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A REPORT TO THE ALASKA BOARD OF FISHERIES



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Regional Information Report No. 5J96-03
Alaska Department of Fish & Game
Commercial Fisheries Management and Development Division
P.O. Box 25526
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EXECUTIVE SUMMARY

Adak red and brown king crab fisheries are managed by the State of Alaska under the terms of the *Fishery Management Plan for the Commercial King and Tanner Crab Fisheries in the Bering Sea/Aleutian Islands* (NPFMC 1989). Principle management measures are size, sex, season and onboard observers. Red king crabs are fished on shallower flat bottom with single line pots and brown crabs are fished very deep on high relief habitat with longlined pots. A proposal to limit the number of pots in Adak red and brown king crab fisheries by vessel size class is before the Board at the March 1996 meeting. Pot limits are frameworked in the FMP meaning they can be specified by the Board by considering specific factors and standards. This report summarizes these factors and standards, reviews previous Board actions on pot limits, and outlines relevant concerns for each fishery with regard to FMP requirements for establishing pot limits. Vessel participation, amount of gear fished, and economic and fishery diversification indices are summarized. The Adak red king crab stock is in poor condition as evidenced by low effort, catch and limited grounds fished compared to historic levels. Effort and harvests in the brown crab fishery are lower in recent years than historically, but, with the advent of longlining pots, the amount of gear on the grounds has increased while the fishing grounds have contracted. Lost gear, preemption of grounds and transfer of effort to this fisheries as a result of other crab fishery closures raises concerns for an excessive number of pots within limited areas. Pot limits in either fishery would be effective only if the number of vessels participating continues at low levels or is regulated.

INTRODUCTION

Adak red and brown king crab fisheries are managed by the Alaska Department of Fish and Game under the terms of a federal fishery management plan (FMP). Principle management measures used in the Adak king crab fisheries are limits on size, sex and season and mandatory observer coverage. Minimum size of male red king crab in the Adak red king crab fishery is 6.5 inches or greater and the season extends from November 1 through February 15. Inseason, the managers have used the option to close the fishery if the catch of red king crab exceeds a harvest limit equaling the average historical catch. Male brown king crab in Adak greater than 6.0 inches may be taken from November 1 through August 15. Legal red king crab may also be retained in the directed brown king crab fishery from depths greater than 100 fathoms when the Adak red crab fishery is open. Beginning with the 1995/96 fishing season the Board required vessels participating in the Adak red and brown king crab fisheries to carry observers during all fishing activities. Both fisheries have the same pot storage requirements (ADF&G 1994). Adak red and brown king crab inhabit dissimilar depths and topography resulting in separate fishing grounds and distinct pot gear. Adak red king crab are fished with a single pot, each with a separate float line, on flat sand or mud bottom, typically at depths less than 100 fm. Brown king crab are common at depths from 100 to 500 fm in high relief habitat such as inter-island passes. Brown crab pot design is not standardized and varies from vessel to vessel. Pots have been longlined for brown

king crab since 1983/84. Regulations establishing a longline of at least 10 pots linked together as legal gear for the brown king crab fishery were adopted by the Board for the 1993/94 season. Since these fisheries are managed under the terms of the *Fishery Management Plan for the Commercial King and Tanner Crab Fisheries in the Bering Sea/Aleutian Islands* (NPFMC 1989), regulations adopted by the Alaska Board of Fisheries (Board) must adhere to the guidelines established within the FMP.

A proposal to limit the number of pots in the Adak red and brown king crab fisheries is before the Board for consideration at its March 1996 meeting. Pot limits are proposed as a means to minimize pot loss, deter preemption of fishing grounds and minimize gear saturation in fishing areas. The proposed pot limits differ for the two fisheries and are structured by vessel size: limits of 80 pots for vessels ≤ 125 ft and 100 pots for vessels > 125 ft in the Adak red king crab fishery; and limits of 480 pots for vessels ≤ 125 ft and 600 pots for vessels > 125 ft in the Adak brown king crab fishery. Pot limits are frameworked within the FMP which means they can be specified by the Board by considering specific factors. These include vessel effort, number of pots fished, conflict with other fisheries, handling mortality, vessel safety, enforcement and analysis of effects on industry. The FMP outlines additional standards to insure equal distribution among all vessels independent of size of any resultant economic burden imposed by pot limits and balancing of harvest and biological conservation of a stock at low abundance through use of pot limits.

This report summarizes available information pertinent to these factors and standards for deliberations on the proposed pot limits in the Adak red and brown king crab fisheries. We review previous Board actions on pot limits, specific requirements of the FMP for establishing pot limits and outline relevant concerns with regard to these requirements for each fishery. Adak red and brown king crab are addressed separately because each of the fisheries are characterized by vastly different fishing grounds and gear. Vessel participation, amount of gear fished and economic and fishery diversification indices are presented for the years 1983/84 to 1994/95. This time series includes historic high effort levels to allow comparisons of data under potential increases in vessel participation should effort levels shift from other commercial king and Tanner crab fisheries in the Bering Sea and Aleutian Islands as a result of depressed or closed fisheries.

Economic impacts of pot limits on the industry are not addressed because: (1) the primary management tool has been a fixed season length, (2) overly restrictive pot limits that might have economic impacts are not justified considering the present levels of effort, (3) no GHs have been specified in either fishery, (4) lack of standardized pots in the brown king crab fishery precludes estimating catch per unit of effort, and (5) the expanse of grounds covered by the fishery, extreme tidal currents and bad weather complicate interpretation of an average soak time needed for modeling catch projections under various scenarios of pot limits.

METHODS

Analyses of historical fishery data for Adak red king crabs are complicated. Historically, vessels registered to fish king crab in the Adak registration area, and the target species was not designated. Therefore, if a fisherman targeted brown king crab and delivered incidentally caught red king crab from those pots, the number of pots recorded for the red king crab fishery were the number fished for the brown king crab. During these early years of the fishery when the average pots fished in both the red and brown king crab fishery were similar, this was not a problem. More recently, longlining of pot gear in the brown king crab fishery has significantly increased the number of pots registered, and when pot numbers registered for vessels targeting brown king crab are applied to the incidental harvest of red king crab, the average pot numbers in the red king crab fishery are biased high. Beginning with the 1993/94 fishing season, fishers in the Adak king crab fisheries were required to register the number of pots by fishery reducing the problem of potentially inflated numbers of pots registered for the red king crab fishery.

All economic and fishery diversification data are based on a calendar year compared to fishery characteristic data that are reported by fishing season. However, the majority of targeted fishing for Adak red and brown king crabs is completed within a calendar year even though the fishing season spans two calendar years. No vessel diversification data is available for the Adak brown king crab fishery other than the subset of information presented for vessels that targeted Adak red king crabs and also fished Adak brown king crabs. Vessel cost data are not available, therefore economic indices based on earnings do not reflect profitability.

There are no estimates of handling mortality for either fishery but observer pot sampling data for the last five years of the brown king crab fishery is summarized to demonstrate our concerns for bycatch of sublegal male and female crabs. Information on bycatch in the Adak red king crab fishery is available only for the 1995/96 fishing season as previous years data are confidential due to the limited number of catcher processor vessels that have targeted Adak red king crab exclusively. The 1995/96 bycatch data were not summarized for Adak red king crabs because the numbers of sublegal male and females crabs incidentally caught was too variable between areas fished to allow pooling of area samples and data by area are confidential.

PREVIOUS BOARD OF FISHERIES ACTIONS ON ADAK POT LIMITS

Pot limits were established by the Board of Fisheries at the February, 1993 meeting for the Bristol Bay red king crab and Bering Sea king and Tanner crab fisheries. Objectives of pot limits in these fisheries were to: 1) reduce total effort to a level where fisheries can be opened and managed with an acceptable risk of overfishing; 2) extend season length for

sufficient time to allow accumulation of adequate fishery performance data required to validate the preseason guideline harvest level (GHL) and assure that overfishing did not occur; and 3) achieve reasonable control of a vessels aggregate of crab pots to limit pot loss. The pot limits were set for two vessel size class categories supported by industry, ≤ 125 ft and >125 ft, based on a 20% difference in gear performance between the size classes (Greenberg et al. 1992). The Board rejected proposals for pot limits in Adak king crab fisheries at the 1993 meeting. In 1994 the Board was petitioned to establish pot limits in the Adak king crab fisheries, but the petition was rejected as they found no pressing concerns to limit pots in these fisheries at that time (ADF&G 1993). In 1994, a staff petition was accepted by the Board to place observers onboard catcher vessels in the Adak king crab fisheries to collect lacking biological and fishery data. The regulation became effective prior to the 1995/96 season and observers are required onboard all vessels participating in these fisheries.

REQUIREMENTS OF THE FMP FOR ESTABLISHING POT LIMITS

The FMP defers much of the management of the BS/AI crab fisheries to the State of Alaska using three categories of management measures: (1) those that are fixed in the FMP and require a FMP amendment to change; (2) those that are framework-type measures which the State can change following criteria set out in the FMP; and (3) those measures that are neither rigidly specified nor frameworked in the FMP. Management measures in categories 2 and 3 above may be adopted under state laws subject to the appeals process provided in the FMP (NPFMC, 1989). Pot limits are a category 2 frameworked management measure that allows the State to specify them following criteria set out in the FMP.

The state is authorized to use pot limits to attain the biological conservation objective and the economic and social objective of the FMP (see Appendix A). In establishing pot limits, the State can consider, within constraints of available information, the following seven factors:

- 1) total vessel effort relative to guideline harvest level (GHL);
- 2) probable concentrations of pots by area;
- 3) potential for conflict with other fisheries;
- 4) potential for handling mortality of target or non-target species;
- 5) adverse effects on vessel safety including hazards to navigation;
- 6) enforceability of pot limits; and
- 7) analysis of effects on industry.

The FMP sets standards for the adoption of pot limits (Section 8.2.7). First, pot limits must be designed in a nondiscriminatory manner. Two examples are given: pot limits that are a function of vessel keel length and pot limits corresponding to historic data on pot registration. The Secretary of Commerce, after review of the pot limits adopted by the Board in 1992, concluded that the nondiscriminatory language in the FMP requires the economic burden imposed by pot limits to be shared equally by large and small vessels alike. Second, pot limits are warranted to restrict deployment of excessive amounts of gear to advance the biological conservation objective and where depressed stock conditions result in small guideline harvest levels and harvest would be a risk without regulating the total number of pots in the fishery.

RED KING CRAB

Seven FMP Factors

1. Total vessel effort relative to GHL:

A. There are no preseason GHLs or regular surveys of these stocks. The area is managed by:

1) 3-S management (size, sex and season); and

2) Historic catch averages in the fishery with a biological closure of February 15. Except for the 1994/95 season, the fishery has been closed 3 times in the past 11 years when the historical average harvest was reached. The 1994/95 fishery was closed after only 17 days due to extremely poor fishery performance.

B. Number of vessels participating in the Adak red king crab fishery has fluctuated inversely with decreases and increases in GHLs for other Bering Sea crab fisheries. Number of vessels with complete registrations (i.e. number of pots and vessel length recorded) are presented by year and proposed vessel length class category in Table 1, Figure 1. Number of vessels was highest during the 1983/84 fishing season, the same season the Bristol Bay red king crab fishery was closed. Vessel effort fluctuated between 30 and 70 vessels from 1984/85 to 1989/90. A significant decline in effort occurred in 1990/91 and corresponds with a resurgence in abundance of snow crab in the Bering Sea. The number of vessels targeting red king crab has remained low since that time. Historically, fewer vessels >125 ft fish for Adak red king crab than vessels ≤125 ft.

C. During the 1994/95 season, with almost twice as much vessel effort than either of the two previous seasons, fishery performance for the first two weeks of the season averaged less than 1 crab per pot. By comparison, during the same period for the 1992/93 and 1993/94 seasons the catch averaged over 16 crabs per pot. Based on poor fishery performance, the 1994/95 season was closed after only 17 days, the shortest season for the area on record. In contrast, the 1995/96 fishery, with 100% mandatory observer coverage, has experienced very little effort and catch.

2. Probable concentration of pots by area:

A. Historically the Adak red king crab fishery has occurred throughout most of the registration area with catches reported from 42 statistical areas in the 1988/89 fishery when 1.6 million pounds was landed. In the last 5 years, fishing effort has concentrated in the Petrel Banks area with catches reported out of only 3-4 statistical areas. Note, not all of a statistical area is viable crab habitat. Review of the average number of pots registered by vessels that have fished Adak red king crab by year and proposed vessel length class categories indicates a slight increase in the number of pots fished since the 1983/84 fishing season (Table 1, Figure 1). Average pots registered by all vessels increased until the 1990/91 fishing season and then declined. Vessels ≤ 125 ft have always registered fewer pots than vessels >125 ft. Average pots registered by vessels over time are presented for 5 ft vessel length intervals in Figure 2 for potential comparison of alternative vessel size class categories.

B. Closure of the Bristol Bay red king crab fishery, declines in the Bering Sea Tanner crab stocks, and uncertainty in future openings throughout Bering Sea crab fisheries, could compel crab vessels with large numbers of pots to re-enter the Adak king crab fisheries when the stock condition improves.

3. Potential for conflict with other fisheries:

A. Present regulations reduce conflicts between the single and longline pot fisheries.

1) Red king crab regulations allow only single pots to be used in the fishery.

2) Red king crab may only be retained in longlined gear fished only at depths greater than 100 fathoms during the open Adak red king crab season.

B. Due to the timing and areas of operation of the crab and groundfish fisheries, there appears to be little or no conflict between them.

C. Significant reductions in the amount of area inhabited by crabs and subsequent shrinking of the fishing grounds that produce the catch may lead to conflict between vessels when large numbers of pots are concentrated in confined areas.

4. Potential for handling mortality of target and non-target species:

A. Fishing too many pots per vessel promotes mortality of target and non-target species when pots are not regularly tended and through pot loss. Lost or not tended pots may continue to fish until the biodegradable panel disintegrates. Captured crabs may be subject to predation, cannibalism or other impairments that reduce growth and hamper ability to molt (Kruse 1993).

B. Fishing a reduced number of pots can result in greater bycatch of sublegal male and female crabs if soak times are also reduced. Information collected from the short and competitive St. Matthew and Pribilof Islands crab fisheries that have very conservative pot limits, indicate fishermen are hauling their gear after shorter soak periods.

1) Shorter soak times may not allow sublegal males and females the opportunity to exit the pots.

2) Retention, on deck sorting and discard of non-target crabs may increase handling mortality through injury or subsequent increased susceptibility to predation, disease or impaired function resulting from capture and return to the sea (Murphy and Kruse, 1995).

C. Conservation may be jeopardized when vessel participation increases to the point where there are too many pots in the fishery for it to be managed without risk of overfishing. When this happens, managers may not open the fishery.

5. Adverse effects on vessel safety including hazards to navigation:

A. Due to the size of the vessels participating in this fishery and its distance from pot storage facilities and ports, only one deck load of gear is traditionally fished. Any reduction in the number of pots that a vessel could use would only increase vessel safety.

6. Enforceability of pot limits:

A. Due to the remoteness and timing of this fishery, it has seldom experienced any enforcement effort.

1) The fishery opens concurrently with the Bristol Bay red king crab season.

2) Most enforcement is done at dockside or through records collected by observers placed on board vessels participating in the fishery.

B. To promote compliance and self policing, pot limits should not be overly restrictive.

7. Analysis of effects on industry:

A. The Adak pot limit proposal was submitted by industry.

B. Large vessel operators have indicated at meetings in Seattle that they generally support the concept of pot limits in this fishery as long as they are not overly restrictive.

C. An overly restrictive pot limit could make the Adak red king crab fishery uneconomical to fish other than as a sideline to the brown king crab fishery.

D. Comparison of harvests, number of vessels fishing, and economic indices with average pots fished per vessel over time gives some indication of potential affects on industry of the proposed pot limits. Trends in Adak red king crab fishery performance and economic indices are presented by calendar year in Table 2, Figure 3. Total pounds harvested and number of vessels fishing track well until 1990 when number of participating vessels bottoms out (Figure 3, A). Trends in gross Earnings also parallel total pounds harvested. Price per pound explains many of the more dramatic discrepancies between total pounds harvested and gross earnings (Figure 3, B). Average pounds per vessel, average earnings per vessel, and average pots fished per vessel are presented in Figure 3, C. Significant increases in average earnings per vessel are accompanied by decreased number of vessels, increased average number of pots and pounds harvested per vessel.

FMP Standards for Pot Limits

Nondiscrimination:

Pot limits established by the Board in 1993 for Bering Sea crab fisheries were developed as a function of vessel size and affected large and small vessels equally. The current proposal for pot limits in Adak red king crab fisheries specifies different numbers of pots for vessels ≤ 125 ft and vessels >125 ft. Derivation of pot limits using the 125 ft vessel length class category split is possible for Adak red king crab based on the Board's previous actions in establishing pot limits in the Bristol Bay and Bering Sea crab fisheries.

Conservation Concerns:

The Adak red king crab stocks are considered severely depressed. Historical catches produced a high of 21 million pounds during the 1964/65 season. High catches occurred for the next 9 years, then rapidly declined, and a total closure of the fishery was made in 1976. Since reopening in 1977, most harvests have been less than 2 million pounds and in recent years, less than 1 million pounds. The 1994/95 fishery was closed early due to poor fishery performance and produced a catch of only 197,000 pounds, the poorest catch in the history of the fishery.

Excessive Amounts of Gear:

When the Bering Sea crab fisheries experience large GHL's, little effort occurs in the Adak red king crab fishery due to its remoteness and distance from processing facilities. With recent declines and closures in the Bering Sea king and Tanner crab fisheries, Adak might experience a surge in effort to explore the viability of the stock should it show any improvement. Since the catch has recently come from a limited geographic area, large numbers of pots could be concentrated on this small stock. Without the ability to regulate the total number of pots under these conditions, the department would be forced to manage conservatively including not opening the fishery. To gauge the potential for increased effort in Adak as a result of changes in abundance of other crab species we review how fishers have diversified effort over time.

Percent of earnings that vessels fishing for Adak red king crab derived from other crab fisheries each calendar year are presented in Table 3, Figure 4. Interpretation is best facilitated by means of an example: of the vessels targeting red king crab in 1983, 12% of

the earnings came from the Adak red king crab fishery, 26% of the earnings are from targeting Adak brown king crab, 29% of the earnings are from targeting Bering Sea Tanner crab and 28% of the earnings came from Statewide Tanner crab.

Earnings from the Adak red king crab fishery were fairly steady through 1989, increased significantly in 1992 and have since declined. The large increase in earnings in 1992 corresponds with a significant decline in earnings from the Bristol Bay red king crab fishery and a significant decrease in number of vessels participating in the Adak red king crab fishery (Table 1). Low earnings from the Adak red king crab fishery in 1994 can be attributed to low harvests resulting from poor stock condition (Table 2). Low abundance of Adak red king crabs and closure of the Bristol Bay red king crab fishery in 1994 appear to have shifted earning potential to the Adak brown king crab, Bering Sea king and Tanner crab, and statewide Tanner crab fisheries.

Bering Sea king crab and statewide Tanner crab show minimal percent contribution to the earnings of fishermen targeting red king crab since 1986. Earnings from these fisheries appear to have been replaced by earnings derived from Bering Sea Tanner crab fisheries. Of the vessels targeting red king crab in any one year since 1985, a significant percentage of total earnings are from Bering Sea Tanner crab. If stocks of Bering Sea Tanner crab decline dramatically, a shift in effort to other open crab fisheries could be expected.

BROWN KING CRAB

Seven FMP Factors

1. Total vessel effort relative to GHL:

A. There are no surveys of this stock or preseason GHL's. The area is managed by:

1) 3-S management; and

2) Historic catch averages in the fishery. In the history of this fishery, only a small portion of the registration area has ever been closed by emergency order to prevent possible overharvest of legal males and high bycatch of mature, sublegal males. The fishery has a regulatory closure of August 15.

B. When the Bering Sea crab fisheries declined during the 1980's, interest and effort in this fishery increased. Number of vessels with accurate vessel registrations by proposed vessel length categories by fishing season are presented in Table 4, Figure 5. Vessel effort was highest during the 1983/84 season when the Bristol Bay red king crab fishery was closed. Vessel effort ranged from 36 vessels to 69 vessels from 1984/85 to 1989/90. In 1990/91, the number of vessels participating in the fishery decreased significantly most likely in response to a record high GHL for Bering Sea snow crab. Vessel effort has remained relatively low since. Until 1990/91 significantly more vessels ≤ 125 ft fished for Adak brown king crab than vessels > 125 feet. In recent years, the number of vessels in the proposed vessel size class categories are more comparable. The number of vessels ≤ 125 ft that participated in the 1994/95 fishery increased 42% while the number > 125 ft increased 116%.

2. Concentrations of gear:

A. The fishery occurs in confined areas across a broad geographic region.

(1) Due to the narrow shelf along the Western Aleutian Islands, the fishery concentrates on very localized stocks on specific grounds.

(2) Due to the remoteness of the fishery and distance to processors, only the catcher processor fleet has routinely fished stocks in the far western areas of the registration area. Catcher only vessels have concentrated their efforts in the areas nearer to markets.

B. Single pots were initially used in the fishery, but due to the depths, currents and tides, longlining of pots became common. Single strings of longline gear can extend over large areas leading to concentration of large numbers of pots in areas that are highly productive. Average number of pots registered by vessels in the proposed vessel length categories by fishing season are presented in Table 4, Figure 5. Average pots registered by all vessels has increased steadily until the 1990/91 season when the average number of pots more than doubled. Vessels ≤ 125 ft have on the average registered fewer pots than vessels > 125 ft. Average number of pots registered in the 1994/95 fishing season declined 20% for vessels ≤ 125 ft and 33% for vessel > 125 ft. Average pots registered by 5 ft vessel length intervals over time are presented in Figure 6 to allow potential evaluation of alternative vessel length class categories.

3. Potential for conflict with other fisheries:

A. Current regulations reduce conflicts between the single and longline pot fisheries.

1) Longline pots may be used only in the brown king crab fishery;

2) Red king crab may only be retained from longline pots fished in depths greater than 100 fathoms when the red king crab season is open.

B. Some conflict of longline gear exists when strings of gear are concentrated on productive grounds and are laid over one another. Grounds may also be preempted by vessels deploying excessive amounts of gear. This gear may fish throughout the registration area while actual fishing effort is concentrated on the most productive grounds. Failure to tend gear can lead to mortality of target and non-target species retained in the pot until the biodegradable panel disintegrates.

C. Due to the length of the fishery, potential conflicts with other groundfish longline and trawl fisheries exist.

4. Potential for handling mortality of target or non-target species:

A. A reduction in the number of pots fished can result in greater bycatch of sublegal male and female crabs if soak times are also reduced. Information collected from the short and competitive St. Matthew and Pribilof Islands crab fisheries that have very conservative pot limits, indicate fishermen are hauling their gear after shorter soak periods.

1) Shorter soak times may not allow non-target sublegal male and female crabs the opportunity to exit the pots.

2) Retention, on deck sorting, and discard of non-target crabs may increase handling mortality through injury or subsequent increased susceptibility to predation, disease or impaired function resulting from capture and return to the sea (Kruse 1993).

B. Handling mortality of non-target crabs in the fishery is thought to be high due to the extreme depths these crabs are retrieved from. Strong currents and tides

displace the non-target crab from their habitat by the time they return to the sea floor. Target and non-target catch of commercial crab species have been accurately enumerated by observers in the Adak brown king crab fishery since 1990 (Table 5, Figure 7). Notably, of the pots sampled, the bycatch of sublegal male and female brown king crabs far exceeds the catch of legal male brown king crabs. These data suggest the Adak brown king crab fishery is a recruit fishery or that the gear design is ineffectual in sorting smaller crabs. Conservation concerns in terms of handling mortality of brown king crabs sorted and returned to the sea are significant. The magnitude of the bycatch of sublegal male and female red king crab is minimal compared to that of brown king crabs. Red king crab bycatch has also decreased dramatically since the 1991/92 fishing season. Other commercial crab species caught in the directed brown king crab fishery include Tanner crab, scarlet king crab, grooved Tanner crab, Korean hair crab and triangle Tanner crab. Bycatch of these species is relatively low.

C. Conservation may be jeopardized when fleet effort increases to the point where there are too many pots in the fishery to adequately manage without risk of overfishing.

D. Preemption of grounds may mean that some pots are left unattended until a later time. These pots will continue to fish until the biodegradable panel disintegrates. Captured crabs may be subject to predation, cannibalism or other impairments that reduce growth and reduce ability to molt (Murphy and Kruse, 1995).

5. Adverse effects on vessel safety including hazards to navigation:

A. Due to the size of vessels participating in this fishery and its distance from pot storage facilities and ports, only one deck load of gear is traditionally fished. Any reduction in the number of pots that a vessel could use would only increase vessel safety.

6. Enforceability of pots limits:

A. Due to the remoteness and timing of the fishery, it has seldom experienced an enforcement effort.

1) The fishery opens concurrently with the Bristol Bay red king crab season where traditionally enforcement efforts have been concentrated.

2) Most enforcement is done dockside or through records collected by observers placed onboard vessels participating in the fishery.

3) Currently, the enforcement vessel is not capable of pulling and resetting longline gear.

B. To create an atmosphere of compliance, and ensure some level of self policing, pot limits should not be overly restrictive.

7. Analysis of effects on industry:

A. The Adak pot limit proposal originated from the industry.

B. Large vessel operators have indicated at meetings in Seattle that they generally support the concept of pot limits in this fishery as long as they are not overly restrictive. Comparison of harvests, number of vessels fishing, and economic indices with average pots fished per vessel over time gives some indication of potential effects on industry of the proposed pot limits. Trends in Adak brown king crab fishery performance and economic indices are presented in Table 6 and Figure 8. Total pounds harvested varies considerably over the past decade and does not track well with vessel effort (Figure 8A). Gross earnings, however, parallel total pounds harvested and small differences between the two can be accounted for by change in price per pound (Figure 8B). Average pounds harvested per vessel and average earnings per vessel follow similar trends until 1994 (Figure 8C). The sharp increase in average earnings per vessel in 1994 results from increased price paid per pound. Since 1989, the total pounds harvested in the fishery, and price per pound (except 1994) has decreased and the number of vessels remained basically constant, yet the average pounds harvested and earnings per vessel spiked in correspondence with increases in the average number of pots fished per vessel.

C. Regulations established by the Board in February of 1993, require brown king crab to be longlined. Limited cost data for conversion from single line pots to a longline pot gear system indicate longlining of pots requires an initial capital outlay far exceeding that of single line pot gear. Estimated cost to outfit 300 standard crab pots for longlining brown king crab is approximately \$400,000 compared to \$200,000 for outfitting 300 single line pots. This does not include new deck hydraulics, rigging or improvements to wheelhouse electronics necessary to longline pots in the brown king crab fishery. Some recent entrants to the brown king crab fishery use conical or stacking pots that are lighter and require fewer alterations to existing hydraulic gear. This gear change may reduce the costs of outfitting a longline system as low as that for standard single line pots. In 1995, the Board required 100% observer coverage

for vessels operating in the Adak brown king crab fishery with costs of an observer to be paid by each vessel. Given the addition of a mandatory observer to the costs of gearing a vessel for a longline fishery, participation in this fishery may be cost prohibitive for many vessels.

FMP Standards for Pot Limits

Nondiscrimination:

Pot limits established by the Board in 1993 for Bering Sea crab fisheries were developed as a function of vessel size and affected large and small vessels equally. The current proposal for pot limits in Adak brown king crab fisheries specifies different numbers of pots for vessels ≤ 125 ft and vessels > 125 ft. Derivation of pot limits using the 125 ft vessel length class category split based on the Board's previous actions in establishing pot limits in the Bristol Bay and Bering Sea crab fisheries would be difficult for the Adak brown king crab fishery because of the differences in gear types. Current pot limits in Bering Sea crab fisheries have been based on single line gear compared to longlined gear in the brown king crab fishery.

Conservation Concerns:

The Adak brown king crab stocks are not surveyed and no population estimates exist. The fishery is managed on size, sex and a protracted season that lasts 9 1/2 months. Harvest levels remain well below historical highs. Observer data now indicates that the fishery relies primarily upon recruit-sized crabs. Recruit crabs are crabs that have entered the fishery at legal size for the first time.

Beginning with the 1995/96 fishing season all vessels participating in this fishery are required to carry an observer. Coverage of the fishery will allow collection of essential biological data, information on non-retained crabs and other bycatch species, and that will be used to assist the Department with refining size limits and seasons.

Excessive Amounts of Gear:

Compared to the high effort levels experienced prior to the 1990/91 season, the fishery has experienced low vessel effort for the past 4 seasons. This can be attributed to the high volume, consistent market fisheries in the Bering Sea and the lower value and distance to shore based processors in this fishery. With fewer vessels participating in the fishery, total pots fished has remained low. However effort increased in the 1994/95 fishery due to the continued closure of the Bristol Bay red king crab and the lower GHs for snow and Tanner crabs. Reduced fishing opportunities in the Bering Sea may continue for some time, and participants in this fishery are concerned that individual vessels may again fish excessive numbers of pots throughout the registration area preempting the more productive grounds. Additional vessel and pot effort may occur in this fishery but the market and demand for brown king crab has recently decreased.

Lacking the ability to regulate the total number of pots that may be placed on the fishing grounds, and the fact that the fishery is presently supporting a small effort over a long period of time, additional large amounts of effort entering into the fishery may justify early closures to meet conservation concerns.

CONCLUSION

The Adak red king crab stock is in poor condition as reflected by recent years decline in harvests and the 1995/96 fishery performance. The distribution of crab has contracted as indicated by the limited area last fished compared to the historical fishery. Conservation of the stock would be of critical concern if vessel participation in the fishery increased significantly. Pot limits in the Adak red king crab fishery could lessen problems with saturating the limited fishing grounds with excessive numbers of pots if the number of vessels participating in the fishery remains low or becomes regulated.

The brown king crab fishery has experienced low effort in recent years compared to the historically large numbers of vessels that have participated. However, the average number of pots fished by a vessel increased as the fishery converted to longlining pots to accommodate severe currents, tides and topography typical on the productive fishing grounds. The reduction in vessels coupled with an increase in average pots fished per vessel has offset declines in average vessel earnings while harvests have decreased. Recent years observations of the fishery indicate production is recruit based magnifying the significant bycatch of non-target sublegal and female brown king crab as a conservation concern. Failure to tend longlined pots used to preempt fishing grounds may also lead to handling mortality of captured crabs. A significant increase in vessel participation due to reduced fishing opportunity in the Bering Sea should be viewed with caution given stock

condition and dynamics of longlining pots. As with the Adak red king crab fishery, a pot limit will be effective in the Adak brown king crab fishery only if the number of vessels participating in fishery continues at low levels or is regulated. Effort may not increase in the brown king crab fishery as gearing up to participate is cost prohibitive for many vessels.

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We thank Marilyn Barr, Larry Boyle, Don Huntsman, Susan Shirley, Donn Tracy, and Mike Ward for their assistance with data compilation. We thank Larry Byrne for his review comments.

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Table 1. Number of vessels with complete registrations that fished Adak red king crab and average number of pots registered by season for all vessels, vessels ≤ 125 ft and vessels > 125 ft.

Year	All Vessels		Vessels ≤ 125 ft		Vessels > 125 ft	
	# of Vessels	Average Pots	# of Vessels	Average Pots	# of Vessels	Average Pots
1983/84	105	127	86	119	19	162
1984/85	63	123	55	114	8	180
1985/86	35	132	30	121	5	200
1986/87	30	135	26	130	4	173
1987/88	46	168	36	154	10	222
1988/89	72	165	54	134	18	256
1989/90	56	191	41	152	15	298
1990/91	6	341	2	265	4	380
1991/92	9	206	7	186	2	275
1992/93	12	226	10	217	2	273
1993/94	12	207	11	200	1	280
1994/95	20	151	17	146	3	177

Table 2. Adak red king crab total pounds harvested¹, estimated gross earnings, number of unique vessels, average pounds/vessel, average earnings per vessel, and price per pound by year.

Source: Alaska Commercial Fisheries Entry Commission, Juneau.

Calendar Year	Total Pounds Harvested ¹ (Millions)	Estimated Gross Earnings (Millions)	Number of Vessels	Average Pounds/Vessel	Average Earnings/Vessel	Average Price/Pound
1983	2.09	\$7.25	109	19,154	\$66,503	\$3.47
1984	1.19	\$2.22	63	18,839	\$35,248	\$1.87
1985	0.85	\$2.51	36	23,720	\$69,736	\$2.94
1986	0.91	\$3.13	38	24,019	\$82,384	\$3.42
1987	1.05	\$4.09	49	21,352	\$83,379	\$3.90
1988	1.75	\$8.74	76	23,022	\$115,065	\$4.99
1989	1.05	\$4.67	54	19,425	\$86,422	\$4.45
1990	0.72	\$2.90	9	79,474	\$321,870	\$4.05
1991	1.01	\$3.44	11	92,120	\$312,470	\$3.39
1992	1.36	\$6.21	12	113,512	\$517,387	\$4.56
1993	0.70	\$2.58	11	63,742	\$234,891	\$3.69
1994	0.21	\$1.16	19	10,796	\$61,060	\$5.52

¹Commercial catch only, confiscated, test fishing, deadloss eliminated.

Table 3. Percent of earnings vessels fishing red king crab derive from other crab fisheries by year and percentages of vessels targeting red and brown crab that are included in analysis. Source: Alaska Commercial Fisheries Entry Commission, Juneau.

Target Fishery	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Adak Red King	12	8	11	6	7	10	5	16	17	37	16	4
Adak Brown King	26	19	18	25	17	9	14	37	12	8	9	18
Bristol Bay Red King		21	17	23	21	18	18	12	11	3	9	
Bering Sea King	29	21	7	5	4	4	2	5	2	3	8	9
Bering Sea Tanner			28	34	45	56	56	29	54	48	58	59
Statewide Tanner	28	23	11	5	2	1						1
% of Vessels Targeting Adak Red King Crabs	100	98	100	100	69	100	96	78	91	100	100	100
% of Vessels Targeting Adak Brown King Crabs	66	100	60	53	56	62	53	46	19	17	18	16

Table 4. Number of vessels with complete registrations that fished Adak brown king crab and average number of pots registered by season for all vessels, vessels ≤ 125 ft. and vessels >125 ft

Year	All Vessels		Vessels ≤ 125 ft.		Vessels >125 ft	
	# of Vessels	Average Pots	# of Vessels	Average Pots	# of Vessels	Average Pots
1983/84	151	121	130	115	21	155
1984/85	36	135	29	123	7	182
1985/86	49	143	43	135	6	200
1986/87	52	191	41	102	11	128
1987/88	54	186	39	169	15	232
1988/89	69	220	49	180	20	315
1989/90	63	240	44	185	19	368
1990/91	13	590	5	606	8	580
1991/92	14	528	7	426	7	629
1992/93	18	474	10	421	8	541
1993/94	20	485	14	423	6	672
1994/95	33	381	20	338	13	449

Table 5. Directed catch and bycatch of crab in pot samples enumerated by observers in the Adak brown king crab fishery, 1990-1995.

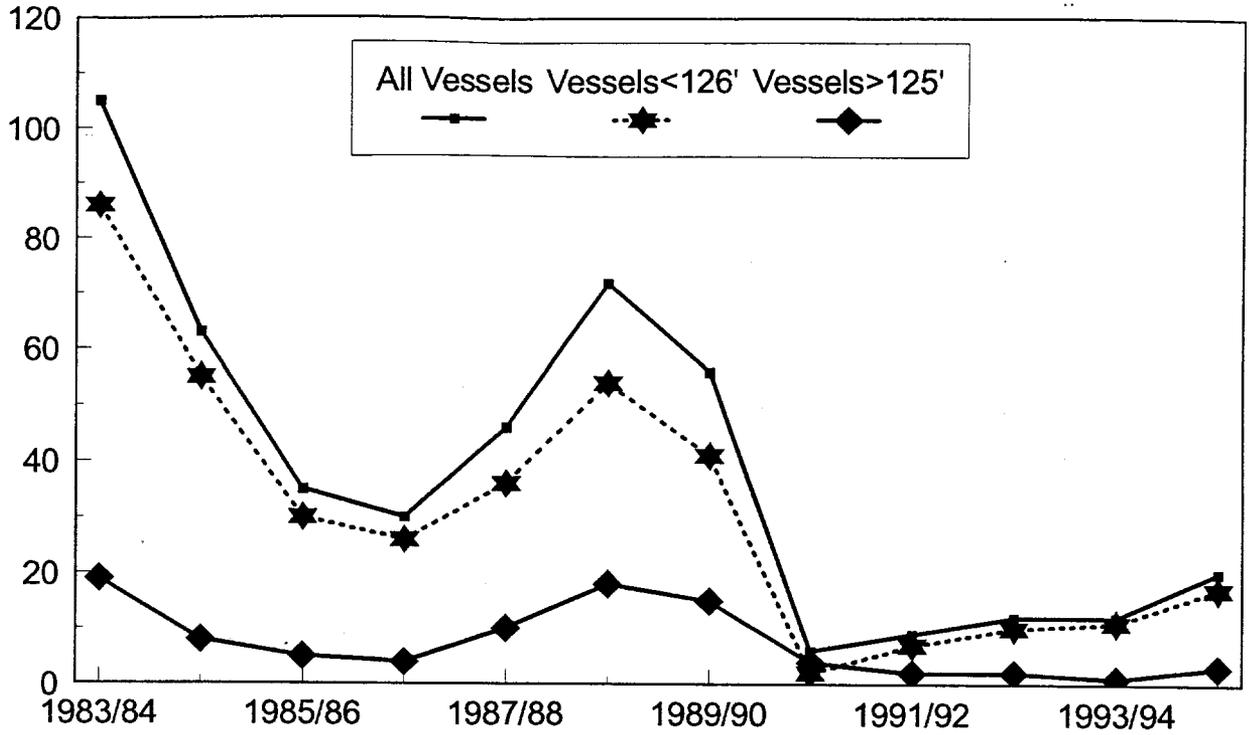
Species	Size and Sex	1990/91 7 Vessels 753 pots	1991/92 7 vessels 888 pots	1992/93 5 vessels 621 pots	19993/94 2 vessels 308 pots	1994/95 4 vessels 1431 pots
Brown King Crab (<i>Lithodes aequispina</i>)	Legal Male	3,249	6,645	3,539	2,087	9,465
	Sublegal Male	7,168	9,320	6,763	3,605	16,725
	Female	8,385	8,830	8,449	3,463	12,288
Red King Crab (<i>Paralithodes camtschaticus</i>)	Legal Male	1,249	1,072	384	79	56
	Sublegal Male	1,741	1,347	105	1	3
	Female	770	1,503	403	1	4
Tanner Crab (<i>Chionoecetes bairdi</i>)	Legal Male	13	2	0	0	1
	Sublegal Male	165	43	3		4
	Female	12	38	0		0
Scarlet King Crab (<i>Lithodes couesi</i>)	Legal Male	150	36	81	96	226
	Sublegal Male	247	81	18	10	30
	Female	580	38	14	30	32
Grooved Tanner Crab (<i>Chionoecetes tanneri</i>)	Legal Male	2	0	14	42	12
	Sublegal Male	5	6	4	10	6
	Female	7	0	1	10	4
Korean Hair Crab (<i>Erimacrus isenbeckii</i>)		51	26	7	6	23
Triangle Tanner Crab (<i>Chionoecetes angulatus</i>)	Legal Male	0	10	3	0	0
	Sublegal Male		30	5		
	Female		10	0		

Table 6. Adak brown king crab total pounds harvested¹, estimated gross earnings, number of unique vessels, average pounds per vessel, average earnings per vessel and price per pound by year. Source: Alaska Commercial Fisheries Entry Commission, Juneau.

Calendar Year	Total Pounds Harvested ¹ (Millions)	Estimated Gross Earnings (Millions)	Number of Vessels	Average Pounds/Vessel	Average Earnings/Vessel	Average Price/Pound
1983	9.91	\$28.88	166	59,678	\$173,963	\$2.92
1984	3.84	\$11.13	112	34,322	\$99,396	\$2.90
1985	5.54	\$9.58	50	110,776	\$191,643	\$1.73
1986	11.11	\$31.00	59	188,340	\$525,469	\$2.79
1987	12.27	\$34.25	68	180,411	\$503,706	\$2.79
1988	7.38	\$21.69	77	95,880	\$281,696	\$2.94
1989	8.99	\$30.67	69	130,222	\$444,448	\$3.41
1990	8.69	\$26.07	27	321,759	\$965,731	\$3.00
1991	5.08	\$15.20	13	390,441	\$1,168,981	\$2.99
1992	5.73	\$11.85	17	347,287	\$697,172	\$2.07
1993	4.50	\$8.90	17	264,977	\$523,529	\$1.98
1994	5.19	\$16.47	19	215,340	\$867,074	\$3.17

¹Commercial catch only; confiscated, test fishing, deadloss eliminated.

Number of Vessels



Average Pots

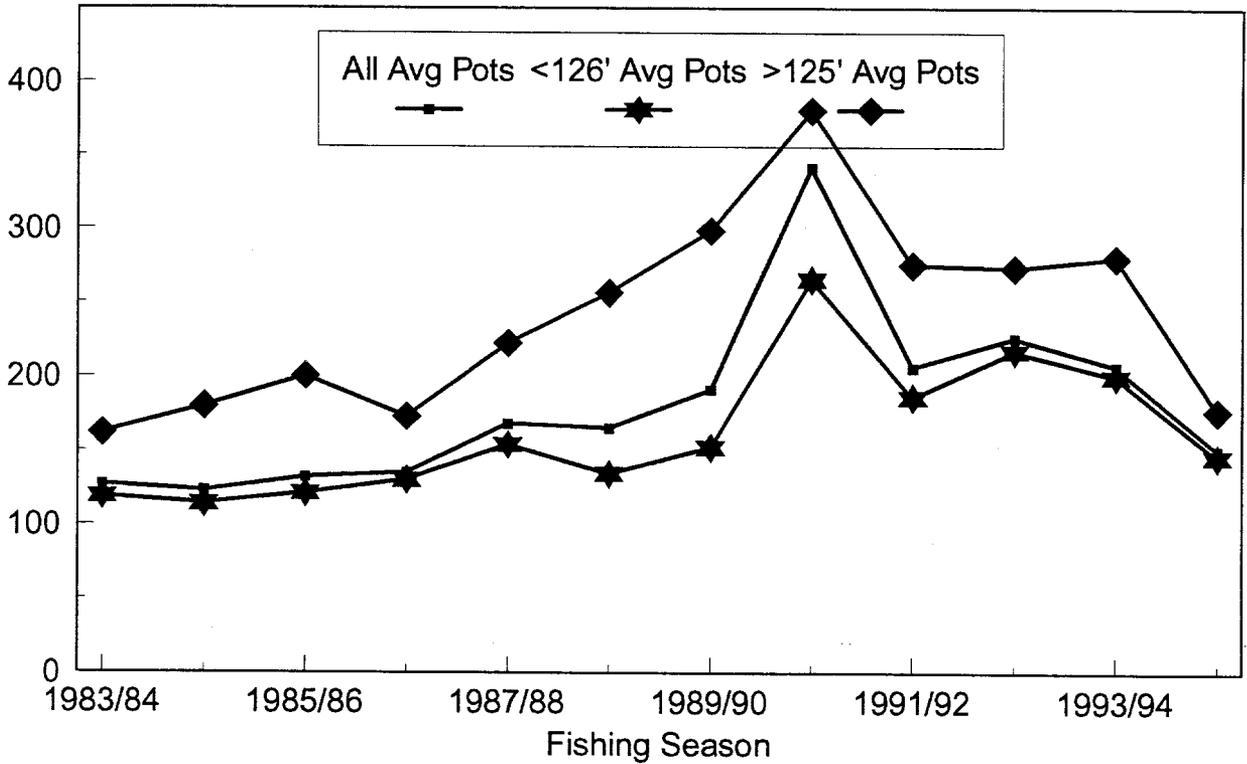


Figure 1. Number of vessels (top panel) and average pots registered (bottom panel) in the Adak red king crab fishery by proposed vessel length category by year.

Avg Pots Registered

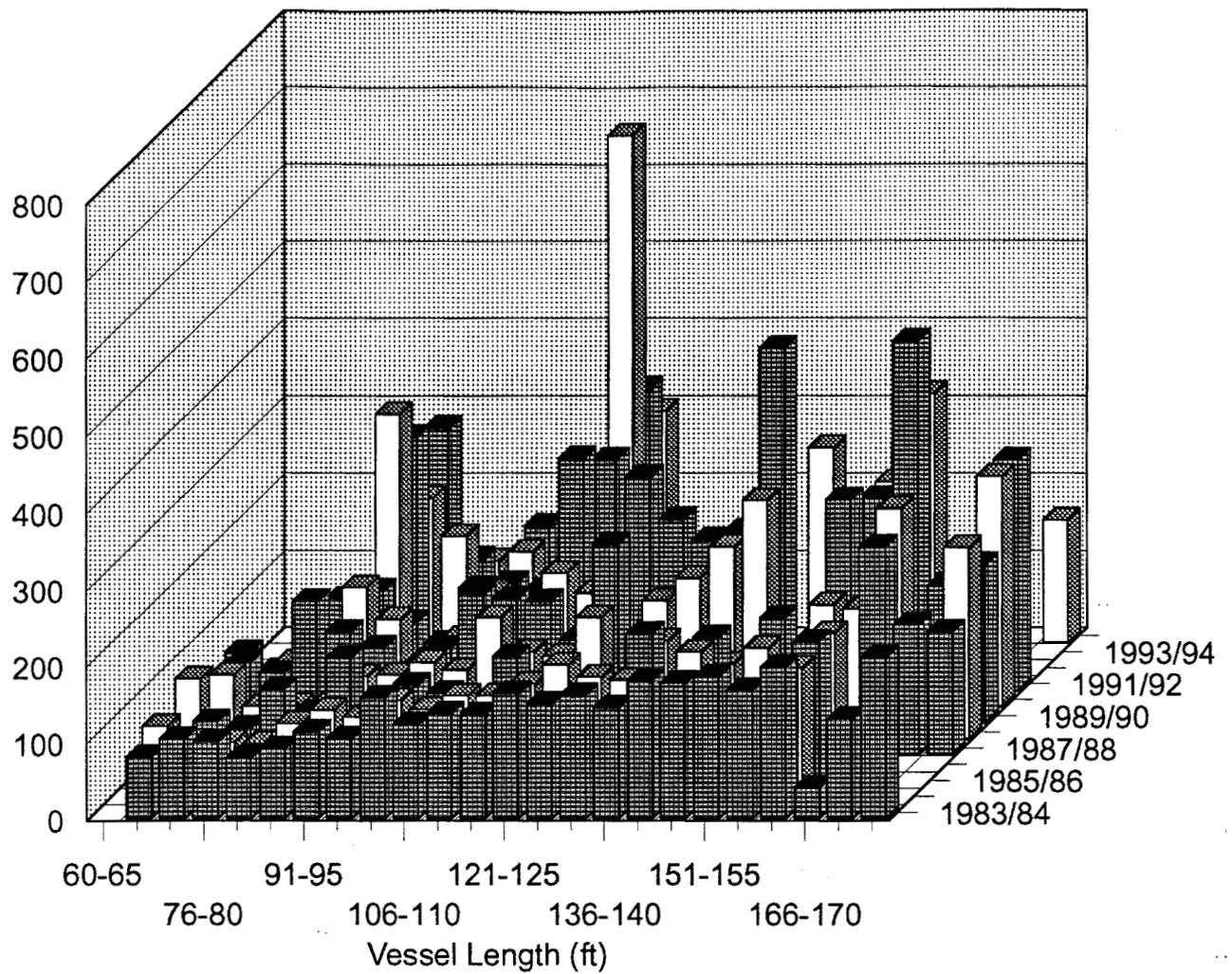


Figure 2. Average pots registered by vessel length interval in the Adak red king crab fishery, 1983/84 to 1994/95.

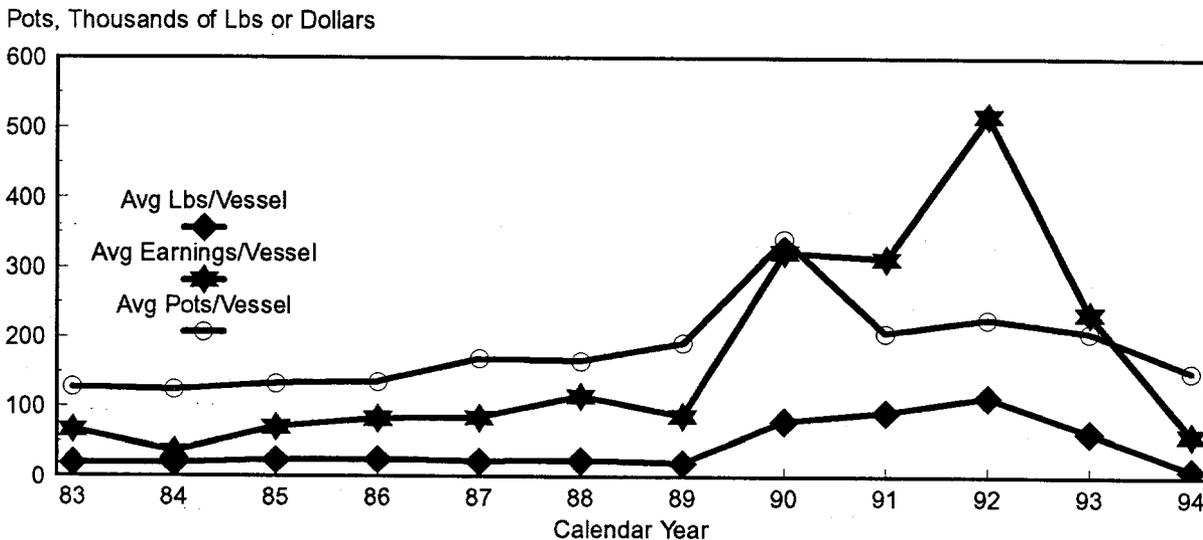
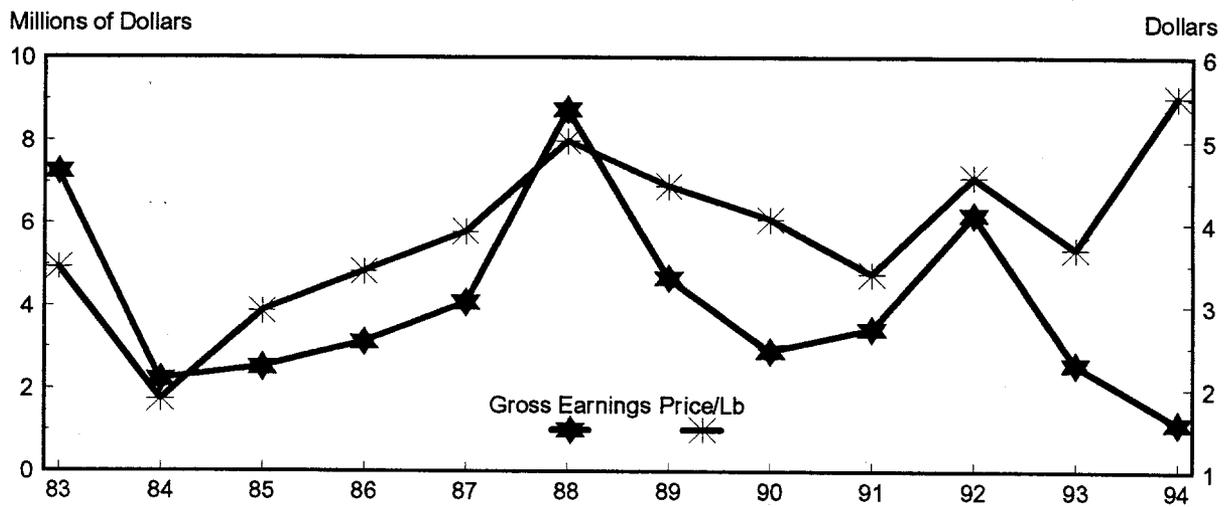
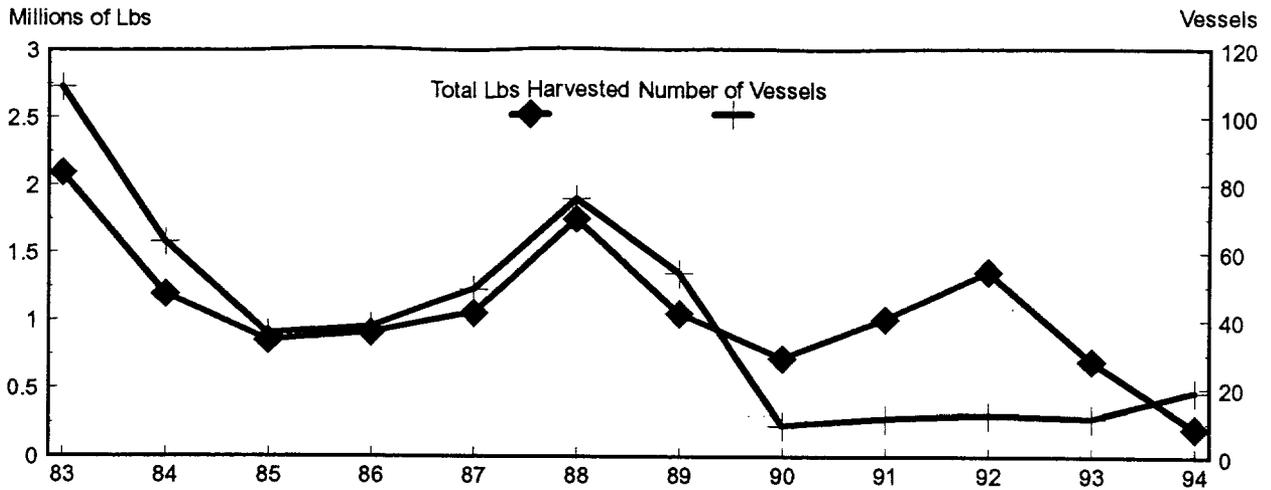


Figure 3. Fishery and economic performance for the Adak red king crab fishery by calendar year 1983 to 1994. Top panel is total pounds harvested and number of vessels. Middle panel is gross earnings and price per pound. Bottom Panel is average pounds per vessel, average earnings per vessel, and average pots registered per vessel. Economic data source: Alaska Commercial Fisheries Entry Commission, Juneau.

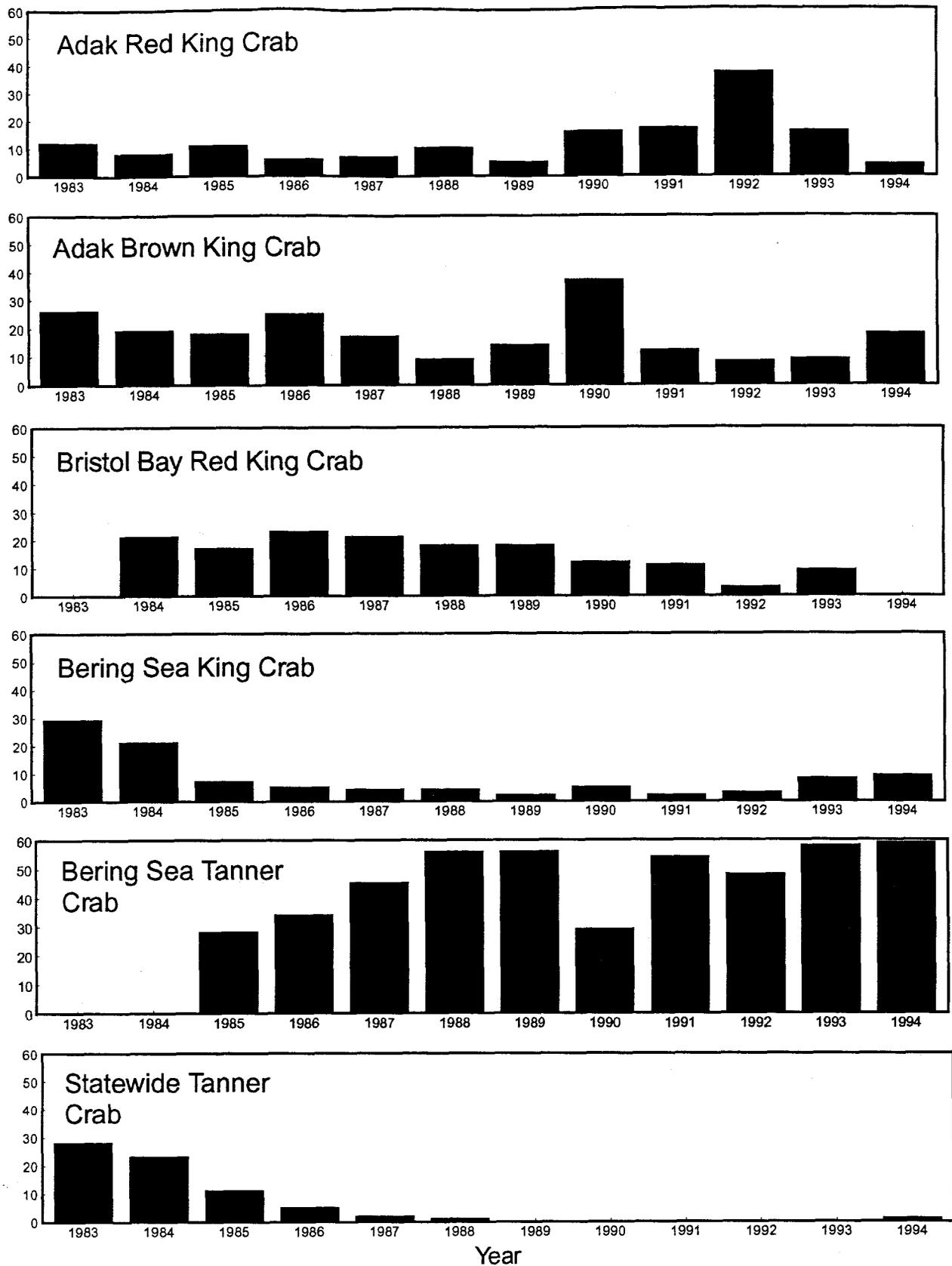
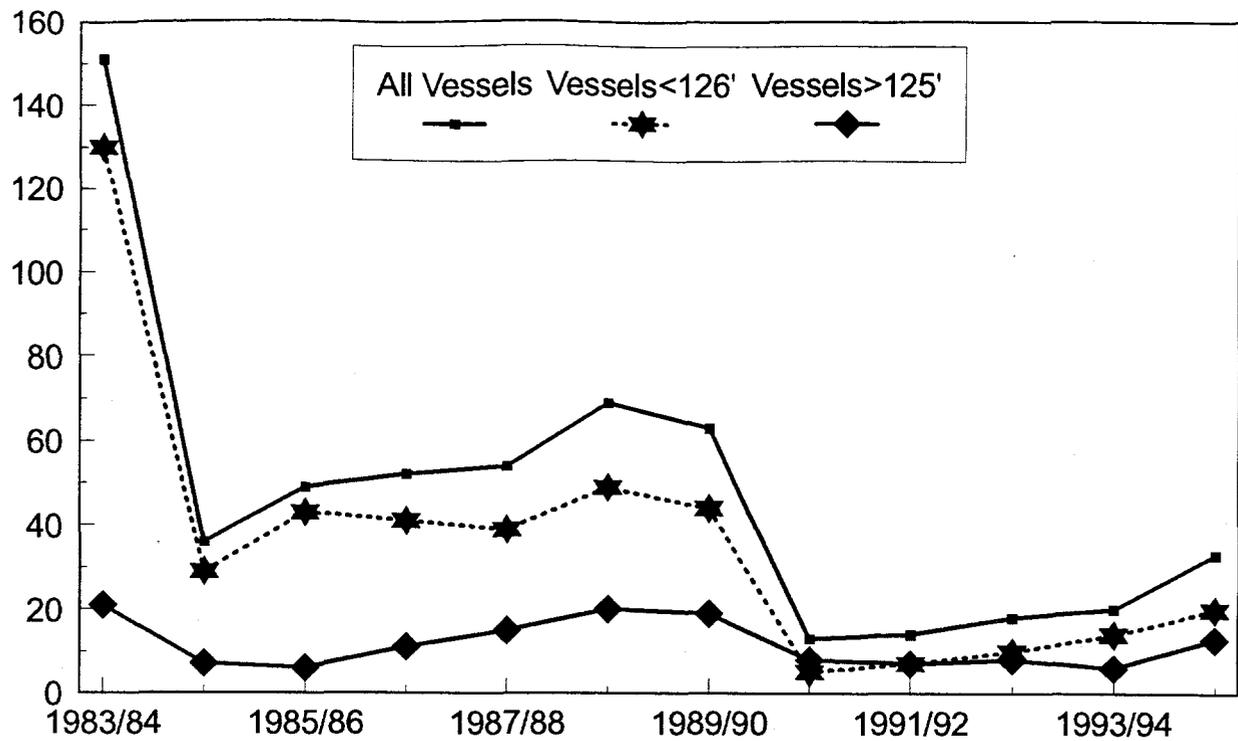


Figure 4. Percent of earnings that vessels fishing for Adak red king crab derived from other crab fisheries by calendar year. Economic data source: Alaska Commercial Fisheries Entry Commission, Juneau.

Number of Vessels



Average Pots

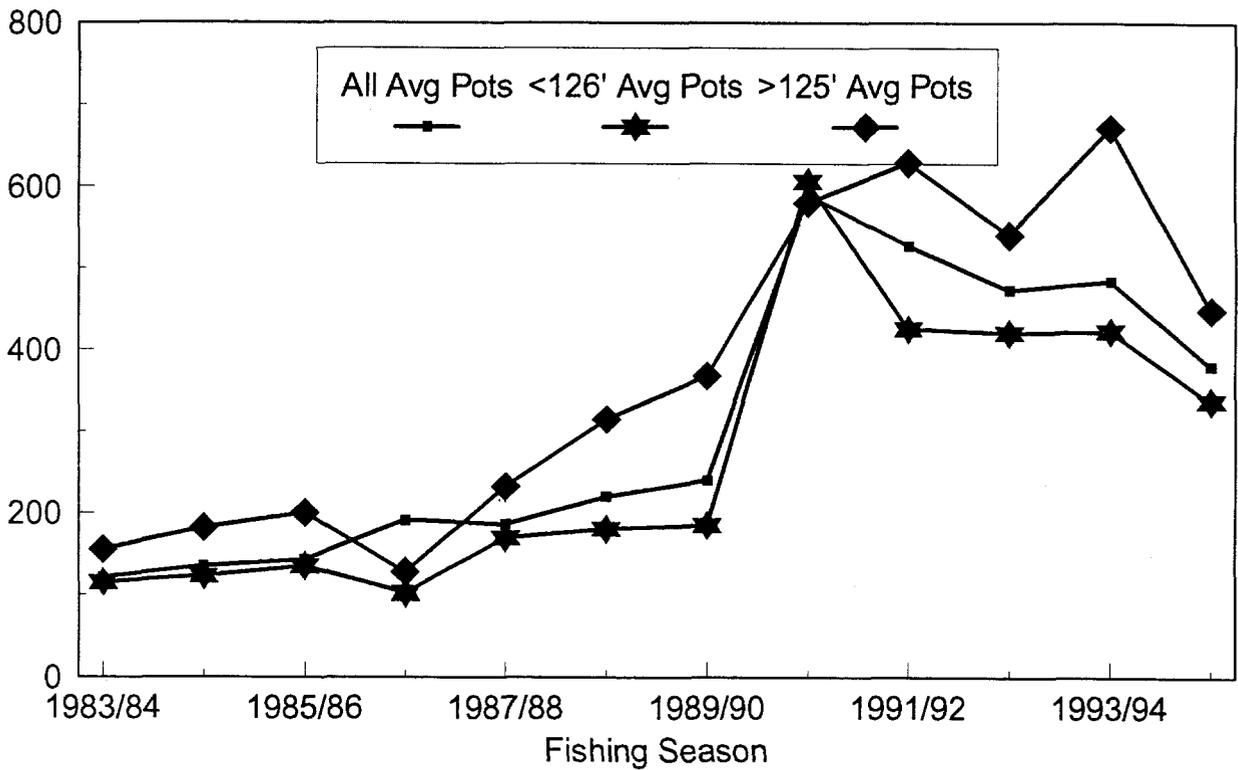


Figure 5. Number of vessels (top panel) and average pots registered (bottom panel) in the Adak brown king crab fishery by proposed vessel length category by year.

Avg Pots Registered

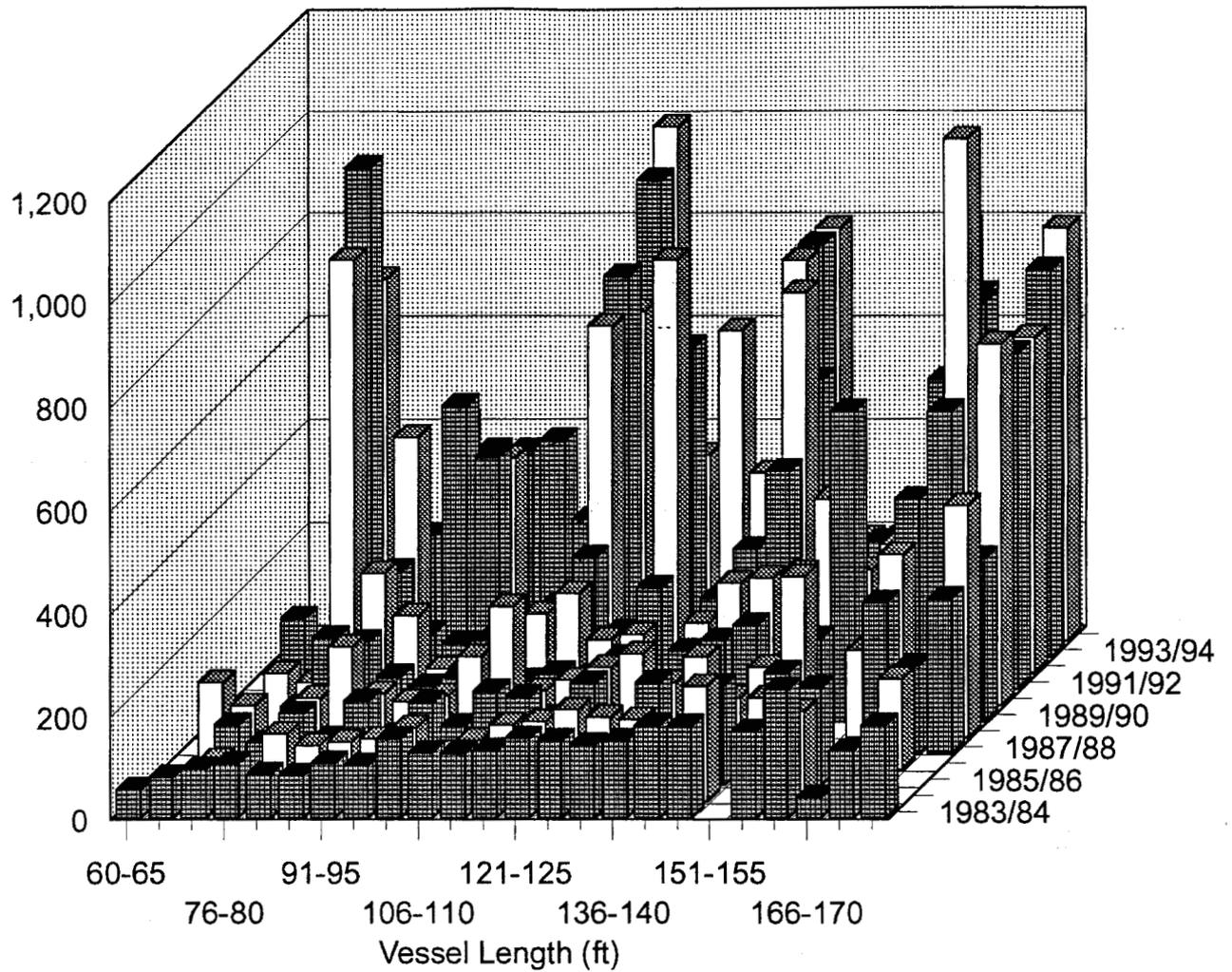


Figure 6. Average pots registered by vessel length interval in the Adak brown king crab fishery, 1983/84 to 1994/95.

Percent

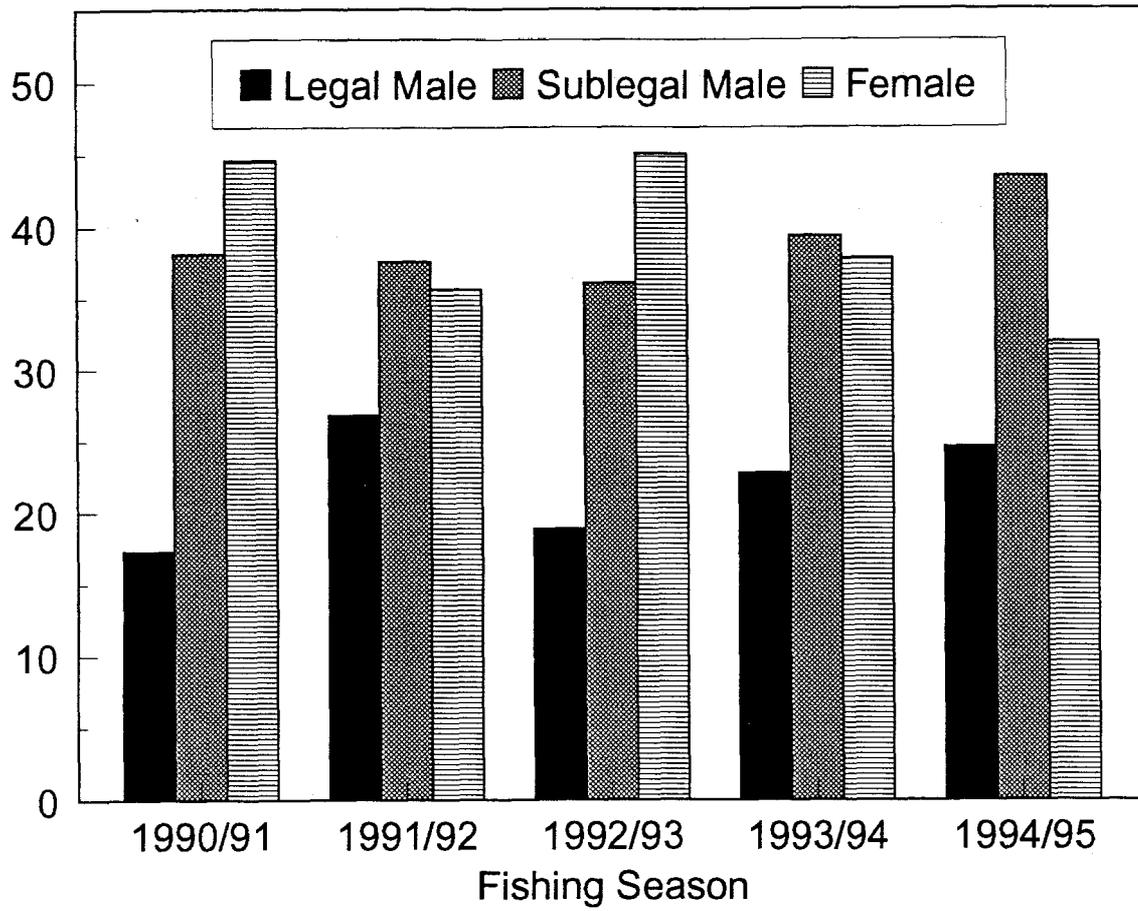


Figure 7. Directed catch and bycatch of brown king crab in pot samples enumerated by observers during the 1990/91 to 1994/95 Adak brown king crab fishing seasons.

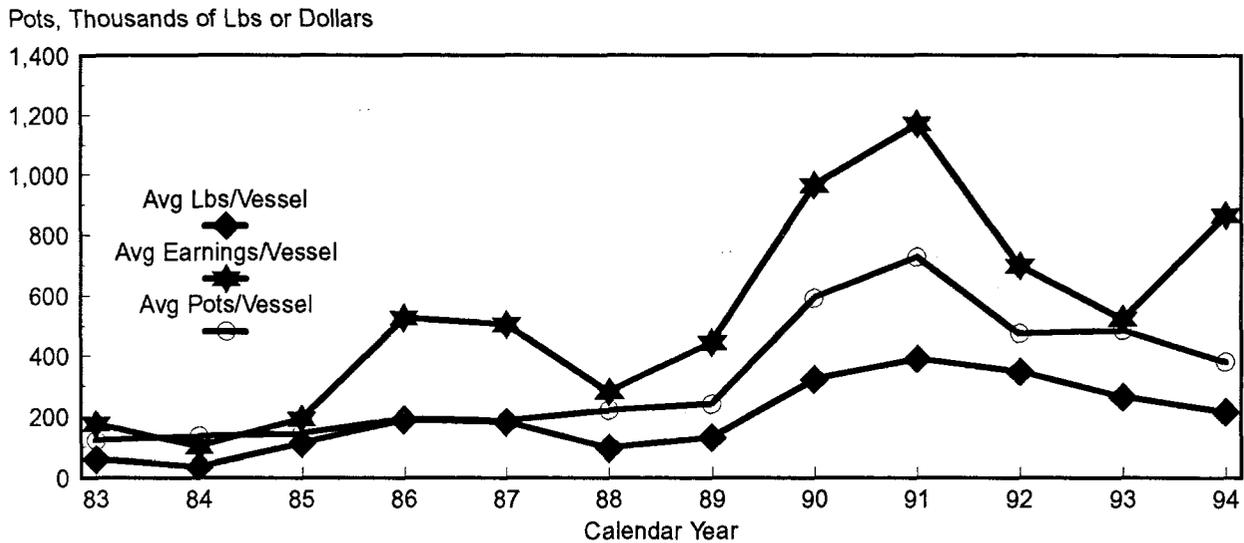
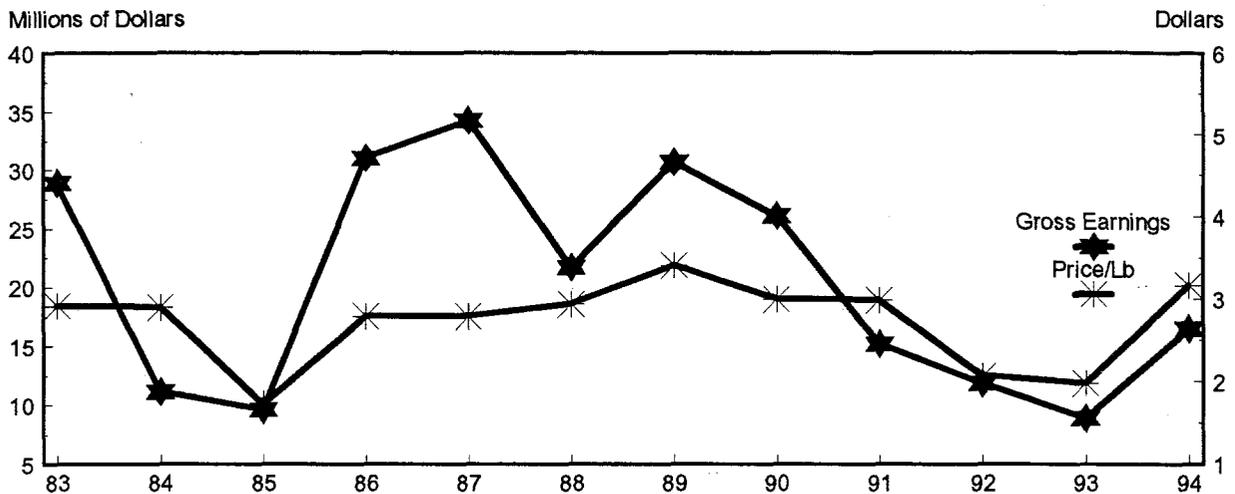
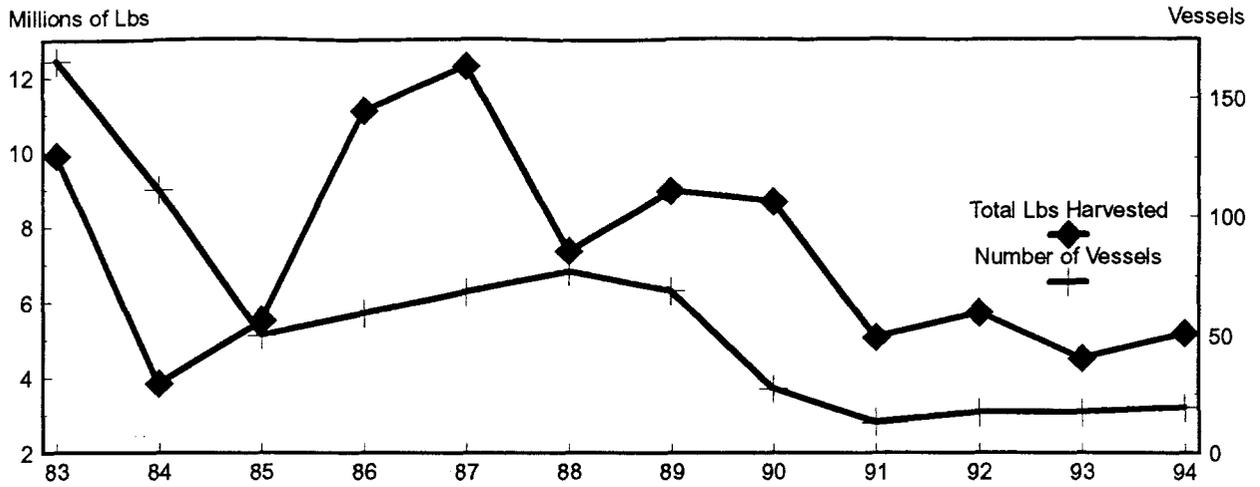


Figure 8. Fishery and economic performance for the Adak brown king crab fishery by calendar year 1983 to 1994. Top panel is total pounds harvested and number of vessels. Middle panel is gross earnings and price per pound. Bottom Panel is average pounds per vessel, average earnings per vessel, and average pots registered per vessel. Economic data source: Alaska Commercial Fisheries Entry Commission, Juneau.

Fishery Management Plan for the Commercial King and Tanner Crab Fisheries in the Bering Sea/Aleutian Islands

7.2.1 Biological Conservation Objective: Ensure the long term reproductive viability of king and Tanner crab populations.

To insure the continued reproductive viability of each king and Tanner crab population through protection of reproductive potential, management must prevent recruitment overfishing (see definition in chapter 4). Management measures may also be adopted to address other biological concerns such as: restricting harvest of crabs during soft shell periods and maintaining low incidental catch of nonlegal crab. Other factors, including those currently under investigation, such as the effects of cold air temperatures on incidentally-caught egg bearing females and their resultant larvae (Carls 1987), could also be considered if they can be shown to result in recruitment overfishing. The maintenance of adequate reproductive potential in each crab stock will take precedence over economic and social considerations.

7.2.2 Economic and Social Objective: Maximize economic and social benefits to the nation over time.

Economic benefits are broadly defined to include, but are not limited to: profits, income, employment, benefits to consumers and less tangible or less quantifiable social benefits such as the economic stability of coastal communities.

To ensure that the economic and social benefits derived for fisheries covered by this FMP are maximized over time, the following will be examined in the selection of management measures:

1. The value of crab harvested (adjusted for the amount of crab dying prior to processing and discarded, which is known as deadloss) during the season for which management measures are being considered (management season),
2. The future value of crab, which stems from the value of a crab as a member of both the parent and harvestable stock,
3. Subsistence harvests within the registration area, and
4. Economic impacts on coastal communities.

This examination will be accomplished by considering, to the extent that data allow, the impact of management alternatives on the size of catch during the current and future seasons and their associated prices, harvesting costs, processing costs, employment, the distribution of benefits among members of the harvesting, processing and consumer communities, management costs, and other factors affecting the ability to maximize the economic and social benefits as defined in this section.

Social benefits are tied to economic stability and impacts of commercial fishing associated with coastal communities. While social benefits can be difficult to quantify, economic indices may serve as proxy measures of the social benefits which accrue from commercial fishing. In 1984, 7 percent of total personal income or 27 percent of total personal income in the private sector in Alaska was derived from commercial fishing industries. However, in coastal communities most impacted by commercial fishing in the BSAI area, the impacts were much greater. In 1984, 47 percent of the total personal income earned in the Southwest Region of Alaska (Aleutian Islands, Bethel, Bristol Bay Borough, Dillingham, and Wade Hampton Census Areas) or 98 percent of the total personal income in the private sector for this region was derived from commercial fishing activities (Berman and Hull 1987). Some coastal communities are more heavily dependent on commercial fish harvesting and/or processing than this. On a statewide basis, shellfish accounted for 21 percent of the total exvessel value of commercial fish harvested in Alaska in 1984. Therefore, social and economic impacts of BSAI crab fisheries on coastal communities can be quite significant and must be considered in attempts to attain the economic and social objective.

Subsistence harvests must also be considered to ensure that subsistence requirements are met as required by law. It is very difficult to evaluate the economic impact of subsistence fishing. Yet, fish, shellfish, and game harvested by subsistence users to provide food for the family or social group can greatly exceed the economic value of the product itself (R. Wolf, ADF&G, Division of Subsistence, personal communication). Data on subsistence red king crab fishing have been obtained in the Norton Sound-Bering Strait area of the BSAI management unit (Thomas 1991; Magdanz 1982, 1983; and Magdanz and Olanna 1984, 1985), and declines in subsistence harvests have been associated with changes in crab distributions, poor ice conditions, and reductions in crab stocks due to commercial harvest and poor recruitment (ADF&G 1986).

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