according to the data available to quantify maximum fishing mortality rate. Each of the 17 stocks in the Bering Sea Aleutian Islands management area is assigned to one of the levels (Table 1).

(1) Data available: Historical catch, sporadic inseason catch and effort data, and mortality. Overfishing for stocks with level 1 data is defined as a fishing mortality rate in excess of F_{msy} where the maximum allowable fishing mortality rate is estimated to equal the natural mortality rate of mature male crab. Inseason fishing mortality rate may be based on a change in the inseason ratio of catch per unit effort (CPUE) of legal to mature male crab or a proportionate reduction in average weekly CPUE.

(2) Data available: Historical catch, continuous inseason catch and effort data, and mortality. Overfishing for stocks with level 2 data is defined as a fishing mortality rate in excess of F_{msy} where the maximum allowable fishing mortality rate is estimated to equal the natural mortality rate of mature male crab. Inseason fishing mortality rate may be based on inseason CPUE and cumulative catch of legal male crab.

(3) Data available: Historical catch, continuous inseason catch and effort data, stock assessment, stock-recruitment, growth, maturity, and mortality parameters. Overfishing for stocks with level 3 data is defined as a fishing mortality rate in excess of F_{msy} where the maximum allowable fishing mortality rate for these stocks cannot exceed F_{msy} estimated as $F_{0.1}$, based on the size of first maturity for male crabs. Guideline harvest levels are estimated annually for level 3 stocks, therefore the fishing mortality rate is established prior to a fishery.

1.3.4 Alternative 4: Variable fishing mortality rate.

Overfishing is defined for each crab stock in the Bering Sea/Aleutian Islands, for which sufficient data exist, as any rate of fishing mortality in excess of a specified maximum level where the maximum level would vary with stock size.

Three information levels were characterized for Alternative 4 definition of overfishing according to the data available to quantify a variable maximum fishing mortality rate. Information level 3 is further divided into options (a) and (b). Each of the 17 stocks in the Bering Sea Aleutian Islands management area is assigned to one of the levels (Table 1).

(1) Data available: Historical catch, sporadic inseason catch and effort data. Default to Alternative 3, level 1.

(2) Data available: Historical catch, continuous inseason catch and effort data, and mortality. Default to Alternative 3, level 2.

(3 a) Data available: Historical catch, continuous inseason catch and effort data, stock assessment, stock-recruitment, growth, maturity, and mortality parameters. Overfishing for the one stock (Bristol Bay red king crab) with a stock-recruitment relationship is defined as a fishing mortality rate in excess of F_{msy} for all stock levels in excess of B_{msy}. The maximum allowable fishing mortality rate for the stock below B_{msy} will vary with stock level, starting from a value of zero at the origin and increasing to a value of F_{msy} at B_{msy}. The overfishing definition for all other stocks with historical catch, continuous inseason catch and effort data, stock assessment, growth, maturity, and mortality parameters would default to Alternative 3, level 3.

(3 b) Data available: Historical catch, continuous inseason catch and effort data, stock assessment, stock-recruitment, growth, maturity, and mortality parameters. Overfishing is defined as a fishing mortality rate in excess of F_{msy} for all stock levels in excess of B_{msy}. The maximum allowable fishing mortality rate for the stock below B_{msy} will vary with stock level, starting from a value of zero at the origin and increasing to a value of F_{msy} at B_{msy}. The single stock-recruitment relationship developed for Bristol Bay red king crab would be extrapolated to other level 3 stocks to estimate B_{msy}.

1.4 Purpose of the document

This environmental assessment (EA) provides background information and assessments necessary for the Secretary of Commerce to determine that this proposed action is consistent with the MFCMA, and other applicable federal law, such as the National Environmental Policy Act (NEPA).

The specific purpose of an EA that is required by NOAA in compliance with NEPA is to analyze the potential impacts of proposed actions, and responsible alternatives, on the quality of the human environment. If the action is determined not to be significant, then the EA will result in a finding of no significant impact (FONSI); this EA would then be the final environmental document required by NEPA. If, however, a FONSI cannot be made, then a more detailed environmental impact statement (EIS) must be prepared.

2.0 ANALYSIS OF PROPOSED ALTERNATIVES

2.1 Introduction

Discussion and analyses are presented to evaluate the impacts that each of the proposed alternatives could have on the Bering Sea/Aleutian Islands king and Tanner crab fisheries. In all cases, evaluation of an alternative is in relation to the status quo. The best available scientific data was used for the supporting analyses, however, the crab FMP team did note that currently there are some crab stocks where insufficient information exists for calculating threshold and all stocks with one exception had insufficient data to calculate a variable fishing mortality rate. The team agreed that a comparison of current levels of exploitation to fishing mortality rates that would yield MSY supported the crab FMP team's assertion that overfishing should not occur under the current management strategy.

Analysis of each alternative is dependent on the amount of information available to define objective and measurable criteria for each king and Tanner crab stock in the Bering Sea/Aleutian Islands management area. Alternative 1 is the "status quo" requiring no objective or measurable criteria. The current FMP defines "recruitment overfishing" and provides for closure of the directed fishery when a stock is below threshold through the process of defining Acceptable Biological Catch (ABC). However, the FMP does not equate "threshold" to "overfishing", nor does it specify the criteria for threshold estimation. For Alternative 2 the minimum information requirements are estimates of natural mortality rate and $F_{0.1}$ for mature male crab to determine maximum rate of fishing mortality. To evaluate inseason fishing mortality rates estimates of fishery catch and effort are needed. In addition, Alternative 2 requires estimates of MSY to establish threshold for level 2 stocks and the equilibrium level of spawning stock to establish and extrapolate threshold for level 3 stocks. Alternative 2 also analyzes current exploitation rates in relation to MSY through the calculation of $F_{0.1}$ when estimates of population abundance, natural mortality, age and length of maturity are available for a stock. Alternative 3 requires estimates of natural mortality and $F_{0.1}$ for mature male crab to determine fishing rates at F_{msy}. To evaluate inseason fishing mortality rates estimates of fishery catch and effort are needed. Alternative 4 requires an estimate of population abundance and a stock-recruitment relationship to estimate B_{msy}.

2.2 Alternative 1: Status quo.

The only definition of overfishing currently contained in the crab FMP is for recruitment overfishing. Recruitment overfishing could occur if a severely reduced stock results from fishing to too low a stock level so that not enough adult crab remain to produce sufficient offspring or recruits to the future fishery. Heavy fishing pressure could also lead to growth and ecosystem overfishing. Growth overfishing could occur if small crabs are caught before they have had a chance to put on weight. Ecosystem overfishing could occur when reduced stocks cause significant ecosystem instability or alteration. It is unknown if these overfishing mechanisms could occur singularly or in combination in crab stocks. Therefore, the overfishing definition for crab stocks should reflect the dynamics of all possible overfishing mechanisms to the extent of the best available data.

The current overfishing definition provides for closure of a directed fishery when the stock is below threshold but is qualitative and contains no objective or measurable criteria for either threshold estimation or equating threshold to overfishing. Lacking identifiable criteria, analysis of the impact of Alternative 1, the status quo, on Bering Sea/Aleutian Islands king and Tanner crab fisheries is unfeasible.

2.3 Alternative 2: Constant fishing mortality rate with threshold (Preferred).

Level 1:

Fishing effort on stocks with level 1 data is sporadic where the catches appear to vary with the amount of fishing effort and the continuation of other fisheries in the areas. Fisheries are currently opened and closed by state regulation based on previous season's catch estimates and inseason fishery performance. The intermittent nature of these fisheries results in biased estimates of the long-term average of the stock (MSY) and prevents calculation of threshold levels. No population estimates are made for any level 1 crab stocks so estimates of F_{msy} are unavailable. Overfishing for level 1 stocks is therefore defined as a fishing mortality rate in excess of F_{msy} where the maximum allowable fishing mortality rate for these stocks is estimated to equal the natural mortality rate of mature male crab.

Currently, stocks with level 1 data include: Bristol Bay brown king crab, Pribilof Islands brown king crab, Saint Lawrence blue king crab, Pribilof Islands red king crab, northern district brown king crab, and Adak C. bairdi Tanner crab. These stocks have only intermittent fisheries and no assessment surveys. The natural mortality rates of mature male crab in stocks with level 1 data are taken from Alverson (1980) for Bristol Bay red king crab, and from Somerton (1981) for Tanner crab. The best estimate of natural mortality rate for mature Bristol Bay brown king crab, Pribilof Islands brown king crab, Saint Lawrence blue king crab, Pribilof Islands red king crab, northern district brown king crab is equal to 0.3, the natural mortality rate for Bristol Bay red king crab. The best estimate of natural mortality rate for mature Adak C. bairdi Tanner crab is equal to 0.3, the natural mortality rate for Eastern Bering Sea C. bairdi Tanner crab. Based on the best estimates of natural mortality rate, the maximum allowable fishing mortality rate for level 1 stocks is 0.3.

Estimates of inseason fishing mortality are at best difficult to calculate for stocks with limited data on sporadic catch and effort. The use of CPUE data is problematic because sorting rates may vary with the duration of effort on an aggregation of crab and seasonal movement of effort from one aggregation to another aggregation of crab. The crab FMP team proposes three methods for determining fishing mortality rate on stocks with level 1 data. First, the Leslie method (Leslie and Davis, 1939) may be used if sufficient inseason fishery performance data (CPUE and cumulative catch) are available to estimate population abundance of legal male crab. The ratio of catch of legal male crab to the population abundance estimate of legal male crab may be used to estimate the fishing mortality rate of legal male crab. This calculated rate may then be compared with the maximum allowable fishing mortality rate to evaluate overfishing. Attempts to apply a leslie analysis to level 1 stocks have yet to produce a meaningful relationship between CPUE and cumulative catch. Second, an estimate of fishing mortality rate based on the ratio of CPUE of legal crab to CPUE of mature crab may be calculated. Data on CPUE of both legal and mature crab are available only from those fisheries with onboard observers. During a short fishery, abundance of sublegal mature crab should not change and the reduction in the legal/mature ratio could be used to estimate the fishing mortality rate. A correction for natural mortality of sublegal mature crab would be necessary for long fisheries. Third, an estimate of fishing mortality rate based on proportionate change in average weekly CPUE may be calculated. Weekly average CPUE may be compared to determine if a proportionate reduction in CPUE equal to the maximum allowable fishing mortality rate (F=M) has occurred. Data on CPUE would be available only in those fisheries with onboard observers or detailed fish ticket information. For unobserved fisheries with fish ticket data, only fishing mortality on legal male crabs can be estimated. Other methods may be employed that provide increased precision and accuracy in estimating actual fishing mortality.

Threshold cannot be defined for stocks with level 1 data because the discontinuous time series of fishery data associated with level 1 stocks prevents estimation of population abundance.

Level 2:

The crab FMP team felt protection would be provided to crab stocks with level 2 data by establishing a maximum allowable fishing mortality rate and threshold. No population estimates are made for any level 2 crab stocks therefore estimates of F_{msy} are unavailable. The maximum allowable fishing rate is therefore defined as a fishing mortality rate in excess of F_{msy} where the maximum allowable fishing mortality rate for these stocks is estimated to equal the natural mortality rate of mature male crab.

Currently, stocks with level 2 data include: Adak brown king crab, Adak red king crab, Eastern Aleutians brown king crab, and Eastern Aleutian C. bairdi Tanner crab. These stocks have directed fisheries but no assessment survey. The fisheries are open under state regulation based on the best available data. Fishing season closures are based on season date, average historical catch, closure of other fisheries or molting of non-targeted species.

The natural mortality rate of mature male crab in level 2 stocks is taken from Alverson (1980) for Bristol Bay red king crab, and from Somerton (1981) for Tanner crab. The best estimate of natural mortality rate for mature Adak brown king crab, Adak red king crab, and Eastern Aleutians brown king crab is equal to 0.3, the natural mortality rate for Bristol Bay red king crab. The best estimate of natural mortality rate for mature Eastern Aleutian C. bairdi Tanner crab is equal to 0.3, the natural mortality rate for Eastern Bering Sea C. bairdi Tanner crab. Based on the best estimates of natural mortality rate, the maximum allowable fishing mortality rate for level 2 stocks is 0.3.

The Leslie method may be used with inseason fishery performance data (CPUE and cumulative catch) to estimate population abundance of legal male crab. The ratio of catch of legal male crab to the population abundance estimate of legal male crab may be used to estimate the fishing mortality rate of legal male crab. This calculated rate may then be compared with the maximum allowable fishing mortality rate to evaluate overfishing. Other methods may be employed that provide increased precision and accuracy in estimating actual fishing mortality.

Stocks with level 2 data experience directed commercial fishing that allows computation of threshold criteria. The crab FMP team incorporated an additional conservation criterion for these stocks by defining thresholds. Commercial fisheries for Bering Sea/Aleutian Islands crab stocks have tended to be closed when the catch fell below 10 percent of the long-term average for a given stock. The crab FMP team feels that catch is indicative of stock size for those years when the fishery was not closed early by other management considerations. A review of the catch history of various fisheries that have been closed shows such a rule would be reasonably consistent with historical fishery closures (Figure 1). With the exception of Adak red king crab, all of the crab fisheries that have been closed were also surveyed so that we may compare the timing of closures under the 10 percent criterion with those proposed for stocks with level 3 data (Table 2). This comparison shows that application of the 10 percent criterion would have involved closures somewhat earlier in time than would occur under the level 3 threshold criteria. The 10 percent criterion also would have lead to earlier than actual closures of the eastern Bering Sea C. bairdi fishery and the Pribilof Islands blue king crab fisheries, however, catches in both of these fisheries hovered near 10 percent for several years before actual closure (Figure 1). For surveyed stocks the 10 percent criterion is slightly more conservative than either the level 3 threshold or actual management practice. Since, in general less is known about

level 2 stocks such conservatism may be warranted. For example, there has never been an assessment survey of any brown king crab stocks.

While the 10 percent criterion provides a reasonable means of closing a fishery it provides no guidance as to when a fishery should be reopened. Also, continued fishing on a stock that is at low levels would lead to a declining threshold over time. In establishing the 10 percent criterion to set thresholds the crab FMP team proposes that fisheries be closed for a period of three years unless data from a survey or test fishery indicate that an opening is warranted. If the fishery is opened after 3 years, the leslie method will be used with inseason fishery performance data to evaluate the population level with respect to the threshold. From the catch history of fisheries that have been closed it appears loss of landings during such a three year period would be minimal. Further, the crab FMP team recommends that no run of catch statistics that is less than three years in length be used in calculating the long-term average catch from which the threshold is calculated. Years where fisheries were curtailed due to factors extrinsic to abundance such as occurrence of soft-shell crabs or bycatch problems might also be excluded. Current estimates of MSY from Table 6 of the FMP would be used to set thresholds and would be updated periodically (Table 3).

The crab FMP team believes that the 10 percent MSY threshold criterion is conservative when taken within the overall regulatory regime currently imposed on Bering Sea/Aleutian Islands crab fisheries. The 10 percent MSY criterion also leads to similar timing of fishery closures when compared to the actual history of fisheries or the proposed level 3 threshold criteria. There is some reservation, however, as to its effectiveness in rebuilding stocks that are at low levels of abundance. It appears that king crab stocks in particular may take long periods of time to recover. The Dutch Harbor red king crab fishery has been closed from 1983 to 1989 and the Adak red king crab catch has remained low from 1975 onwards. Brown king crab fisheries have been developed since 1980 and very little is known of their probable fluctuations. In this regard, the crab FMP team intends that the period of time chosen to calculate threshold values should be chosen to reflect conditions within the stock that maximize reproductive potential.

The crab FMP team will apply the Leslie method to level 2 stocks to estimate abundance and express threshold as a percentage of abundance, rather than a percentage of catch, when adequate inseason CPUE data are available.

Level 3:

The crab FMP team identified $F_{0.1}$ criteria and threshold levels that provide crab stocks with level 3 data added protection from overfishing. Level 3 data include estimates of population abundance and commercial fisheries CPUE enabling calculation of these criteria. In addition supporting analyses are presented to compare current levels of exploitation to fishing mortality rates that would yield MSY. Currently, stocks with level 3 data include: Eastern Aleutians red king crab, Bristol Bay red king crab, Pribilof Islands blue king crab, Saint Matthew blue king crab, Norton Sound red king crab, Bering Sea C. bairdi Tanner crab, and C. opilio Tanner crab. These stocks have both a directed fishery and an assessment survey.

The following analysis sets forth estimates of F_{msy} and compares them to current exploitation rates for crab stocks with level 3 data in the Bering Sea/Aleutian Islands management area. Based on the work of Clark (1990), this analysis assumes that his F_{mmy} approximates F_{msy}, and that $F_{0.1}$ is equal to or less than F_{mmy}. Crab are relatively slow growers, and in some cases recruitment may be delayed owing to overestimation of the size of maturity. Overestimation would lead to a situation

where the true maturity size is less than the size of first capture used in the analysis. Values of $F_{0.1}$ have been estimated for level 3 stocks according to standard yield-per-recruit methods. Input parameters, estimates of $F_{0.1}$ and associated exploitation rates u(0.1), are given in Table 4 for Bristol Bay red king crab, and Bering Sea C. bairdi and C. opilio Tanner crab. Expected exploitation rates u(e), based on current harvest strategies are also given. It should be noted that ages of first capture are set at estimated sizes of first maturity for male crabs. Thus, exploitation biomass for the analysis is considered to be the stock of mature males. Input parameters M, k, W(inf), and t(0) were taken from Alverson (1980) for Bristol Bay red king crab and from Somerton (1981) for Tanner crabs. Ages at first capture, t(c), were estimated from the growth parameters and maturity sizes.

The proposed definition of overfishing for stocks with level 3 data indicates the maximum allowable fishing mortality rate cannot exceed F_{msy} estimated as $F_{0.1}$, based on the size of first maturity for male crabs. The estimated exploitation rate u(0.1) associated with $F_{0.1}$ for Bristol Bay red king crab is equal to 0.3 and is extrapolated to other level 3 king crab stocks, in the absence of growth and mortality estimates. The estimated exploitation rates u(0.1) for C. bairdi and C. opilio are both 0.2.

Maximum values for u(e) in Table 4 have been established by ADF&G (1990) for mature male king crabs at 0.2 and are less than the estimate for u(0.1). The results obtained for Bristol Bay red king crabs are assumed to hold for other level 3 king crab stocks lacking parameter estimates. The estimated values of u(e) for C. bairdi and C. opilio, based on long-term averages under constant harvest rate strategies of 0.4 and 0.58 on large males, respectively, are also less than the corresponding estimates of u(0.1). Therefore, unless these strategies are changed, or unless bycatch mortality on sublegal males of a species in its target fishery is greater than u(0.1)-u(e), it is not expected that fishing mortality on these crabs stocks will exceed F_{msy}.

In the following analysis, a threshold level is estimated for Bristol Bay red king crabs based on a stock-recruitment relationship for that stock. This estimate is then extrapolated to the other level 3 stocks in the absence of comparable stock-recruitment parameter estimates. Extrapolating stock-recruitment parameters was deemed acceptable for estimating thresholds because they serve to conserve a stock's long-term reproductive capacity.

The estimated Ricker stock-recruitment relationship for Bristol Bay red king crab, with replacement line, is shown in Figure 2. The intersection of the replacement line with the curve is defined as the equilibrium level of spawning stock, S_{eq}. Thompson (1990) has used this level, estimated in the absence of fishing, as an estimate of the pristine spawner biomass, to which he then applied an appropriate fraction to estimate the threshold. The appropriate fraction was determined by Thompson to be about 0.2 for a generalized groundfish stock. It should be noted that Quinn et al. (1989) arrived at a similar result of 0.25 for a pollock stock, using an age structured simulation model. Assuming Thompson's results can be applied to red king crab, where fishing is minimal on females and age 8 males, the threshold for the Bristol Bay stock is estimated as $0.2*S_{eq}$. By equating the stock-recruitment curve and the replacement line to a common R (Figure 2) it can be shown $S_{eq} = -[\ln(c)-\ln(a)]/b$. The stock-recruitment parameters a and b are estimated to be 3.2988 and 0.0664 by fitting the model to the data series through 1988. The slope, c, of the replacement line is estimated from the stock-recruitment time series, assuming an equal sex ratio in the total spawning stock, as the ratio of average abundance of age 8 male recruits to average spawning stock abundance: c = 8.8/45.4 = 0.2. The threshold is then calculated to be 8.4 million fertilized females, based on an S_{eq} estimated to be 42.2 million fertilized females.

Thompson's logic for threshold estimation requires the left hand limb of the stock-recruitment curve to have an inflection point. The model used for red king crab assumes no inflection point (Figure 2). However, the crab FMP team felt it more prudent to assume inflection at low stock levels, and therefore a depensatory mechanism with the attendant need for a threshold, rather than to assume that depensation does not exist. The consequences of a wrong assumption is less severe if depensation is absent as the stock should recover quickly from low levels--a phenomenon that has yet to be seen in Bering Sea/Aleutian Islands king crab stocks.

In the absence of stock-recruitment parameters, thresholds for the remaining level 3 stocks are estimated by assuming the threshold estimated for the Bristol Bay red king crab stock, relative to its long-term average spawning stock abundance, is the same for all stocks. Thus, $T_{(i)} = T_{(rk)}/S_{(avg,rk)} * S_{(avg,i)}$, with a variable period for computing $S_{(avg,i)}$, depending on the available data set. Mature male, rather than female crab, data series were used for the other level 3 stocks because of the greater overall apparent sampling reliability exhibited by males. Estimated thresholds are given in Table 5, as well as their hind casted performance compared to actual past management without thresholds. Under threshold management, closures would have occurred somewhat more often for Bristol Bay red king crabs and Pribilof blue king crabs, and a little less often for C. bairdi. Results for the other stocks are the same for hindcasts and actual management.

2.4 Alternative 3: Constant fishing mortality rate.

The definition of overfishing for Alternative 3 differs from Alternative 2 by not requiring a threshold. Under Alternative 3, depensatory mechanisms acting to maintain a stock at low levels are assumed not to exist. Please refer to maximum allowable fishing mortality rate analysis for stocks with level 1, 2, and 3 data presented for Alternative 2 as it is the same as that necessary for Alternative 3. Please refer to maximum allowable fishing mortality rate analyses for stocks with level 1, 2, and 3 data presented for Alternative 2 as they are the same as those necessary for Alternative 3.

Threshold is not included in the Alternative 3 overfishing definition but the crab FMP does provide for closure of a directed fishery when a stock is at low levels through the ABC process.

2.5 Alternative 4: Variable fishing mortality rate.

The definition of overfishing for Alternative 4, levels 1 and 2 is the same as for Alternative 3, levels 1 and 2. The definition of overfishing for Alternative 4, level 3 a) is the same as for Alternative 3, level 3 except for Bristol Bay red king crab. Please refer to maximum allowable fishing mortality rate analyses for stocks with level 1, 2 and 3 data presented for Alternative 2 as they are the same as those necessary for Alternative 4.

The definition of overfishing for Alternative 4, level 3 a) is a fishing mortality rate in excess of F_{msy} for all Bristol Bay stock levels in excess of B_{msy}. The maximum allowable fishing mortality rate for the Bristol Bay stock below B_{msy} will vary with stock level, starting from a value of zero at the origin and increasing to a value of F_{msy} at B_{msy}. A preliminary estimate of B_{msy} was calculated using the Bristol Bay stock-recruitment relationship. B_{msy} is calculated as the level of spawning stock where the slopes of the stock-recruitment curve and the replacement line are equal. The overfishing definition for all other stocks with historical catch, continuous inseason catch and effort data, stock assessment, growth, maturity, and mortality parameters would default to Alternative 3, level 3.

The definition of overfishing for Alternative 4, level 3 b) is a fishing mortality rate in excess of F_{msy} for all stock levels in excess of B_{msy}. The maximum allowable fishing mortality rate for the stock below B_{msy} will vary with stock level, starting from a value of zero at the origin and increasing to a value of F_{msy} at B_{msy}. A preliminary estimate of B_{msy} was calculated using the Bristol Bay stock-recruitment relationship. B_{msy} is the level of spawning stock where the slopes of the stock-recruitment curve and the replacement line are equal. A relationship between mature male crab abundance and Bristol Bay B_{msy} would need to be determined to extrapolate the Bristol Bay stock-recruitment relationship to other stocks with abundance data and derive the respective estimates of B_{msy}.

Alternative 4 was discussed during the May 7 and 8, 1990 meeting of the crab FMP team and excluded from this amendment because it is an approach different from the Westward Region FMP's endorsed by the Board of Fisheries during their March 1990 meeting. This alternative was added at the request of the Scientific and Statistical Committee proceeding their review of the amendment at the June Council meeting. The Westward Region FMP's for Bristol Bay red king crab, Kodiak red king crab, St. Matthew blue king crab, and Pribilof Islands blue king crab specify a new method of calculating guideline harvest level. The harvest rate is now based on an exploitation rate of 20% of the mature male crab. The exploitation rate remains constant at 20% with two exceptions: 1) when sorting rates of crab are high no more than 60% of the legal male crab can be removed; and 2) when abundances of crab are below estimated threshold values, the fishery will not be opened and the guideline harvest level will be set to zero.

Comparison of Alternative 4 to Alternative 2 is made for Bristol Bay red king crab in Figure 3. Alternative 4 would allow the exploitation rate to increase to 30% of the mature males, a level corresponding to F_{msy}, as stock abundance approached B_{msy}. Alternative 2 limits the exploitation rate to 20% of the mature male population regardless of stock size. Alternative 4 may result in lower exploitation rates as a stock approached the threshold than would Alternative 2 which would result in constant exploitation rate until a stock reaches threshold. Alternative 4 would continue to allow harvest below threshold, however, the exploitation rate would decline as the stock abundance decreased.

Analysis required for implementation of Alternative 4 would be extensive as it is anticipated the alternative would change current management strategies for stocks with abundance estimates.

2.6 Biological and physical impacts

The task of defining overfishing in an objective and measurable manner has merited considerable research within fisheries science. Usually, the attempted solutions have implicitly defined overfishing as any harvest above an optimal level. The optimal fishing rate has usually been specified as the rate corresponding to MSY, or another optimum value that maximizes some specified objective function. This approach is very different from the one specified in the 602 guidelines which define overfishing in terms of jeopardizing a stock's long term capacity to return to the MSY level, not in terms of deviating from some optimum point such as the MSY level. The SSC definition of overfishing as "fishing so hard that the average long-term yield is reduced" is more conservative than the 602 definition based on stock collapse. The overfishing definitions for crab stocks in the Bering Sea/Aleutian Islands management area provide a set of constraints that keep the stocks from falling below a point of no return and insure the preservation of a stock's long-term reproductive capacity.

Commercial fishing mortality on the crab stocks managed under the crab FMP should remain sufficiently small in the future so that overfishing should not occur under the current management program. Protection would be achieved by preventing fishing mortality rates in excess of F_{msy}. Other environmental factors beyond management control have a great influence on the crab stocks. Because stock levels fluctuate greatly from year to year, an extra degree of safety to insure the preservation of a stock's long-term reproductive capacity can be obtained by specifying a stock-specific threshold level. Ideally, determination of such a threshold level would be based on detailed knowledge of stock and ecosystem dynamics, unfortunately such information is unavailable for all the crab stocks managed by the FMP with the exception of the Bristol Bay red king crab stock for which a spawner-recruit relationship has been calculated. The best scientific data available is used to estimate the threshold levels for stocks with level 2 and 3 data. Data is currently unavailable for estimation of threshold for crab stocks with level 1 data managed under the FMP.

The reason for developing an objective and measurable definition of overfishing is to protect the crab stocks managed by the FMP. While the designation of overfishing definitions is largely administrative for the crab FMP, it is anticipated that adoption of Alternatives 2 or 3 would result in minimal impacts on the crab stocks. Predators on a crab stock would be largely unaffected unless a crab stock reached threshold and limited predator food availability or the Council determined use of the multispecies exemption clause was not advisable based on a risk analysis. Alternative 2 (the preferred alternative) would provide the most protection because fishing mortality is kept below F_{msy} and because a threshold is already used in the ABC process.

2.7 Socioeconomic impacts

During 1989 approximately 500 catcher vessels, 23 catcher/processors, 21 shorebased processors, and 16 floating processors were engaged in harvesting and/or processing all shellfish resources in the entire Westward Region. The number of vessels participating in the 1989 fishery on each of the 17 stocks in the Bering Sea/Aleutian Islands management area is presented in Table 1.

For the Bering Sea/Aleutian Islands management area the 1989 king crab catch was approximately 22.9 million pounds valued at 92 million dollars and the 1989 Tanner crab catch was approximately 156.8 million pounds valued at 133.7 million dollars.

Alternative overfishing definitions 2 and 3 should in practice not impose new constraints on any of the fisheries except those targeting brown king crab. The best information available indicates criteria used in each of the alternatives result in negligible deviations from current management practices with the one exception. No measurable impact is anticipated on Bering Sea/Aleutian Islands red and blue king crab and Tanner crab fisheries. It is anticipated the effect of the alternatives on brown king crab stocks will be to restrict the current level of fishing mortality. Since no objective method of measuring fishing mortality rate on these stocks has been tested the extent of the restrictions is uncertain.

Alternative overfishing definition 4, level 3b, would alter the current exploitation rate for those stocks affected by the Westward Region FMP's. The Extent of change in exploitation rates needs to be determined for all stocks affected by this alternative.

In the event a stock reached threshold or the rate of fishing mortality exceeded that defined as overfishing, Alternatives 2, 3, and 4 would affect non-directed fisheries by limiting fishing mortality

unless the Council invoked the multispecies exemption clause. A risk analysis would be necessary to determine whether or not the multispecies exemption clause (section 602.11(c)(8)) should be invoked.

2.8 Reporting costs

No additional reporting costs are anticipated under any of the alternatives.

2.9 Administrative, enforcement, and information costs

No additional administrative or enforcement costs are anticipated under any of the alternatives. Information is collected from a limited number of crab stock assessment surveys and from all crab fisheries to provide the best available information on the status of Bering Sea/Aleutian Island crab stocks. The cost to assess additional stocks that are currently not surveyed would be substantial.

2.10 Distribution of costs and benefits

No significant redistribution of costs and benefits is anticipated under any of the alternatives.

3.0 EFFECTS ON ENDANGERED SPECIES AND ON THE ALASKA COASTAL ZONE

None of the alternatives described here would constitute an action that might affect endangered or threatened species or their habitats within the meaning of the regulations implementing Section 7 of the Endangered Species Act of 1973. For this reason, consultation procedures, pursuant to Section 7, are not necessary.

None of the alternatives described here would be a federal action directly affecting the coastal zone of Alaska within the meaning of Section 307 (c) (1) of the Coastal Zone Management act of 1972 and its implementing regulations. Each of these alternatives comply to the maximum extent practicable with the Alaska Coastal Management Program.

4.0 FINDINGS OF NO SIGNIFICANT IMPACT

For the reasons discussed above, neither implementation of the status quo nor any of the alternatives to that action would significantly affect the quality of the human environment, and the preparation of an environmental impact statement on the final action is not required by Section 102 (2) (c) of the NEPA or its implementing regulations.

_____ _____

Asst. Administrator for Fisheries, NOAA Date

5.0 LIST OF PREPARERS

Crab Fishery Management Plan Team

Raymond Baglin, Chairman
National Marine Fisheries Service
P.O. Box 21668
Juneau, AK 99802

Steve Davis
North Pacific Fishery Management Council
P.O. Box 103136
Anchorage, AK 99510

William Donaldson
Alaska Department of Fish and Game
211 Mission Rd.
Kodiak, AK 99615

Peggy Murphy
Alaska Department of Fish and Game
P.O. Box 3-2000
Juneau, AK 99802

Robert Otto
National Marine Fisheries Service
P.O. Box 1638
Kodiak, AK 99615

Jerry Reeves
National Marine Fisheries Service
7600 Sand Point Way NE
Seattle, WA 98115

Dana Schmidt
Alaska Department of Fish and Game
211 Mission Rd.
Kodiak, AK 99615

Tom Shirley
University of Alaska
11120 Glacier Highway
Juneau, AK 99801

6.0 COORDINATION WITH OTHERS

The crab FMP team is comprised of fishery scientists and managers from the National Marine Fisheries Service, the Alaska Department of Fish and Game, the North Pacific Fishery Management Council, and the University of Alaska. The team also coordinated with other staff of those agencies. The SSC of the Council has reviewed the alternatives and analysis for amendment 1 to the FMP for the commercial king and Tanner crab fisheries in the Bering Sea/Aleutian Islands.

7.0 LITERATURE CITED

ADF&G. 1990. Management plan for Westward Region king crab stocks: Kodiak Island red king crab, Bristol Bay red king crab, St. Matthew blue king crab, Pribilof Islands blue king crab. Draft MS Report. April 15, 1990. 35pp.

Alverson, W.G. 1980. An analysis of size limitation for the Alaska red king crab. MS report. Natural Resources Consultants, 4055 21st Ave. W., Seattle, WA. 98199. 57 pp.

Clark, W.G. 1990. Choosing an exploitation rate on the basis of life history parameters. Unpubl. manuscr., International Pacific Halibut Commission, Seattle, WA 98145-2009. 11pp.

Leslie, P.H., and D.H.S. Davis. 1939. An attempt to determine the absolute number of rats on a given area. Journal of Animal Ecology 8: 94-113.

Quinn, T.J., II, R.M. Fagan, and J. Zheng. 1989. Threshold management policies for exploited populations. MS report. Juneau Center for Fisheries and Ocean Sciences, University of Alaska Fairbanks, 11120 Glacier Hwy., Juneau, AK 99801-8677. 37 pp.

Somerton, D.A. 1981. Life history and population dynamics of two species of tanner crab, Chionoecetes bairdi and C. opilio, in the Eastern Bering Sea with implications for the management of the commercial harvest. Ph.D. Dissertation, University of Washington, Seattle, WA. 220pp.

Thompson, G.G. 1990. A proposal for a threshold stock size and maximum fishing mortality rate. Appendix I In: Groundfish EA/RIR, Chapter 3. 20pp.

Table 1. Stocks of king and Tanner crab in the Bering Sea/Aleutian Islands management area categorized by amount of fishery and survey information available and the number of vessels participating in the 1989 fishery indicated.[1]

Level 1 Sporadic Fisheries with No Surveys	Number of Vessels	Level 2 Directed Fisheries with No Surveys	Number of Vessels	Level 3 Directed Fisheries with Surveys	Number of Vessels
Bristol Bay brown king crab	--[2]	Adak brown king crab	74	E. Aleutians red king crab	--
Pribilof Islands brown king crab	2	Adak red king crab	73	Bristol Bay red king crab	211
St. Lawrence blue king crab	5	E. Aleutians brown king crab	13	Pribilof Islands blue king crab	--
Pribilof Islands red king crab	--	E. Aleutians *C. bairdi* Tanner crab	12	St. Matthew blue king crab	69
Northern District brown king crab	2			Norton Sound red king crab	10
Adak *C. bairdi* Tanner crab	36			Bering Sea *C. bairdi* Tanner crab	109
				Bering Sea *C. opilio* Tanner crab	168

[1] Total number of individual vessels participating is less than a sum of all vessels in the table because many of the vessels participate in more than one fishery.
[2] No fishery.

Table 2. Comparison of actual and estimated fishery closures under a threshold criterion of 10 percent of MSY for stocks with fishery and/or survey data available.

Stock	Years the fishery is closed		
	Actual	10 percent MSY[2]	Threshold[2]
Bristol Bay Red king crab	1983	1983-1985	1985-1986
Adak Red king crab	1976	1976-1978	--
E. Aleutians red king crab	1983-1989	1983-1985	None
Pribilof Islands blue king crab	1988-1989	1984-1986	1985-1989
Eastern Bering Sea C. bairdi	1986-1987	1984-1986	1986

[1] Minimum years if there were no survey or test fishery.
[2] Refers to proposed level 3 crab fishery thresholds.

Table 3. Threshold estimates (millions of pounds) and actual and estimated fishery closures under threshold criterion for Alternative 2, level 2 crab stocks.

Stock	Threshold			Threshold Closed Years	Actual Closed Years
	Years	MSY	10% MSY		
Adak red king crab[1]	1960-1986	7.0	0.70	1976-1978	1976
Adak brown king crab	1981-1986	7.4	0.74	None	None
E. Aleutians Brown king crab	1981-1987	1.4	0.14	None	None
E. Aleutians C. bairdi	1973-1986	0.7	0.07	None	None

[1] Assumes the 1979 catch of 0.47 would have been above threshold given the 1976-1978 fishery closure.

Table 4. Estimates of $F_{0.1}$, associated parameters, and comparisons with expected rates of exploitation for Alternative 2, level 3 crab stocks.

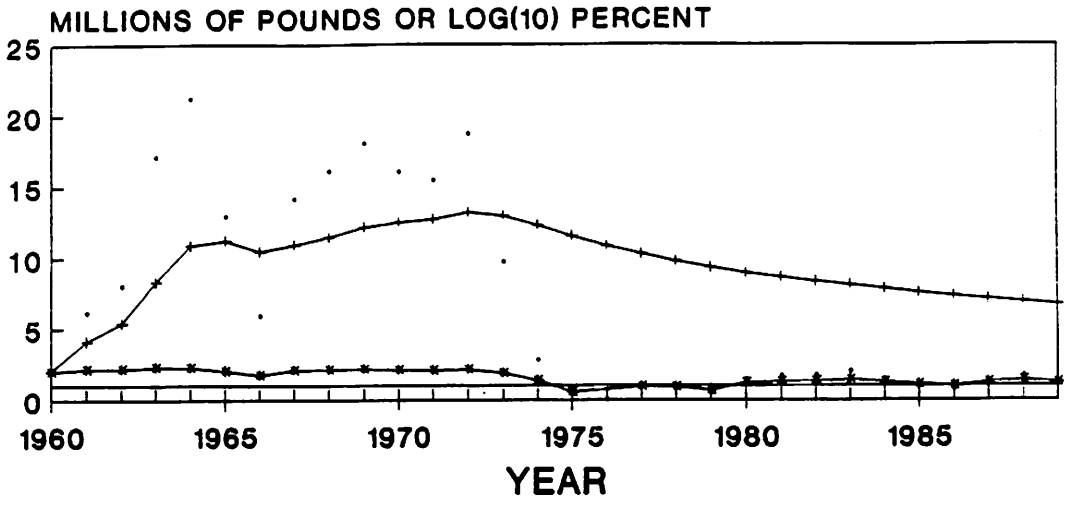
Parameter	Stock		
	Bristol Bay Red king crab	Eastern Bering Sea *C. bairdi*	Eastern Bering Sea *C. opilio*
M	0.30	0.30	0.30
k	0.17	0.16	0.19
L(inf) in mm	190	200	140
W(inf) in lbs	12.6	5.7	2.6
t(0) in yrs	0.7	0.8	0.9
t(c) in yrs	7	6	5.5
l(c) in mm	120	110	78
$F_{0.1}$	0.40	0.30	0.30
u(0.1)	0.30	0.20	0.20
u(e)[1]	0.20	0.09	0.04

[1] Maximum rate allowed by ADF&G policy for red king crab; 1976-1989 average for *C. bairdi*; 1982-1989 average for *C. opilio*.

Table 5. Threshold estimates, average spawning stock (millions of crabs), and actual and estimated fishery closures under threshold criterion for Alternative 2, level 3 crab stocks.

Stock	Threshold	Ratio	S(avg)	Years	Closures	
					Threshold	Actual
Bristol Bay red king crab (females > 89mm)	8.4	0.17	50.1	1969-1989	1985-1986	1983
E. Aleutian red king crab (males > 119mm)	0.75		4.41	1976-1987	1983-1987	1983-1989
Norton Sound red king crab (males > 120mm)	0.27		1.60	1976-1989	None	None
Pribilof Islands blue king crab (males > 109mm)	0.77		4.60	1974-1989	1985-1989	1988-1989
St. Matthew Island blue king crab (males > 104mm)	0.60		3.55	1978-1989	None	None
Eastern Bering Sea *C. bairdi* (males > 109mm)	14.3		85.5	1976-1989	1986	1986-1987
Eastern Bering Sea *C. opilio* (males > 78mm)	309.4		1845.9	1982-1989	None	None

ADAK RED KING CRAB
CATCH HISTORY 1960-1989



EASTERN BERING SEA TANNER CRAB
CATCH HISTORY 1976-1989

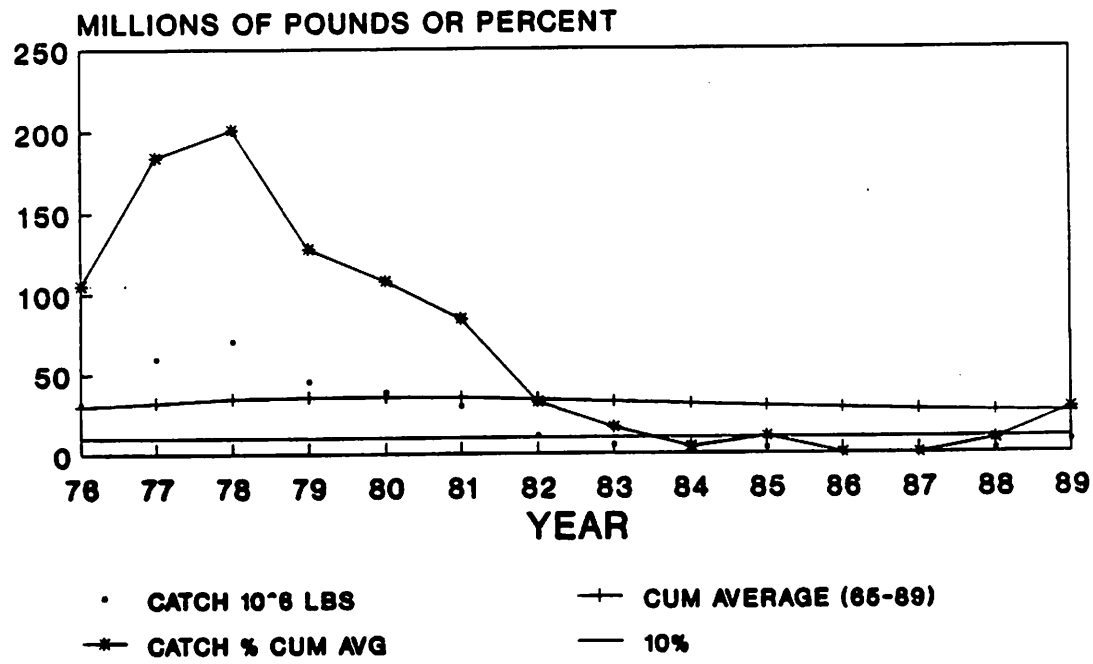
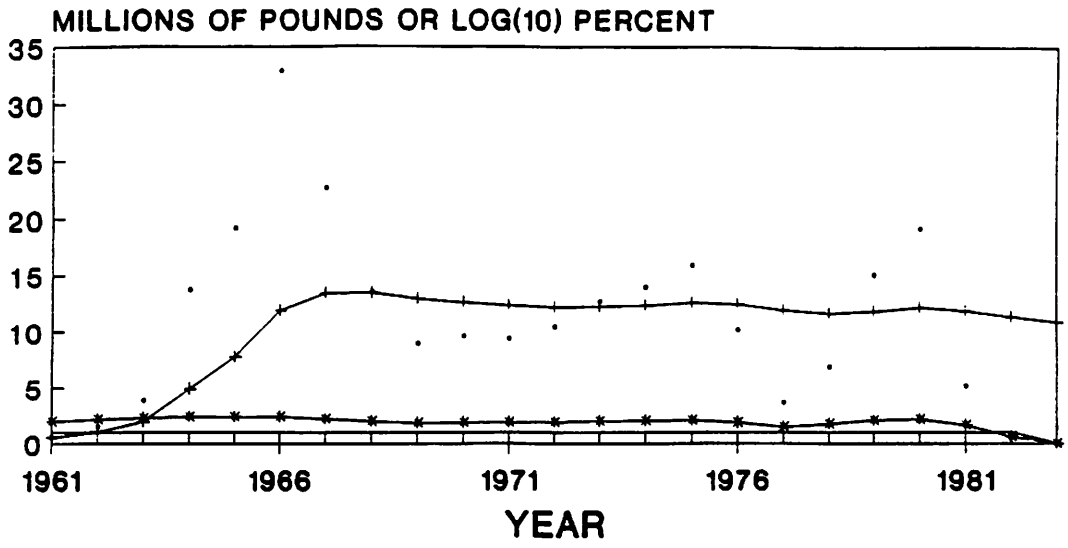


Figure 1. Catch histories of Bering Sea/Aleutian Islands crab stocks where closures have been imposed, showing application of proposed closure at a threshold of 10 percent of the historic (cum) average catch for the fishery (MSY).

DUTCH HARBOR RED KING CRAB
CATCH HISTORY 1961-1983



PRIBILOF BLUE KING CRAB
CATCH HISTORY 1964-1989

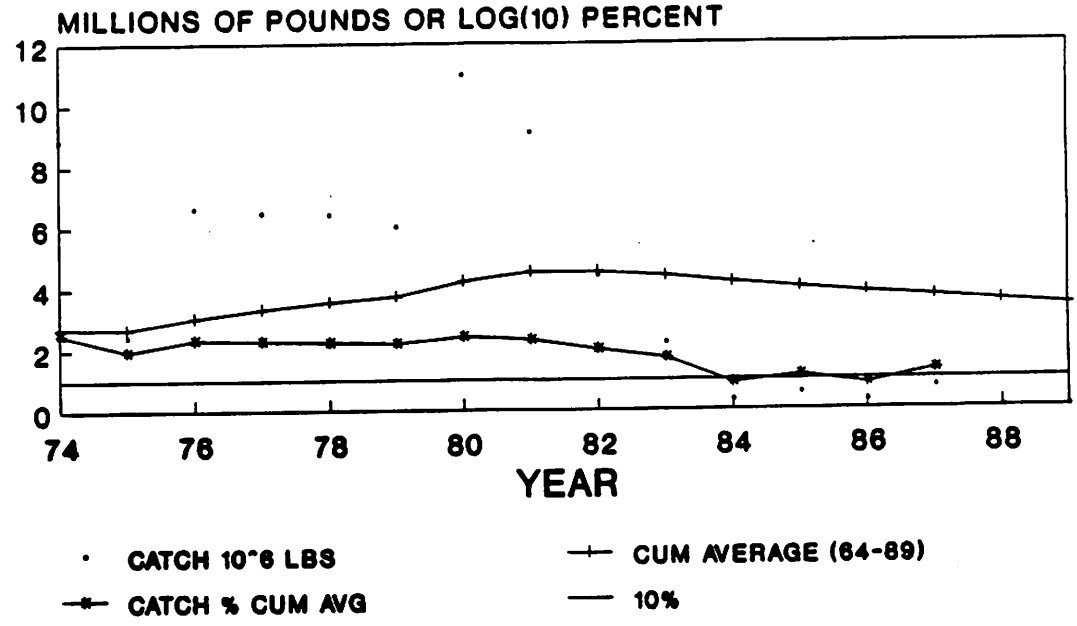


Figure 1. (cont.) Catch histories of Bering Sea/Aleutian Islands crab stocks where closures have been imposed, showing application of proposed closure at a threshold of 10 percent of the historic (cum) average catch for the fishery (MSY).

BRISTOL BAY RED KING CRAB
CATCH HISTORY 1969-1989

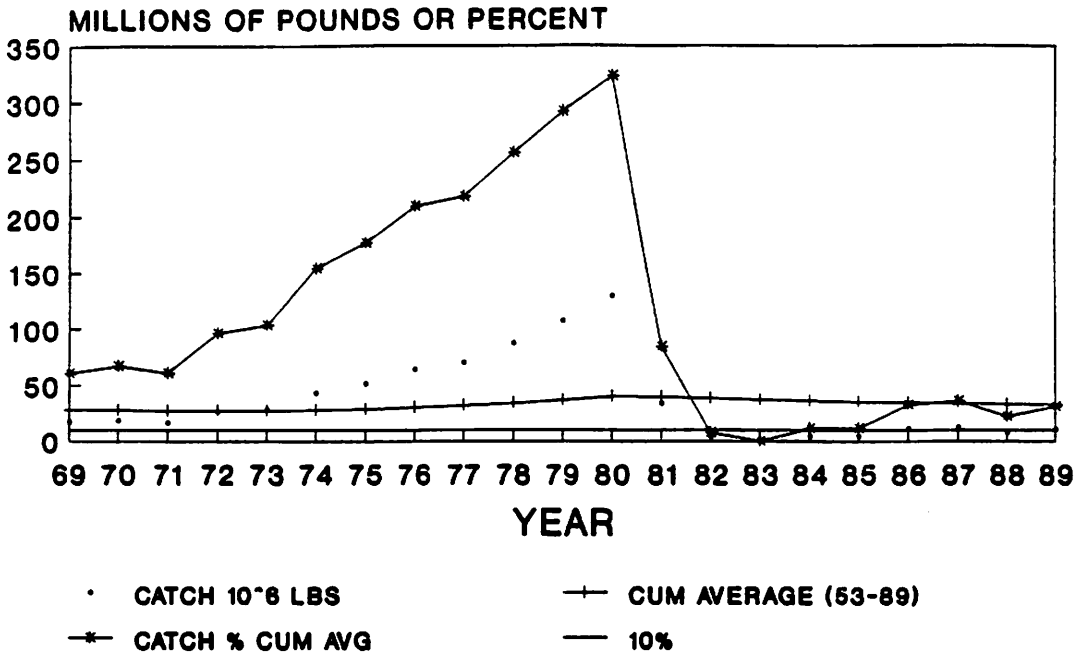


Figure 1. (cont.) Catch histories of Bering Sea/Aleutian Islands crab stocks where closures have been imposed, showing application of proposed closure at a threshold of 10 percent of the historic (cum) average catch for the fishery (MSY).

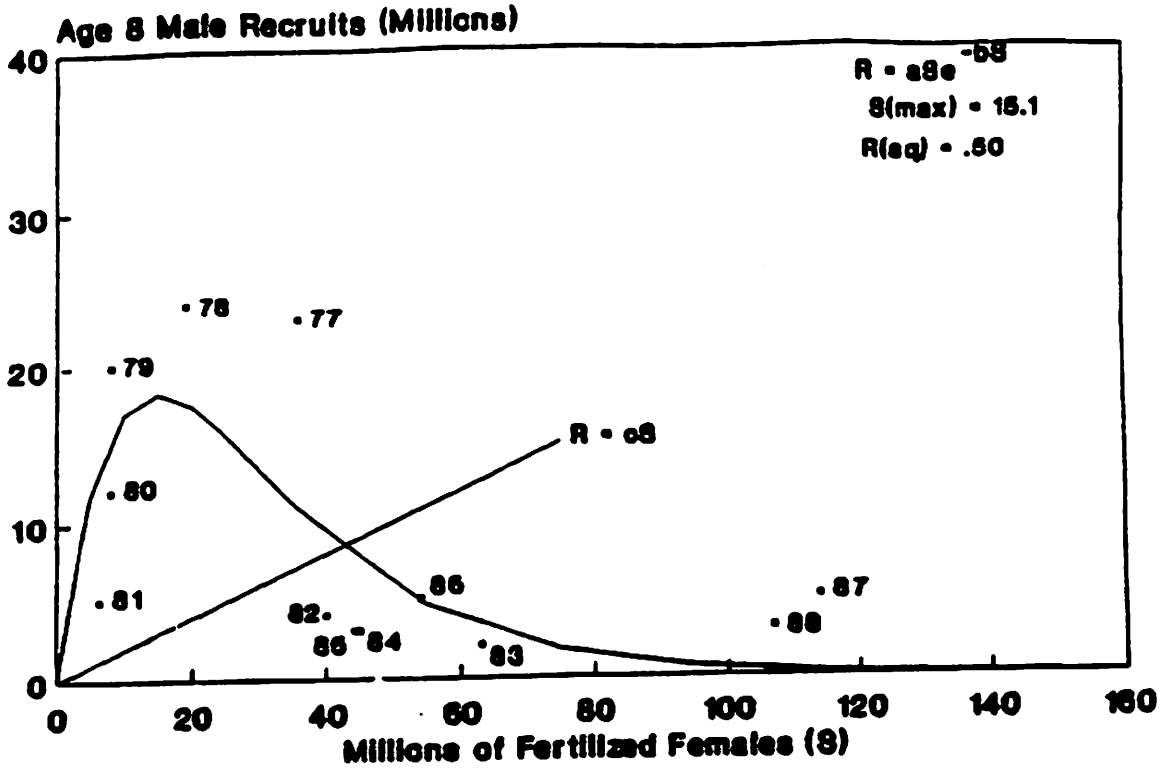


Figure 2. Bristol Bay red king crab stock-recruit relationship.

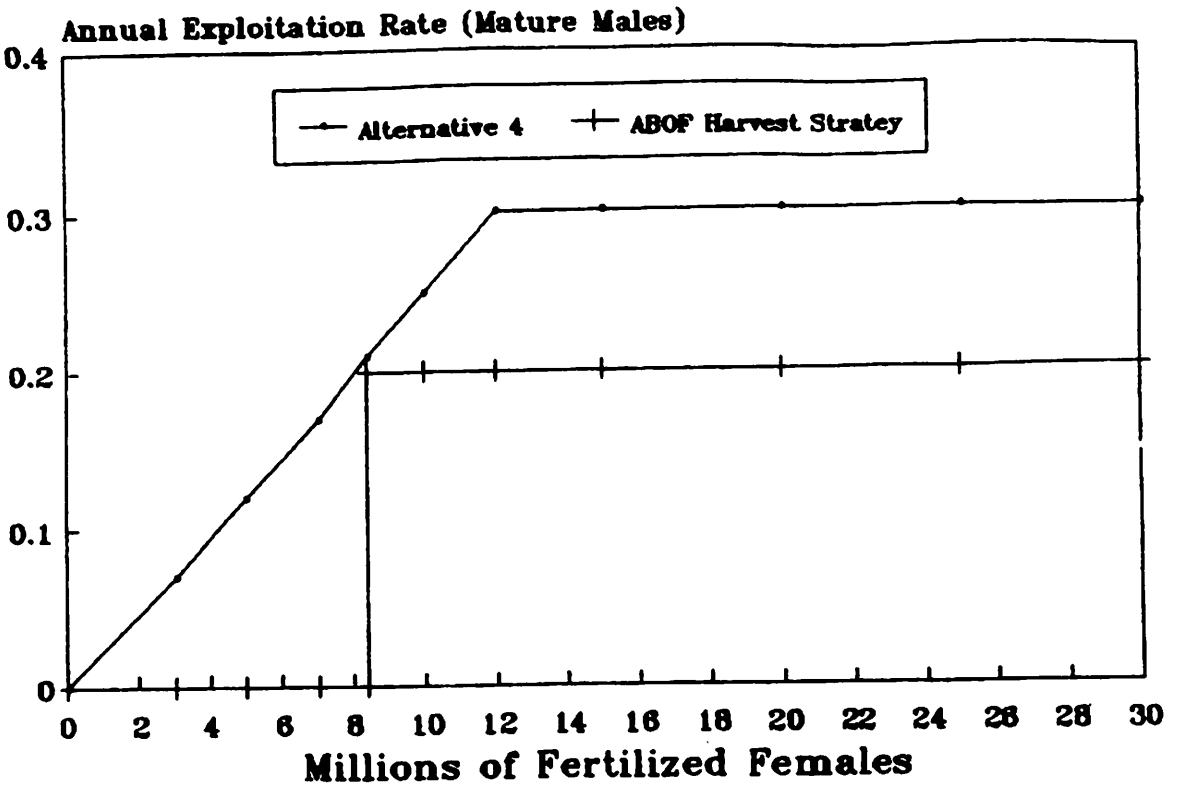


Figure 3. Bristol Bay red king crab comparison of harvest strategies.

AGENDA D-2(b)
SEPTEMBER 1990

Sept. 15, 1990

Mr. Clarence Pautzke
Executive Director
North Pacific Fisheries Management Council
P.O. Box 103136
Anchorage, AK 99510

Re: EARIR Amd. 1 Crab FMP

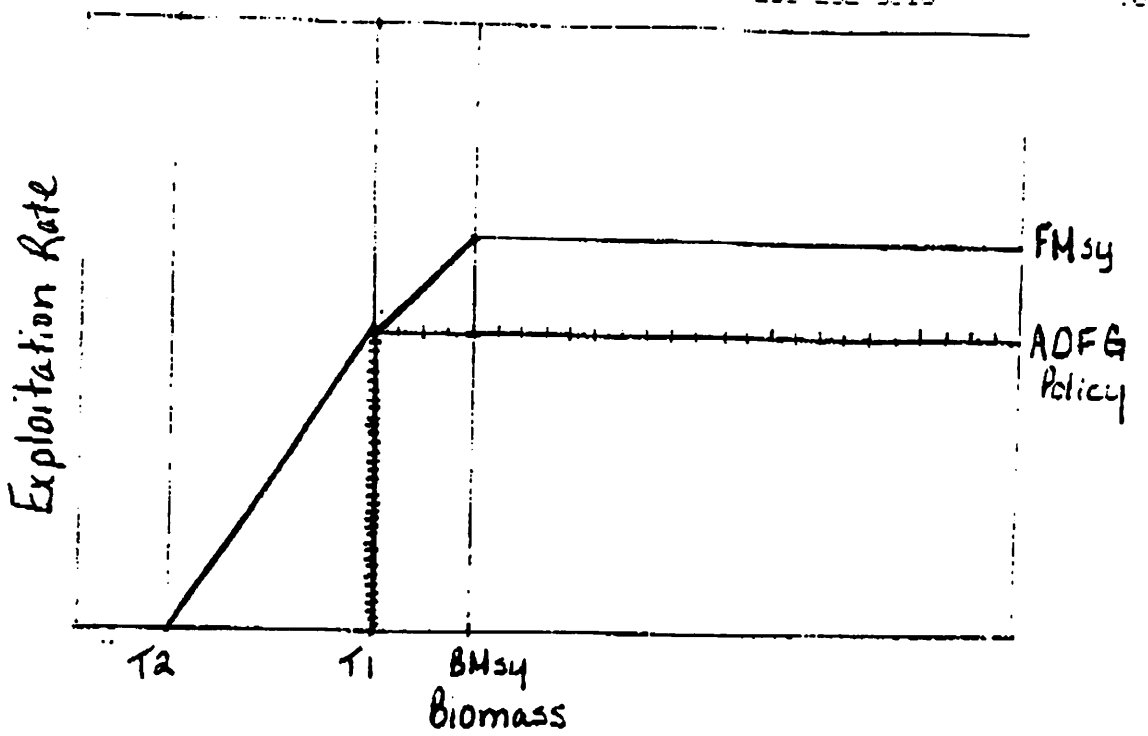
Dear Clarence:

I am writing to suggest a modified combination of the alternatives in the EARIR, and a rejection of Alternative 2 as it is presented.

Under Alternative 2 the Council would constantly be going through the multi-species exemption process as a result of having misdefined the degree of fishing mortality that consitiutes overfishing. This would make a sham of the exemption process which is intended for extrordinary circumstances, not as part of the normal management process.

As Section 2.6 pg. 12 makes clear, the 602 guidelines are meant to avoid jeopardizing a stocks potential to return to BMsy. This is very different from setting as policy the optimum rebuilding schedule for a depressed stock. As noted in the ground fish overfishing definition amendment, the task is not to adopt the most conservative definition (i.e. no fishing), but the most appropriate.

If a threshold based definition is to be developed, I support the suggestions in Dr. Bovans letter of Aug. 3rd, of designating two thresholds. One which results in termination of directed fishing, and a second which terminates all fishing induced mortality. Graphically this would appear as a hybred of Alt. 2 plus 4.



While the above is appropriate policy it is not clear that it is an appropriate or necessary overfishing definition. If I understand the definition of FMsy correctly, property applied it is in and of itself a constraint that prevents overfishing. That is, an FMsy value above zero indicates that there is surplus production available from a stock of fish for rebuilding and a FMsy value is not to exceed that surplus. Since FMsy is calculated for a given set of environmental conditions and environment is not static, the possibliity of non-fishing induced pertubations in the environment means that at low stock levels there is an increased degree of risk that fishing at a previously calculated safe FMsy value might be the straw that broke the camels back. Thus it is good policy not to fish up to FMsy, despite its theoretical acceptablilty at low stock levels. (i.e.; when you are down to the last reproductive pair and they have three offspring you don't harvest the "extra one".)

This does not mean that <u>by definition</u> any level of fishing mortality below an arbitrary threshold constitutes overfishing, anymore than it would be good policy to say that any level of fishing up to FMsy is okey dokey above that same threshold. The appropriate <u>level</u> of fishing mortality either side of a threshold is still a policy decision though the Council might chose to board the range of policy options.

If a 2 plus 4 pair of thresholds are to be identified as policy, then the upper threshold should be defined as the point the Council is required to restrict F to a value lower than FMsy to begin a rebuilding schedule. This fits, I believe, with the testimony of Dr. Fox, et al, on MFCMA reauthorization concerning dual thresholds (circulated in the August Council mailing) whereby they indicated that while this may not represent a point where irrevocable biological damage is done, that there may w

be an "economic point of no return" below such a level where it is economically unacceptable to take corrective action.

The lower threshold would be set sufficiently above zero to ensure that you don't take that tail of the last fish. The degree to which it is set above zero should reflect the credibility of concerns about hypothetical depensatory mechanisms and concerns about the uncertainties around calculations of FMsy values.

As the EARIR inplies, this 2 plus 4 policy could be administered within the ABC setting process if Alt. 3 were adopted. Dr. Bevan makes a valid counter point that the overfishing definition may be the only place in the Plan for a written reference to the Councils conservation ethic. However, Alt. 2 unmodified would precipitate a situation whereby the Council would need to make routine use of the multispecies exemption clause which was intended for exceptional situation, not routine management.

That is to say, without an exemption:
Fishing for Bardii would be suspended when King crab is low.
Fishing for King crab & Bardii would be suspended when Opilio crab is low.
Fishing for King crab & Opillio would be suspended when Bardii is low.
Fishing for Sablefish (longline) would be suspended when Brown crab is low.
Fishing for PCod (pots & longline) would be suspended when any crab is low.
And of course trawling would be closed whenever anything was below threshold.

I believe a 2 plus 4 potion at a double threshold allows the Council to make a policy statement, incorporate conservative safeguards against uncertainty and still recognize the "any threshold level should take into consideration the importance of a species in the fisheries complex".

Notwithstanding the common sense of such a policy approach, Alt. 3 remains the most straight forward means of satisfying the requirements of the 603 guidelines which is the immediate task before you.

Sincerely,

David Fraser

AMERICAN FACTORY TRAWLER ASSOCIATION

SEP 18 1990

SENT BY TELEFAX

September 17, 1990

Clarence Pautzke
Executive Director
NPFMC
P.O. 103136
Anchorage, Alaska 99510

Re: Comment - Proposed Amendment 1, Crab FMP

Dear Clarence,

These comments are directed to the draft "overfishing definition" alternatives currently outlined within the Crab FMP's Amendment #1 EA/RIR package. An effective overfishing definition should not jeopardize the potential for a stock's return to BMsy and should reasonably promote stock growth within the context of the multi-species biomass harvested in the North Pacific. At the same time, the operative definition need not be the most conservative approach possible. It appears the current proposals are far more severe relative to stock recovery and maintenance than necessary - and these definitions may grossly exceed requirements stated in the Federal 602 guidelines. The resulting costs to the broad fishing industry pursuing many different species will be both unnecessary and huge. We urge that the economic impact analysis be reworked to adequately address the predicable broad range of losses which will be sustained by fishermen generally, and to consider the consequences of additional possible definitions.

Alternative approaches have previously been suggested which bear consideration. A double threshold level overfishing definition, addressing termination of directed fishing as separate from termination of all fishing induced mortality, is one possible approach to responsible management. There are others. We hope the Council will allow additional time for development of a more rational overfishing definition scheme.

Sincerely,

Vincent A. Curry
Director, Government Affairs

4039 21st Avenue West • Suite 400 • Seattle, Washington 98199
Telephone: 206-285-5139 • Fax: 206-285-1841

AGENDA D-2(d)
SEPTEMBER 1990

June 14, 1990

Mr. Don Collinsworth
Chairman, North Pacific Fishery
Management Council
Post Office Box 103136
605 West Fourth Avenue, Suite 306
Anchorage, Alaska 99510

Re: Federal Observers on Crab Fishing Vessels

Dear Mr. Collinsworth:

It is our understanding that the North Pacific Council will be reviewing the 1990 data collection program at its meeting in Anchorage later this month, and that the Council will be considering changes to that program for the 1991 fishing year. The undersigned members of the North Pacific fishing industry are writing to request that the federal observer program be extended to include crab fishing vessels.

As you are aware, the federal observer program implemented by the Council for 1990 mandated varying levels of observer coverage, ranging from 30% to 100%, on longline, pot and trawl vessels engaged in the groundfish fisheries under the Council's jurisdiction. The Council's program did not, however, require observers on crab fishing vessels during the 1990 fishing year. This omission was due, at least in part, to the fact that the State of Alaska had just implemented a mandatory observer program of its own on the catcher/processor component of the crab fishery.

The State of Alaska's observer program has now been in place for two years. The state's program is restricted to the 25 or so crab catcher/processors which participate in the Alaska crab fisheries. It does not cover the 400 or so catcher vessels which also engage in the crab fisheries off Alaska. Furthermore, the state program is designed primarily to serve as an extension of the state's enforcement arm. Very little, if any, biological or scientific data has been generated from the program. Other shortcomings in the state program were described in length in testimony to the Council last April and have also been detailed to the Board of Fish. (See attached article from the Alaska

Commercial Fisherman, dated March 30, 1990.) Those alleged problems include: inadequate qualification standards and training of observers; conflicts of interest by observer contractors; suspected payoffs; substance abuse by observers; inaccurate or nonexistent data collection procedures; and so on.

The value to management of reliable, real time, fishery generated data has already been demonstrated by the 1990 federal groundfish observer program. Only fully qualified and adequately trained observers are capable of collecting such data -- and it is needed in the crab fishery as well as in the groundfish fishery. Crab observers could, for example, collect crab bycatch and handling mortality data which is essential to both crab and groundfish management.

We are not suggesting that the state program on catcher/processors be abandoned. That is an issue for the State of Alaska to decide. We do, however, believe that it is essential to incorporate the crab catcher fleet, which is not included in the state program, into the federal observer program. As far as the catcher/processors are concerned, observer data from that component of the fleet would be useful as well, but under no circumstances should a vessel be required to carry two observers (one federal and one state) at the same time. One solution would be for the state to consider waiving its observer requirement whenever a catcher/processor carries a federal observer. Such coordination of state and federal observer programs is specifically contemplated by ¶ 8.1.3 of the crab FMP.

In our view, it is essential that the Council establish a comprehensive, well-coordinated, centrally managed observer program which is designed to collect the data needed to properly manage all of the fisheries under the Council's jurisdiction. Unless and until the crab fleet is brought within that program, an essential piece of the management puzzle will be missing.

Thank you for your consideration of the points discussed above. Most of the signatories to this letter will be at the June meeting of the Council and available to answer any questions that you might have regarding the points discussed above.

Mr. Don Collinsworth
June 14, 1990
Page 3

Sincerely yours,

NORTH PACIFIC FISHING VESSEL OWNERS' ASSOCIATION

AMERICAN HIGH SEAS FISHERIES ASSOCIATION

MIDWATER TRAWLERS COOP

ALASKA FACTORY TRAWLER ASSOCIATION

ALASKA GROUNDFISH DATA BANK

HIGHLINERS ASSOCIATION

Board Corrects Weaknesses in State Observer Program

Observers that take gratuities, skippers that offer them, contractors that have a financial interest in the companies to whom they are assigning observers, vessel owners that hire their relatives as observers . . . These were only a few of the examples of how the intentions of the state of Alaska's crab offshore observer program have been circumvented that came up during last week's Board of Fisheries discussion of the program and how to improve it.

Since the program, which requires observers on vessels processing crab offshore, was implemented for the red king crab season in Bristol Bay, September 25, 1988, managers within the Alaska Department of Fish and Game have had the opportunity to observe, investigate and evaluate the program and the regulations promulgating it, and they presented to the board their conclusions as the basis for changes they proposed to correct the shortcomings and make the program truly work.

The Problems

As Alan Quimby of the Alaska Department of Fish and Game's shellfish program recited a list of problems being encountered by program managers with industry, contractors, the observers themselves and even the department, it was clear that lack of standards for what amounts to conflict of interest has undermined the program, made the data collected through it suspect, and provided a fertile bed for corruption.

Quimby had a specific list for the board of the problems. In terms of industry, crab processors have selected their own observers from the lists provided by contractors, rather than taking what's sent them; or they've hired their own family members as observers; or they've changed contractors to get "less experienced, less strict" observers; or they've contracted directly with individuals to be observers rather than used the contractor system. They have offered gratuities to observers to "turn their heads." They've put observers ashore before processing and have otherwise denied them access and information vital to their jobs. They've exploited observers' situation [illegible]

More Problems

Contractors, too, have created problems for the program by allowing industry to choose among the observers on the list rather than simply assigning an observer to them. They have allowed members of the same families to work in the same fisheries. They've hired members of their own families as observers. They've not trained the observers adequately. They've failed to assure that observers have no conflict of interest because of having a financial interest in a crab processor with taking an observer position or that they themselves have no conflict of interest for the same reason.

In terms of the observers themselves, the program managers have had problems with substance abuse (with an exclamation mark) on the part of observer, with their taking gratuities from industry, for their providing incorrect data through faulty measuring and failing to complete forms. Observers have falsified data and provided incorrect reports. Individuals have contracted directly with processors as observers rather than through contractors. Some of them have been overzealous in their enforcement actions. Others of them have failed to notify the department of improper activities. Some of them have been just plain sexist, non-functioning and in the way.

And Even More

In his litany, Quimby did not spare the department itself from having a part in the weaknesses of the crab observer program. Training and testing of observers is too lenient, he said. Department members have failed to notice bad data. They've established no recertification requirements or time limits. They've allowed observers to be briefed and debriefed in area Fish and Game offices not responsible for the management of that particular fishery. Standards for contractors are inadequate.

(See Observer Problems on Page 18)

(Continued from Page 3)

The department has no adequate means of rescuing an observer from a situation in which he is being intimidated or exploited. The department has allowed catch reports in long-term fisheries to go unreported for several weeks. It has failed to follow up with reliable debriefings of observers on catcher/processors that may be transporting product out of the state. Briefing and debriefing facilities are inadequate. And ADF&G has no means of enforcing gross violations.

All in All

As it was drafted, said Quimby, the Mandatory Crab Observer Program had two major goals: enforcement and data collection.

The program has had varied success at obtaining its objectives, he said. He pointed to data showing that during the first few months of the program, there had been a tremendous dampening of illegal crab retention, but that since then this ability has continued to erode. Furthermore, the collection of biological data has been greatly lacking or nonexistent.

"The failures of the program stem entirely from the Department's inability to directly control hiring, training and placement of observers. The Department has only the power to react by decertifying an observer after the problem has occurred. The Observer Coordinator and other staff are spending more time trying to handle conduct problems with observers and contractors than collecting biological data."

Concluded Quimby, the third party contracting for observers is not a desirable program. It should be replaced by a fully funded State or Federal program."

A COMPARISON OF CATCHER-PROCESSOR VESSEL AND CATCHER VESSEL FISHING PERFORMANCE IN THE 1989 BERING SEA RED KING CRAB FISHERY

By: Dana Schmidt
B. Alan Johnson

Regional Information Report[1] No. 4K90-2
Alaska Department of Fish and Game
Division of Commercial Fisheries, Westward Region
211 Mission Road
Kodiak, Alaska 99615

January 1990

[1] Contribution 4K90-2 from the Kodiak area office. The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Division of Commercial Fisheries.

Abstract

This report is the third in a series, evaluating differences in catch rates between catcher processors and catcher vessels in the Bering Sea red king crab fishery. During the 1988 and 1989 Bristol Bay red king crab fishery, on-board observers were placed on catcher-processor vessels. In the 1989 fishery, the average pounds landed per catcher vessel was approximately 59,000 compared with an average of approximately 72,000 for the catcher-processor vessels when comparisons of vessels of similar sizes were made (130 ft-170 ft). The landing rate was 56 pounds per pot-lift versus 47 pounds per pot-lift respectively. In 1989 as in 1988, the pounds landed per pot-lift, and pounds landed per number of registered pots by catcher-processor vessels were not significantly larger than the catcher vessels but differences in these rates were highly significant in 1987. We conclude that the observer program which was instituted in the 1988 and 1989 fishery remains the primary factor contributing to the similarity in the catch per unit effort reported by the catcher fleet and the catcher-processor fleet. There does appear to be a shift in CPUE between the past two years, although not statistically significant. Continued vigilance is warranted to insure that observers remain effective in deterring undersized processing.

Introduction

This report is a continuation of previous examinations of the differences in catch rates observed between catcher-processor vessels and catcher vessels participating in the Bristol Bay red king crab fishery. The previous reports, hereafter referred to as the 1987 Report or the 1988 Report[2], addressed differences between the 1987 and 1988 fisheries. This observer program was first implemented during the 1988 Bristol Bay red king crab fishery. The differences in catch rates reported in the 1987 Report was one of the factors considered by the Board of Fisheries in establishing the mandatory observer program. This report addresses the catch rates observed between the catcher-processor fleet and the catcher fleet during the 1989 fishery and compares these results with the 1988 Report.

The number of catcher-processor vessels that participated in recent Bristol Bay red king crab fishery was similar to the previous year with 18 participating catcher-processor vessels in 1989 as compared with 20 in 1988.

This report examines apparent differences in catch rates between the catcher-processor vessels and catcher vessels in the 1989 fishery. Because of the high number of observers that were decertified, the effectiveness of the program as a deterrence to processing sub-legal animals has been questioned. The vessel size, the number of pots registered, and the number of pots lifted are examined in this report, similar to the 1988 Report. Because of the area manager's observation of potentially more pots being fished by catcher-processor vessels, and consequently, increased soak times, we have examined the number of pot-lifts closer by comparing them with the number of pots registered. The use of numbers of pots registered provides an alternative method of examining the effective amount of effort of a given vessel and coupled with pot-lift data, soak time effects on catch per unit effort (CPUE) can be evaluated. Catch per unit effort was projected by using the reported number of pot-lifts and the number of pots registered as the effort.

Therefore, the objective of this analysis is to determine if the pounds landed and the CPUE were significantly different for the catcher-processor vessels in the fishery held during September 1989 and to determine if on-board observers remained effective. If CPUE differences occurred, we examined if these differences can be explained by known differences between the two types of vessels or changes in soak time.

Methods

The methods used are the same as those reported in the 1988 Report. The data used in this analysis were obtained from the fish tickets and vessel registration forms. For catcher-processor vessels, a single fish ticket was usually submitted for the entire season, although on

[2]Schmidt, D. and B. A. Johnson. 1988. A Comparison of Catcher-Processor and Catcher Vessel Fishing Performance in the 1987 Bering Sea Red King Crab Fishery. Regional Information Report No. 4K88-14. Alaska Department of Fish and Game, Division of Commercial Fisheries, Kodiak.
Schmidt, D. and B. A. Johnson. 1989. A Comparison of Catcher-Processor and Catcher Vessel Fishing Performance in the 1988 Bering Sea Red King Crab Fishery. Regional Information Report No. 4K89-1. Alaska Department of Fish and Game, Division of Commercial Fisheries, Kodiak.

longer fisheries, a fish ticket is completed weekly. For catcher vessels, a ticket is completed at each landing. The basic data from the fish tickets consisted of pounds landed, number of crab landed, and number of pot-lifts. The basic data from the vessel registration forms consisted of numbers of pots registered and length of vessel. The data resolution is that of vessel, i.e. multiple fish tickets were combined for a single vessel.

For testing differences in means we used the non-parametric test that was used in the 1987 and 1988 Reports. The test used in known as the Mann-Whitney or Wilcoxon rank sum test (Conover 1980).

A graphical method was used to locate differences in the sampling distributions of these data. The quantile-quantile plot or Q-Q plot (Chambers et al. 1983, Hoaglin et al. 1983, and Gnanadesikan 1977) can be used to determine if a sample distribution is similar to some other distribution. The analysis of distributional differences was necessary because we could easily have had a segment of the catcher-processor fleet that landed crab at normal or sub-normal rates, while another segment of the catcher-processor fleet that experienced very high landing rates. Differences in means may be very minor in this case, but distributional differences could be very large. Because the distributional patterns did not show any patterns not observed in the 1988 and 1987 Reports, the plots were not included in this report.

Results

Comparisons of Pounds Landed and CPUE for 1989

All mean values for each variable except the pounds per pot-lift and pounds per pot registered were significantly greater for the catcher-processor vessels as indicated by the test statistics (Table 1). This is identical with the 1988 fishery data.

Table 1.— Test statistics for difference in mean values between catcher-processor vessel (N=18) and catcher vessel (N=193).

	Mean values			
Variable	Catcher vessel	Catcher-processor vessel	Ratio of means	P-value Wilcoxon test
Pounds landed	46276	74085	1.60	<0.01
Number of pot-lifts	957	1296	1.35	<0.01
Pounds per pot-lift	50.0	55.0	1.10	0.10
Number of pots registered	248	388	1.56	<0.01
Pounds per pots registered	187.1	189.4	1.01	0.45
Vessel length (ft)	100	161	1.60	<0.01

Examination of the Q-Q plot CPUE data for the entire data set or for the subset of data reflecting vessels in the 130 ft-170 ft category, did not suggest any trends not observable from the tabular data. Therefore the plots are not presented in this report.

Although the difference in average pounds landed between the two vessel types is significant ($P<0.01$), the pounds landed may be affected by the number of pot-lifts or the size of vessel. As an alternative measure of effort, registered number of pots was also used as a comparative basis. For both measures of CPUE, the catcher-processor vessels did not have significantly different values when compared to the catcher vessels (Table 1). Note that the P-value for pounds per pot-lift is 0.10 as compared with 0.38 the previous year for the same parameter. This value is not considered significant using the $P=0.05$ criteria.

As in previous years, we further examined the data to determine if length of vessel would explain the differences observed. To provide similar size classes of both catcher-processor and catcher vessels, vessels of 130–170 feet were selected, identical to the procedures used in 1987 and 1988. This group included 10 catcher-processor vessels and 19 catcher vessels. This grouping provided sufficient numbers of vessels and low significant difference of length ($P=0.03$) (Table 2).

Table 2.— Test statistics for difference in mean values between catcher-processor vessel (N=10) and catcher vessel (N=19) with length between 130 ft and 170 ft.

	Mean values			
Variable	Catcher vessel	Catcher-processor vessel	Ratio of means	P-value Wilcoxon test
Pounds landed	59392	71917	1.21	0.34
Number of pot-lifts	1305	1209	0.93	0.19
Pounds per pot-lift	47.0	56.1	1.19	0.18
Number of pots registered	332	391	1.18	0.04
Pounds per pots registered	176.0	180.9	1.03	0.48
Vessel length (ft)	152	159	1.05	0.03

For vessels of size 130–170 feet in length, there was not a statistical difference between mean pounds landed, contrary to the observations of 1988. Neither measure of CPUE shows a statistical difference between catcher-processor vessels and catcher vessels as would be expected from the previous examination of the full fleet (Table 2). The number of pot-lifts are not significantly different for the catcher-processor vessels, also differing from the 1988 fishery.

Comparisons of 1987, 1988 and 1989 Fisheries

We have analyzed the 1989 Bering Sea red king crab fish ticket data in an attempt to determine if a disparity existed in pounds landed per unit effort between the catcher vessels and

the catcher-processor vessels. If a disparity exists, two possible explanations are possible. Illegal catch could be one explanation, because of the high number of observers which were decertified during 1989. This suggests that their ability to act as deterrents to sub-legal processing may have been compromised. Increased soak times is one other possible explanation suggested by ADF&G management staff. This should be detectable as a discrepancy between the pounds landed per pot-lift, and the pounds landed per pot registered.

Table 3 tabulates the differences in the catch values between 1987, 1988 and 1989 for both vessel types between 130 and 170 ft in keel length. The pounds landed by the catcher-processor vessels in 1989 were approximately 1.2 times higher than the catcher vessels, when considering vessels of similar length. This compares with 2.5 times higher in 1987 and 1.3 times in 1988. It is a safe assumption that the pounds landed are relatively free from reporting errors. When comparing the vessels in total, the catcher-processor vessels had landings that were 1.6 times larger that of the catcher vessels in 1989 versus 2.3 times larger in 1987, and 1.4 times in 1988.

Table 3.— 1987, 1988 and 1989 mean values for catcher-processor vessel and catcher vessel with length between 130 ft and 170 ft.

	Catcher vessels			Catcher-processor vessels			Ratios		
Variable	1987	1988	1989	1987	1988	1989	1987	1988	1989
Pounds landed	54844	40131	59392	136074	53817	71917	2.48	1.34	1.21
Number of pot-lifts	1013	795	1305	1396	1043	1209	1.37	1.31	.93
Pounds per pot-lift	58.5	54.4	47.0	92.4	50.9	56.1	1.58	0.94	1.19
Number of pots registered	300	316	332	398	410	391	1.32	1.30	1.18
Pounds per pots registered	183.0	126.9	176.0	330.3	132.4	180.9	1.80	1.04	1.03
Vessel length (ft)	152	155	152	155	158	159	1.01	1.05	1.05

Note in Table 2 that there was not a significant difference in pots lifted between vessels for 1989 but a significant difference in the numbers of pots registered. Assuming all registered pots were fished, longer soak times would have occurred. Although CPUE values were not significant between vessel types, the change in CPUE expressed as pounds per pot from the 1988 data, may be explained by longer soak times reflecting nearly identical pounds per pot registered during 1988 and 1989. Note also that the differences from 1987 are still quite large, reflecting the continued effectiveness of on-board observers in providing similar CPUE values between vessels of similar size, regardless of processing modes.

Discussion

Analysis of vessels of all lengths indicates that catcher-processor vessels had average pounds landed per pot-lift higher than that of an average catcher vessel but not significant. When the vessels compared were vessels of similar keel lengths, average pounds landed per pot-lift

by catcher-processor vessels was again not significantly different than that reported by the catcher vessels.

When compared with 1988, the mean 1989 CPUE expressed as pounds per pot-lift increased. However the catch per pot registered stayed essentially the same. Since the number of pot-lifts reported by catcher-processor vessels dropped in 1989, the differences in CPUE observed can be explained by increased soak time. When compared with 1987, the effectiveness of the on-board observers remains obvious.

From the previous discussion, it appears that parity in the fleet has been maintained in 1989 by the presence of mandatory observers on the catcher-processor vessels. Changes in CPUE values expressed as pounds per pot-lift were not paralleled when CPUE was expressed as pounds per pot registered. Since pot-lifts dropped in the catcher-processor fleet, when compared with the equivalent sized catcher fleet, increased soak time may be a primary cause of the difference. The economic advantage of catcher-processor vessels, beyond the processing capabilities, previously explained by the increased number of pot-lifts in 1988, is now explainable by increased soak time of the number of pots registered. However, the difference in average pounds landed between the vessel types was not statistically significant in 1989. Equivalent sized vessels, based on total number of pounds landed in 1989, actually caught crab at a lesser rate in 1989 (1.21 differential) than in 1988 (1.34). If comparative increased CPUE from catcher-processor vessels were in part, caused by lack of observer diligence, the amount is too small to be detected by the analysis presented here.

Conclusions

We examined the pounds landed as a function of the number of vessels, the number of pot-lifts, and the number of pots registered to determine if significant differences occurred. With an on-board observer the pounds landed for catcher-processor vessels was larger than catcher vessels but not significantly larger in 1989. Both 1989 and 1988 rate of landings contrast sharply with 1987 data. Our conclusions have not changed since the 1988 report. To provide equal enforcement of size and sex regulations established for this fishery it is essential that a mandatory on-board observer program continue. The costs of continuing this program are very small when compared with the potential value of illegal crab taken by unobserved processing vessels.

Literature Cited

Chambers, J. M., W. S. Cleveland, B. Kleiner, and P. A. Tukey. 1983. Graphical methods for data analysis. Wadsworth, California.

Conover, W. J. 1980. Practical nonparametric statistics. John Wiley, New York.

Hoaglin, D. C., F. Mosteller, and J. W. Tukey. 1983. Understanding robust and exploratory data analysis. John Wiley, New York.

Gnanadesikan, R. 1977. Methods for statistical data analysis of multivariate observations. John Wiley, New York.

UNITED STATES DEPARTMENT (
National Oceanic and Atmospheri
National Marine Fisheries Ser
P.O. Box 21668
Juneau, Alaska 99802-1668

DATE: September 18, 1990

MEMORANDUM FOR: Steve Davis, Deputy Director
North Pacific Fishery Management Council

FROM: Raymond E. Baglin
Chairman, Crab Plan Team
National Marine Fisheries Service, Juneau

SUBJECT: Observer Program Comments

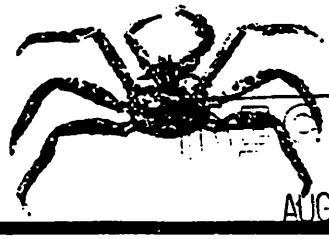
During its August 7 - 9 meeting, the Council requested a detailed report on the crab observer program from the Alaska Department of Fish and Game (ADF&G) and an opinion from the Crab Plan Team on the adequacy of the current crab observer program. Specifically, the Council expressed interest in whether or not a Federal observer program should be instituted to cover catcher vessels in addition to the State program that covers catcher/processor and floating processor vessels.

The Crab Plan Team believes that it is important to get representative data on bycatch, including non-target crab species, undersize and female crab, and halibut from an observer program. The ADF&G's analysis of catch per unit effort (CPUE) data has been unable to detect any differences between catcher processing vessels and catcher vessels. The Plan Team feels that the ADF&G should conduct additional analysis of existing observer data for fisheries such as the brown king crab fishery where bycatch data are currently available to confirm whether or not sampling only catcher processing vessels provide a representative sample. If the additional analysis shows that the catch of catcher processing vessels is not representative of catcher vessels, sampling aboard catchers would be necessary to obtain a representative description of the fleet-wide bycatch.

The main objectives of the State's observer program, as specified by the Board of Fisheries, are to collect biological data for the crab observed and determine compliance with regulations. Information has been collected by the State observer program on bycatch mainly from fisheries with prolonged seasons such as the brown king crab fishery and C. bairdi fishery. Red and blue king crab seasons have been very short and observers have only been able to enforce size limits, with limited time available for collecting biological data. This year the Board of Fisheries has added an observer requirement for all catcher processing vessels and processing vessels participating in the C. opilio fishery. The ADF&G staff believes that with the experience they have obtained, they should be able to collect needed bycatch data this season for all the fisheries with their existing program.

The Crab Plan Team recommends that the Council request the Board of Fisheries to expand the current program to provide for additional analysis of existing observer data and provide for increased bycatch data collection.

COMMERCIAL FISHERIES



NEWS RELEASE

ALASKA DEPARTMENT
OF FISH & GAME

STATE OF ALASKA

Department of Fish and Game
Don W. Collinsworth, Commissioner

Ken Parker, Director
Division of Commercial Fisheries

Westward Region
211 Mission Road
Kodiak, AK 99615

Contact: William E. Nippes
Shellfish/Groundfish
Management Coordinator

IMMEDIATE RELEASE

Date: August 27, 1990

ATTENTION WESTWARD SHELLFISH FISHERMEN

New regulations adopted by the Alaska Board of Fisheries at its March 1990 meeting will become effective on September 21, 1990. The following changes were made which effect Westward shellfish fisheries:

SEASONS:

-The Bristol Bay red king crab fishery will open November 1, which is a change from the current September 25 opening.

-The *C. bairdi* fishery in the Bering Sea east of 166°W. longitude will open seven days after the closure of the Bristol Bay red king crab fishery or on November 7, if there is no king crab fishery.

-The *C. bairdi* fishery in the Eastern Aleutians, Western Aleutians and Eastern Subdistrict of the Bering Sea will close March 31. The *C. opilio* fishery will also close March 31 in the Eastern Subdistrict.

GEAR:

-In the Bristol Bay king crab area, gear may be stored for ten days after the season in water deeper than 25 fathoms.

-In the Bering Sea east of 166°W. longitude, Tanner crab gear may be stored for seven days in water deeper than 25 fathoms prior to the announced opening.

-An eight inch minimum mesh size for one third of one vertical surface of all pots used in Bristol Bay king crab fishery.

-Pot limit for Kodiak Tanner crab

1. When the guideline harvest level exceeds seven million pounds, no more than 150 pots may be operated.

2. When the guideline harvest level is between three and seven million pounds, no more than 100 pots may be operated.

3. When the guideline harvest level is less than three million pounds, no more than 75 pots may be operated. NOTE: Identification stickers will be required on pots.

DELIVERIES:

-Increase time to 60 hours for delivery of king crab from St. Matthew to Dutch Harbor, Akutan and King Cove.

SCALLOP CLOSED WATERS:

-In addition to areas previously closed to scallop fishing, additions were made to include areas already closed to bottom trawling.

OBSERVERS:

-The Board made minor changes to the observer manual and also included the changes below.

1. Require Bachelor Degree or Department approval for all observers.

2. Developed conflict of interest standards to clear up confusion on who can and cannot be a contractor.

3. Require certification of contractors.

4. Reduce time an observer can spend on one vessel to 90 days in 12 consecutive months.

5. Allow observers limited access to loran coordinates of vessel they are assigned.

6. Require observers on all floating processors and catcher/processors that process *C. opilio*.

STATEWIDE GEAR:

-Provide escape panel as follows:

A sidewall, which may include the tunnel, of all shellfish and groundfish pots must contain an opening equal to or exceeding 18 inches in length, except that in shrimp pots the opening may be a minimum of 6 inches in length. The opening must be laced, sewn or secured together by a single length of untreated 100 percent cotton twine no larger than 30 thread. The biodegradable twine may be knotted at each end only. The opening must be within six inches of the bottom of the pot and parallel to it. The biodegradable twine cannot be tied or looped around the web bars. Dungeness crab pots may have the pot lid tie-down straps secured to the pot at one end by a single loop of untreated cotton twine no larger than 30 thread as a substitute for the above requirement. A Dungeness crab pot lid must be secured such that when the twine degrades, the lid will no longer be securely closed.

-Allow longlining of shrimp pots.

-Restrict the use of pot gear for 14 days prior to and 14 days after the king and Tanner seasons by vessels fishing the king and Tanner season.

These regulation changes will become law on September 21, 1990.

CRAB OVERFISHING ALTERNATIVES

DATA LEVELS	1 Historical catch, Sporadic inseason,	2 Historical catch, Continuous inseason,	3 Historical catch, Continuous inseason , stock assessments, stock-recruitment data, growth, maturity, mortality data
CRAB STOCKS	Bristol Bay brown Pribilof brown St. Lawrence blue Pribilof red N. District brown Adak bairdi	Adak brown Adak red E. Aleutian brown E. Aleutian bairdi	E. Aleutians red Bristol Bay red Pribilof blue St. Matthew blue Norton Sound red Bering Sea bairdi Bering Sea opilio
ALT 1	Recruitment overfishing is the condition that occurs when the spawning stock is reduced too low to ensure adequate production of young crabs.		
ALT 2 Constant F w/ threshold	Overfishing if: F greater than natural mortality of mature males. Cannot define threshold	Overfishing if: F greater than natural mortality of mature males. OR Any harvest if stock is at or below a threshold equal to 10% of long term average catch (MSY)	Overfishing if: F greater than F_{msy} which is approximated by $F_{0.1}$ based on size of first maturity of males. OR Any harvest if stock is at or below a threshold equal to 20% pristine exploitable biomass estimated as 20% of best estimate of equilibrium level of spawning stock.
ALT 3 Constant F w/o threshold	Overfishing if: F greater than F_{msy} estimated as natural mortality of mature males.	Same as Alt 3 Level 1	Overfishing if F greater than F_{msy} as approximated by $F_{0.1}$ based on size of first maturity of males.
ALT 4 Variable F w/o threshold	Same as Alt 3 Level 1	Same as Alt 3 Level 1	Option (a): All stocks except Bristol Bay red would be as Alt 3 level 3. Bristol Bay red: overfishing if F greater than F_{msy} for stocks above B_{msy}. If stock is below B_{msy} than F_{max} ranges from 0 to F_{msy} at B_{msy}. Option (b): Use same formula for Bristol Bay reds and extrapolate its stock recruitment relationship to other crab species.

ALTERNATIVE OVERFISHING DEFINITIONS

Alternative 1: Status Quo - Recruitment Overfishing

Alternative 2: Constant Fishing Mortality Rate with Threshold

$$F > F_{msy}$$

Any F when $N <$ Threshold

Alternative 3: Constant Fishing Mortality Rate

$$F > F_{msy}$$

Alternative 4: Variable Fishing Mortality Rate

For $N > B_{msy}$ $F > F_{msy}$

For $N < B_{msy}$ F varies with N

SIMILARITIES OF ALTERNATIVES 2, 3, AND 4

Overfishing = $F > F_{msy}$

When N > Threshold, Non-directed Fisheries Proceed

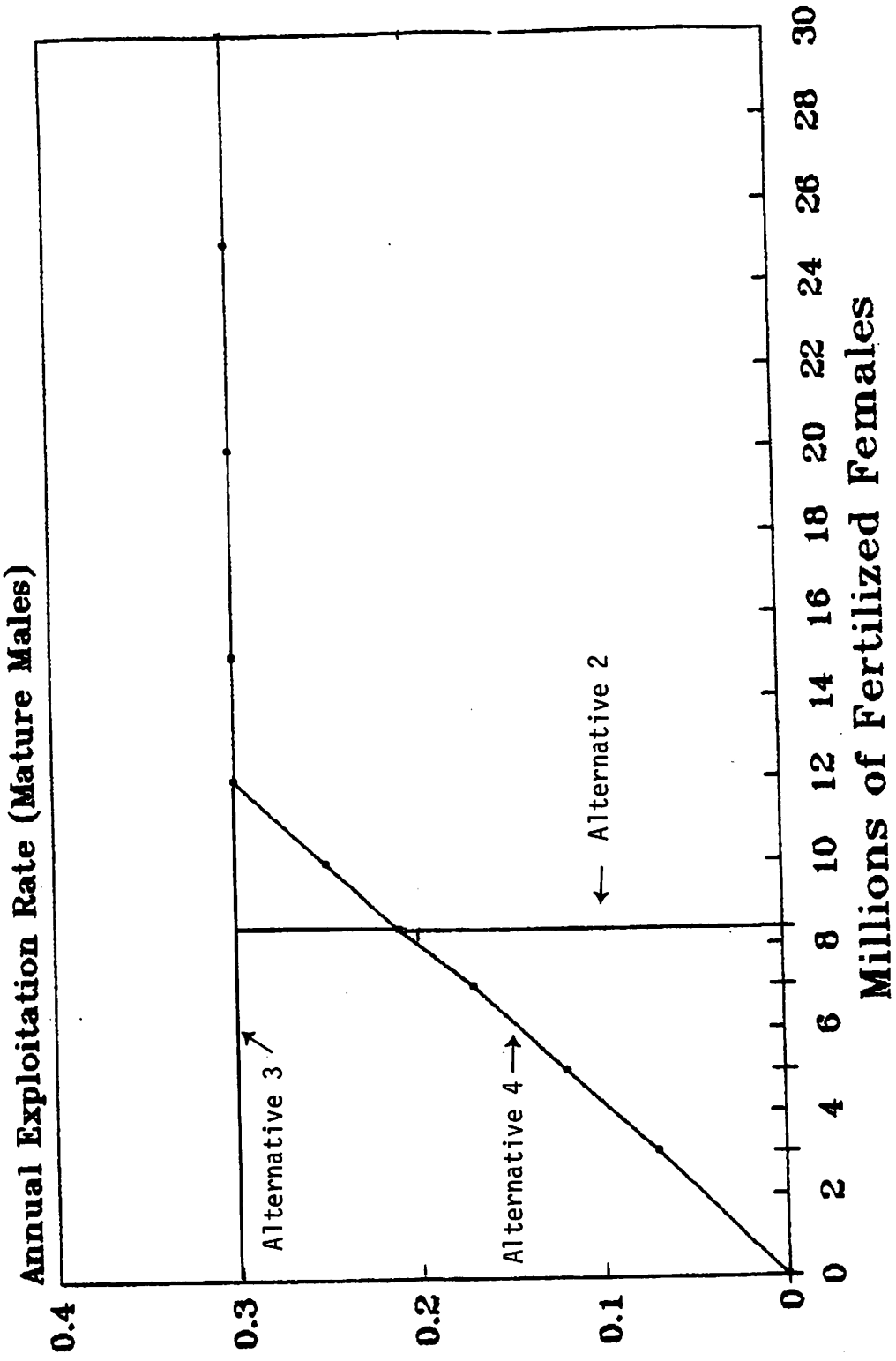
DIFFERENCES BETWEEN ALTERNATIVES 2, 3, AND 4

Alternative 2: When N < Threshold, No Directed Fishery

When N < Threshold, Non-directed Fisheries may or may not proceed

Alternative 3: When N < Threshold, $F > F_{msy}$

Alternative 4: When N < Threshold, F varies with N


Annual Exploitation Rate (Mature Males)
0.4
0.3
0.2
0.1
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Millions of Fertilized Females
Alternative 2
Alternative 3
Alternative 4

DISADVANTAGES OF ALTERNATIVES 2, 3, AND 4

Alternative 2: Requires 1) Preparation of Risk Analysis
and 2) a Council Determination
Time Consuming

Alternative 3: When N < Threshold, $F <= F_{msy}$

Alternative 4: When N < Threshold, Accuracy of F is ?
Requires Extensive Analyses - Time Consuming
Methodology is Untested for Crab Stocks

Alternatives 2, 3, and 4: Possible Change in Harvest Policy for
Adak Brown King Crab Fishery

CRAB PLAN TEAMS PREFERRED OVERFISHING DEFINITION

Alternative 2

Protects Stocks by Preventing $F > F_{msy}$

Preserves Stock's Longterm Reproductive Capacity by Specifying a Threshold

If N < Threshold, A Risk Analysis is Performed to Determine if Multispecies Exemption Clause should be Invoked

Alternative 2 is an Objective and Measurable Definition of Overfishing that will Protect the Crab Stocks Managed by the FMP

ALTERNATIVE OVERFISHING DEFINITIONS

Alternative 1: Status Quo - Recruitment Overfishing

Alternative 2: Constant Fishing Mortality Rate with Threshold

Info Level 1: $F = M$, No Threshold can be specified

Info Level 2: $F = M$, Threshold = 10 % of MSY

Info Level 3: $F > F_{0.1}$, Threshold = 20 % S_{eq}

Alternative 3: Constant Fishing Mortality Rate

Info Level 1: $F > M$

Info Level 2: $F > M$

Info Level 3: $F > F_{0.1}$

Alternative 4: Variable Fishing Mortality Rate

Info Level 1: Default to Alternative 3, Information Level 1

Info Level 2: Default to Alternative 3, Information Level 2

Info Level 3a: For Bristol Bay: For $N > B_{msy}$ $F > F_{msy}$

For $N < B_{msy}$ F varies with N

All Other Level 3 stocks default to Alternative 3, Information Level 3.

Info Level 3b: For $N > B_{msy}$ $F > F_{msy}$

For $N < B_{msy}$ F varies with N

GROUNDFISH INDUSTRY SURVEY

	Catchers	Ca./Proc.	Floaters	Shoreside
Number of surveys sent	1332	358	22	140
# of surveys received as of 9/28/90	16	2	0	1
Percent returned	1.2%	0.6%	0.0%	0.7%
PART ONE: GENERAL DESCRIPTION				
Homeport/location	x	x	x	x
How long at this location			x	x
Vessel/plant age	x	x	x	x
Primary fishing area	x			
Original vessel purpose		x	x	x
Primary delivery port	x			
Primary fishing gear	x			
Deliver shoreside or at sea?	x			
Last year with joint ventures	x			
Processing plant size				x
Vessel length	x	x	x	
Gross tons	x	x	x	
No. of engines	x	x	x	
Fuel type and HP	x	x	x	
Other propulsion			x	
Average Fuel Consumption				
running	x	x	x	
harvesting	x	x		
processing		x	x	
harvesting & processing		x		
Hold capacity	x	x	x	x
Percent RSW	x	x		
Freezer/cold storage capacity		x	x	x
Characteristics of average trip				
Transit time in ave. trip	x	x		
Fishing days in ave. trip	x	x		
No. of hauls/day in ave. trip	x	x		
length of time gear is down	x	x		
No. of hooks/pots per set	x	x		
Ave. codend size	x	x		

GROUNDFISH INDUSTRY SURVEY

	Catchers	Ca./Proc.	Floaters	Shoreside
Delivery time in ave. trip	x			
Marine mammal encounters in ave. trip	x	x		
No. of trips per year	x			
Max distance to shoreside delivery	x			
Deliveries received in ave. month			x	x
Delivering vessels in ave. month			x	x
Ownership interests in catcher boats			x	x
Weight of catch/deliveries: 1/89 - 6/90		x	x	x
Value of catch/deliveries: 1/89 - 6/90		x	x	x
PART TWO: OPERATING CHARACTERISTICS				
Operating Characteristics by month 1/89-6/90:				
Number of operating days	x	x	x	x
Target species	x	x	x	x
Crew size	x	x	x	x
Shifts or watches /day	x	x	x	x
Watch length	x	x	x	x
Gear used	x	x		
Full time crew size	x	x	x	x
Target area	x	x		
Weight of discards by species	x	x	x	x
Foreign Interests				
Foreign capital, mgmt, ownership?	x	x	x	x
Foreign loans?	x	x	x	x
Percentage of debt	x	x	x	x
Nationality of debt	x	x	x	x
Foriegn ownership/investment?	x	x	x	x
Percentage interest	x	x	x	x
Nationality of owners	x	x	x	x
Active foreign management?	x	x	x	x
Long term buying arrangemt?		x	x	x
Labor Supply				
Areas from which workers come	x	x	x	x
Difficulty in securing workers?	x	x	x	x
From Alaska?		x	x	x
Comment on labor supply	x	x	x	x

GROUNDFISH INDUSTRY SURVEY

	Catchers	Ca./Proc.	Floaters	Shoreside
Product Recovery Rates by product form, area (GOA, BSAI); 1/89 - 6/90				
P.R.R. for pollock		x	x	x
P.R.R. for cod		x	x	x
P.R.R for Flatfish		x	x	x
P.R.R. for rockfish		x	x	x
Note: There are 180 possible entries per species, a total of 720.				
Processing configuration by month: 1/89-8/90				
Line setup		x	x	x
Species throughput/hour		x	x	x
Rated capacity		x	x	x
Meal production		x	x	x
Processing Employees (#)		x		
Processing Employees (FTE)		x		
PART THREE: FIXED ANNUAL COSTS				
Legal fees	x	x	x	x
Association fees	x	x	x	x
Admin/office expenses	x	x	x	x
Marketing		x	x	x
Quality control		x	x	x
Debt service on vessel/plant	x	x	x	x
Debt service on gear	x			
Debt service on equipment	x	x	x	x
Debt service on operating funds	x	x	x	x
P & I insurance	x	x	x	x
Hull insurance	x	x	x	x
Scheduled maintenance	x	x	x	x
Moorage	x	x	x	
Taxes: B & O	x	x	x	x
Taxes: Property	x	x	x	x
Taxes: Income	x	x	x	x
Taxes: Other	x	x	x	x
Utilities: water				x
Utilities: electricity				x
Utilities: waste disposal				x
Utilities: sewer				x
Other fixed costs	x	x	x	x

GROUNDFISH INDUSTRY SURVEY

	Catchers	Ca./Proc.	Floaters	Shoreside
PART FOUR: VARIABLE MONTHLY COSTS				
Cost of raw pollock by area (189-6/90)			x	x
Cost of raw cod by area (189-6/90)			x	x
Cost of raw flatfish by area (189-6/90)			x	x
Cost of raw rockfish by area (189-6/90)			x	x
Monthly expenditures from 1/89 - 6/90 by area and species.				
harvesting Labor (* by month only)	x*	x		
processing Labor		x	x	x
Packaging material		x	x	x
Storage/shipping-freight		x	x	x
Variable expenditures by month; 1/89 - 6/89				
nonprocessing labor			x	
labor transportation	x	x	x	x
labor room/board				x
groceries/supplies	x	x	x	
fuel/lubricants	x	x	x	x
gear repair/replacement	x	x	x	x
ice	x			
fish tax	x	x	x	x
bait	x	x		
surimi additives		x	x	x
other	x	x	x	x
PART FIVE: PRODUCT PRICE DATA				
Px at first sale by product form, area, & month (1/89-6/90) (720 entries)				
pollock		x	x	x
cod		x	x	x
flatfish		x	x	x
rockfish		x	x	x
Amount & value by market, form, & area		x	x	x
% of annual var. costs spent in AK.	x	x	x	x
Outside Alaska	x	x	x	x
Methods of paying crews		x	x	x
Capitalized value of operation:				
for all fisheries	x	x	x	x
only groundfish	x	x	x	x

1990 Status of Eastern Bering Sea Crab Stocks

by

B. G. Stevens and R. A. MacIntosh

Kodiak Island Laboratory
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
P. O. Box 1638
Kodiak, Alaska 99615

September 1990

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER:
B. G. Stevens and R. A. MacIntosh. 1990. 1990 Status of Eastern Bering Sea Crab Stocks. Unpubl. rep., 19 p. Alaska Fisheries Science Center, Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE, Seattle, WA 98115-0070.

EXECUTIVE SUMMARY

The following is a summary of conclusions presented in this report. All figures given are estimated total numbers of crabs, plus or minus 95% confidence intervals. Estimates for 1989 and 1990 were compared by t-test; values of t greater than 2.0 were considered significant. Some changes which appear large may not be statistically significant due to large variance in the data. See text for descriptions of size ranges.

Red king crab (*Paralithodes camtschatica*) All Districts combined.

Legal males:	9.4 million ± 28%; Non-significant decrease of 22%.
Pre-recruits:	No significant change.
Large females:	No significant change.
Outlook:	Populations below average and stable. Landings increasing in 1990 due to new management scheme.

Pribilof Islands blue king crab (*P. platypus*) Pribilof District.

Legal males:	409,000 ± 69%; Non-significant increase of 80%.
Pre-recruits:	Significant increase of 1200%.
Large females:	Non-significant increase of 108%.
Outlook:	Population low but may be increasing; trends not detectable. Fishery closed for 1990.

St. Matthew blue king crab (*P. platypus*) Northern District.

Legal males:	1.66 million ± 49%; Non-significant increase of 12%.
Pre-recruits:	No significant change.
Large females:	Significant decrease of 88%.
Outlook:	Population appears average and stable. Landings average.

Tanner crab (*Chionoecetes bairdi*) Eastern District.

Legal males:	45.2 million ± 36%; Non-significant increase of 34%.
Pre-recruits:	Non-significant decrease of 22%.
Large females:	Non-significant increase of 53%.
Outlook:	Population high and may be leveling off. Fishery increasing due to growth of pre-recruits into legal categories.

Tanner crab (*C. opilio*) All Districts combined.

Large males:	420.3 million ± 19%; Significant increase of 125%.
Pre-recruits:	Non-significant increase of 25%.
Large females:	Non-significant decrease of 27%.
Outlook:	Overall population high and stable with large recruitment of pre-recruits into large sizes. Fishery improving dramatically in near term.

Hair crab (*Erimacrus isenbeckii*)

Large males:	0.6 million ± 58%; Non-significant increase of 40%.
Pre-recruits:	Non-significant increase of 26%.
Large females:	Non-significant increase of 84%.
Outlook:	Population above average and improving due to recent recruitment. Fishery nonexistent.

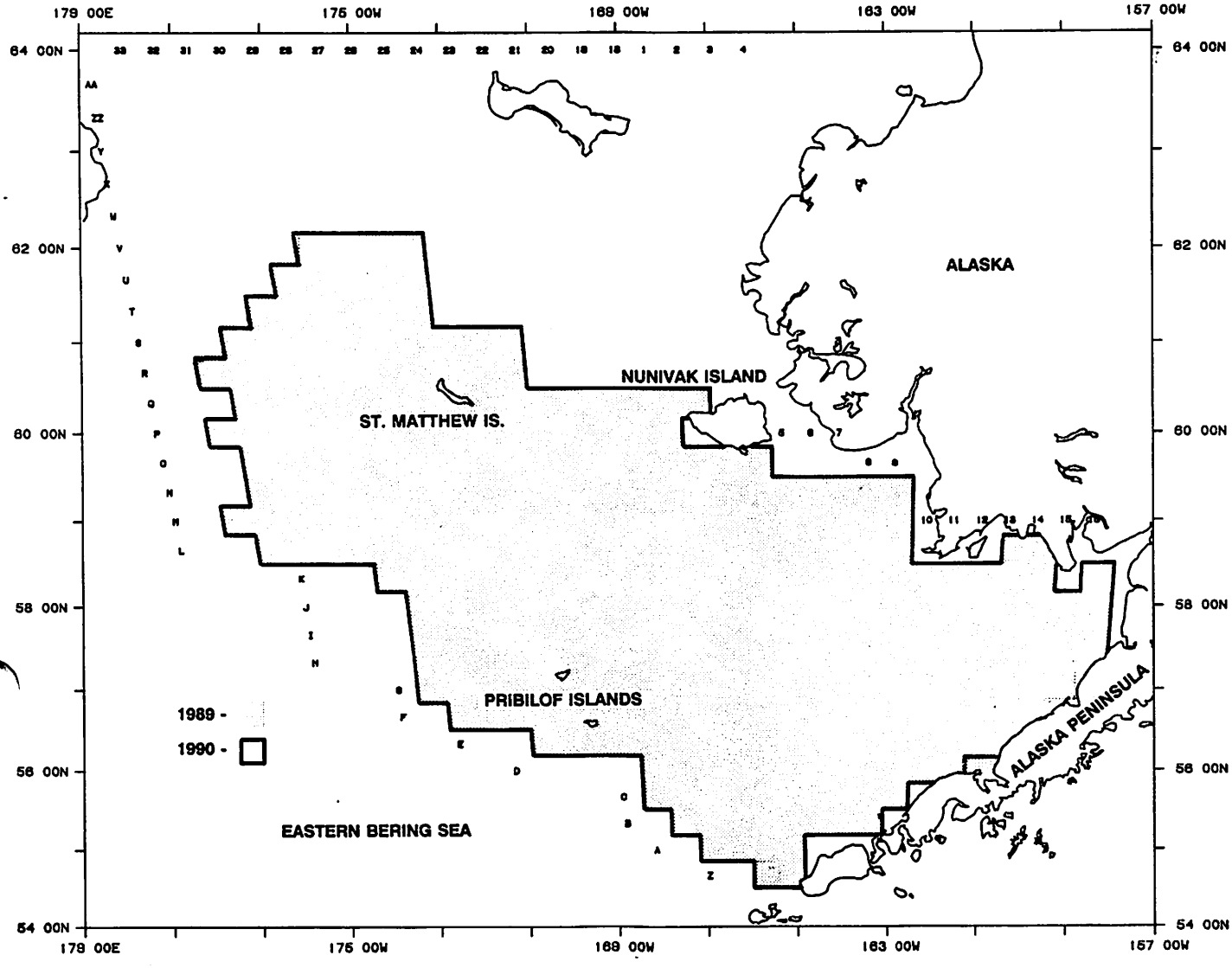


FIGURE 1. NMFS eastern Bering Sea crab survey area in 1989 and 1990.

Distribution and Abundance of King Crab Stocks

Red King Crab

The estimated abundance of legal (≥6.5 in cw, ≥135 mm cl) male red king crabs in the Bristol Bay District (south of 58°39'N lat. and east of 168°W long.) and the Pribilof District (south of 58°39'N lat. and west of 168°W long.) was 9.2 million crabs which represents a non-significant[1] decrease of 22% from last year (Table 1). Pre-recruit (110-134 mm cl) and juvenile (<110 mm cl) crab showed no significant change. There has been little recruitment of juveniles to this population in several years (Fig. 2).

In 1990 we found less than 0.1% of male crabs in molting or soft-shell condition (vs 1.3% last year). Among legal-sized crab, 44.2% were oldshell, skipmolt crabs (vs 51.5% last year). Molting of male crabs appears to have been completed prior to the survey.

The estimated abundance of large[2] (≥90 mm cl) females in the Bristol Bay and Pribilof Districts showed no significant change from last year and now stands at 17.5 million crabs. The estimated abundance of small females showed a non-significant increase of 62%. In June, 14.7% of all females were still molting or soft-shell (vs 41.7% last year), including 19.7% of large females. Among large females, the

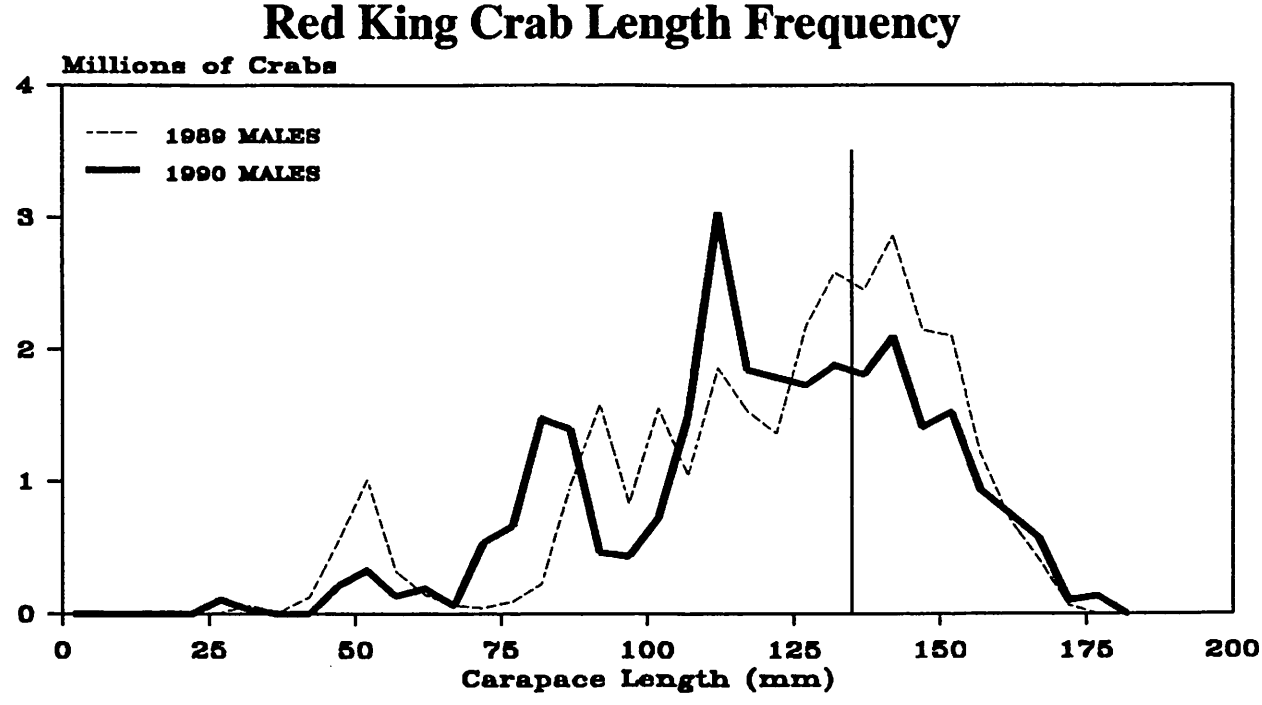


FIGURE 2. Estimates of abundance for male red king crab (P. camtschatica) by 5 mm length classes, 1989-1990. Vertical line indicates lower limit of legal size.

1. "Significant" is a statistical term implying that the difference between two abundance estimates has a 95% chance or more of being real, rather than simply the result of chance. Generally, stocks or portions which are less abundant or occur at fewer locations such as blue king crab or hair crab, have greater variance, so large differences may appear to be non-significant. Comparisons were made via a two-sample unpaired 't'-test, and values of t greater than 2.0 were considered significant.

2. Throughout this report, the term "large females" refers to those females larger than the median size at maturity, i. e., the size at which 50% are mature. A small number of females above this size may actually be immature, but the majority are mature crabs which should contribute to reproduction of the population.

Table 1. Annual abundance estimates (millions of crabs) for red king crab (P. camtschatica) in Bristol Bay and the Pribilof District from NMFS surveys.

	Males				Females			Grand
Size[1](mm)	<110	110-134	≥135	Total	<90	≥90	Total	Total
Width(in)	<5.2	5.2-6.5	≥6.5		<3.5	≥3.5		
1969	41.0	20.3	9.8	71.1	18.3	28.5	46.8	117.9
1970	9.5	8.4	5.3	23.2	4.9	13.0	17.9	41.1
1972[2]	14.1	8.0	5.4	27.5	7.0	12.1	19.1	46.6
1973[3]	50.0	25.9	10.8	86.7	24.8	76.8	101.6	188.3
1974[3]	59.0	31.2	20.9	111.1	37.7	72.0	109.7	220.8
1975	84.9	31.7	21.0	137.6	70.8	58.9	129.7	267.3
1976	70.2	49.3	32.7	152.2	35.9	71.8	107.7	259.9
1977	80.2	63.9	37.6	181.7	33.5	150.1	183.6	365.3
1978	62.9	47.9	46.6	157.4	38.2	128.4	166.6	324.0
1979	48.1	37.2	43.9	129.2	45.1	110.9	156.0	285.2
1980	56.8	23.9	36.1	116.8	44.8	67.6	112.5	229.3
1981	56.6	18.4	11.3	86.3	36.3	67.3	103.6	189.9
1982	107.2	17.4	4.7	129.3	77.2	54.8	132.0	261.3
1983	43.3	10.4	1.5	55.2	24.3	9.7	34.0	89.2
1984	81.8	12.6	3.1	97.6	57.6	17.6	75.1	172.7
1985	13.7	10.1	2.5	26.3	6.9	6.8	13.7	39.9
1986	11.8	12.3	5.9	30.1	4.5	5.4	9.8	39.9
1987	20.1	12.6	7.9	40.6	16.8	18.3	35.1	75.7
1988	8.5	6.4	6.4	21.3	2.7	15.7	18.4	39.7
1989	8.6	9.4	11.9	29.9	4.4	16.9	21.2	51.1
1990	8.2	10.2	9.2	27.6	7.2	17.5	24.7	52.2
Limits[4]								
Lower	4.1	4.9	6.5	18.5	0.0	6.0	8.6	27.1
Upper	12.3	15.4	11.9	36.7	14.9	29.1	40.7	77.4
±%	50	52	29	33	108	66	65	48

1 Carapace length (mm).
2 Limited survey in 1971, not used for population estimate.
3 1973 and 1974 estimates considered unreliable.
4 Mean ± 2 standard errors for most recent year.

proportion which had molted and extruded new, uneyed eggs was 97.2% compared to 51.1% in June, 1989, and 94% in 1988. Fluctuations in the timing of molting, mating, and embryo extrusion may be related to annual variations in water temperature, particularly following the unusually cold winter of 1989.

The Bristol Bay fishery will open on November 1, 1990 with a guideline harvest of 17.1 million pounds relative to an estimated stock of 55.1 ± 16.0 million pounds. The target exploitation rate was set at 31% of the legal male biomass, as determined according to Board of Fisheries policy. In 1989, 10.3 million lbs were landed, with a CPUE of 8 crabs/pot-lift (Fig. 3)[3].

3. Alaska Dept. Fish and Game, 1990. Westward Region shellfish report to the Alaska Board of Fisheries. ADF&G, Div. of Commercial Fisheries, Westward Regional Office, 211 Mission Rd., Kodiak, AK 99615, 295 p.

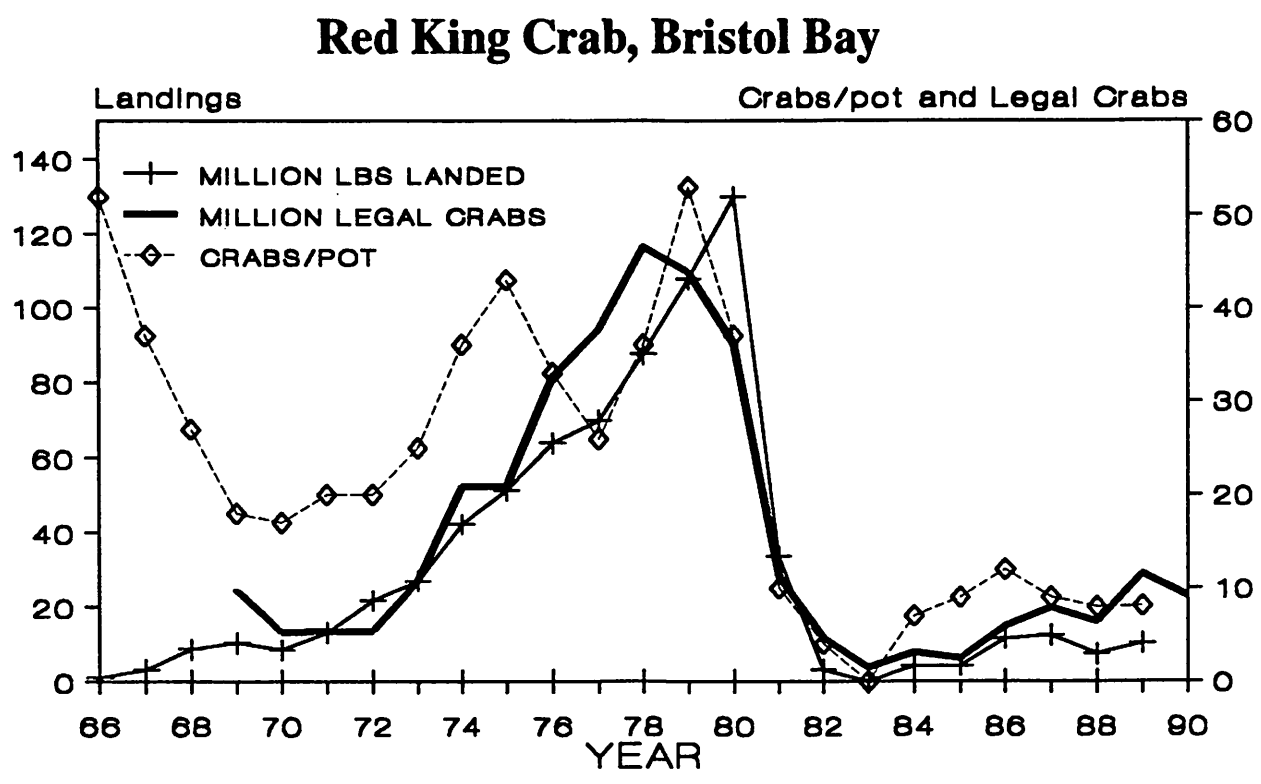


FIGURE 3. U. S. landings in millions of lbs, catch-per-unit-of-effort as crabs/pot, and the abundance of legal red king crabs (P. camtschatica) in millions in Bristol Bay, estimated from the NMFS trawl surveys.

Pribilof Islands Blue King Crab (*P. platypus*)

The estimated abundance of legal (≥6.5 in, or ≥135 mm cl) males was 409,000 crabs (Table 2), a non-significant increase of 80% from last year. The number of pre-recruits increased by 1200% and is now higher than it has been since 1982. The abundance of juveniles (<110 mm cl), however, showed a non-significant decline of 43%. Size-frequency data (Fig. 4) indicate that recruitment of juveniles to larger size groups has improved, continuing a trend started in 1988. This population is still depressed (Fig. 5), and the fishery will not be opened in 1990. Among legal males, 36.4% were in new, hardshell condition, and the remainder (63.6%) were oldshells.

The estimated abundance of large (≥90 mm cl) females showed a non-significant increase of 108% from last years level. Historically, estimates of female abundance have been imprecise due to the preference of females for rocky habitat which is not sampled well by trawls. Among large females, 85.3% were new hardshells, and 14.7% oldshells. Blue king crab are predominantly biennial spawners. Only a portion of the female population spawns in a given year, while the remainder is in the non-embryo-bearing phase. Among mature females 79.4% carried new, uneyed embryos and 20.6% carried empty embryo cases. No males or females were in molting or soft-shell condition indicating that molting was completed for 1990.

Table 2. Annual abundance estimates (millions of crabs) for blue king crab (P. platypus) in the Pribilof District from NMFS surveys.

	Pribilof District							
	Males				Females			
Size[1](mm) Width(in)	<110 <5.2	110-134 5.2-6.5	≥135 ≥6.5	Total	<90 <3.5	≥90 ≥3.5	Total	Grand Total
1974	4.4	3.1	1.9	9.4	0.6	10.9	11.5	20.9
1975	4.1	8.0	7.5	19.6	0.0	8.8	8.8	28.4
1976	10.3	2.1	3.9	16.3	0.4	17.7	18.1	34.4
1977	3.2	2.2	9.4	14.8	2.2	17.5	19.7	34.5
1978	1.2	5.8	4.3	11.3	0.3	35.5	35.8	47.1
1979	6.4	1.5	4.6	12.5	5.2	2.9	8.1	20.6
1980	1.9	1.4	4.2	7.5	0.8	101.9	102.7[3]	110.2
1981	4.8	1.4	4.2	10.4	3.4	11.6	15.0	25.4
1982	1.2	0.7	2.2	4.1	0.7	8.6	9.3	13.4
1983	0.6	0.8	1.3	2.8	0.2	9.2	9.4	12.2
1984	0.5	0.3	0.6	1.3	0.3	3.1	3.4	4.8
1985	0.06	0.16	0.32	0.54	0.18	0.52	0.70	1.24
1986	0.02	0.02	0.43	0.47	0.04	1.86	1.90	2.37
1987	0.57	0.08	0.73	1.38	0.39	0.58	0.97	2.35
1988	1.10	0.0	0.20	1.29	0.77	0.43	1.20	2.49
1989	3.21	0.10	0.22	3.54	2.29	1.28	3.57	7.11
1990	1.84	1.24	0.41	3.48	1.82	2.66	4.48	7.96
Limits[2]								
Lower	0.28	0.11	0.13	0.87	0.00	0.45	0.76	1.6
Upper	3.39	2.36	0.69	6.09	3.80	4.87	8.20	14.3
±%	85	91	69	75	109	83	83	80

1 Carapace length (mm).
2 Mean ± 2 standard errors for most recent year.
3 Female estimates considered unreliable in 1980.

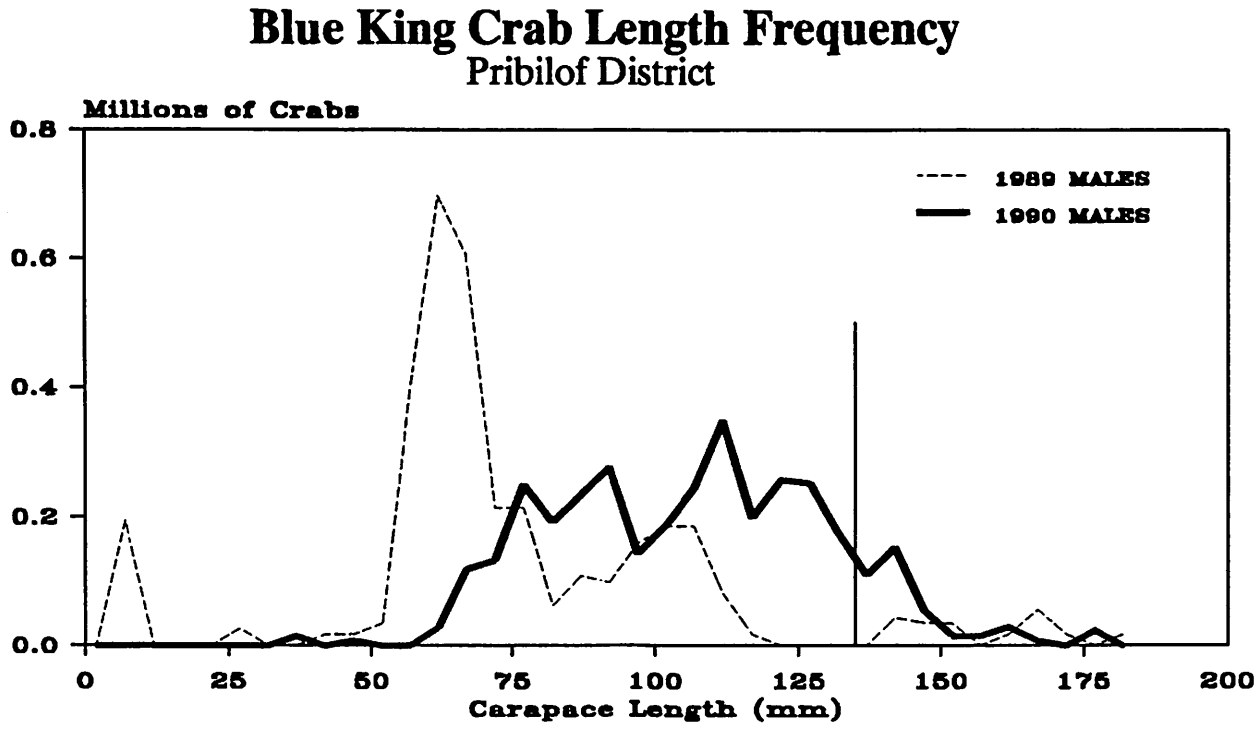


FIGURE 4. Estimates of abundance for Pribilof District male blue king crab (P. platypus) by 5 mm length classes, 1989-1990. Vertical line indicates lower limt of legal size.

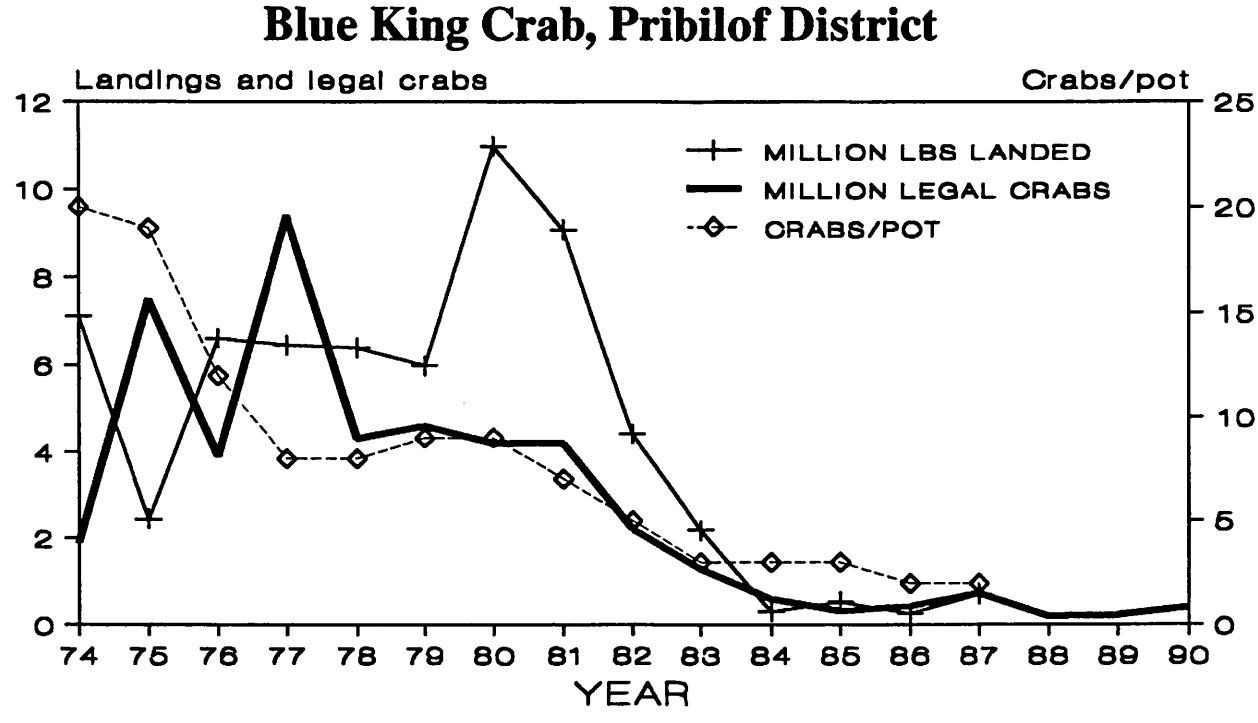


FIGURE 5. U. S. landings in millions of lbs, catch-per-unit-of-effort (CPUE) as abundance of legal blue king crabs (P. platypus) in millions in the Pribilof District, estimated from the NMFS trawl surveys.

St. Matthew Island Blue King Crab
(P. platypus)

The estimated abundance of legal (≥5.5 in cw, or ≥120 mm cl) crabs was 1.66 million crabs (Table 3), a non-significant increase of 12% from last year. The abundance of pre-recruits showed a non-significant decline of 22%. The abundance of juvenile males showed a large and unexplainable decrease, but estimates for this size group are typically imprecise. Size-frequency data (Fig. 6) show that what appeared to be improving recruitment in 1989 may have been an artifact. The abundance of large females (≥80 mm cl) showed a significant decrease of 88% but estimates of female abundance are usually imprecise, probably due to habitat preference, as explained above. Among legal males, 7.4% were molting or softshell, 83.2% were new hardshells, and 9.5% oldshells. For large females, these figures were 27%, 64% and 9%, respectively. Of the two mature females caught, one was carrying new uneyed embryos and the other was in the process of hatching eyed embryos.

The 1990 fishery opened on September 1 with a guideline harvest of 1.9 million lbs out of an estimated stock of 6.8 million lbs. Preliminary ADF&G statistics for the 1990 fishery indicate that 31 vessels landed 1.7 million lbs, with CPUE of 15 crabs/pot-lift (Fig. 7) (Ken Griffin, ADF&G, P.O. Box 308, Dutch Harbor, AK 99692, pers. commun., September 1990). The target exploitation rate was 29% (by weight). In comparison, during 1989, 69 vessels landed 1.2 million pounds or 248,000 crabs for an estimated exploitation rate of 20% and an average CPUE of 8 crabs per pot-lift[3].

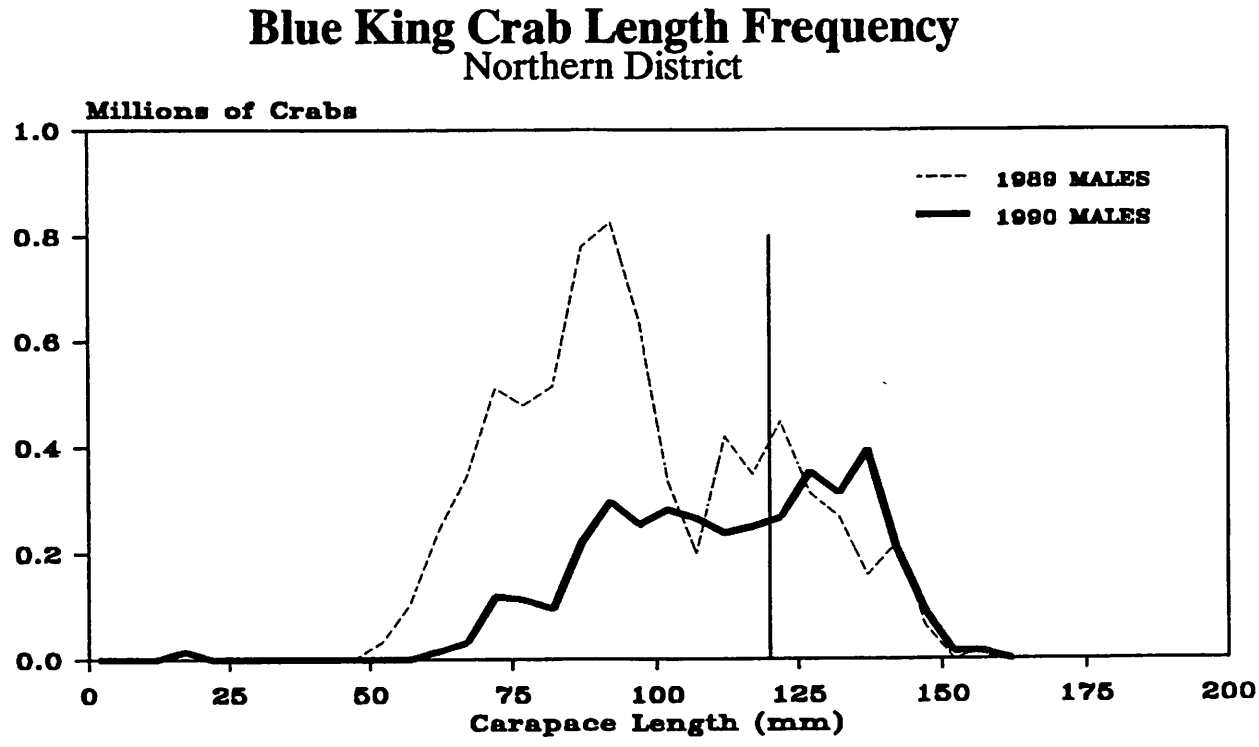


FIGURE 6. Estimates of abundance for St. Matthew Island (Northern District) male blue king crab (P. platypus) by 5 mm length classes, 1989-1990. Vertical line indicates lower limit of legal size.

Table 3. Annual abundance estimates (millions of crabs) for blue king crab (*P. platypus*) in the Northern District from NMFS surveys.

Northern District

	Males				Females			Grand
Size[1](mm)	<105	105-119	≥120	Total	<80	≥80	Total	Total
Width(in)	<4.3	4.3-5.5	≥5.5		<3.2	≥3.2		
1978	5.6	2.4	1.8	9.8	0.8	0.4	1.2	11.0
1979	4.9	2.3	2.2	9.4	1.7	0.9	2.6	12.0
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	0.0	0.5	0.5	6.8
1982	3.2	2.6	6.8	12.5	0.4	0.7	1.1	13.7
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	0.46	0.35	1.08	1.89	0.08	0.13	0.21	2.10
1986	0.56	0.40	0.38	1.34	0.25	0.06	0.31	1.65
1987	1.07	0.73	0.74	2.53	0.46	0.22	0.68	3.21
1988	1.44	0.65	0.83	2.92	0.90	0.79	1.70	4.62
1989	4.80	0.97	1.48	7.25	1.58	1.68	3.27	10.52
1990	1.44	0.75	1.66	3.85	0.45	0.20	0.65	4.50
Limits[2]								
Lower	0.14	0.21	0.85	1.69	0.04	0.00	0.05	1.75
Upper	2.74	1.29	2.47	6.01	0.86	0.42	1.24	7.25
±%	90	72	49	56	91	114	92	61

1 Carapace length (mm), categories reflect smaller average size in the Northern District; 80 mm is the median size at maturity for females.

2 Mean ± 2 standard errors for most recent year.

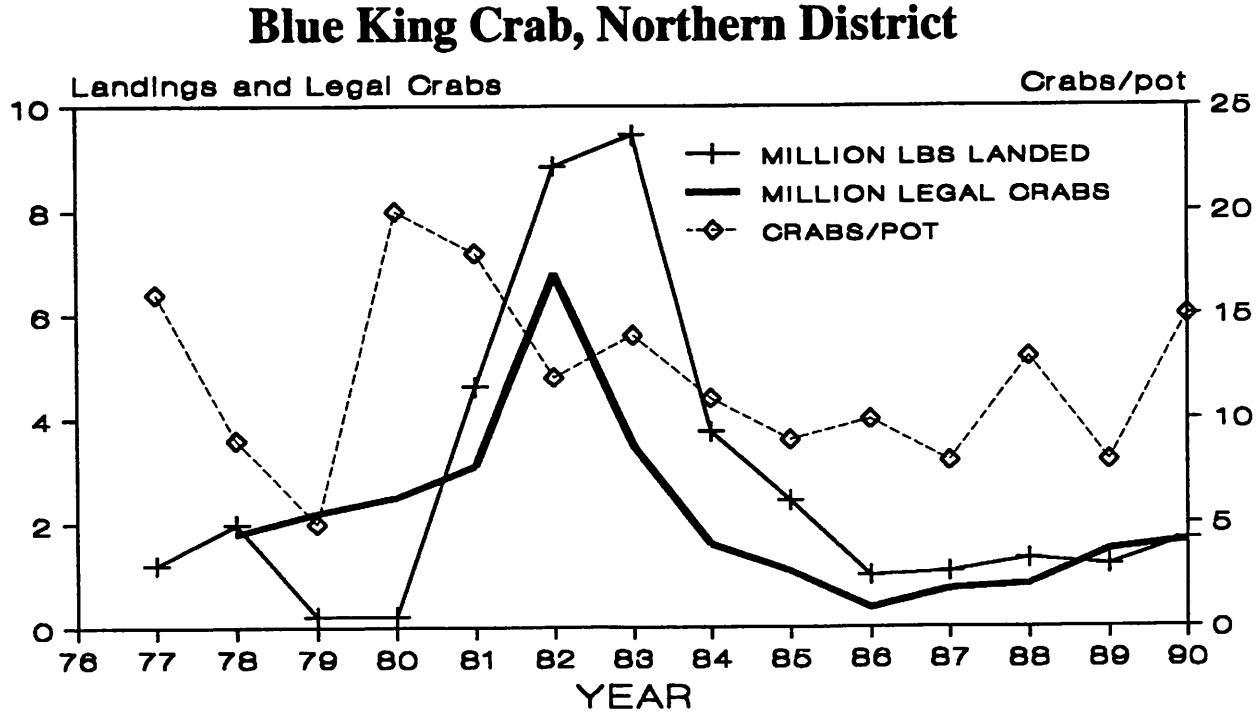


FIGURE 7. U.S. landings in millions of lbs, catch-per-unit-effort (CPUE) as crabs/pot, and the abundance of legal blue king crabs (P. platypus) in millions in the Northern District, estimated from the NMFS trawl surveys.

Distribution and Abundance of Tanner Crabs

C. bairdi

Although the legal minimum size of 5.5 in cw is equivalent to 140 mm cw, legal crabs are defined in this report as ≥138 mm cw because of the difference between scientific measure (between spines) and commercial measure (spine tip to spine tip). The data included in Table 4, however, show large crabs as males ≥135 mm, because this is closer to the lower limit of sizes landed, and has been used for a long-term index since 1976.

The estimated abundance of legal (≥138 mm cw) male *C. bairdi* in the Eastern District is 45.2 million crabs (with 53.7 million ≥135 mm cw; Table 4). About 78% of the legal crab were located east of 166°W long. The Eastern District (east of 173°W long.) includes 99.7% of large males, (prior to 1989, all estimates were for the combined Bristol Bay and Pribilof Districts, which included 98.4% of large males in 1988). The estimated total abundance of legal crabs increased by 34% from last year. This group has increased each year since 1986. This years increase is not as great as the previous three and may indicate that this population is nearing peak abundance and is leveling off. The estimated abundance of pre-recruits (110-134 mm cw) showed a non-significant decrease of 22%, and the estimate of small males (<110 mm cw) showed a similar decrease. The past 3 years have been characterized by substantial recruitment of small males and growth of those into pre-recruit and legal sizes. A relatively small proportion (6%) of legal males were molting or softshell, whereas new hardshells comprised 83%, and oldshells were 11%.

The abundance of large (≥85 mm cw) females (all Districts) showed a non-significant increase of 53%, but the abundance of small (<85 mm) females showed a non-significant decline of 27% from last year. Only 29% of large females were new hardshells, whereas 70% were oldshells, and <1% molting or softshell. This is additional evidence that recruitment is slowing as this population nears

Table 4. Annual abundance estimates (millions of crabs) for Tanner crabs (C. bairdi) from NMFS surveys. Data for 1989-present for Eastern District; all prior data for Bristol Bay and the Pribilof Districts.

	Males				Females			Grand
Size[1](mm) Width(in)	<110 <4.3	110-134 4.3-5.3	≥135 ≥5.3	Total	<85 <3.4	≥85 ≥3.4	Total	Total
1976	180.2	136.6	109.5	426.3	174.7	220.4	395.1	821.4
1977	255.0	116.3	92.1	463.4	328.4	215.8	544.2	1,007.6
1978	124.2	81.2	45.6	251.0	116.1	73.3	189.4	440.4
1979	133.1	47.7	31.5	212.3	122.6	42.1	164.7	377.0
1980	453.3	65.0	31.0	549.3	326.9	106.8	433.7	983.0
1981	303.8	24.0	14.0	341.8	324.2	79.1	403.3	745.1
1982	88.8	46.9	10.1	145.8	126.4	83.6	210.0	355.8
1983	146.3	32.0	6.7	185.0	180.1	45.4	225.5	410.5
1984	85.1	21.2	5.8	112.1	107.0	33.4	140.4	252.5
1985	31.1	9.4	4.4	44.9	24.2	15.6	39.8	84.7
1986	110.4	12.9	3.1	126.4	68.2	13.7	81.9	208.3
1987	230.1	19.7	8.3	258.0	193.3	35.5	228.8	486.8
1988	287.3	59.7	17.4	364.4	184.8	81.0	265.8	630.2
1989	403.0	102.1	42.3	547.5	338.6	63.8	402.4	949.9
1990	286.1	78.8	53.7	418.6	266.5	97.4	363.9	782.5
Limits[2]								
Lower	208.9	61.5	35.5	334.9	175.9	51.6	251.1	586.0
Upper	363.3	96.1	72.0	502.3	357.1	143.2	476.7	979.1
± %	27	22	34	20	34	47	31	25

1 Carapace width (mm).
2 Mean ± 2 standard errors for most recent year.

peak abundance. Over 96% of large females were ovigerous, and 99% of those were carrying new, uneyed embryos, showing that the period of larval hatching and embryo extrusion was completed by the time of the survey.

In 1990 about 24.5 million pounds were harvested[3] by 79 vessels, with average CPUE of 15 crabs/pot-lift (Fig. 9)(Ken Griffin, ADF&G, P.O. Box 308, Dutch Harbor, AK 99692, pers. commun., September 1990). Current estimates show that the population of legal males is increasing and is currently estimated at 107.3 ± 38.2 million lbs, 99.7% of which is located in the Eastern District. The harvest guideline for 1990-91 has been set at 42.8 million lbs, for an exploitation rate of 40%.

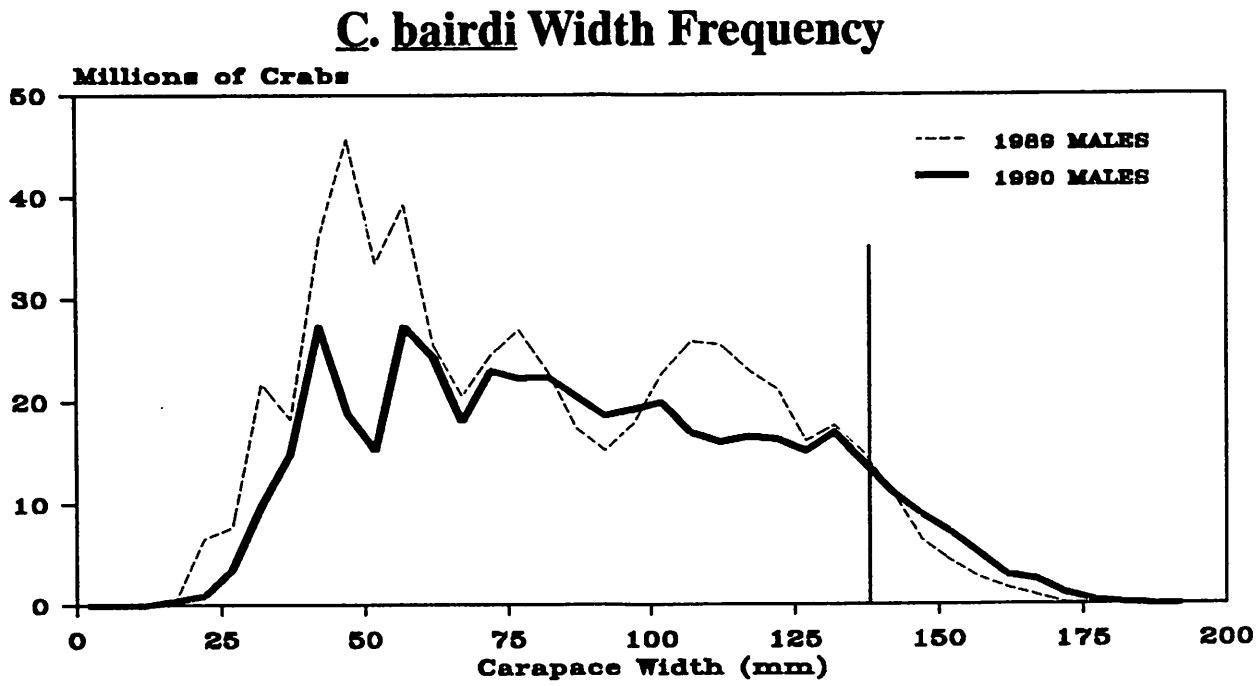


FIGURE 8. Estimates of abundance of male C. bairdi in Bristol Bay and the Pribilof District by 5 mm width classes, 1989-1990. Vertical line indicates lower limit of legal size.

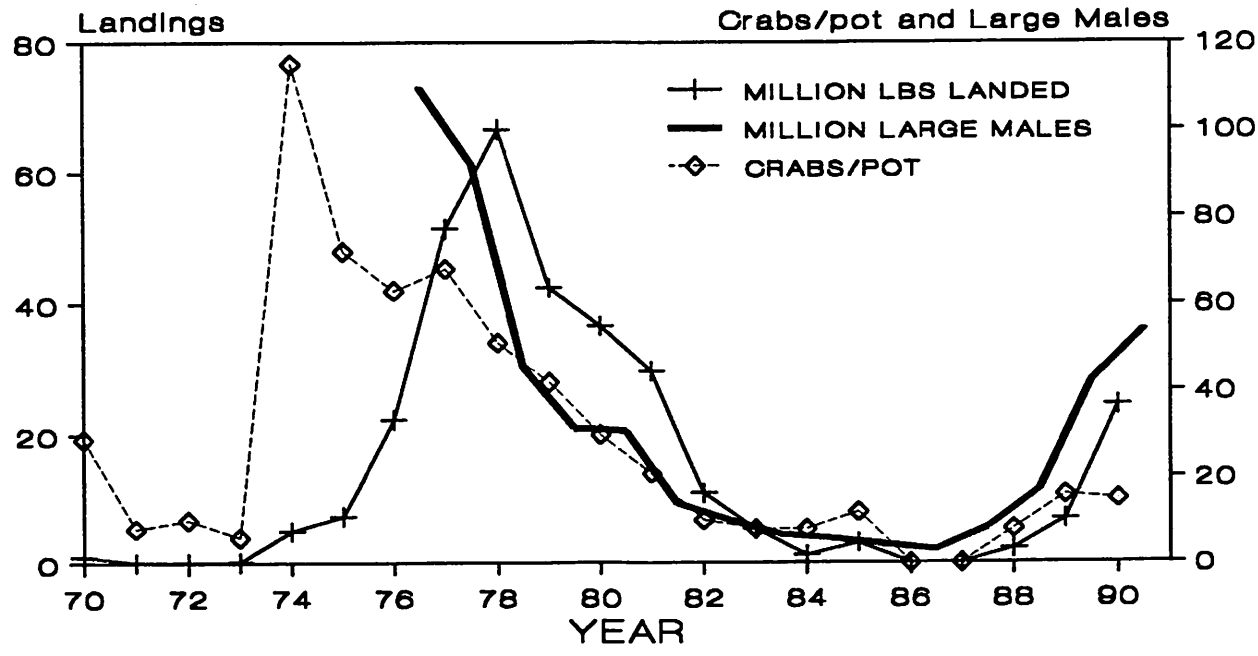


FIGURE 9. U.S. landings in millions of lbs, catch-per-unit-effort (CPUE) as crabs/pot, and the abundance of large male C. bairdi in millions in the Bristol Bay and Pribilof Districts (prior to 1989), or the Eastern District (after 1988), estimated from the NMFS trawl surveys.

C. opilio

Although the legal minimum size limit for *C. opilio* is 3.1 in cw (78 mm), processors currently prefer a minimum size of 4.0 inches (102 mm). Therefore, the size ranges for male *C. opilio* used in this report are defined as follows: sublegal, <3.1 in (<78 mm) cw; small, 3.1-4.0 in cw (78-101 mm); large, ≥4.0 in cw (≥102 mm); and very large ≥4.3 in cw (≥110 mm).

The estimated number of large (≥102 mm cw) males (Eastern and Western Districts combined) is 420.3 million crabs, a significant increase of 125% from last year (Table 5). Small males (78-101 mm cw) showed a non-significant increase of 25%, and very large males (≥110 mm cw) showed a significant increase of 132%. Sublegal males (<3.1 in cw) showed a significant decrease of 35%. Overall, total males showed no significant change from the previous level; increases in larger size groups are primarily due to growth of pre-recruit crab (Fig. 10). The estimated abundance of large female (≥50 mm cw) crabs showed a non-significant decrease of 27%, and small females showed a non-significant decrease of 24%. Major recruitment of postlarval crab occurred in the mid-1980's, and recruitment to the fishery has improved as juveniles matured. From 1989 to 1990 a large number of males grew about 20 mm, a larger than expected increment.

Among male crabs ≥100 mm cw, i.e. the exploited stock, in the Eastern District 9.2%, were in molting or softshell condition, 88% were newshells indicating a recent molt, and 3% were oldshells (these may have some scratch

Table 5. Annual abundance estimates (all Districts combined) for eastern Bering Sea Tanner crabs (C. opilio) from NMFS surveys (millions of crab).

	Males				Females			
Size[1](mm) Width(in)	<102 <3.7	≥102 ≥4.0	≥110 ≥4.3	Total	<50 <2.0	≥50 ≥2.0	Total	Grand Total
1982	*	*	21.7	2073.2	402.6	2255.8	2658.4	4731.7
1983	*	*	22.1	1858.1	673.1	1228.4	1912.6	3759.7
1984	1237.4	153.2	73.9	1390.7	610.5	581.7	1192.2	2582.9
1985	547.8	74.9	40.7	622.6	258.2	123.5	381.7	1004.3
1986	1179.0	83.1	45.9	1262.0	790.6	422.0	1212.5	2474.5
1987	4438.9	150.8	70.0	4589.8	2919.3	2929.3	5848.6	10438.4
1988	3467.2	171.0	90.1	3638.2	1235.3	2322.7	3556.0	7194.2
1989	3646.1	187.1	81.2	3833.1	1922.8	3790.7	5713.4	9546.5
1990	2860.4	420.3	188.7	3280.7	1463.3	2798.1	4261.4	7542.1
East(%)[2]	67.1	78.3	78.5	68.5	59.8	60.4	60.2	63.8
Limits[3]								
Lower	2202.5	340.4	152.9	2591.7	702.4	1762.8	2684.7	5276.4
Upper	3518.3	500.1	224.6	3969.6	2224.2	3833.4	5838.1	9807.7
±	23	19	19	21	52	37	37	30

1 Carapace width in mm.
2 Proportion of size group in Eastern District.
3 Mean ± 2 standard errors for most recent year.
* Estimates not available at present time.

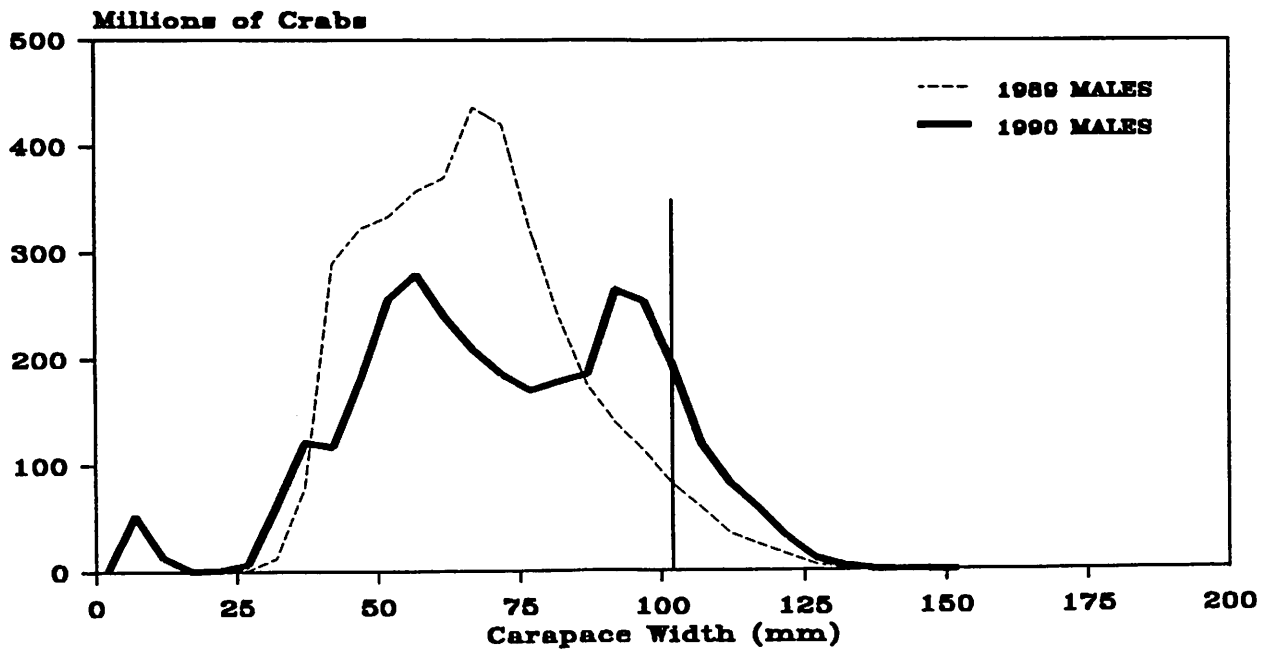


FIGURE 10. Estimates of abundance for male C. opilio, all Districts combined by 5 mm width classes, 1989-1990. Vertical line indicates minimum size preferred by industry.

marks and be slightly duller than newshells, but still fairly clean). Less than 0.1% were very oldshells (dark colored, often with wound marks and/or overgrown with barnacles and other organisms). In the Western District, 17.1% were molting or softshells, 67% were newshells, 12.8% were oldshells, and 2.8% were very oldshells.

Almost no females were molting or softshell, indicating that the female molting period was completed. Oldshells comprised 56% of large females in the Eastern District, and 80% in the Western District indicating that this population may be cresting also. Considering only large female crabs, about 77% carried new uneyed embryos (vs 84% last year) indicating that hatching and extrusion were close to completion by the time of the survey.

Preliminary 1990 ADF&G statistics[3] indicate that about 161.7 million lbs were landed (Fig. 11) by 178 vessels, with average catches of 135 crabs/pot (Ken Griffin, ADF&G, P.O. Box 308, Dutch Harbor, AK 99692, pers. commun., September 1990). Currently there are an estimated 543 (± 103) million pounds of large males (≥4.0 in cw) within the survey area of which about 78% by weight exist east of 173°W long. The harvest guideline for 1991 has been set at 315 million lbs for large crab, of which 167.3 million lbs are very large (≥4.3 in cw).

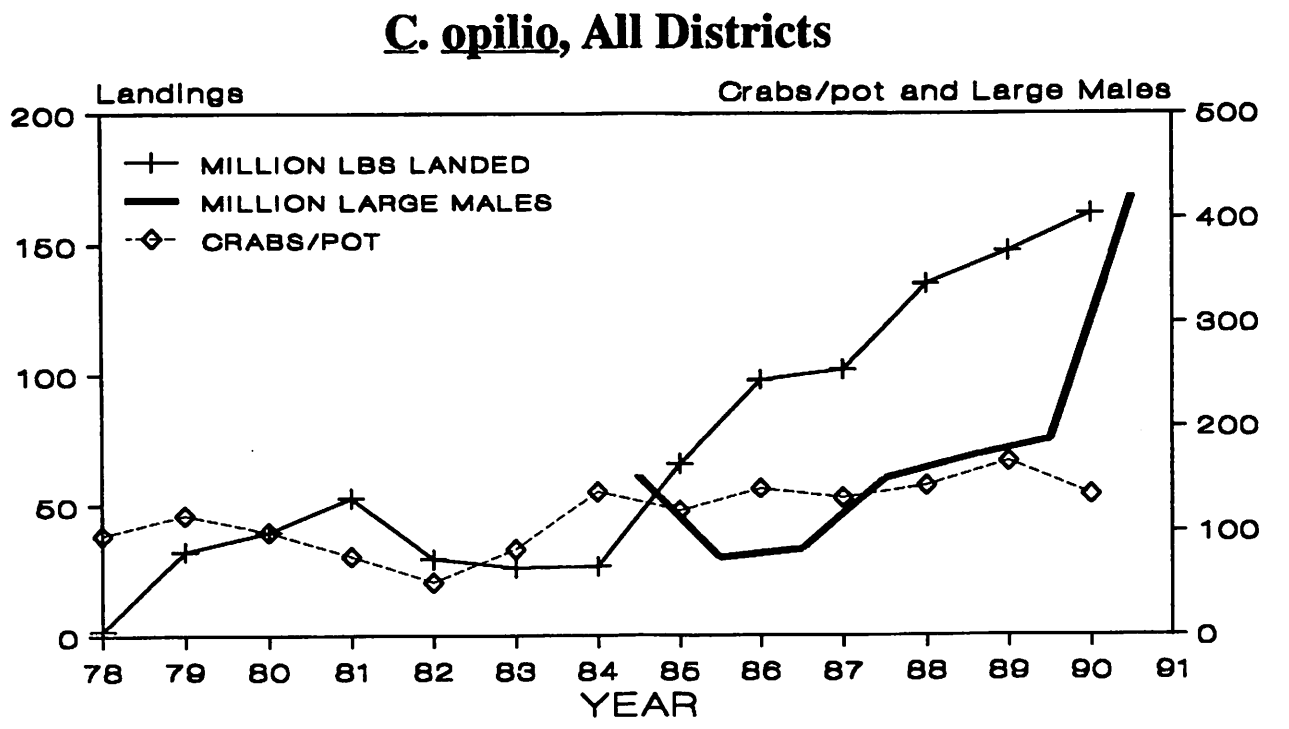


FIGURE 11. U.S. landings in millions of lbs, catch-per-unit-effort (CPUE) as crabs/pot, and the abundance of large male (≥102 mm cw) C. opilio in millions (all Districts combined), estimated from the NMFS trawl surveys.

Distribution and Abundance of Hair Crab

Because of their patchy distribution and low densities, estimates of abundance of hair crab are often imprecise. We have never found many female or small male crab during the survey and hence have little understanding of their distribution or abundance.

The estimated abundance of large male hair crabs has been declining since 1981 and has been very low since 1988 (Table 6). The current estimate of 553,000 shows a non-significant increase of 40% over the past year. The estimated abundance of small (<3.5 in cl) males shows a non-significant increase of 26% from last year, continuing a trend begun in 1987. The estimated abundance of total females shows a significant increase of 191% from last year, but this estimate is unreliable as indicated above. Size-frequency data (Fig. 12) show improved recruitment of small male crabs in the past 3 years, and may indicate future improvement in the fishable stocks. Shell conditions for hair crab are difficult to determine, and may not be very precise. The majority of males (92%) and females (88%) were new hardshell crabs.

Landings have been largely incidental to Tanner crabbing although there is occasionally some directed effort. No hair crab were landed in the last year (Ken Griffin, ADF&G, P.O. Box 308, Dutch Harbor, AK 99692, pers. commun., September 1990). Currently there are an estimated 1.1 million pounds (±58%) of large male crabs within the survey area. The fishery and markets have both been intermittent and probably will remain so in the near future. There are no guideline harvest levels, closed seasons or size limits for hair crab. CPUE has not been predictable due to low effort in recent years (Fig. 13).

Table 6. Annual abundance estimates (millions of crabs) for hair crabs (Erimacrus isenbeckii)from NMFS surveys. The size at entry to the U.S. fishery is approximately 90 mm (3.5 in) carapace length.

	Males			Females	Grand
Size[1] (mm)	<90	≥90	Total	Total	Total
Length(in)	<3.5	≥3.5			
1979	6.4	16.1	22.5	1.6	24.1
1980	6.0	13.7	19.7	3.1	22.8
1981	6.1	15.9	22.0	0.8	22.8
1982	1.4	7.7	9.1	0.4	9.5
1983	0.9	4.8	5.7	0.9	6.6
1984	1.1	2.9	4.0	0.4	4.4
1985	0.53	2.22	2.75	0.22	2.97
1986	0.71	1.46	2.17	0.37	2.54
1987	1.95	1.19	3.14	0.91	4.05
1988	3.98	0.55	4.52	0.85	5.37
1989	12.30	0.40	12.72	0.30	13.02
1990	15.58	0.55	16.14	0.87	17.00
Limits[2]					
Lower	0.00	0.23	0.00	0.35	0.35
Upper	33.3	0.87	33.89	1.38	35.27
±%	113	58	110	59	107

1 Carapace length (mm).
2 Mean ± 2 standard errors for most recent year.

Hair Crab, Erimacrus isenbeckii

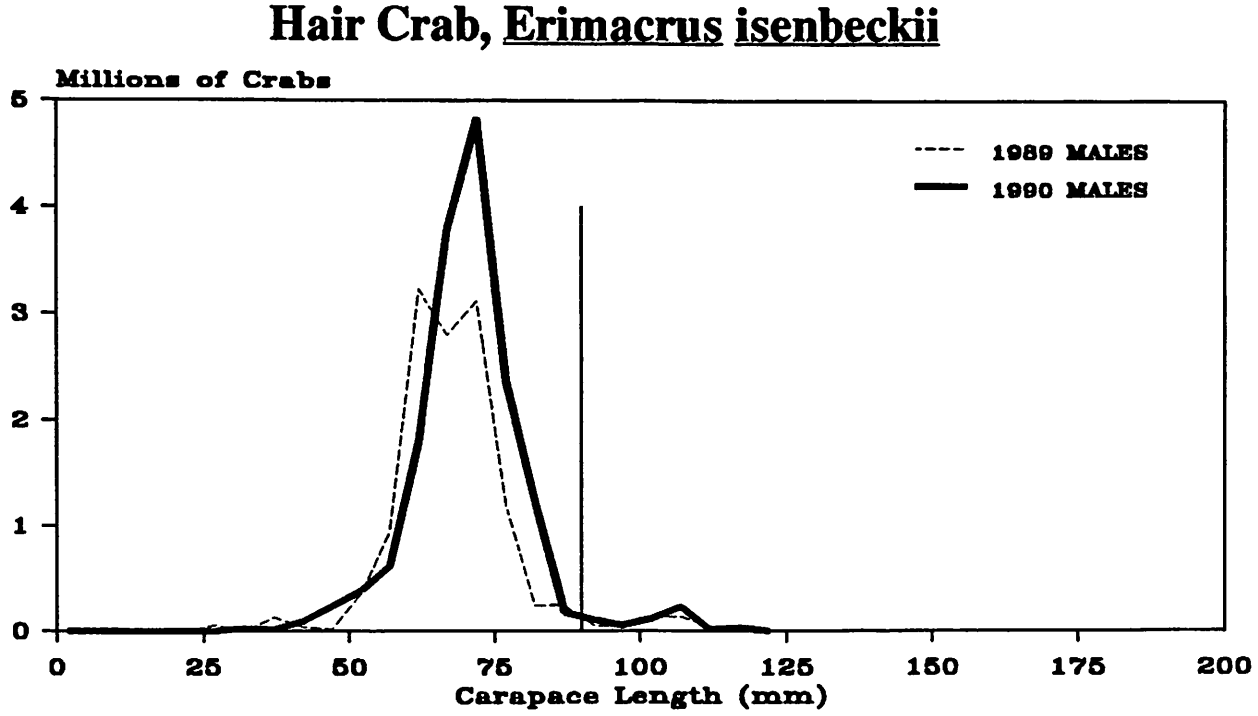


FIGURE 12. Estimates of abundance for male hair crab (E. isenbeckii) by 5 mm length classes, 1989-1990. Vertical line indicates lower limit of large size group.

Hair Crab, Erimacrus isenbeckii

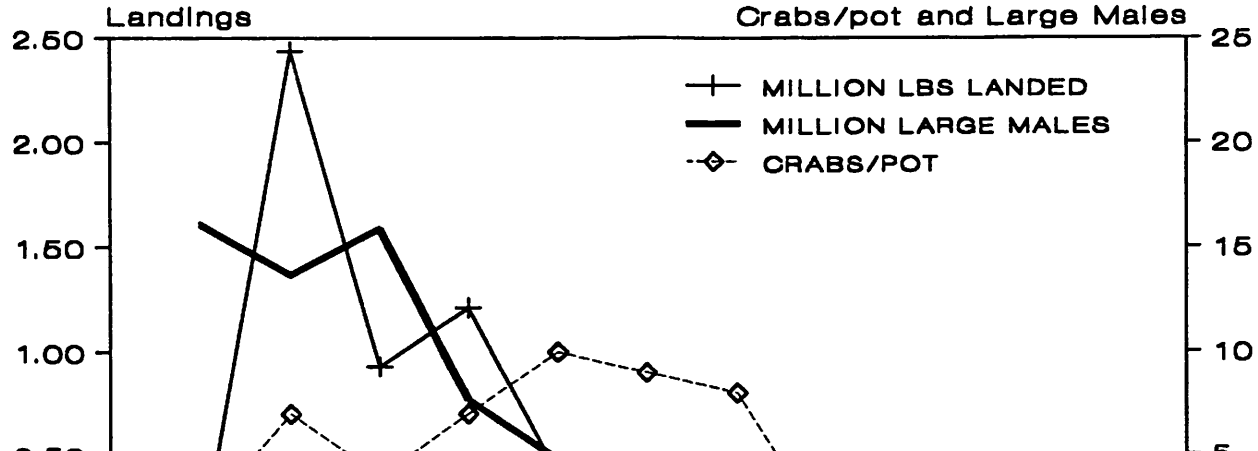


FIGURE 13. U.S. landings in millions of lbs, catch-per-unit-of-effort (CPUE) as crabs/pot, and the abundance of large male (≥90 mm cl) hair crab (E. isenbeckii) in millions (all Districts combined), estimated from NMFS trawl surveys.

Bottom Temperatures

The average bottom water temperature in 1990 was 2.2°C as compared to 3.0°C in 1989 and 2.2°C in 1988. The coldest waters were encountered around St. Matthew Island. The warmest waters were found in Kuskokwim Bay and inner Bristol Bay. Most year-to-year variation in temperature is associated with relatively shallow areas of the continental shelf and near shore. There is little year-to-year change in the Pribilof Islands and other shelf edge areas where temperatures are moderated by incursions of deep ocean water. The effect of water temperature on changes in the distribution and abundance of crabs in the eastern Bering Sea is poorly known.

As an index of mean temperature in the area most important to larval and juvenile red king crab growth, the average temperature has been determined from the June survey data for 37 stations along the Alaska Peninsula since 1971. This coastal temperature index for 1990 was 3.40°C (Fig. 14), which is equivalent to the 1971-1990 average.

Conclusions

In the early or mid-1980's, a major recruitment event occurred for both species of Tanner crab. In 1990 these crab have continued to recruit to both the survey gear and the exploitable population. Pribilof Island blue king crabs, as well as hair crab, have also shown improved signs of recruitment of small crab; however, lack of knowledge concerning growth rates of those two species leads to uncertainty about the timing of the event. In contrast, Bristol Bay red king crab and St. Matthew Island blue kings show little sign of recruitment, but the survey has generally been unsuccessful in detecting such crab until they are typically 50-75 mm cl, or 5-8 years of age. Whatever conditions are responsible for such recruitment events may have been limited to the outer shelf area, where it would have affected all but the latter two stocks. Shelf and coastal water temperatures remained in the average range, as they have since 1983.

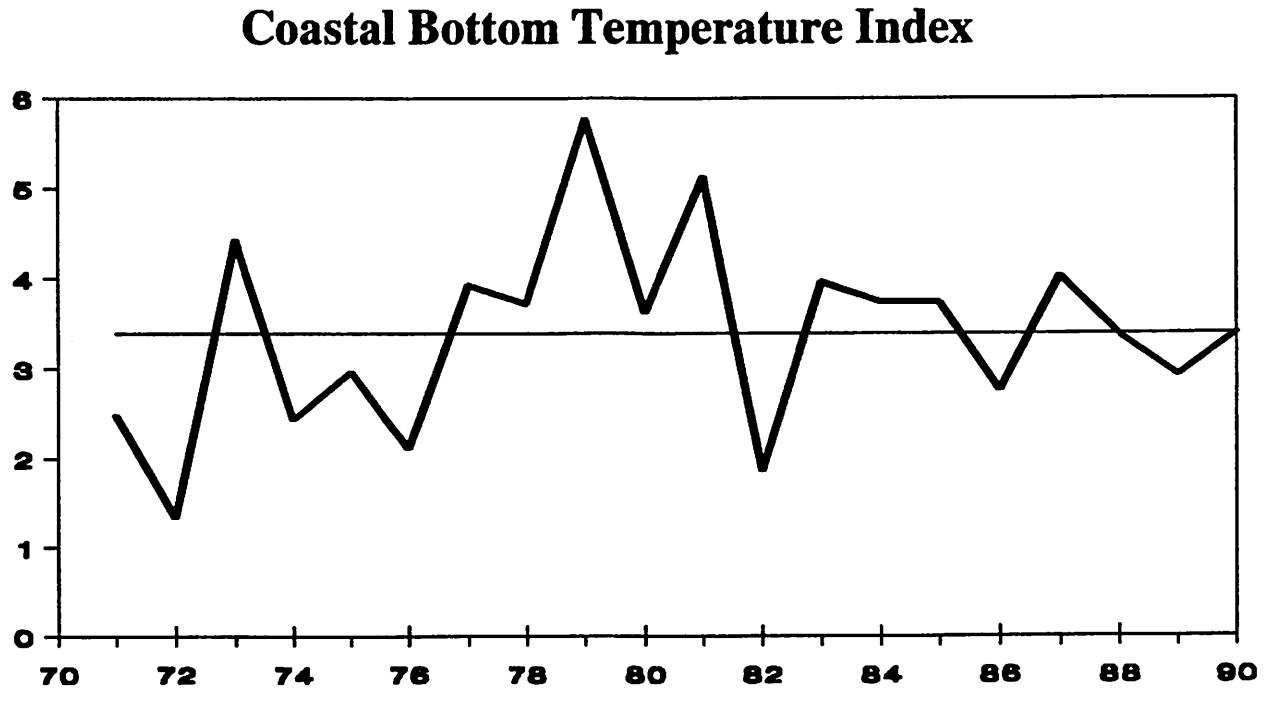


FIGURE 14. Coastal bottom temperature index (mean of 37 survey stations along the Alaska Peninsula) in degrees C for 1971-present. Horizontal line is average value over the entire period.

SUMMARY OF THE MANDATORY OBSERVER PROGRAM

Report of September, 1990 to:
The North Pacific Fisheries Management Council

By:

Dana Schmidt, Earl Krygier, and Peggy Murphy

Regional Information Report[1] 4K90-30

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

September 1990

[1]The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished division reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Division of Commercial Fisheries.

MANDATORY SHELLFISH OBSERVER PROGRAM

I. Introduction

In April 1988, the Alaska Board of Fisheries adopted regulations requiring onboard observers for all vessels that process king crab and C. bairdi Tanner crab in the waters off Alaska. In 1990, this was expanded to include C. opillo Tanner crab. The Mandatory Observer Program was adopted after the Board received staff reports which indicated large discrepancies between catcher only vessels and catcher/processors and concluded that the only way that the catches could differ this greatly would be due to the processing of sublegal crab by the catcher/processor. Because of the significant variability of the data within the two types of vessels, it can not be inferred from pounds landed or pounds landed per pot lift or number of registered pots, that an individual vessel was fishing illegally. However, when these two types of vessels are examined in aggregate, we cannot envision any variable affecting fishing efficiency, that could account for the differences observed, other than lack of sorting of sub-legal crabs. The approximate 60,000 lb average difference between the catcher/processor and catcher only vessel would have a total ex-vessel of $5,000,000 at the average prices received during the 1987 Bering Sea red king crab fishery. Minimum crab size limit is generally enforced by measurement of crabs at the delivery sites. However, catcher/processors discard carapaces when crab are sectioned and processed. Observers, recording the size structure of the catch, functionally enforce minimum size limits. The Board also agreed that the observer program would be the only means of obtaining much needed biological information from the shellfish fisheries. The cost of the program is borne by industry, and utilizes third party contractors.

The department developed guidelines and certification requirements for both observers and contractors, provided training and data collection standards and forms, tested observers and provided briefings and debriefings before and after the at sea observations occurred. Daily reports were required from all observers during short duration king crab fisheries with weekly reporting during the longer duration fisheries. Observers report in code, the number of legal males, pots pulled, sampling conditions and in certain cases, statistical areas fished during the previous 24 hour period or week.

After two seasons of observer coverage, ADF&G staff and the public presented a laundry list to the Board of Fisheries connoting real and perceived short comings of the onboard observer program. With the aid of an Ad Hoc committee of industry, ADF&G staff, legal council, and Board of Fish members, the Board adopted a number of changes to the state's shellfish onboard observer program. These included:

1. A strict interpretation of conflict of interest with respect to co-investment and degree of Kindred was set for both observers and contractors

2. Requirements for observer educational and work experience were defined

3. Observer duties and responsibilities were more clearly defined

4. The "opilio" Tanner crab fishery was required to support onboard observers. These actions were taken to alleviate perceived short comings in our existing

program, which addresses both conservation, management, and enforcement objectives.

II. Specific problems raised by the industry

The letter presented to the Council under Tab D-2 at the June Council meeting, regarding the crab observer program, from NPFVOA, American High Seas, Midwater Trawl Coop, AFTA, Alaska Groundfish Data Bank, and the Highliners Assoc., presented a number of issues regarding the State of Alaska's crab observer program. The issues raised would certainly have had relevance prior to the March Board of Fisheries meeting when crab issues were addressed. But considering the actions taken by the Board to realign the crab observer program, and the inclusion of industry - particularly some of the signatories of this letter - in developing those changes, we believe the issues raised to be no longer pertinent. The following provides a summary response to the major points raised.

1. They do assert that the observer coverage is not adequate.

   The Department believes that the actions of the Board of Fisheries has addressed this question. While it is correct that the state does not have observers on catcher vessels, there is a catch delivery sampling program to cover catcher vessels. Sample size for the dockside program and onboard observer program are more than adequate to obtain accurate assessment of quantity and quality of landed product. For the at sea sampling program, the number of vessels and the number of pots examined appears to provide adequate precision for the long duration fisheries for bycatch samples. There is no information which would indicate that the observed fleet is fishing in areas different, or more effectively, than the unobserved fleet. ADF&G scientists believe that the present monitoring system adequately samples the whole crab fleet. Variation in gear type among vessels is relatively minor and certainly not dependent upon whether product is processed at sea. This letter calls for an additional observer program, at considerable expense, for determination of bycatch rates that have not been recognized as a serious problem, except for other shellfish species. The data available from the current observer program has been used to modify regulations to reduce this problem at the previous meeting of the Alaska Board of Fisheries.

2. It was suggested that we don't collect or use biological/fishery information.

   In fact, the State of Alaska uses the information which it collects in both the onboard and shore side observer program to manage the fishery in-season and out of season; often relying on daily reports to manage. Just as NMFS uses <u>its groundfish data</u> collection information to open and close the fisheries, project closures, and suggest management measures to the Council, ADF&G uses its in-season crab data collection information to similarly manage the crab fishery. The Board of Fisheries has mandated that this program be used to both enforce regulations and collect management information. As an example, the information collected from this program was presented to the Board of Fisheries who,with this justification, adjusted crab seasons and gear to reduce bycatch of soft shell, juvenile, and female crab in the crab fishery. Four published informational reports have been compiled using ADF&G observer data. In

addition to existing staff, ADF&G has recently established and hired three positions to help further administer and compile information from the observer program. Observer information and samples can greatly help understand the dynamics of the crab resources and fisheries. Analysis of bycatch composition and rates will further aid the Board of Fisheries in structuring the crab fisheries.

3. The letter also raises the concern that the program is poorly designed and executed; particularly in respect to observer qualifications.

   We note that the NMFS groundfish observer program is modelled, in part, after our state program which uses third party contractors. ADF&G's original specifications for observers were those listed under NMFS's foreign observer program. They were modified under the urging of industry. What this letter doesn't mention, is that the Board of Fisheries - in their March meeting, restructured the state program to rectify the shortcomings mentioned. In fact, our program now goes beyond the federal observer program in some ways. We are particularly concerned that they not only request that catcher vessels be under the NMFS observer program, but that catch/processor vessels also be allowed to have NMFS observers instead of ADF&G observers. Since both agency programs draw from the third party observer supply companies, the difference would only be in a lessening of third party contractor standards. Under the state program, some observer supply companies, unless restructured, are likely to be decertified and no longer partake in the State observer program. Decertification will result from both implied and reported infractions in conflict of interest. Because of potential illegal landing of small crab creating major financial incentives for the hiring of "friendly observers", contractors who have any other business dealings with the crab industry have been considered to be in conflict.

Even though this crab fishery is managed under a crab FMP, actual management is deferred to the state. The state uses its program to manage the crab fishery in-season. Bringing in a federal program on top of the state program will cause confusion and may disrupt the state's ability to manage this fishery. If additional changes are required to the state's program, these could, and should, be accommodated through the Board of Fisheries process. This would be much more cost effective and efficient than administratively conducting two programs.

What may be the real concern of the authors, is that the costs of the program are not born equitably between the catcher vessels and the catcher/processors. Since this fishery is jointly managed under an FMP, we would hope that any changes to the Magnuson Act which would rectify the imbalance of those who pay for the observer coverage also include the state observer program so that all vessels share equitably in the cost of management.

III. Summary of observer data

The observer program and the ADF&G port sampling program have provided three types of information.

First, the mandatory shellfish observer program has procedures used to determine the legality of the landed and processed product. These procedures were recommended by the Department of Public Safety for use to insure the information

collected can be used for enforcement of the sex and size specifications established for a particular crab fishery. Collection of this information has been a priority for short duration fisheries where potential landing of sub-legal crab is high, or in longer duration fisheries where enforcement of the size limit is recognized as a problem. A similar enforcement activity occurs by ADF&G and public safety employees during shore based examination of landings and by ADF&G staff aboard floating processors and occasionally aboard catcher or catcher processor vessels.

The second type of information collected by both at sea observers and ADF&G port samplers (on floating processors as well as shore based plants), involves collection of the shell size, age, and condition information from delivered product, as well as verifying accuracy of fish ticket data. Extensive sampling from all fisheries have resulted in a large percentage of the total landings being examined and measurements from thousands of landed crab. Some quality control problems with the observer data sets obtained have resulted in eliminating significant amounts of this information from the data base. Length frequency data from both programs are generally merged and reported in the spring Board of Fisheries report.

The third type of information is bycatch data from the pots being fished. The entire contents of a sub-sample of pots have been examined to determine what animals are being discarded. The primary emphasis has been on long duration fisheries during the period when crab are molting. Collection of groundfish data has occurred but with limited emphasis because of low catch rates. Sufficient data have been obtained for public release for the 1988-1989 Adak Brown crab fisheries and the 1989 Tanner crab fisheries. These are summarized in the attached table and have been previously been made available to industry. The high bycatch rates of red king crab in the C. bairdi fishery were a major factor in adoption of a March 31st closure date of this fishery, the onset of the molting period of red king crab. Additional regulations were adopted to address sorting by increasing panel sizes in crab pots.

Daily catch reports from both catcher vessels and catcher-processor vessels are also used in season for projection of closure dates when a quota is to be reached and to obtain in-season catch per unit effort data to use for stock abundance analysis. Cooperation of vessels with and without observers has been high, with accurate information generally being transferred. Non-reporting of vessels has decreased with observers presence however.

Improvements planned for the groundfish bycatch data for the upcoming year include additional data collection (length measurements) with supplemental species identification training. These procedures should insure accurate estimates of total weight caught. Improved training by use of live crab should also help in identifying shell age and condition, a shortcoming observed in much of the observer data obtained to date. Assistance in tag recovery programs are also anticipated to be a contribution the observers will make this coming year.

When enforcement concerns are being met by the observer program, the collection of bycatch data increases. As these data require much more diligence and training to complete properly, improved observer standards and experience should improve the amount of useable data obtained. Industry suggestions for improvement are always welcome and have been lively topics at the Board of Fisheries meetings.

Summary of Bering Sea Bycatch Data in Directed Crab Fisheries

Incidental catch rate, number of animals per metric ton of landed crab and number of animals per landed crab, in observed crab fisheries, Sept. 1988 thru August 1989. Three fisheries, Dutch Harbor brown crab in 1988 and Bristol Bay red crab in 1988 and 1989, had too few vessels observed to release data.

	Bering Sea Eastern District C. bairdi 1989						Adak Brown King Nov 1, 1988 thru Aug 15, 1989					
	----No./mt----			----No./Crab-----			-----No./mt-----			----No/Crab----		
	Mean[1]	Min[2]	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Tanner[3]												
Legal	----------Target Species-------						2.7	0[4]	251	0.005	0.000	0.490
Sublegal	1391.8	279	1979	1.515	0.303	2.155	17.9	0	879	0.035	0.000	1.714
Female	178.6	14	265	0.194	0.015	0.289	10.6	0	565	0.021	0.000	1.103
Total	1570.4	292	2245	1.710	0.318	2.444	31.2	0	1695	0.061	0.000	3.307
King[5]												
Legal	245.6	0	780	0.267	0.000	0.849	---------Target Species----------					
Sublegal	502.2	0	1381	0.547	0.000	1.504	534.8	171	2066	1.043	0.333	4.029
Female	250.9	0	834	0.273	0.000	0.907	609.4	231	2323	1.189	0.451	4.531
Total	998.8	0	2995	1.087	0.000	3.261	1144.2	402	4389	2.232	0.784	8.560
Cod	112.4	14	187	0.122	0.015	0.204	44.4	6	820	0.087	0.012	4.531
Halibut	1.0	0	19	0.001	0.000	0.021	4.1	0	18	0.008	0.000	0.034
No. Pots			1322						1385			
No. vessels			7						13			
Mortality Rate Estimate												
Fishery lbs			6,948,201						8,957,945			
Deadloss lbs[6]			34,664						122,251			
Deadloss/Mort. Rate			0.5%						1.4%			

[1] The Mean is the fishery average.
[2] The Min and Max are the extreme individual vessel rates.
[3] Incidental catch of Tanner crab in the brown king crab fishery was predominantly C. bairdi.
[4] 0 and 0.000 indicate no catch.
[5] Incidental catch of king crab in the C. bairdi crab fishery was predominantly red king crab.
[6] The fishery deadloss is used as an estimate of incidental catch mortality.

IV. Evaluation of adequacy of coverage.

To address industries concerns on the adequacy of coverage of the existing shellfish observer program, we must look at the observer program combined with existing ADF&G staff and other sources of data used at addressing management questions. The major information needs for management of fisheries are as follows:

1. Stock abundance and composition

This information is generally obtained through independent trawl and pot surveys. In the Bering Sea, NMFS, and most recently ADF&G have conducted such efforts. Pot research surveys provide information on bycatch problems that may be experienced in the fishery as well as other information on abundance and condition of the target species. In stocks not surveyed, only the harvest rates obtained from landings data and the composition of the catch is available. The recent observer data from catcher processors in the Adak Brown crab fishery has provided some information useful in determining recruitment trends and crab condition, previously not available. Groundfish bycatch data are also available. Observer recovery of tags in the future may be highly useful in determining abundance of commercially sized crab plus providing additional information on crab size, shell age of tagged crab recovered in the fishery. Recovery rates may also provide data on mortality of crab. In general, these data are best obtained by independent surveys and are not dependent upon observer coverage.

2. Verification of catch numbers and rates, catch size and age composition, and molting problems.

These data are obtained from both ADF&G port samplers and mandatory observers. Coverage has been extensive in all of the fisheries managed by ADF&G and large samples are available, both in terms of numbers of crab examined as well as percentage of the vessels. Prior to the observer program, catcher processors had such difference in catch per unit effort, in season data analysis would require separation of these data from shore or floater based deliveries for accurate projections of the harvest so closure dates could be set. These data are generally similar when soak time or other variables are accounted for among the two components of the fleet. Problems are related to individual vessels and observers and not components of the fleet in general. The Bering sea red king crab fishery was examined in 1987 for time and area affects on the distribution of catch rates among the catcher vessels and the catcher processors. Despite major differences in catch rates between the vessel types, differences in area fished when examined by statistical area could not be discerned. Small numbers of vessels of either type limited this type of comparison however.

3. Estimation of bycatch rates in directed crab fisheries.

Bycatch rates can only be established by on-board observers. Pot surveys provide some insight into problem areas but still leave unresolved the general problems occurred by the fleet in general. The mandatory observer program has provided our first opportunity to obtain this type of data. Coverage is dependent upon the percentage of the fleet composed of catcher-processor vessels. Fisheries included under the Bering Sea Crab FMP have generally a higher percentage of catcher-processors participating as the total poundage decreases. Thus although

numbers of vessels included with observer drops, the percentage of total landings increases. The additional table below provides a summary of statistical areas that have had at least a single delivery in a given month from both catcher-processors (observed) versus catcher vessels for major recent Bering Sea red king crab fisheries. Note that the fishery with the smallest percentage of the catch coming from statistical areas without both catcher processor and catcher vessel landings recorded is the Adak Brown crab fishery. Small numbers of vessels and a protracted season over a large geographical area are contributing factors. During the time period presented, approximately 50% of the catch came from catcher processors with on-board observers.

Summary Table of Bering Sea Crab Fisheries Time and Area Landings Data

Bristol Bay Red King Crab Fishery

Time Frame	Catcher-Processor and Catcher Landings (Bycatch Observed) (18% Total Catch)* Monthly	Entire Fishery	Catcher only Landings (Bycatch Not Observ.) (72% Total Catch)** Monthly	Entire Fishery
Stat. Areas (29 Total)	16	--	13	--
% of Total Catch	96%	--	4%	--

Bering Sea C. Bairdi Tanner Crab

Time Frame	Catcher-Processor and Catcher Landings (Bycatch Observed) (8% Total Catch)* Monthly	Entire Fishery	Catcher only Landings (Bycatch Not Observ.) (82% Total Catch)** Monthly	Entire Fishery
Stat. Areas (44 Total)	10	4	21	9
% of Total Catch	71%	9%	16%	4%

Adak Red King Crab

Time Frame	Catcher-Processor and Catcher Landings (Bycatch Observed) (37 % Total Catch)* Monthly	Entire Fishery	Catcher only Landings (Bycatch Not Observ.) (63 % Total Catch)** Monthly	Entire Fishery
Stat. Areas (33 Total)	3	--	26	4
% of Total Catch	59%	--	31%	10%

Adak Brown King Crab

Time Frame	Catcher-Processor and Catcher Landings (Bycatch Observed) (50% Total Catch)* Monthly	Entire Fishery	Catcher only Landings (Bycatch Not Observ.) (50% Total Catch)** Monthly	Entire Fishery
Stat. Areas (80 Total)	10	22	33	15
% of Total Catch	33%	40%	10%	17%

* Potential percentage of total weight of landings where bycatch may be examined by observers.
** Potential percentage of total weight of landings where bycatch cannot be observed with existing program.

Summary

Of the three types of data collected in crab fisheries the first two have essentially equal information being collected from both catcher and catcher processor vessels by the combination of port samplers and mandatory observers. Observer quality control is the primary problem but recent Board of Fisheries actions have provided some remedies. Only the bycatch data collection is limited to catcher-processors only, although the Department has placed limited staff aboard catcher only vessels on occasion. The prevalence of catcher processor's in Bering Sea fisheries have provided sufficient opportunity to collect adequate data where the Department of Fish and Game, following Board of Fisheries general guidelines, has found bycatch data collection to be a priority. As observer quality improves, and a general acceptance of catcher processor vessel crews of keeping landings legal, the amount of data will increase. Examination of time and area data from landings reports does not suggest that catcher processor differ in their fishing patterns to suggest any major bias in using data from catcher-processor only vessels in assessing bycatch.

If a funding mechanism develops in the future for providing for observer coverage by assessing a fee from the fleet, observer's could be placed on all types of vessels. The inherent problems with enforcement of size and sex prohibition on at sea processors will continue and will probably insure 100% observer coverage requirements for at sea processors in the future.

D2C

Contractor's Role

Contractors will be the employer of the observer and will contract with vessel owners to supply trained observers to all vessels. Specifically, the contractor will:

1. Secure contracts directly with the vessel owners/operators,
2. Hire observers and provide all administrative functions and responsibilities associated with the employment of observers (wages, insurance, etc.),
3. Train observers to meet certification requirements,
4. Provide all logistical support for observers (e.g. food, accommodation, sampling equipment, travel to/from vessels, travel to/from ADF&G information and debriefing meetings),
5. Assign observers to vessels without regard to requests from vessel owners/skippers for specific individuals,
6. Provide observer gear,
7. Provide departmental personnel 48 hour advance notice of observer's arrival at area office.
8. Provide departmental personnel with a training program plan or outline to be approved by ADF&G.

Contractor Qualifications

An independent contracting agent who provides onboard observers

1. may not be an individual, partnership, or corporation with a personal or direct financial interest in the proceeds of any vessel licenced to process or harvest in the afffected fishery, other than the provision of observers;

2. shall assign observers to vessels without regard to requests from vessel owners or operators for a specific individual;

3. must be approved by the department;

   A. The department may approve an independent contracting agent only after

      i. The contracting agent applies to the department in writing for approval;

      ii. The contractor completes a written conflict of interest statement on a form provided by the department;

      iii. The department has reviewed the statement submitted under (ii) of this subsection and has determined that no conflict of interest exits;

   B. An independent contracting agent must submit a new conflict of interest statement to the department within 30 days of any event which would change any information provided in his or her most recent statement;

   C. The department may require renewal of the conflict of interest statement by a contracting agent at any time;

"financial interest" means any source of income or a capital investment held by an individual or by the individual's spouse or blood relation up to and including the second degree of kindred;

"personal interest" means an interest held or involvement by an individual, partnership, or corporation, or an individual's immediate family member or parent, including membership in any organization from which, or as a result of which, a person or organization receives a benefit.

The above contractor qualifications become effective on September 1, 1990.

Observer Qualifications

An observer must be represented by a contractor, certified by ADF&G and be physically able to carry out their duties and not be incapacitated by chronic or debilitating seasickness.

To avoid a "conflict of interest," the observers (1) must be employed by an independent contracting agent, (2) may not have a financial interest in the observed fishery, (3) may not have a personal interest in the vessel to which he or she is assigned, (4) may not solicit, accept, or receive, directly or indirectly, a gift, whether in the form of money, service, loan, travel, entertainment, hospitality, employment, promise, or in any other form, that is a benefit to the observer's personal or financial interests, under circumstances in which it could be reasonably inferred that the gift is intended to influence the performance of official duties, actions, or judgement, and (5) may not be an observer on any company vessel that he/she has worked on as a paid crew member.

Minimum Qualifications

ADF&G requires that observers have:

1. A minimum of a Bachelor of Science degree in Natural Sciences,or
2. NMFS observer experience, or
3. Other education or experience approved by ADF&G.

Training

It is the responsibility of the contractor to provide observers who are able to meet the requirements set forth below, prior to certification testing. Required skills include:

1. Ability to identify both male and female king crab (red, blue, brown), and male and female tanner crab of both commercial species.

2. Ability to accurately read a vernier caliper and properly measure the crab species, as well as the ability to use a fixed measuring gauge to determine legal size animals.

3. Understand how the shellfish regulation book is organized so that appropriate regulations can be looked up.

4. Possess a radio-telephone (FCC) operator's license and ability to use a radio for communications.

5. Ability to identify common fish species caught as bycatch in pots, such as Pacific cod, halibut and sablefish (black cod).

6. Understand the procedures outlined in this manual.

7. Be capable of performing observer duties while on board the vessel.

8. Be capable of taking good quality, close up photographs.

ADF&G Certification

The observer will spend approximately 2-3 days in Dutch Harbor for final orientation and certification testing. All costs for transportation, housing, meals and salary must be borne by the observers or their contractors.

The certification process will consist of two parts. The first part will be a final review of crab identification and measurement, sampling objectives and procedures, regulations pertaining to the crab fishery, an explanation of radio codes to be used, and other instruction that ADF&G may provide. The second part will be practicum given to see if the applicant understands and possesses the ability to carry out the work assignment. If the applicant does not demonstrate a grasp of the duties required, the applicant will be released. ADF&G reserves the right not to certify any individual deemed not qualified, exhibiting poor judgment, lacking the appropriate skills necessary for the job, or scoring less t
han 90 percent on the certification exam.

ADF&G De-certification

ADF&G reserves the right of de-certification. Grounds for de-certification are:

1. Failure to complete assigned tasks as described.
2. Substance abuse that affects job performance.
3. Violent or criminal behavior or possession of controlled substances.

4. Soliciting or accepting bribes or gratutities.
5. Failure to assist the State in criminal cases.
6. Failure to report illegal activities as observed.
7. Other conduct or activities that interfere with observer duties.
8. Emotional and physical relationships involving anyone onboard the vessel.

ADF&G Re-certification

ADF&G requires that if after six months, a certified observer has never participated in any crab fishery as an observer, he or she must be re-certified prior to being placed as an observer. A certified observer who has previosly completed a successful trip but has not participated as an observer for 12 months, must be re-certified. Persons de-certified for 1,5,6,7, or 8 above may be re-certified after one year.

Observer Evaluation and Placement

All observers are placed on probationary status until they have successfully completed an accumulation of 30 observer days. Until that time, they will be evaluated/de-briefed within 30 days of first assignment. All observers who have achieved permanent status will be de-briefed within at least every 90 days of placement. No observer will spend more than 90 days on any one vessel in 12 consecutive months.

OBSERVER GEAR

Except as noted, all gear must be supplied by the observer or his contractor.

Mandatory Gear (Not supplied by ADF&G)

1. 35 mm waterproof camera capable of taking close-up, good quality photos
2. Two 300 mm (12") stainless steel vernier calipers of a type approved by the ADF&G (Appendix 1)
3. Two crab measuring sticks for each appropriate legal size specific to the fishery being observed (see Regulation Booklet for appropriate sizes; measuring sticks can be purchased for about $10 in fishing supply outlets.)
4. Cassette tape recorder using standard cassettes, must be as small as possible, battery operated and able to operate in damp environment
5. Two sets of batteries for tape recorder
6. Two clipboards for 8 1/2" X 11 paper
7. Small can of rust preventative to keep calipers well lubricated
8. A minimum of 12 each #2 pencils with erasers
9. A means to sharpen pencils
10. Two thumb counters
11. Small calculator, battery operated