

ALEUTIAN RED AND BROWN KING CRAB POT LIMITS:

A REPORT TO THE ALASKA BOARD OF FISHERIES



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## EXECUTIVE SUMMARY

Aleutian 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* (FMP) (NPFMC 1989). Management measures are frameworked within the FMP meaning they can be specified by the Alaska Board of Fisheries (Board) by considering specific factors and standards. This report reviews previous Board actions on pot limits, summarizes the FMP factors and standards relevant to pot limits, and outlines benefits and drawbacks of pot limits for Aleutian area red and brown king crab fisheries with regard to FMP requirements. The Aleutian red king crab stocks are in poor condition. The commercial fishery on the Dutch Harbor stock of red king crab has been closed since the 1983/84 season and the fishery on the Adak stock was closed in 1996. Survey results for the Dutch Harbor red king crab stock indicate no commercial fishery is likely in the foreseeable future. The Adak red king crab stock is not surveyed so a small exploratory fishery with controlled effort could yield information on stock status. Given the closure of Aleutian red crab fisheries, and lack of comparable data between the Dutch Harbor and Adak stocks due to the long closure of the Dutch Harbor fishery comparison of fishery statistics for an evaluation of pot limits for Aleutian red king crab stocks is difficult. Additionally, the closure of the Aleutian red crab fisheries questions the usefulness of pot limits at this time. The brown crab stocks have maintained relatively constant harvest levels. However, effort has varied with the advent of longlining of pots, fluctuations in abundance of other crab stocks, and refinement of gear and fishing strategy. Observer data and a survey of Aleutian brown king crab in 1997 should provide guidance on how viable commercial fisheries for brown king crab will be in upcoming years. Transfer of fishing effort to Aleutian brown king crab as a result of other crab fishery closures raises concerns for an excessive number of pots within limited areas, increased potential for lost gear and possibly preemption of grounds. Pot limits in the Aleutian brown king crab fishery would be effective only if low vessel participation is maintained or number of vessels is regulated.

## INTRODUCTION

The Aleutian Islands king crab registration area "O" was established in 1996 by combining the Dutch Harbor and Adak king crab registration areas, "O" and "R" (Figure 1). Historically, 5 districts were defined for harvest of red king crab in the Dutch Harbor area and six for the Adak area. Red king crab have not been harvested in the Dutch Harbor area since 1983 and the Adak fishery was closed in 1996 (Table 1). Productivity of red king crab stocks throughout the Aleutian area is depressed and no commercial fishery is anticipated in the foreseeable future. Two major stocks of brown king crab have been designated for the new Aleutians area with the division occurring at 174°W. longitude; the Seguam stock to the east of 174° W. and the Adak stock to the west of 174° W. These stocks have maintained commercial fisheries

since full exploitation was reached in 1982. Data from onboard observers and a survey during summer 1997 will be used to evaluate status of Aleutian area brown king crab stocks.

Aleutian red and brown king crab fisheries are managed by the Alaska Department of Fish and Game under the terms of the *Fishery Management Plan for the Commercial King and Tanner Crab Fisheries in the Bering Sea/Aleutian Islands* (NPFMC 1989). Current management measures used in the Aleutian king crab fisheries are limits on size, sex and season and observer coverage is mandatory. Minimum size of male red king crabs is 6.5 inches. Red king crab may be harvested from November 1, when opened by emergency order until the fishery is closed by emergency order. Male brown crab 6.0 inches and greater may be taken from September 1 until the season is closed by emergency order. Over the history of harvests in the Aleutian area, managers have used the option to close fisheries on the red king crab stocks if the catch exceeded a harvest limit equaling the average historical catch. The duration of the commercial fishing season for the Adak brown king crab stock remained the same from 1985 to 1995 but the fishing season length for the Dutch Harbor stock has been abbreviated in recent years as harvests exceeded the average historical catch.

Legal red king crab may also be retained in the directed brown king crab fishery from depths greater than 100 fathoms when the red crab fishery is open. Red and brown king crab inhabit dissimilar depths and topography resulting in separate fishing grounds and distinct pot gear. 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 brown king crab fisheries in the Aleutian area were adopted by the Board for the 1993/94 season. Beginning with the 1995/96 fishing season the Board required vessels participating in the Aleutian area red and brown king crab fisheries to carry observers during all fishing activities. Since these fisheries are managed under the terms of a federal FMP, regulations adopted by the Alaska Board of Fisheries (Board) must adhere to the guidelines established within the FMP.

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.

We summarize available information pertinent to the FMP factors and standards for deliberations of proposed pot limits in Aleutian red and brown king crab fisheries. Red and brown king crab are addressed separately because fisheries on each of these species are characterized by vastly different fishing grounds and gear. Additional information on impacts of pot limits on industry and economic burden imposed by pot limits for the brown king crab fishery targeting the Adak stock are addressed under a separate report. We refer the reader

to the report titled *An economic discussion of proposed pot limits for the Adak brown king crab fishery* by Drs. J. Greenberg, M. Hermann, and K. Criddle (1997).

## METHODS

Historic data needed for comparison of Dutch Harbor and Adak red king crab fishery performance data is limited. The Commercial Fisheries Entry Commission has maintained vessel characteristic data since 1978. Vessel keel length provided in these data are needed to associate harvest and number of registered pots to the proposed vessel length classes for pot limits. Vessel keel length data from 1978 were applied to the 1977 list of registered vessels that harvested Dutch Harbor red king crab to expand the data for analysis an additional year.

Number of pots a vessel fishes is recorded at the time a vessel registers for a fishery. Number of pots registered was not available for the Adak red king crab fishery prior to 1980 so only three years data are available for comparison of average pots registered between the two fisheries.

During the early years of Aleutian area king crab fisheries the average pots fished in the red and brown king crab were similar. The number of pots fished per vessel began to increase with the advent of longlining pot gear in the brown king crab fisheries in 1983. Ten years later in 1993, vessels fishing king crab in the Aleutian area were required to register separately for red and brown king crab fisheries because the number of pots fished by vessels in the two fisheries differed significantly. Vessels are allowed to harvest red and brown king crab as long as the red king crab fishery is open. Until 1993 a vessel targeting both species registered the number of pots longlined for brown king crab plus the number of single lined pots for fishing red crab. The number of pots registered by vessels employing this fishing strategy would exceed the actual number of pots fished for either species. Therefore the average number of pots registered for vessels landing brown or red king crab may be biased high prior to 1993.

Fishery diversification data are based on a calendar year compared to fishery characteristic data that are reported by fishing season. No vessel diversification data is available for the Aleutian brown king crab fisheries other than the subset of information presented for vessels that targeted the Adak red king crab stock and also fished brown king crabs.

There are no estimates of handling mortality for red or brown king crab. Pot sampling data by observers in the Aleutian brown king crab fisheries are summarized for 1990-1995 to outline concerns for bycatch of sublegal male and female crabs. Information on bycatch in the fishery targeting Adak red king crab stock is confidential prior to the 1995/96 fishing season due to the limited number of catcher processor vessels that targeted Adak red king crab exclusively. The 1995/96 observer data are too limited to summarize and insure confidentiality of vessels.

## **PREVIOUS AND PROPOSED BOARD OF FISHERIES ACTIONS ON POT LIMITS**

The Board rejected pot limit proposals for Adak king crab fisheries in 1993 when they were first considered for other Bering Sea and Aleutian Island crab stocks because they were not needed to manage the fisheries at the current effort levels. Pot limits were established in 1993 for 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 levels so fisheries could be opened and managed with an acceptable risk of overfishing; 2) extend season length for sufficient time to accumulate adequate fishery performance data required to validate the preseason guideline harvest level (GHL) and reduce risk of overfishing; and 3) limit pot loss by achieving reasonable control of a vessel's aggregate of crab pots. These pot limits were set for two vessel size class categories supported by industry,  $\leq 125$  ft and  $>125$  ft. Additionally, these size categories are consistent with the NPFMC vessel size classes under the vessel moratorium. Pot limits for vessels  $\leq 125$  ft and  $>125$  ft. were based on a 20% difference in gear performance between the size classes (Greenberg et al. 1992). In 1994 the Board was petitioned by industry to establish pot limits in the Adak king crab fisheries, but the petition was rejected as they found no pressing concerns to limit pots fished per vessel in these fisheries at that time (ADF&G 1995). Proposals for Adak and Dutch Harbor king crab registration areas were considered by the Board in 1996 but a proposal for Adak red and brown king crab pot limits was not approved. However, the Board indicated a willingness to consider pot limits for the new Aleutian area again during its 1996/97 meeting cycle, pending completion of an economic analysis to satisfy requirements of the federal FMP. Pot limits were proposed by industry as a means to minimize gear saturation in fishing areas and resultant increases in pot loss, and deter preemption of fishing grounds. The proposed pot limits differ for red and brown king crab fisheries and were structured by vessel size: limits of 80 pots for vessels  $\leq 125$  ft and 100 pots for vessels  $>125$  ft in fisheries targeting red king crab; and limits of 480 pots for vessels  $\leq 125$  ft and 600 pots for vessels  $>125$  ft in fisheries targeting brown king crab.

## **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 two 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:

- 1) pot limits that are a function of vessel keel length; and
- 2) 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. The second standard warrants pot limits to:

- 1) restrict deployment of excessive amounts of gear;
- 2) advance the biological conservation objective; and
- 3) to address depressed stock conditions that result in small guideline harvest levels and harvests that would be at 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 the Adak and Dutch Harbor red king crab stocks. The area is managed by:

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

2) Comparison of cumulative inseason catch to average historic catch with a biological closure of February 15. In the past 10 years, the Adak fishery has been closed 2 times prior to February 15 when the historical average harvest was reached. The fishery was closed after 27 days in 1994/95 because of poor fishery performance compared to the previous two seasons. The Aleutian red king crab fishery was not opened for the 1996/97 season.

B. The majority of vessels harvesting red king crabs in the Dutch Harbor and Adak red king crab fisheries during the late 1970's were  $\leq 125$  ft (Figure 2). Overall larger vessels participated in the Adak red king crab fishery than the Dutch Harbor king crab fishery. Over the history of the Aleutian Islands red king crab fisheries the smaller vessels averaged higher harvests than large vessels (Figure 3). In recent years the opposite is true and large vessels averaged higher harvests than small vessels. Number of vessels harvesting red king crab in each fishery by five foot vessel length intervals are shown in Figure 7. Fishery catch statistics for both stocks and economic performance of the Adak red king fishery are available in Appendix Tables 1, 2, and 3.

2. Probable concentration of pots by area:

A. Historically the Aleutian red king crab fisheries occurred throughout most of the Dutch Harbor and Adak registration areas. Catches were reported from 42 statistical areas in the 1988/89 Adak fishery when 1.6 million pounds was landed. From 1991 to 1995, fishing effort 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.

B. In early years of the Aleutian red king crab fisheries vessels registered on average between 100 and 200 pots with slightly more pots being registered by vessels  $>125$  ft. (Figure 2). More recently in the Adak fishery the difference between number of pots registered by small and large vessels is greater. Average pots registered in the Aleutian king crab fisheries by five foot vessel length intervals are shown in Figure 8.

C. 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 Aleutian red 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 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 number of vessels fishing, average pots registered, and average harvests by vessel size class over time provides baseline data for evaluation of pot limits.

*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 Aleutian red king crab fisheries specifies different numbers of pots for vessels  $\leq 125$  ft and vessels  $>125$  ft. Derivation of pot limits using the 20% difference in gear performance between these vessel size categories based on the Board's previous actions in establishing pot limits in the Bristol Bay and Bering Sea crab fisheries is feasible for Aleutian red king crab fisheries because the unit of effort, a single line pot is the same. Assuming the same 20% difference in gear performance demonstrated for the two vessel size classes for Bristol Bay red king crab applies to Aleutian red king crab fisheries, then one would assume that the percent difference in average pots registered per vessel and the average catch per vessel would also be similar. The Average percent difference in average pots registered between vessel size classes was 30% for Bristol Bay red king crab from 1986 to 1990. The average percent difference in average pots registered between vessel size classes was 27% for the Dutch Harbor red king crab fishery from 1980 to 1981 and 3% for the Adak red king crab fishery from 1991 to 1994. The Average percent difference in average pounds harvested between vessel size classes was 22% for Bristol Bay red king crab from 1986 to 1990. The average % difference in average pounds harvested between vessel size classes was 72% for Dutch Harbor and -2% for Adak red king crab fisheries from 1977 to 1982. More recently, the average % difference in average pots registered and average pounds harvested between vessel size classes targeting the Adak red king crab stock in recent years was 30% and 62% for the years 1991 to 1994. The years 1991 to 1994 are believed most representative of recent fishery performance.

### Conservation Concerns:

The Aleutian red king crab stocks are considered severely depressed. The fishery targeting the Dutch Harbor red king crab stock has been closed since 1983 and no catch of red king crab during the 1995 survey of the Dutch Harbor stock indicates it is in poor condition and abundance extremely low (Gish et. al. 1996). The 1996/97 fishery targeting the Adak red king crab stock was not opened due to poor fishery performance in the 1995/96 fishery which produced a catch of only 39,000 pounds. Historical catch peaked at 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 Adak red king crab 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.

### Excessive Amounts of Gear:

When the Bering Sea crab fisheries experience large GHL's, little effort has targeted the Adak red king crab stock due to it's remoteness and distance from processing facilities. With recent declines and closures in the Bering Sea king and Tanner crab fisheries, The Aleutian area might experience a surge in effort if the viability of red king crab stocks should they show any improvement. Since geographic distribution of a stock contracts as abundance declines, a stock beginning to rebuild also occupies a reduced geographic range and would be vulnerable to overharvest if excessive effort concentrated on the limited 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 on the Adak red king crab stock 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 harvesting Adak red king crabs derived from other crab fisheries each calendar year are presented in Table 2, Figure 4. Interpretation is best facilitated by means of an example: of the vessels targeting red king crab in 1983, 12% of their earnings came from the Adak red king crab fishery, 26% of their earnings came from the Adak brown king crab fishery, 29% of their earnings were from the Bering Sea Tanner crab fishery and 28% of their earnings came from statewide Tanner crab fisheries.

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 pot fisheries could be expected.

## **BROWN KING CRAB**

### *Seven FMP Factors*

#### 1. Total vessel effort relative to GHL:

A. There are no regular surveys of Aleutian brown king crab stocks and preseason GHL's were announced for the first time for the 1996/97 fishery. The area is managed by:

1) 3-S management; and

2) Historic catch averages in the fishery. In the history of fisheries on Aleutian brown king crab stocks, 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 targeting the Adak brown king crab stock opens November 1 concurrent with the Bristol Bay red king crab fishery and has a regulatory closure of August 15. The fishery targeting the Dutch Harbor brown king crab stock opens September 1, two weeks before the Bering Sea king crab fisheries and has a regulatory closure of January 15.

B. When the Bering Sea crab fisheries declined during the 1980's, interest and effort in the Aleutian brown king crab fisheries increased. Number of vessels registering for Aleutian fisheries by proposed vessel length categories by year (Figure 5). The bulk of vessels fishing brown king crab in the Aleutians have been  $\leq 125$  ft. Over the history of these fisheries larger vessels have averaged higher harvests than small vessels (Figure 12). Number of vessels harvesting brown king crab and average harvests by five foot length intervals are shown in Figures 10 and 11. Fishery catch statistics for Aleutian brown king crab stocks and economic performance are available in Appendix Tables 4, 5, 6, and 7.

#### 2. Concentrations of gear:

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

(1) Due to the narrow shelf along the Aleutian Islands, the brown king crab fisheries concentrate on very localized stocks on specific grounds.

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

B. Single pots were initially used in Aleutian brown king crab fisheries, 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.

C. Average number of pots registered by vessels targeting the Dutch Harbor and Adak brown king crab stocks by the proposed vessel length categories by fishing season are presented in Figure 5. Average pots registered by large vessels has increased steadily over the history of these fisheries. Smaller vessels  $\leq 125$  ft have on the average registered fewer pots than vessels  $>125$  ft. Average pots registered by vessels harvesting Aleutian brown king crab by 5 ft vessel length intervals over time are presented in Figure 11.

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 fisheries;

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

B. Some conflict of longline gear could occur if vessels were concentrated on productive grounds and one vessel laid gear over another vessels gear. Grounds could also be preempted by vessels deploying excessive amounts of gear. Excessive 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 may result in greater bycatch of sublegal male and female brown king crabs if soak times are also reduced. Information from industry indicates long soak times are common in the Aleutian brown king crab fisheries.

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.

C. Target and non-target catches of commercial crab species have been accurately enumerated by observers in the fishery targeting the Adak brown king crab stock since 1990 (Table 4). 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.

D. 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.

E. Preemption of grounds means 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 Aleutian brown king crab fisheries and the 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 targeting the Adak brown king crab stock 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 pot limit proposal originated from industry and specified pot limits for fisheries targeting the Adak red and brown king crab fisheries.

B. Comparison of number of vessels fishing, average pots registered, and average harvests by vessel size class over time provides baseline data for evaluation of pot limits.

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. In 1995, the Board required 100% observer coverage for vessels operating in the Aleutian 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 the Aleutian brown king crab fisheries 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 Aleutian brown king crab fisheries specifies different numbers of pots for vessels  $\leq 125$  ft and vessels  $> 125$  ft. Derivation of pot limits using the 20% difference in gear

performance between these vessel size categories based on the Boards previous actions in establishing pot limits in the Bristol Bay and Bering Sea crab fisheries is difficult for Aleutian brown king crab fisheries primarily because the unit of effort differs. 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. However, if the same 20% difference in gear performance demonstrated for the two vessel size classes for Bristol Bay red king crab was valid for Aleutian brown king crab, then one would assume that the percent difference in average pots registered per vessel and the average catch per vessel would also be similar. The Average percent difference in average pots registered between vessel size classes was 30% for Bristol Bay red king crab from 1986 to 1990. The average % difference in average pots registered between vessel size classes was 15% for Dutch Harbor and 31% for Adak brown king crab fisheries from 1991 to 1995. The Average percent difference in average pounds harvested between vessel size classes was 22% for Bristol Bay red king crab from 1986 to 1990. The average % difference in average pounds harvested between vessel size classes was -141% for Dutch Harbor and 72% for Adak brown king crab fisheries from 1991 to 1995.

#### Conservation Concerns:

No population estimates exist for Aleutian brown king crab stocks. A single survey of brown king crab in the Aleutian Islands was conducted in 1991 but covered a small portion of the habitat occupied by this species. The fisheries are managed on size, sex and season. Harvest levels remain well below historical highs. Observer data now indicates that the fisheries rely primarily on recruit-sized crabs that enter the fishery at legal size for the first time. Beginning with the 1995/96 fishing season all vessels participating in Aleutian brown king crab fisheries are required to carry an observer. Coverage of the fisheries 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 and evaluating status of the stocks.

#### Excessive Amounts of Gear:

Compared to the high effort levels experienced prior to the 1990/91 season, the Aleutian brown king crab fisheries have experienced low vessel effort for the past 5 seasons. This may be attributed to the high volume, consistent market fisheries in the Bering Sea and the lower value and distance to shore based processors for the Aleutian brown king crab fisheries. With fewer vessels participating in the fishery, total pots fished has remained low. However effort increased in the 1994/95 fishery apparently due to the continued closure of the Bristol Bay red king crab and a decline in GHs for snow and Tanner crabs. Reduced fishing opportunities in the Bering Sea may continue for some time, and participants in the fishery targeting the Adak brown king crab stock are concerned that individual vessels may fish excessive numbers of pots throughout the registration area preempting more productive grounds. Lacking the ability

to regulate the total number of pots that may be placed on the fishing grounds, and the fact that the Aleutian brown king crab fisheries have supported a small fleet over a long period of time, an influx of vessels into the fishery may justify closing fishing seasons earlier to insure conservation.

## **CONCLUSION**

The Aleutian red king crab stocks are in poor condition as reflected by recent fishery closures. The distribution of crab has contracted as indicated by the limited area last fished compared to the historical fishery. Pot limits in the Aleutian red king crab fishery could lessen problems of saturating the limited fishing grounds with excessive numbers of pots if the stock status merits a fishery. However, this study indicates that the results from the Greenberg et. al. (1982) study of economic impacts of pot limits on the Bristol Bay red king crab fishery may not be applicable to the Aleutian red king crab stocks because the percent change in vessel performance between size categories is not comparable. Therefore, information to evaluate the economic impacts and non-discriminatory nature of proportional pot limits for the Aleutian red king crab fisheries is not available at this time.

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. Though a significant increase in vessel participation may be predicted if reduced fishing opportunity in other Bering Sea crab fisheries occurs; it should be viewed as a low likelihood given the stock condition and dynamics of longlining pots. Effort may not increase in the brown king crab fishery as gearing up to participate may be cost prohibitive for many vessels. Longline of pots in the brown king crab fisheries makes application of the Greenberg et al. study on Bristol Bay red king crab to the Aleutian brown king crab fisheries questionable due to the difference in gear. This study supports that conclusion. Therefore, an economic analysis of pot limit impacts on the Aleutian brown king crab was completed and presented under separate title. As with the Aleutian red king crab fishery, a pot limit will be effective in the Aleutian brown king crab fishery only if the number of vessels participating in the brown king crab fishery continues at low levels or is regulated.

## **ACKNOWLEDGMENTS**

We thank Larry Byrne, Skip Gish, Carol Smith, Terry Smith, Sue Engle, Mary Schwenzfeier, Kathleen Herring and Don Huntsman for assistance with data compilation. We thank Jie Zheng and Larry Byrne for review comments.

## LITERATURE CITED

- Alaska Department of Fish and Game. 1993. Findings of the Alaska Board of Fisheries on Bering Sea - Aleutian Islands crab fisheries pot limits. Alaska Department of Fish and Game. Division of Boards FB-5-92. 10 pp.
- Alaska Department of Fish and Game. 1995. Shellfish fishing regulations of the Alaska Board of Fisheries for commercial fishing in Alaska, 1995-96 edition. Alaska Department of Fish and Game. Commercial Fisheries Management and Development Division. 131 pp.
- Greenberg, J.A. and M. Herrmann. 1993. Some economic impacts of pot limits in the Bristol Bay red king crab fishery. Pages 705-721 *in* G.H. Kruse, D.M. Eggers, R.J. Marasco, C. Pautzke, and T.J. Quinn II, editors. Proceedings of the international symposium of management strategies for exploited fish populations. University of Alaska Fairbanks, Alaska Sea Grant Report 93-02, Fairbanks.
- Kruse, G.H. 1993. Biological perspectives on crab management in Alaska. Pages 355-384 *in* G.H. Kruse, D.M. Eggers, R.J. Marasco, C. Pautzke, and T.J. Quinn II, editors. Proceedings of the international symposium of management strategies for exploited fish populations. University of Alaska Fairbanks, Alaska Sea Grant Report 93-02, Fairbanks.
- Murphy, M.C., and G.H. Kruse. 1995. An annotated bibliography of capture and handling effects on crabs and lobsters. Alaska Fishery Research Bulletin 2(1):23-75.
- North Pacific Fisheries Management Council. 1989. The Fishery Management Plan for the Commercial King and Tanner Crab Fisheries in the Bering Sea/Aleutian Islands. North Pacific Fisheries Management Council, Anchorage, Alaska. 172 pp

Table 1. Comparison of number of vessels, average pots registered, average pounds harvested and percent difference between vessel classes by stock, vessel length class and year for Aleutian red king crabs.

Year	Number of Vessels				Ave. Pots Registered				Ave. Lbs. Harvested (1000's)			
	<=125		>125		<=125		>125		<=125		>125	
	Dutch	Adak	Dutch	Adak	Dutch	Adak	Dutch	Adak	Dutch	Adak	Dutch	Adak
77	4		7		87		113		117.5	71.3	30.6	61.4
78	12		5		142		181		152.7	24.1	54.5	20.1
79	14		3		119		182		145.9	90.7	182.8	45.5
80	39	109	9	4	112	151	163	220	56.0	35.1	5.1	24.3
81	56	89	17	2	129	179	183	150	4.9	17.4	4.0	38.8
82	80	85	18	7	130	184	166	158		16.5		30.7
Ave. 77-82	34	94	10	4	120	171	165	176	95	43	55	37
% Dif.							27%	3%			-72%	-2%
90		3		4		543		380		52.7		59.1
91		7		2		186		275		42.3		137.7
92		6		1		184		295		62.5		21.0
93		11		1		200		280		17.0		169.1
94		17		3		146		177		8.1		16.8
95		4		0		119				9.7		
Ave. 90-95		9		2		230		281		32		80.7
% Dif.								18%				68%
Ave. 91-94						180		257		27.9		86.2
% Dif.								30%				62%
Ave. 90-94						252		281		36.5		80.7
%Dif.								10%				55%

Percent difference (% Dif.) is the difference between fishery performance of large (>125 ft.) and small (< 125 ft.) vessels.

For example, from 1991 to 1994, the 68% difference in average pounds harvested between large and small vessels  
 $68\% = (862,000 \text{ lbs} - 279,000 \text{ lbs}) / 86.2 \text{ lbs}$ .

Table . 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	1995
Adak Red King	12	8	11	6	7	10	5	16	17	37	16	4	1
Adak Brown King	26	19	18	25	17	9	14	37	12	8	9	18	46
Dutch Harbor Brown King	1	6	1	3	1	1	2	2				1	6
Bristol Bay Red King	FC <sup>a</sup>	21	17	23	21	18	18	12	11	3	9	FC	FC
Bering Sea King	28	15	6	2	3	3	2	3	2	3	8	8	3
Bering Sea Tanner			28	34	45	56	56	29	54	48	58	59	38
Statewide Tanner	28	23	11	5	2	1						1	
% of Vessels Targeting Adak Red King Crabs	100	98	100	100	69	100	96	100	100	100	92	95	100
% of Vessels Targeting Adak Brown King Crabs	66	100	60	53	56	62	53	46	19	17	14	9	16
% of Vessels Targeting Dutch Harbor Brown King Crabs	28	92	8	24	23	29	15	6				14	6

<sup>a</sup> Fishery Closed.

Table 3. Comparison of number of vessels, average pots registered, average pounds harvested and percent difference between vessel classes by stock, vessel length class and year for Aleutian brown king crabs.

Year	Number of Vessels				Ave. Pots Registered				Ave. Lbs. Harvested (1000's)			
	Dutch <=125	Adak <=125	Dutch >125	Adak >125	Dutch <=125	Adak <=125	Dutch >125	Adak >125	Dutch <=125	Adak <=125	Dutch >125	Adak >125
85	10	43	1	6	150	147	200	131	149	205.9	289.7	244.9
86	14	49	3	9	131	179	250	153	114	180.7	88.6	410.4
87	18	39	5	15	150	193	187	195	64	118.5	41.9	175.0
88	12	51	9	21	142	168	276	281	53	86.5	102.5	205.0
89	6	44	7	19	262	182	373	324	88	78.7	164.8	314.0
90	8	3	8		263	720	332		60	331.3	131.5	0.0
Ave. 85-90	11	38	6	14	183	265	270	217	88	167	136	225
% Dif.							35%	23%			36%	50%
91	4	7	7	8	263	426	150	575	35	150.6	180.1	589.5
92	3	10	7	7	150	421	300	490	63	103.8	164.1	495.0
93	2	15	2	6	300	413	392	571	89	113.5	365.1	461.3
94	9	23	5	11	392	395	386	484	51	141.7	252.8	259.5
95	12	21	5	4	386	471	519	975	77	130.2	200.0	493.2
Ave. 91-95	6	15	5	7	298	425	349	619	63	128	232	460
% Dif.							15%	31%			73%	72%

Table 4. 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	1993/94 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		

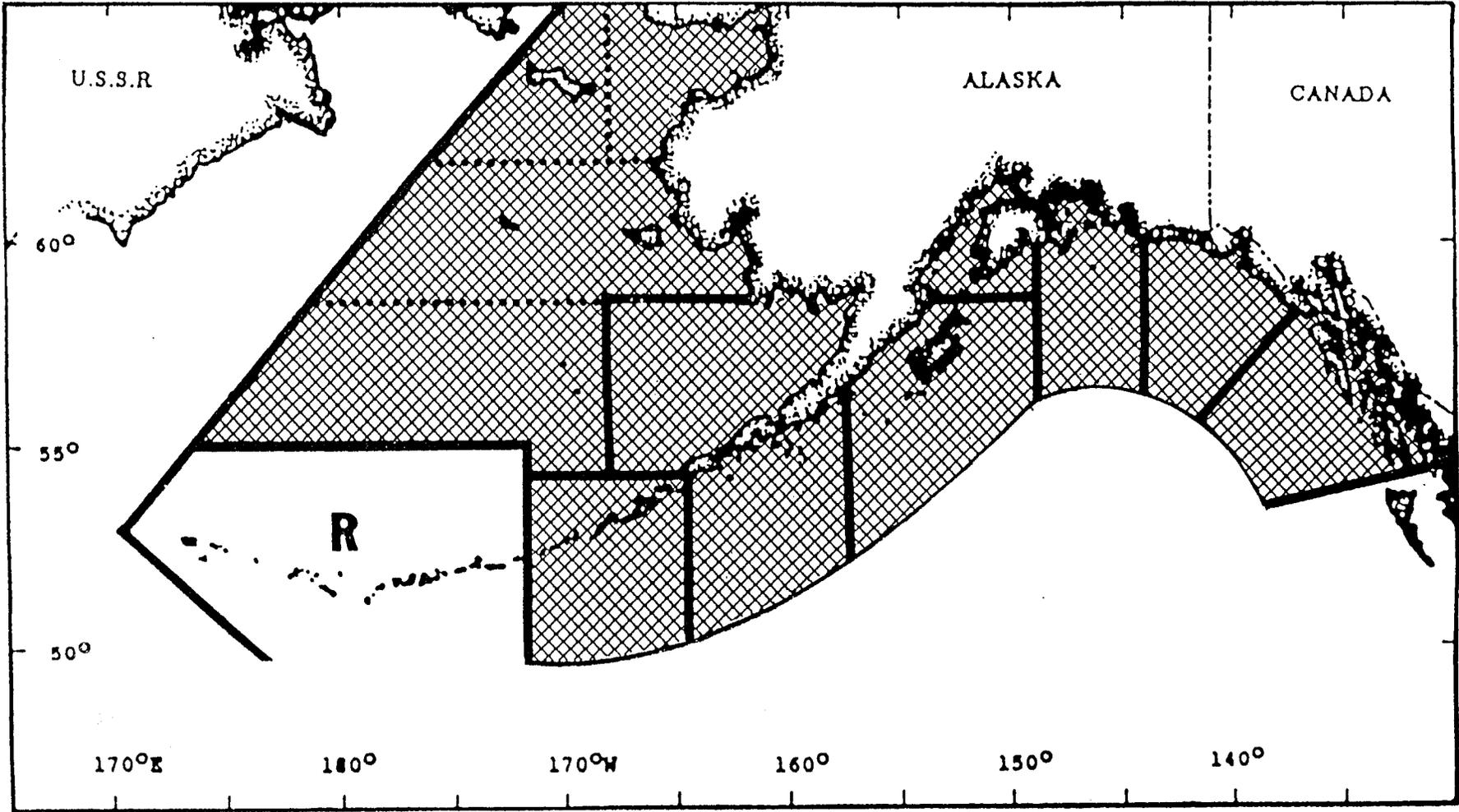


Figure 1. Aleutian Islands king crab management area.

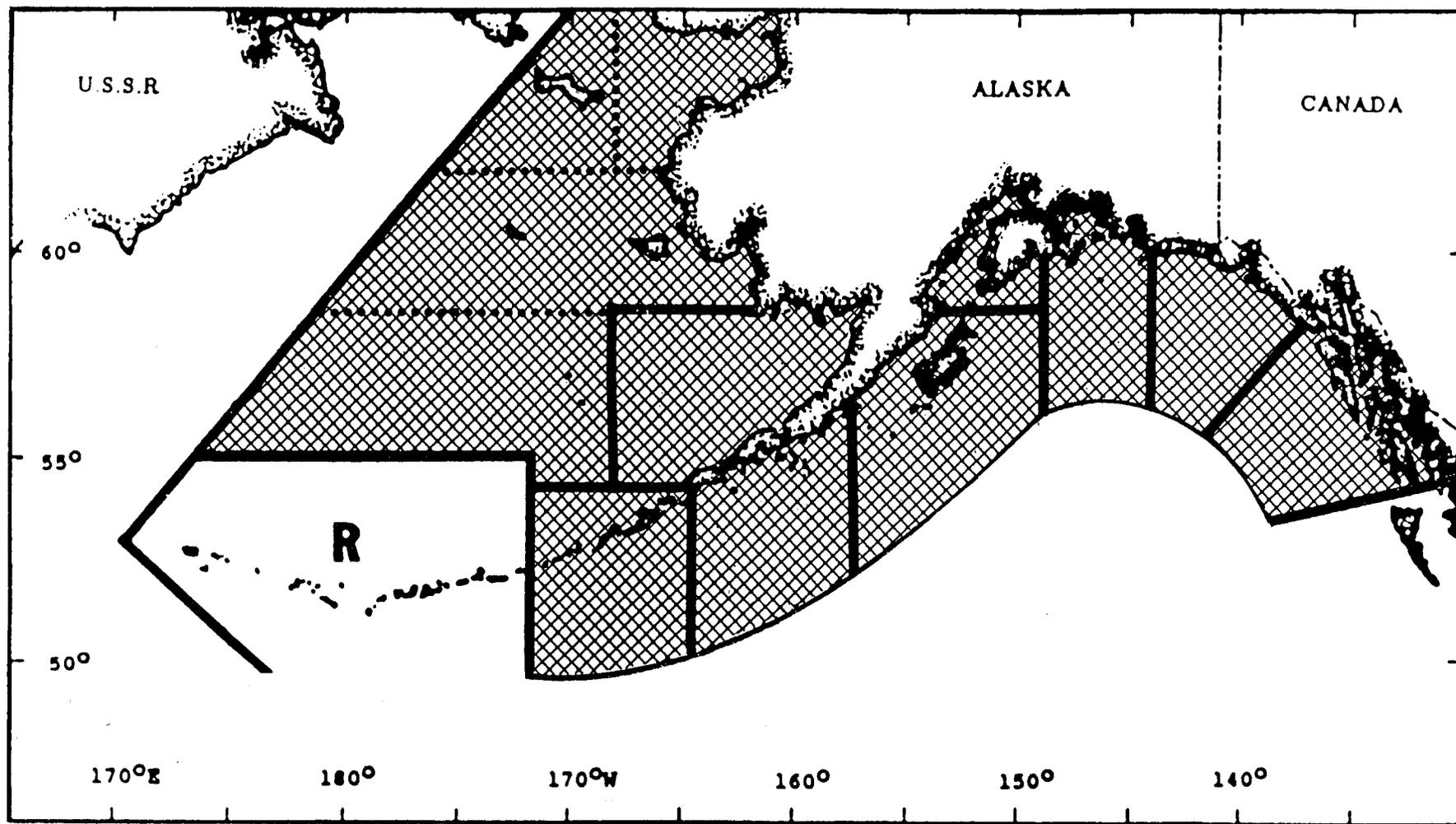
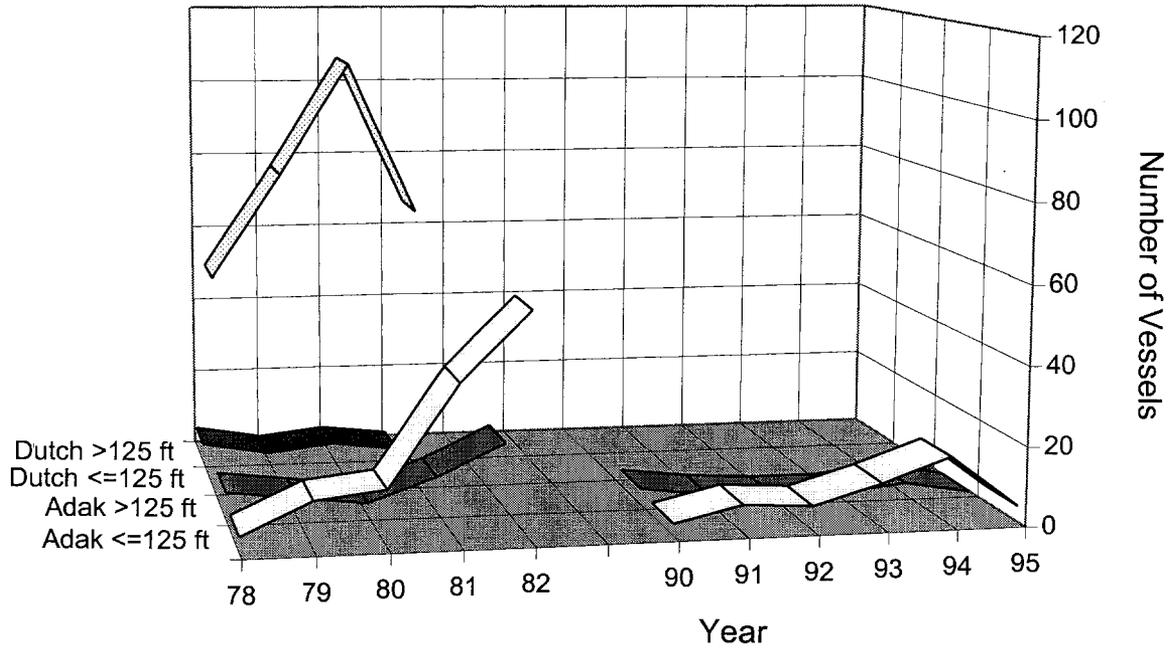


Figure 1. Aleutian Islands king crab management area.

### Red King Crab



### Red King Crab

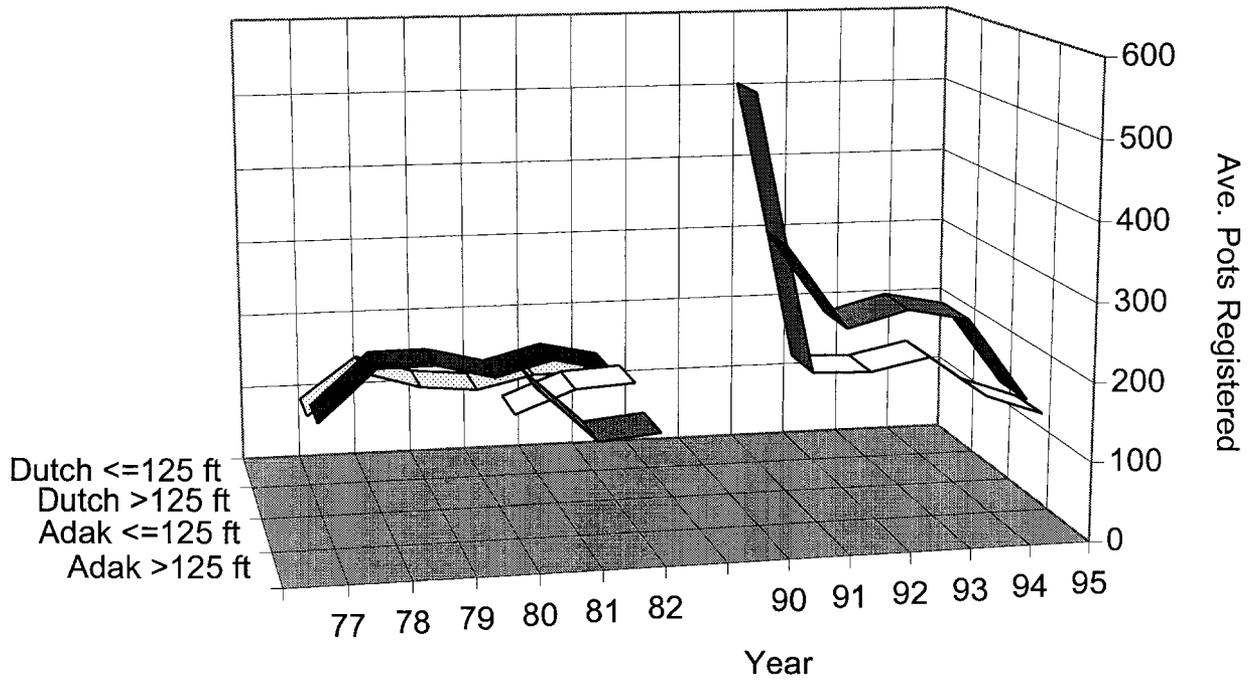


Figure 2. Number of vessels (top) and average pots (bottom) registered in the Aleutian red king crab fisheries by year sequence, vessel size class, and fishery.

### Red King Crab

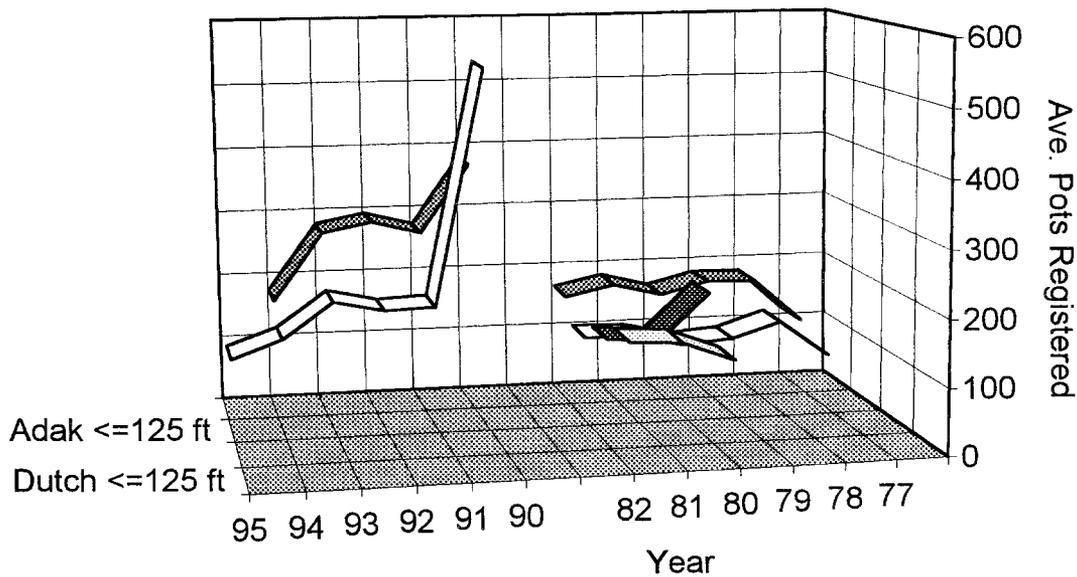
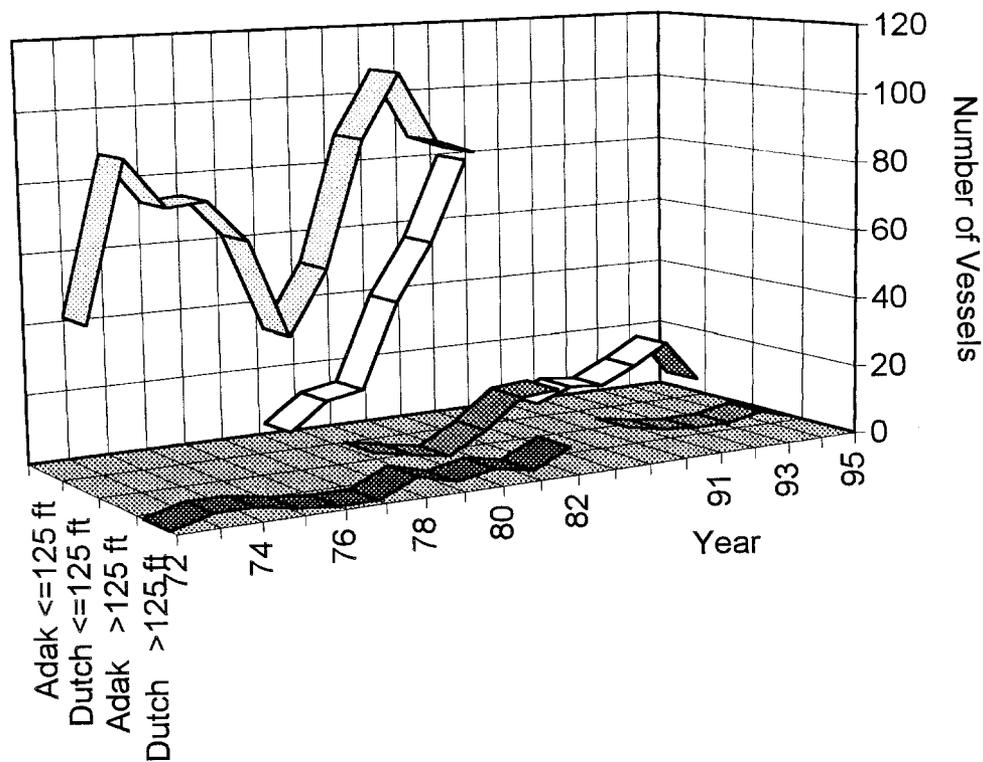


Figure 2. Number of vessels (top) and average pots (bottom) registered in the Aleutian red king crab fisheries by year sequence, vessel size class, and fishery.

### Red King Crab

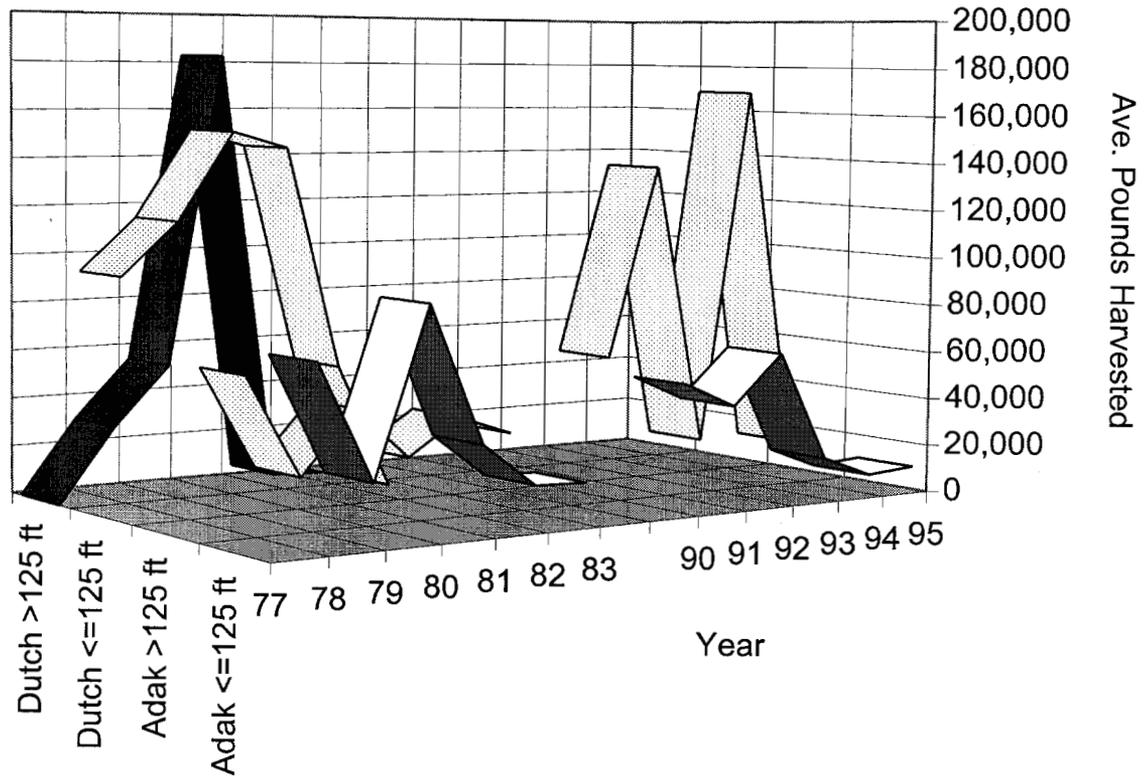


Figure 3. Average pounds harvested in the Aleutian red king crab fisheries by year sequence, vessel size class and fishery.

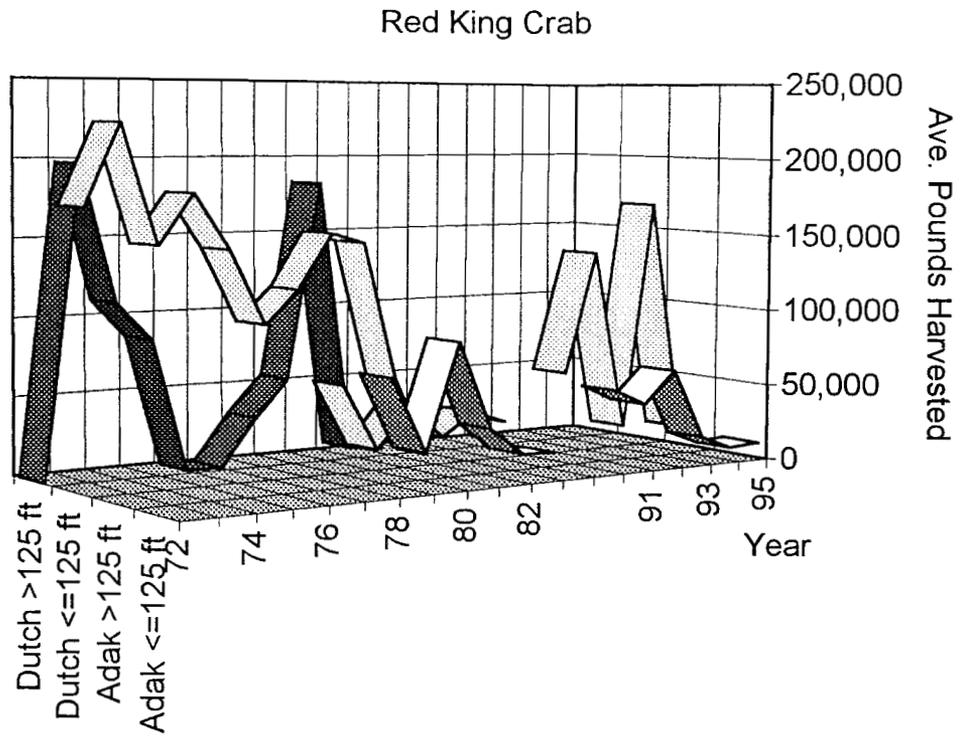


Figure 3. Average pounds harvested in the Aleutian red king crab fisheries by year sequence, vessel size class and fishery.

### Red King Crab Fishery Diversification

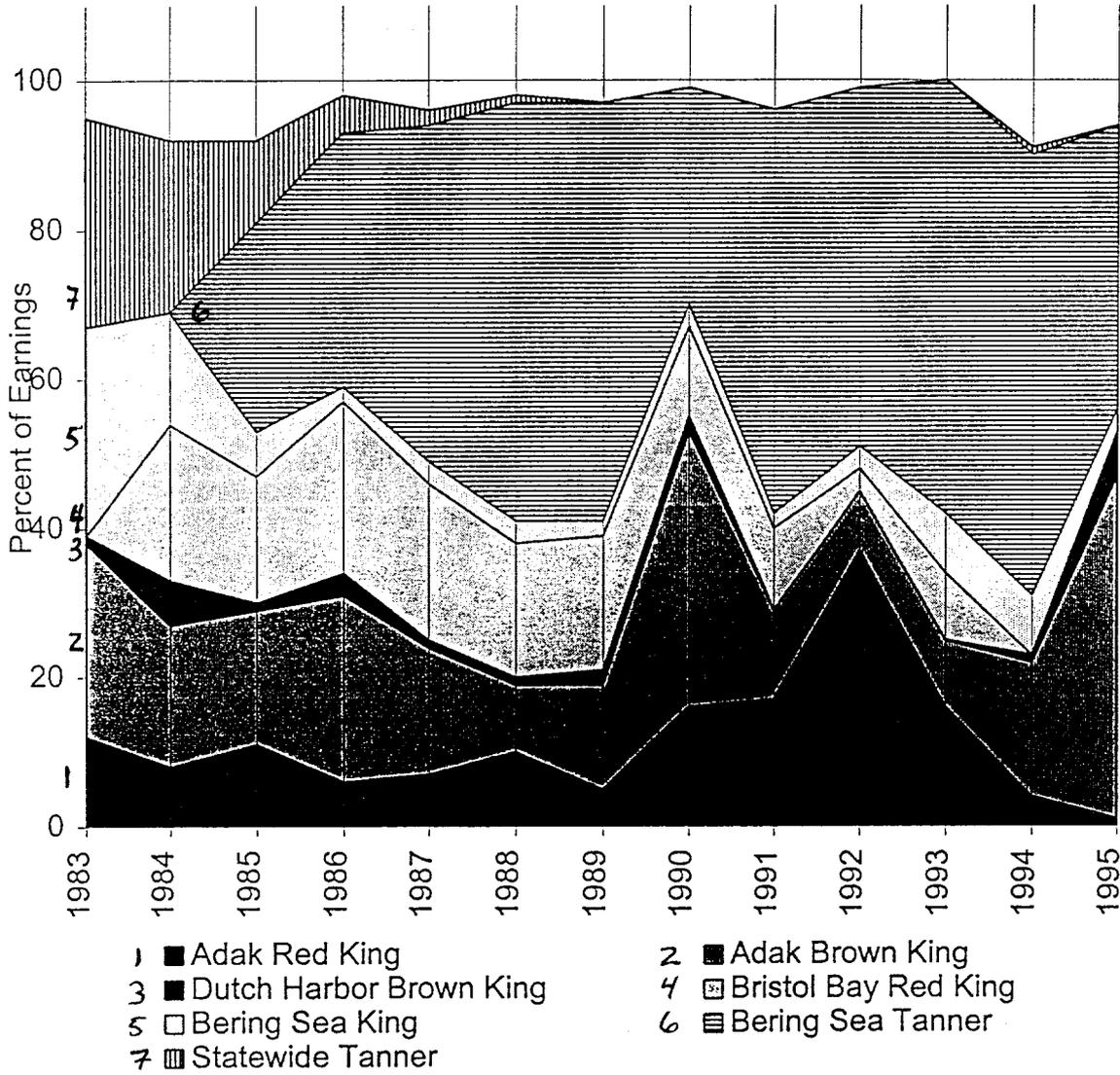


Figure 4. Percent of earnings that vessels targeting the Adak red king crab stock have derived from other crab fisheries by year.

### Red King Crab Fishery Diversification

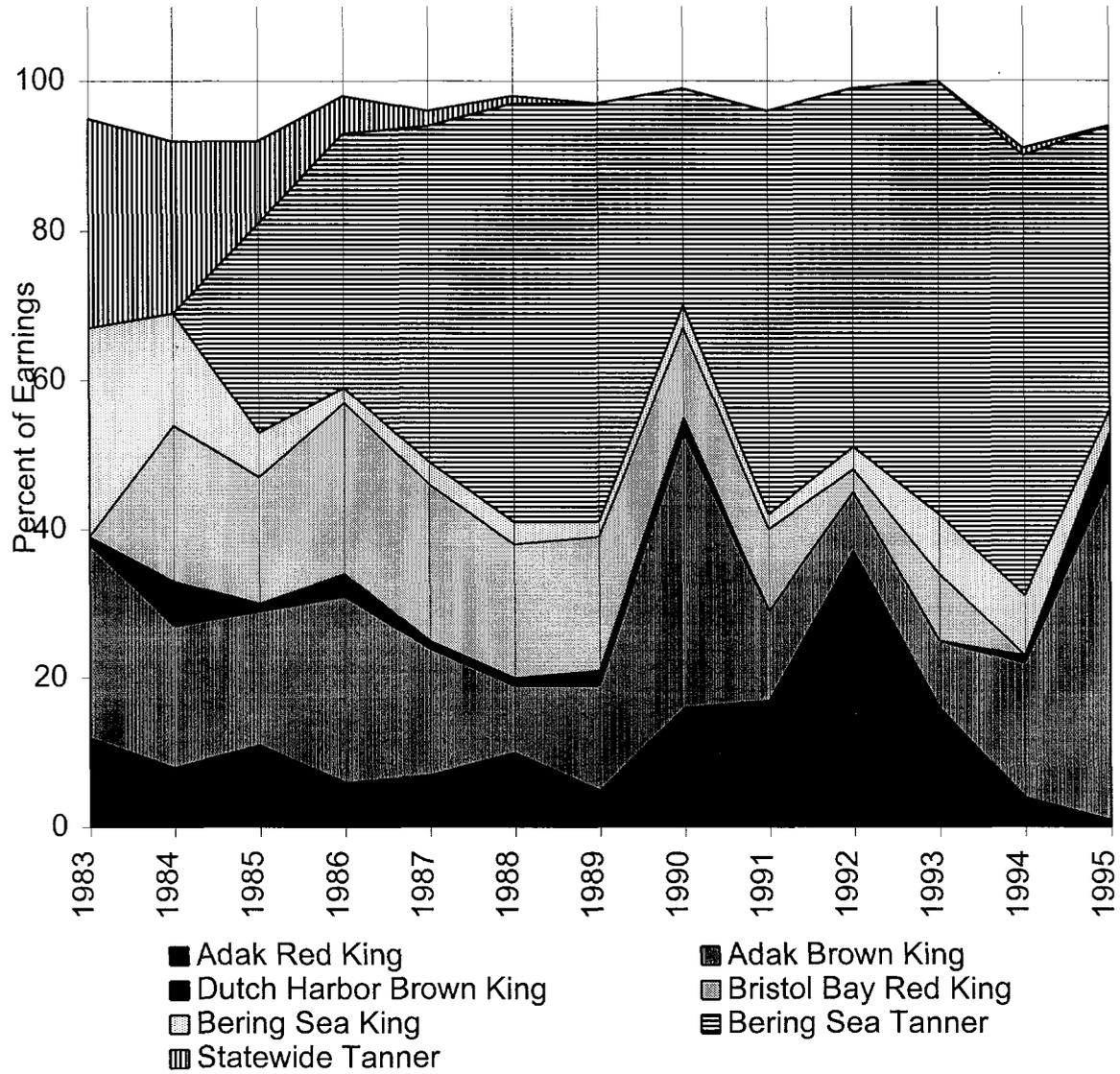
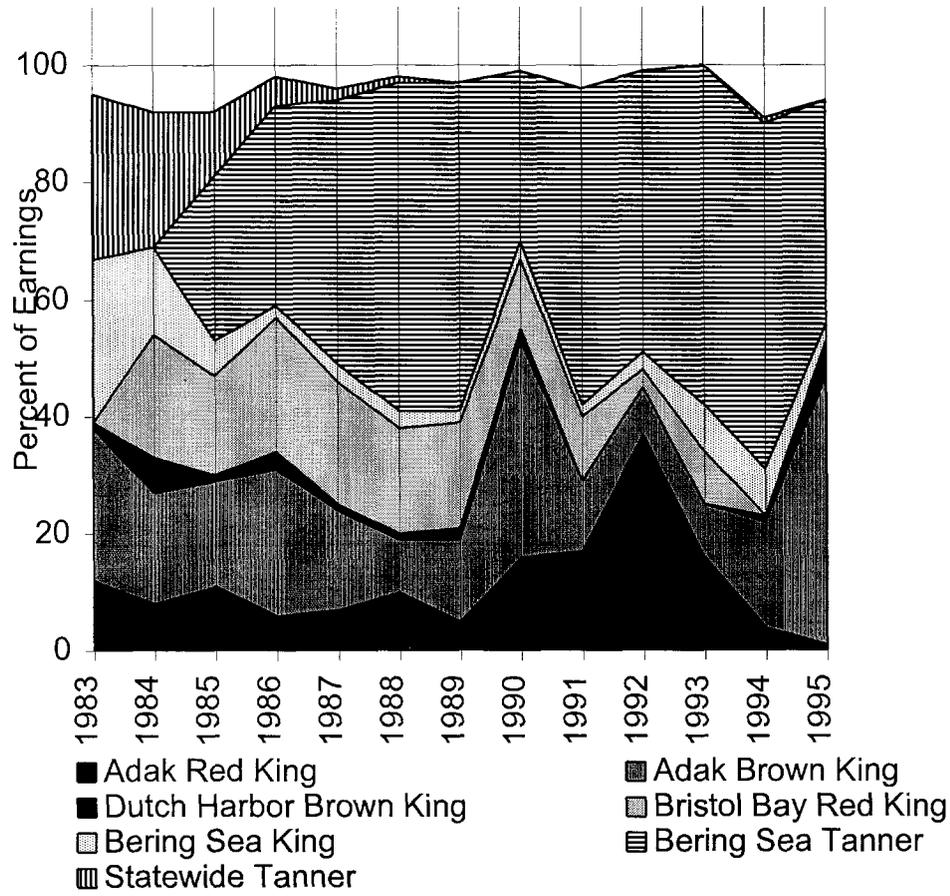


Figure 4. Percent of earnings that vessels targeting the Adak red king crab stock have derived from other crab fisheries by year.

## Red King Crab Fishery Diversification



### Brown King Crab

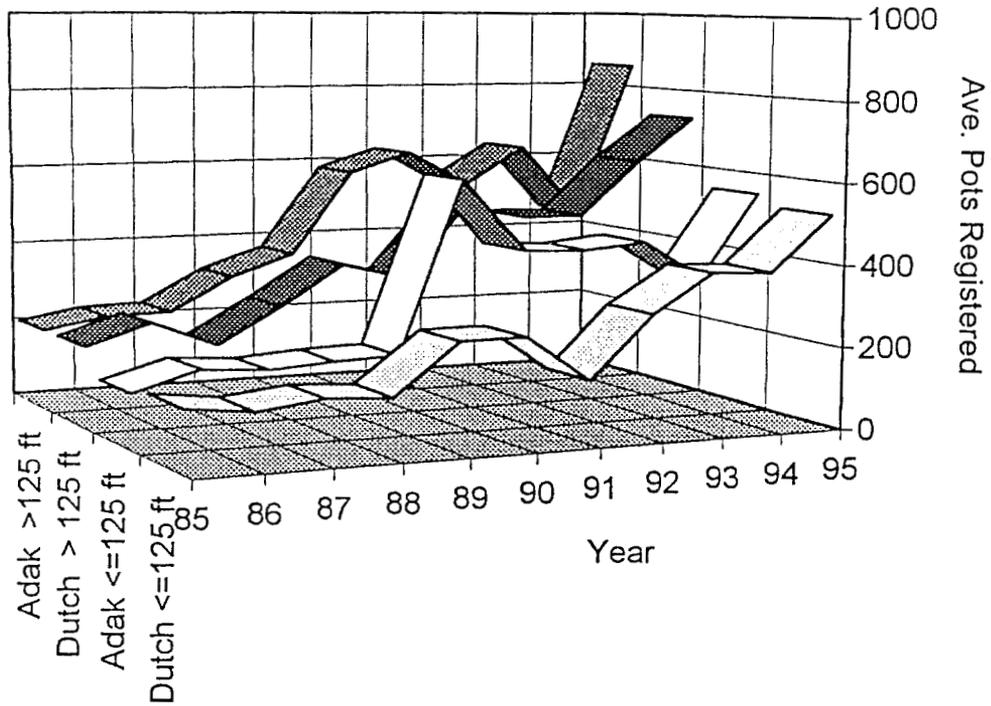
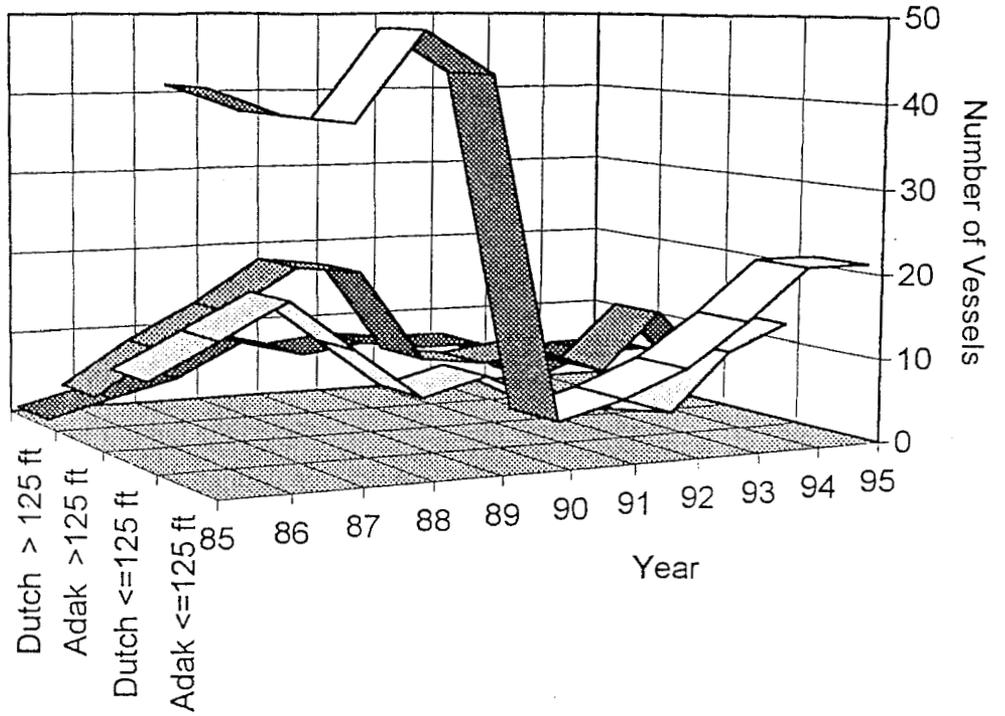


Figure 5. Number of vessels (top) and average pots (bottom) registered in the Aleutian brown king crab fisheries by year, vessel size class, and fishery.

### Brown King Crab

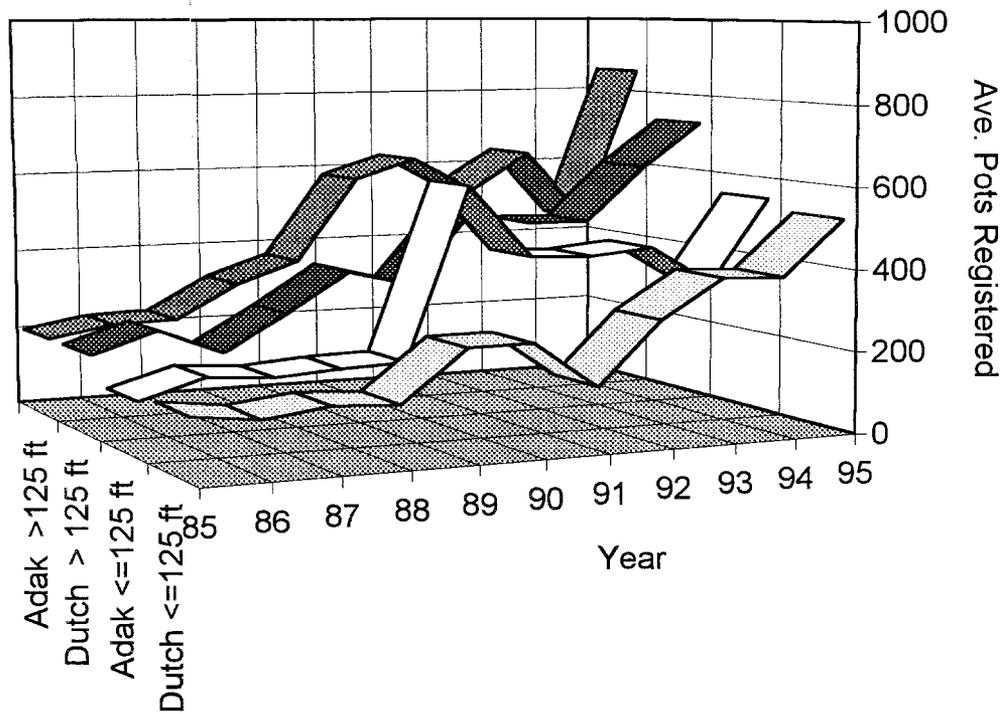
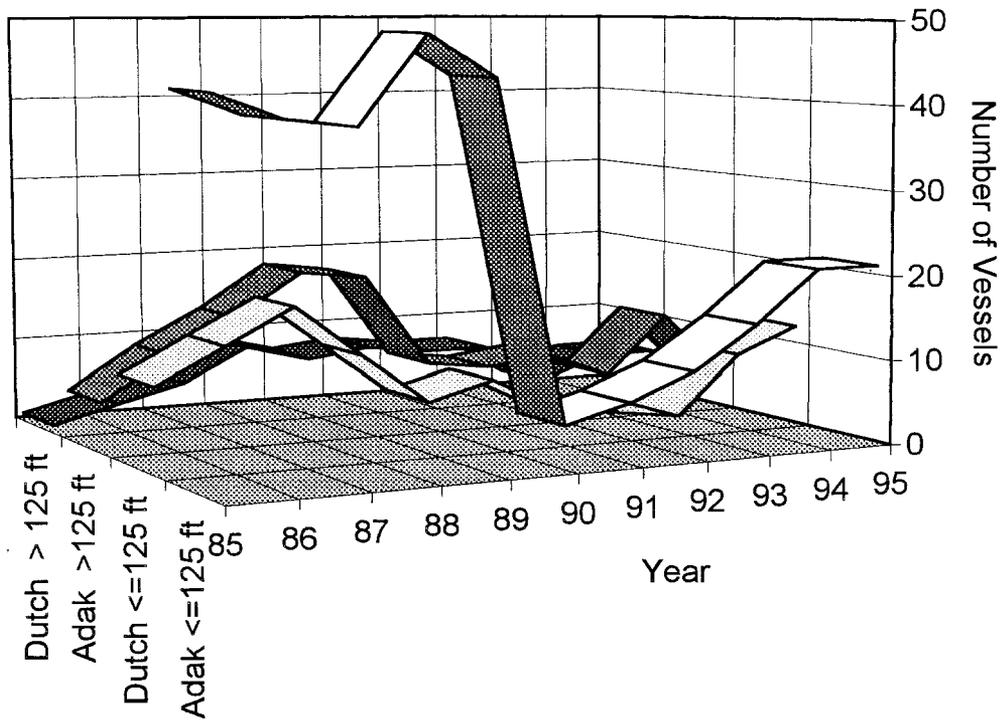


Figure 5. Number of vessels (top) and average pots (bottom) registered in the Aleutian brown king crab fisheries by year, vessel size class, and fishery.

### Brown King Crab

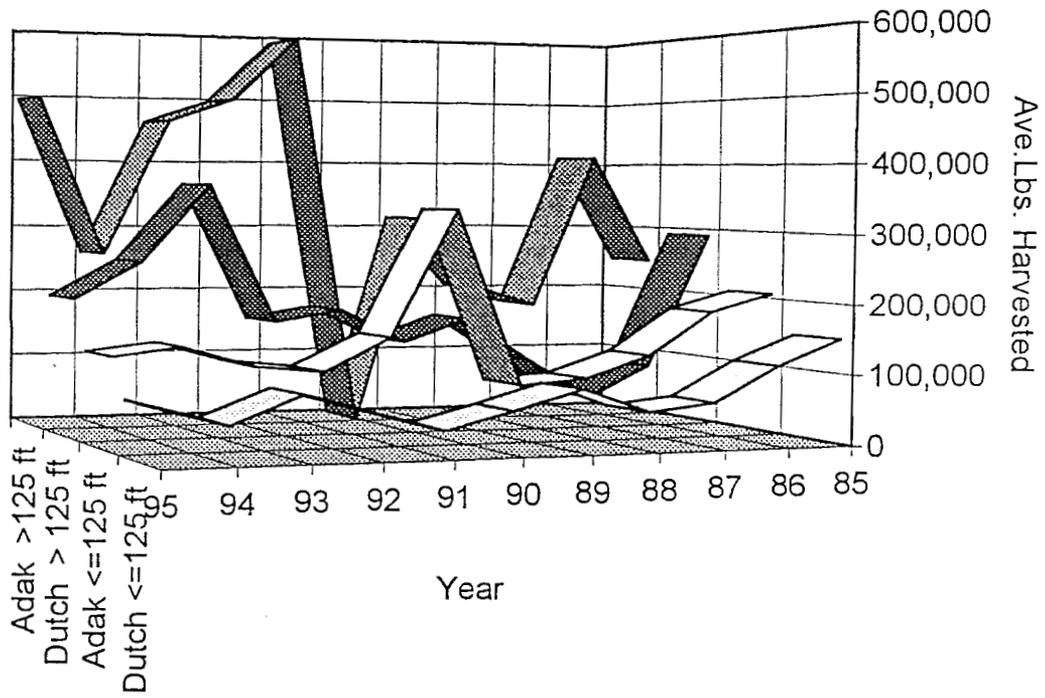


Figure 6. Average pounds harvested in the Aleutian brown king crab fisheries by year, vessel size class and fishery.

### Brown King Crab

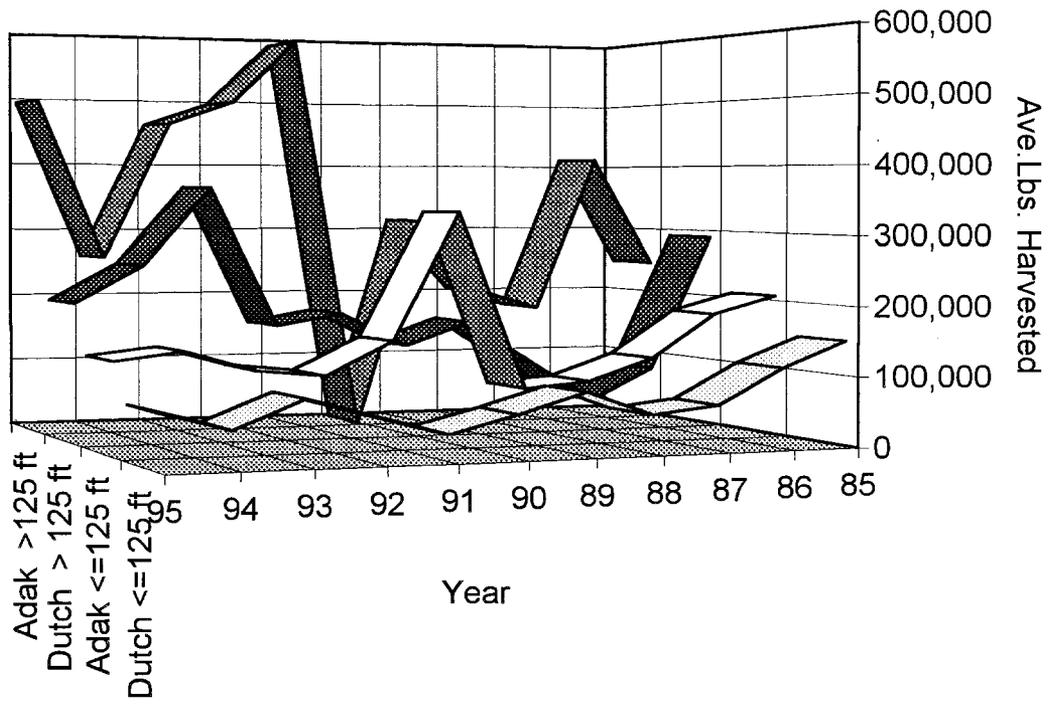
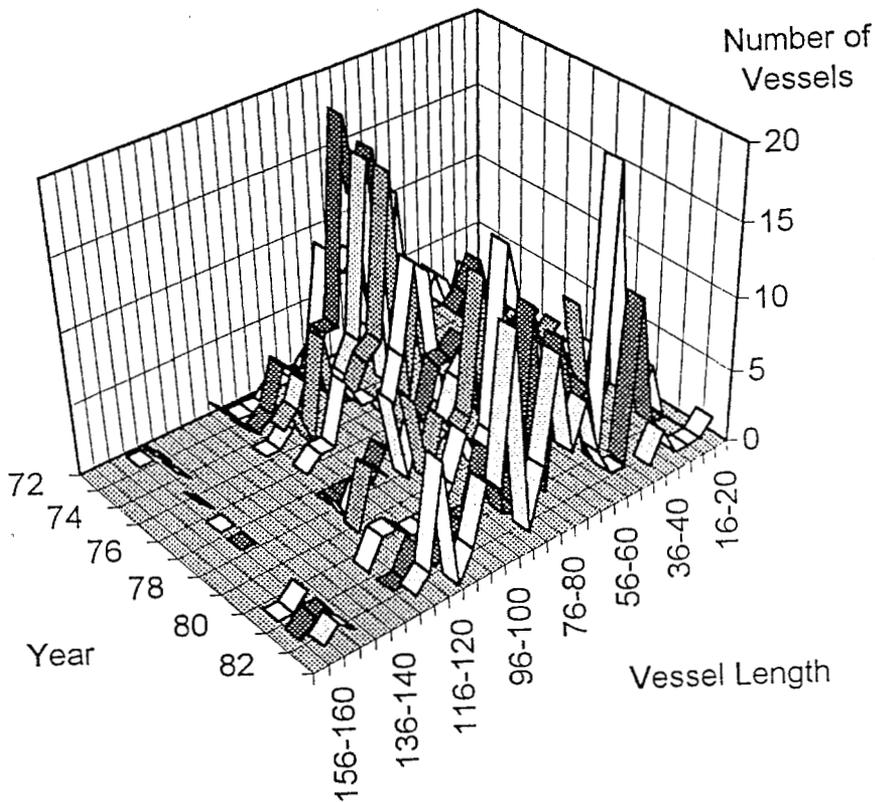


Figure 3. Average pounds harvested in the Aleutian brown king crab fisheries by year, vessel size class and fishery.

### Dutch Harbor Red King Crab



### Adak Red King Crab

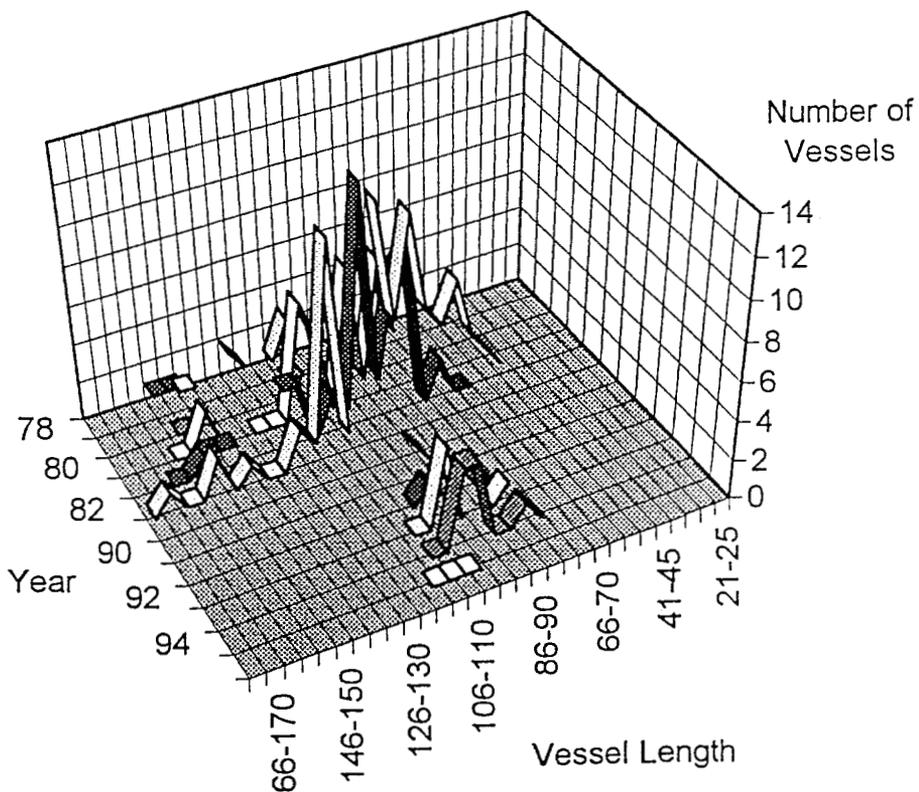
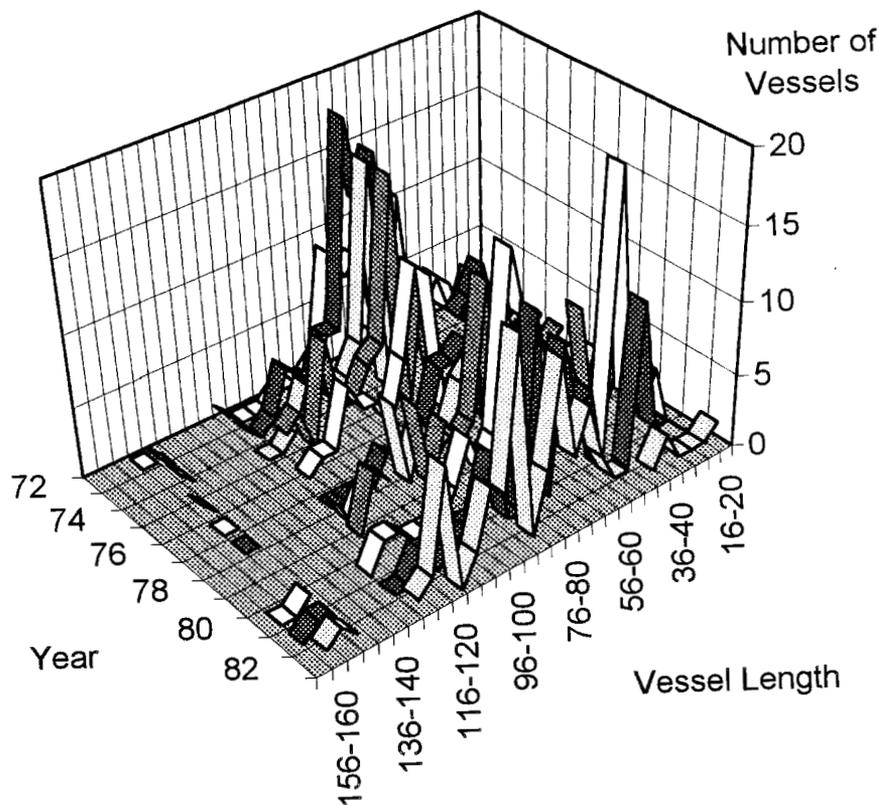


Figure 7. Number of vessels targeting Dutch Harbor and Adak red king crab stocks by vessel length and year. The last eleven years (1972 - 1982) of the Dutch Harbor fishery are shown in the top panel and the last six years (1990-1996) of the Adak fishery and the five years (1978-1982) corresponding to the last five years of the Dutch Harbor fishery are shown in the bottom panel.

### Dutch Harbor Red King Crab



### Adak Red King Crab

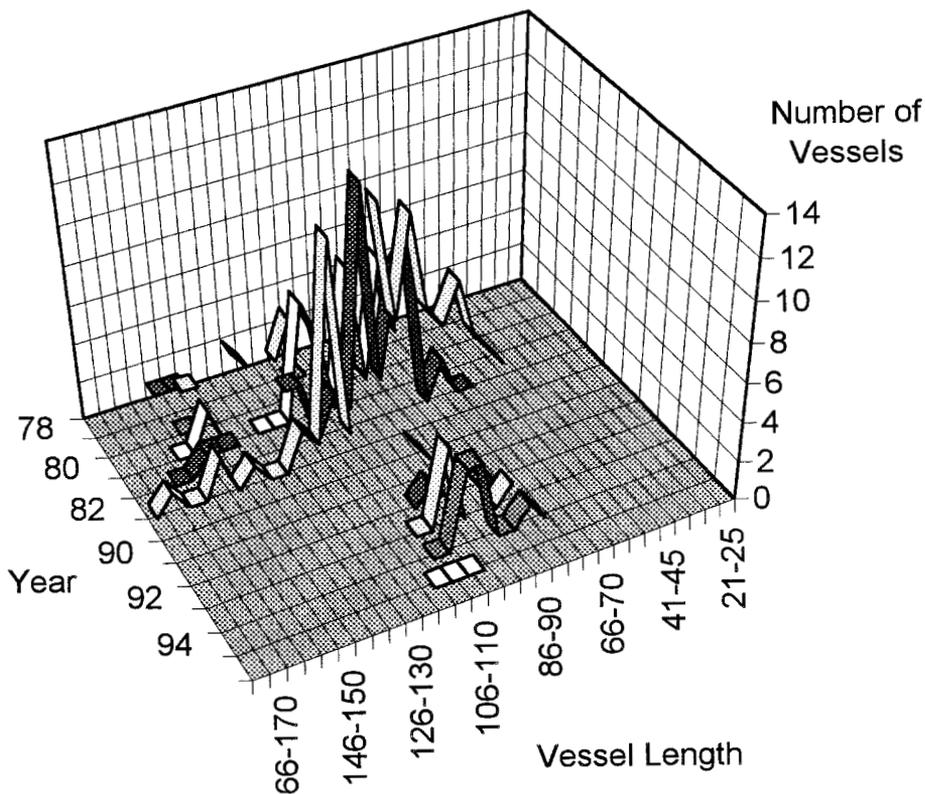


Figure 7. Number of vessels targeting Dutch Harbor and Adak red king crab stocks by vessel length and year. The last eleven years (1972 - 1982) of the Dutch Harbor fishery are shown in the top panel and the last six years (1990-1996) of the Adak fishery and the five years (1978-1982) corresponding to the last five years of the Dutch Harbor fishery are shown in the bottom panel.

### Red King Crab

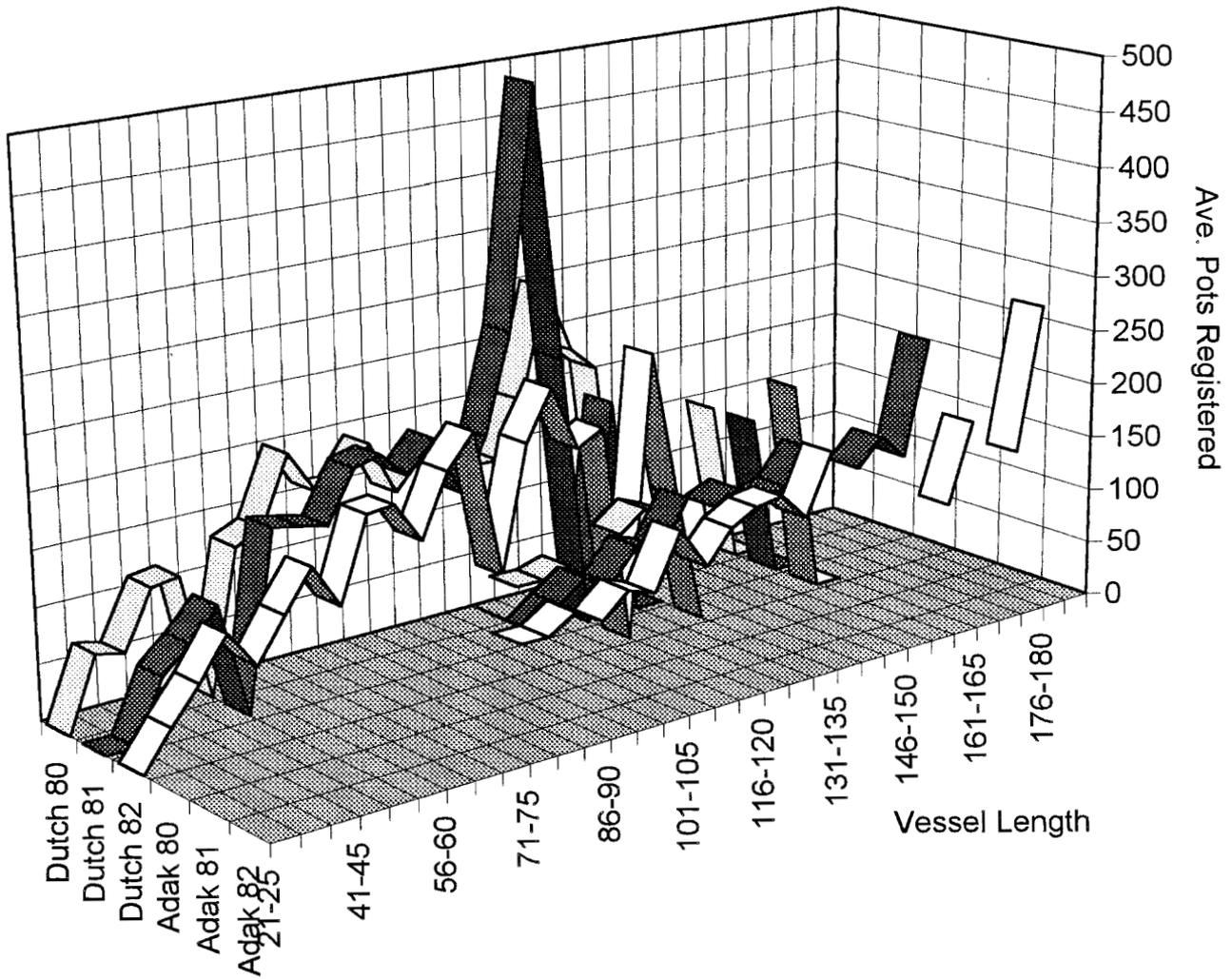


Figure 8. Average Pots registered in the Aleutian king crab fisheries by vessel length and by fishery year.

### Red King Crab

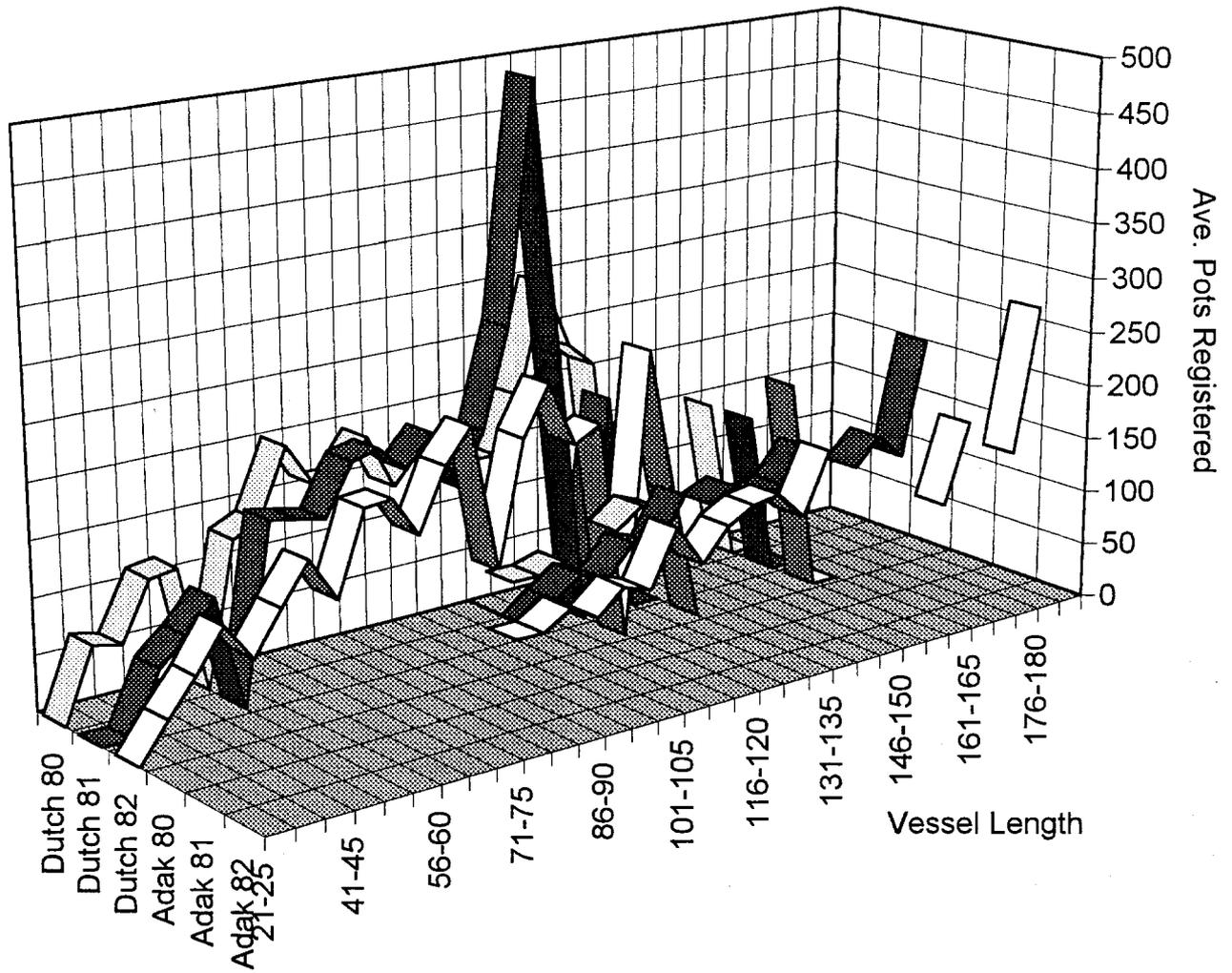
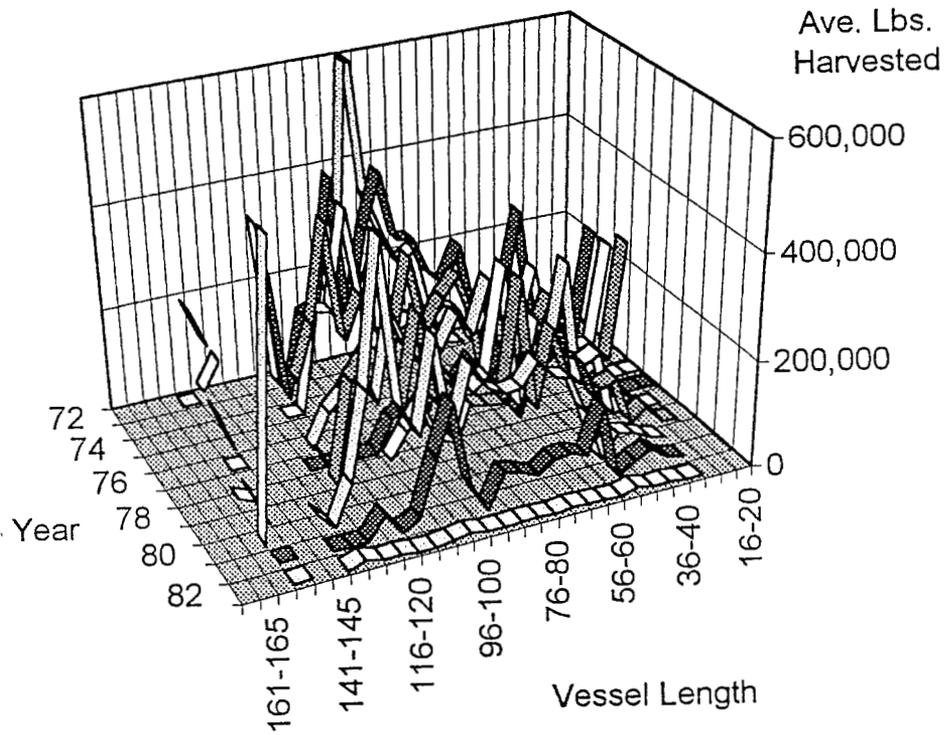


Figure 8. Average Pots registered in the Aleutian king crab fisheries by vessel length and by fishery year.

### Dutch Harbor Red King Crab



### Adak Red King Crab

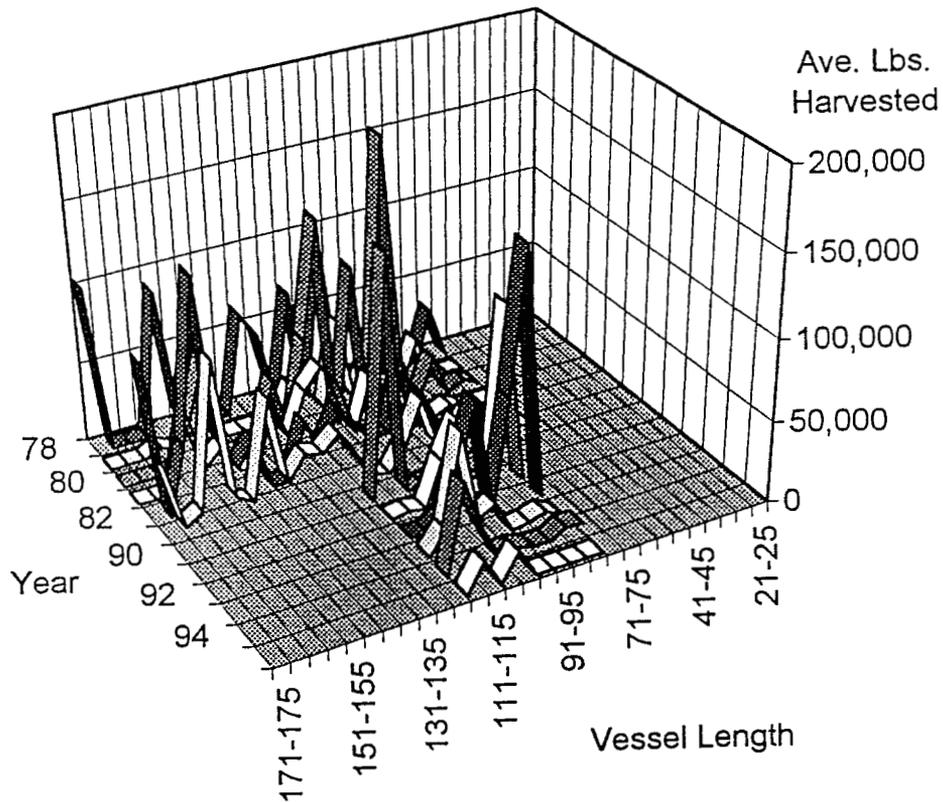
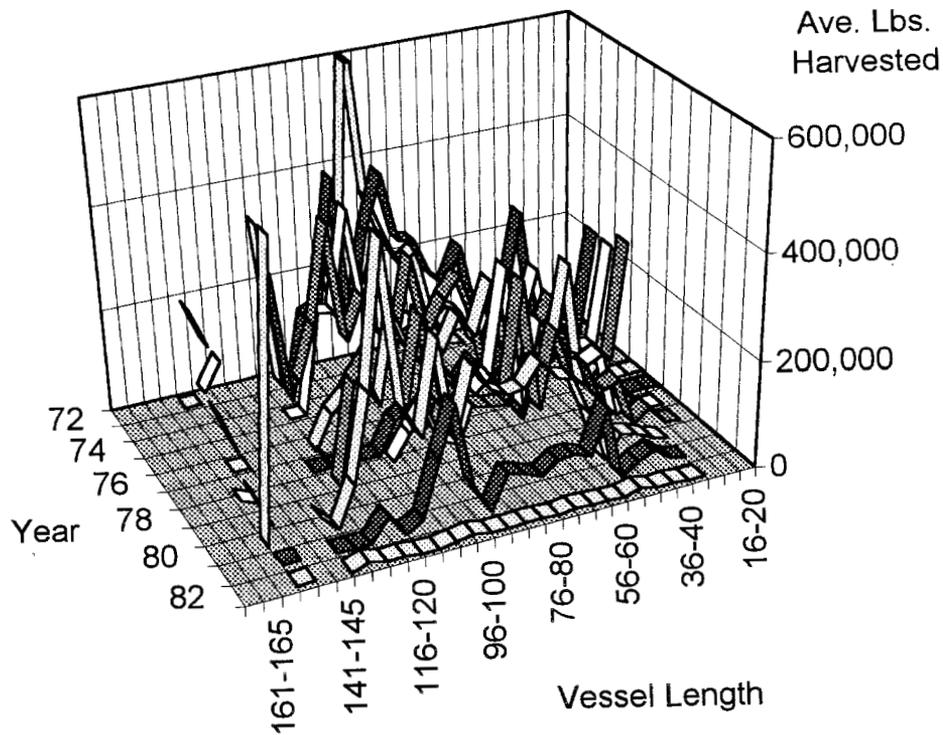


Figure 9. Average Pots registered by vessels targeting Dutch Harbor and Adak red king crab stocks by vessel length and year. The last eleven years (1972 - 1982) of the Dutch Harbor fishery are shown in the top panel and the last six years (1990-1996) of the Adak fishery and the five years (1978-1982) corresponding to the last five years of the Dutch Harbor fishery are shown in the bottom panel.

### Dutch Harbor Red King Crab



### Adak Red King Crab

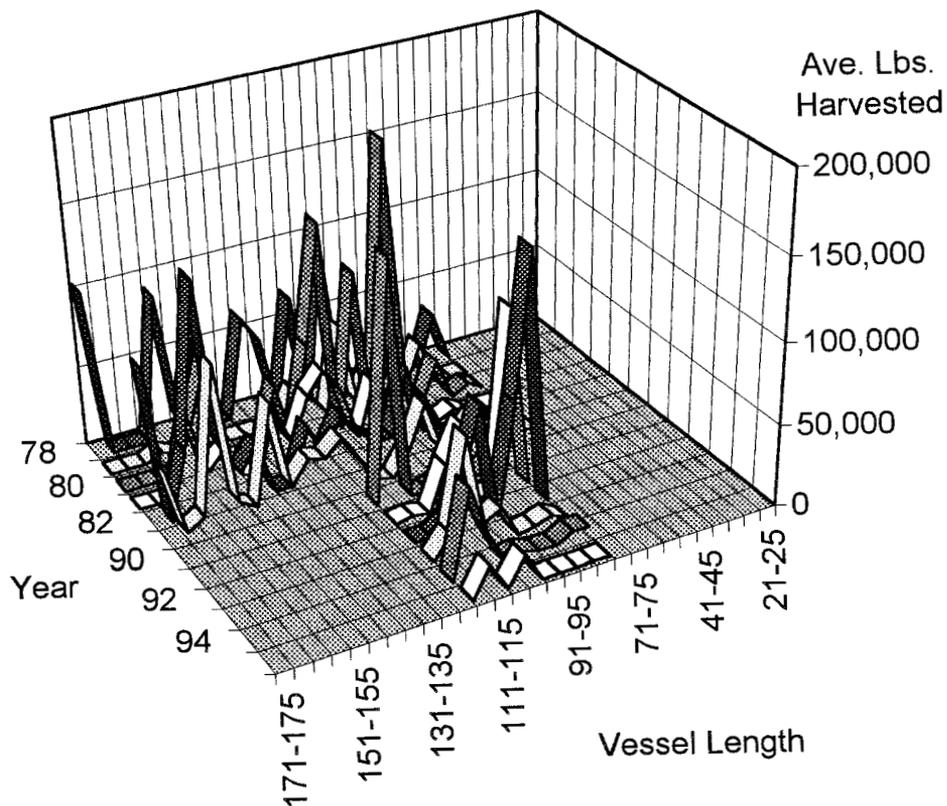
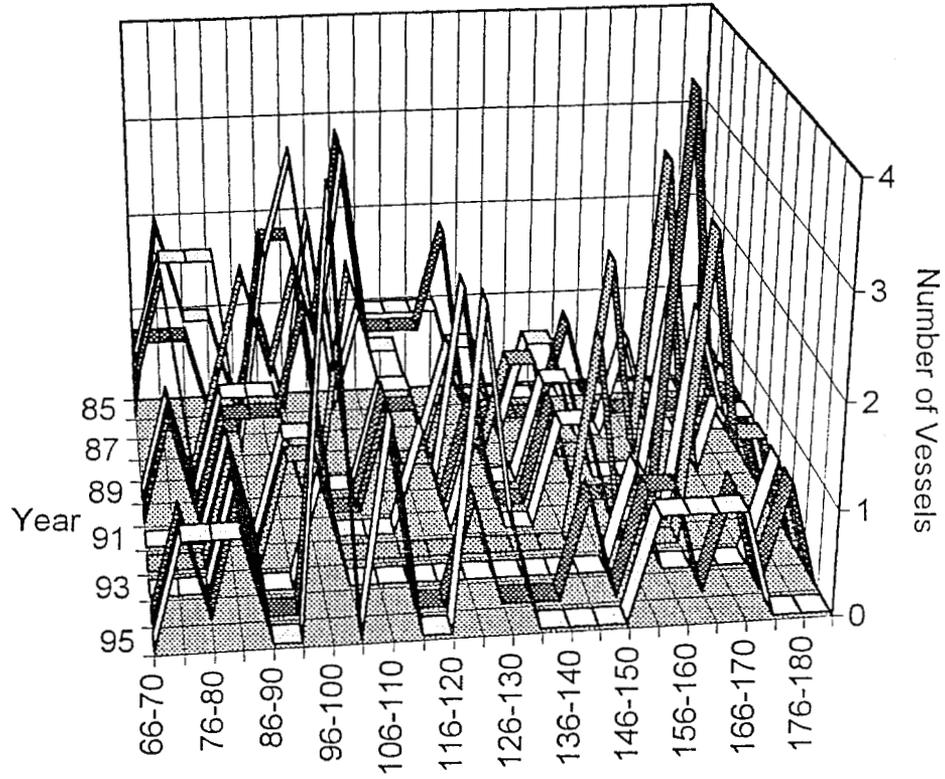


Figure 9. Average Pots registered by vessels targeting Dutch Harbor and Adak red king crab stocks by vessel length and year. The last eleven years (1972 - 1982) of the Dutch Harbor fishery are shown in the top panel and the last six years (1990-1996) of the Adak fishery and the five years (1978-1982) corresponding to the last five years of the Dutch Harbor fishery are shown in the bottom panel.

### Dutch Harbor Brown King Crab



### Adak Brown King Crab

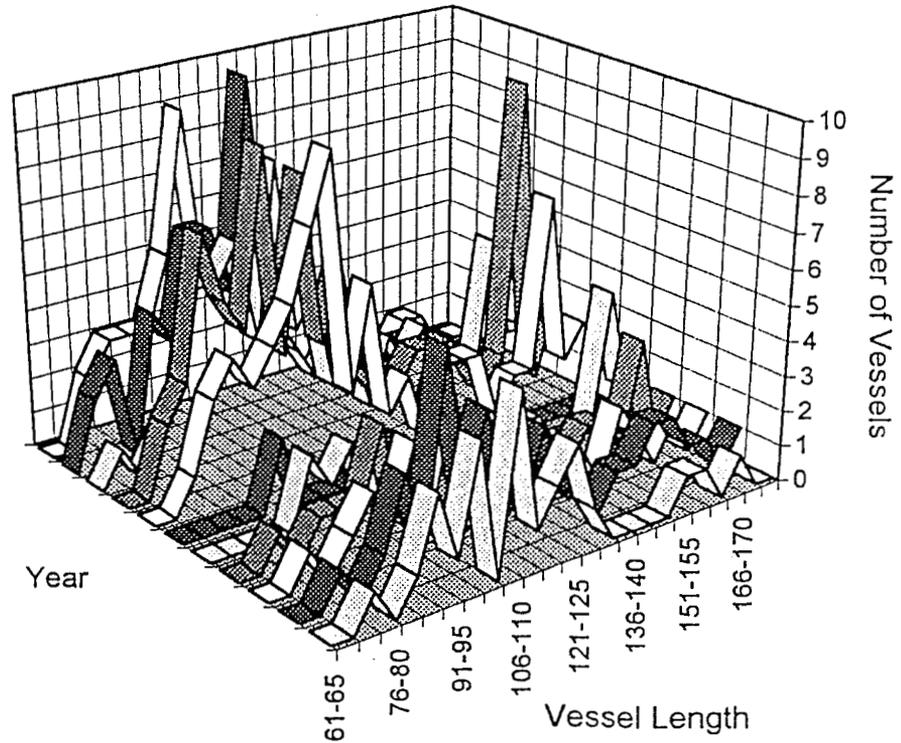
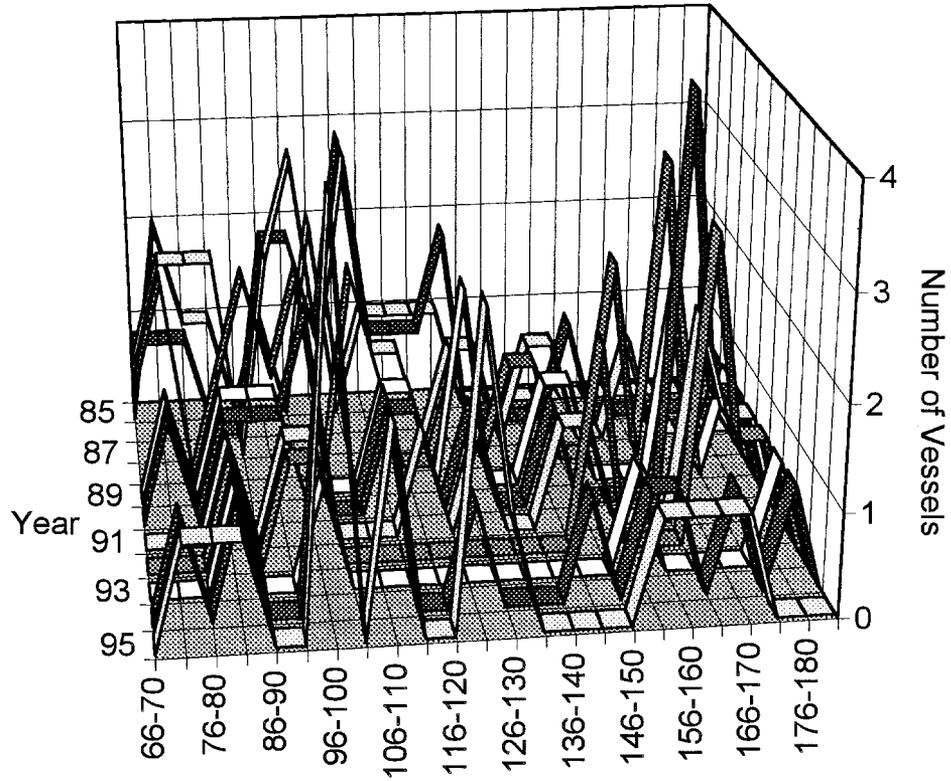


Figure 10. Number of vessels targeting Dutch Harbor (top) and Adak (bottom) brown king crab stocks by vessel length and year.

### Dutch Harbor Brown King Crab



### Adak Brown King Crab

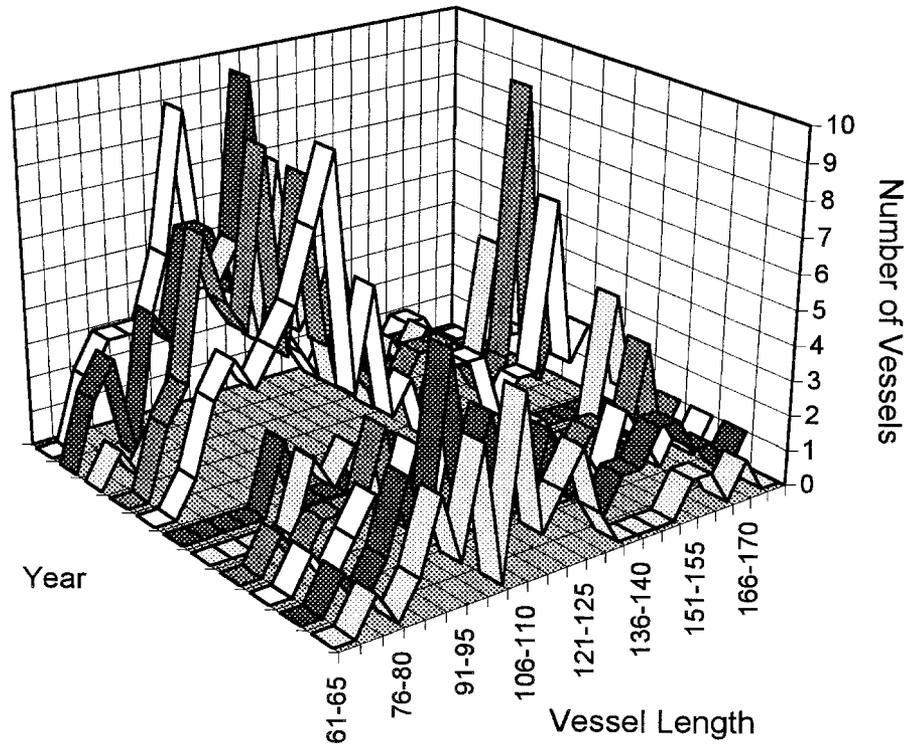
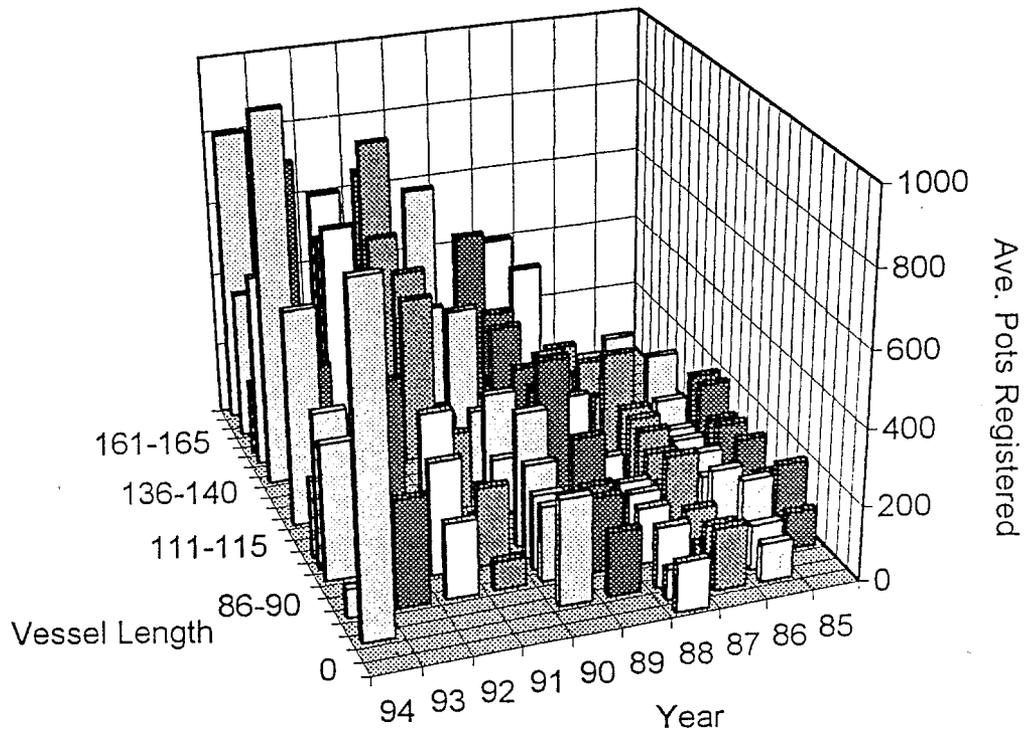


Figure 10. Number of vessels targeting Dutch Harbor (top) and Adak (bottom) brown king crab stocks by vessel length and year.

### Dutch Harbor Brown King Crab



### Adak Brown King Crab

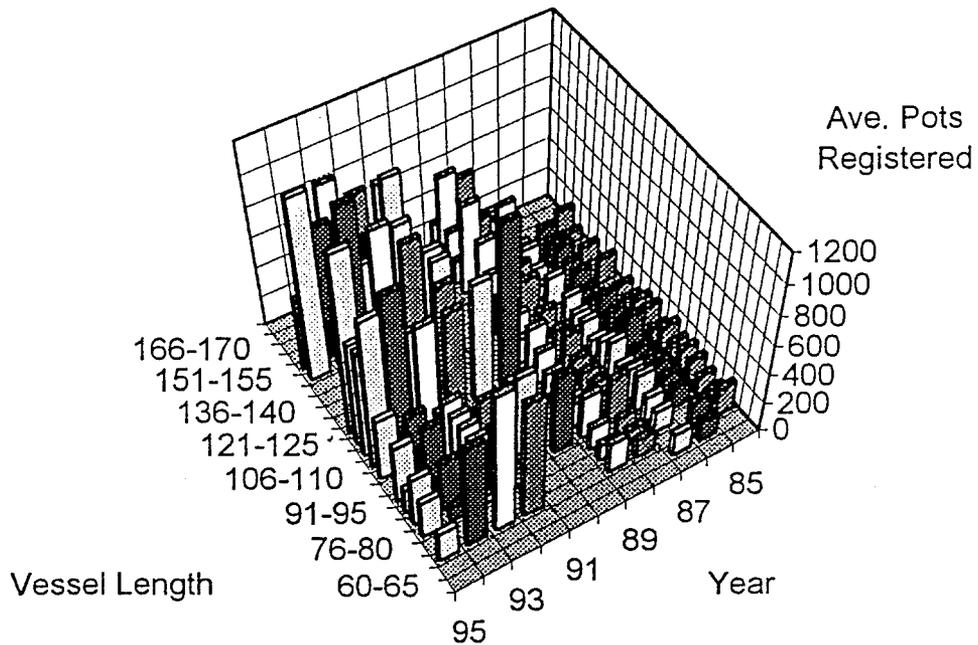
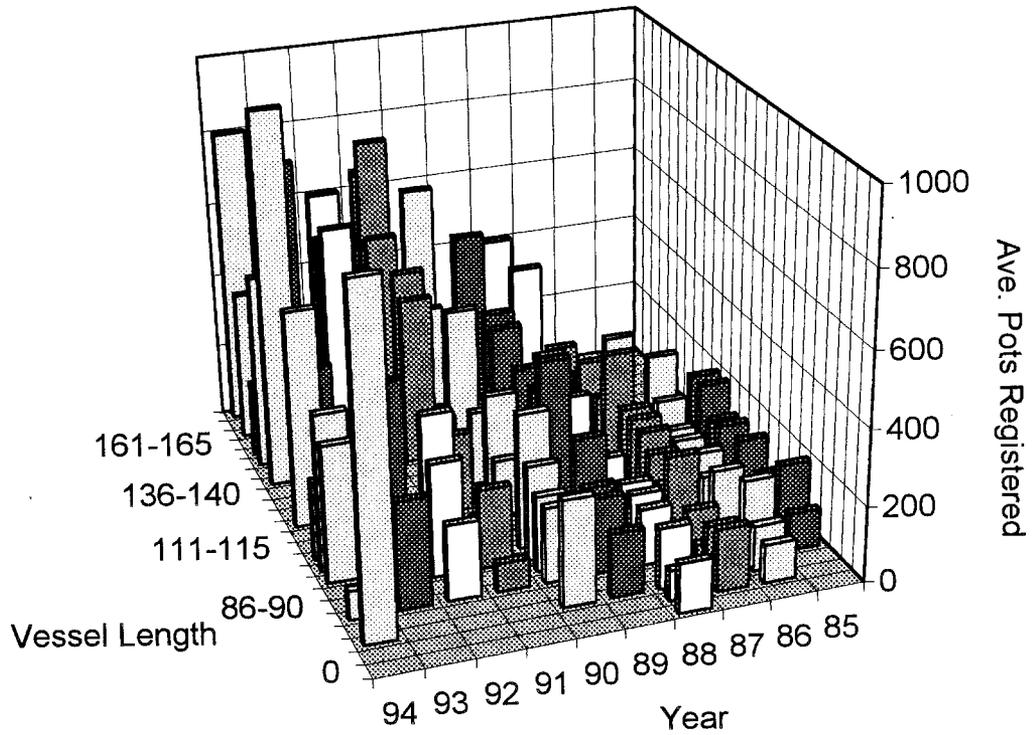


Figure 11. Average pots registered by vessels targeting Dutch Harbor (top) and Adak (bottom) brown king crab stocks by vessel length and year. Note the X and Z axis switch between the plots for the two stocks.

### Dutch Harbor Brown King Crab



### Adak Brown King Crab

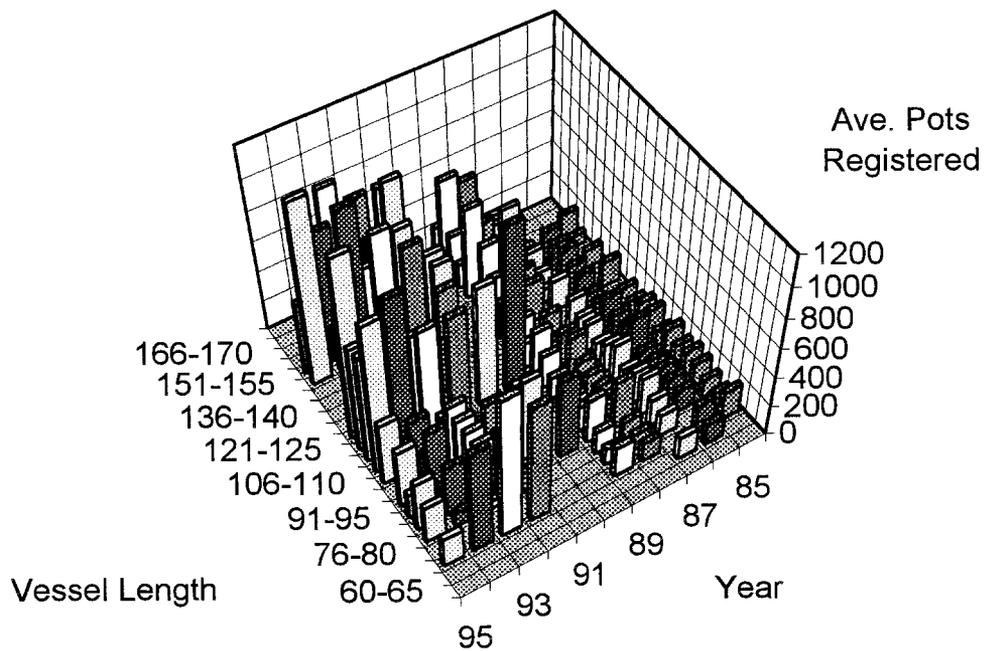
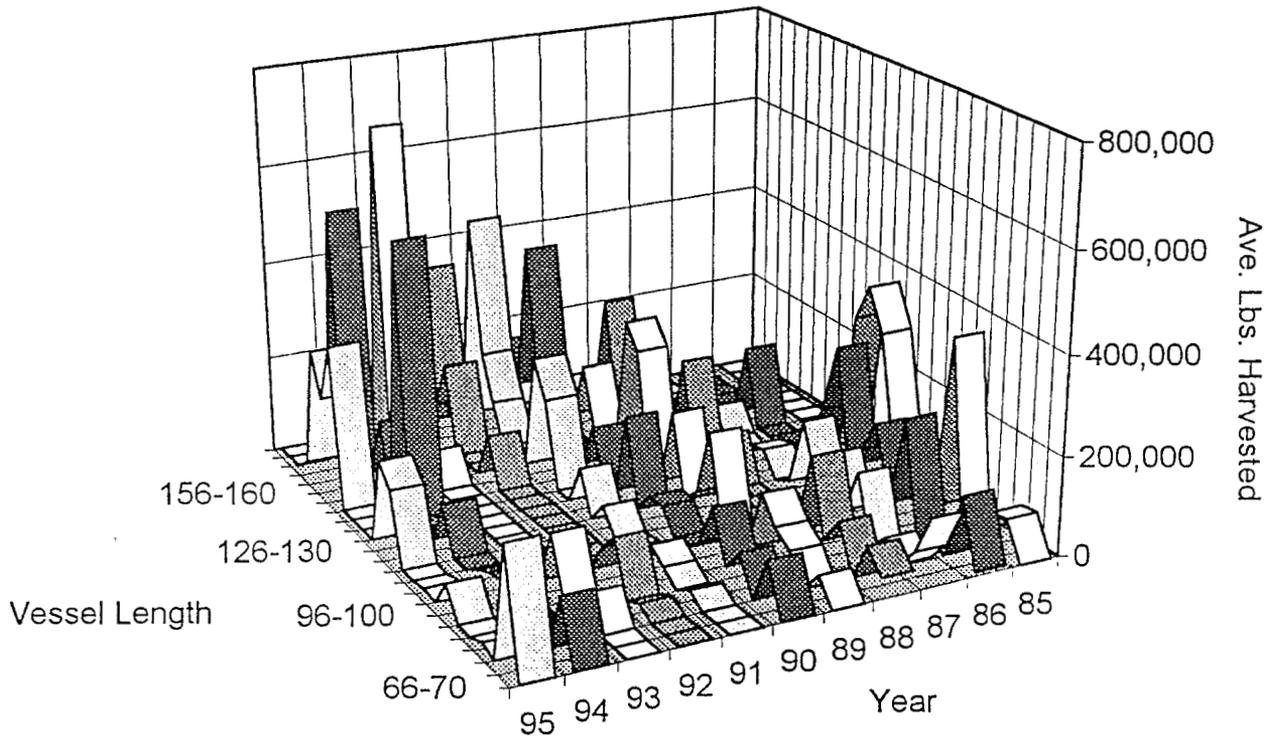


Figure 11. Average pots registered by vessels targeting Dutch Harbor (top) and Adak (bottom) brown king crab stocks by vessel length and year. Note the X and Z axis switch between the plots for the two stocks.

### Dutch Harbor Brown King Crab



### Adak Brown King Crab

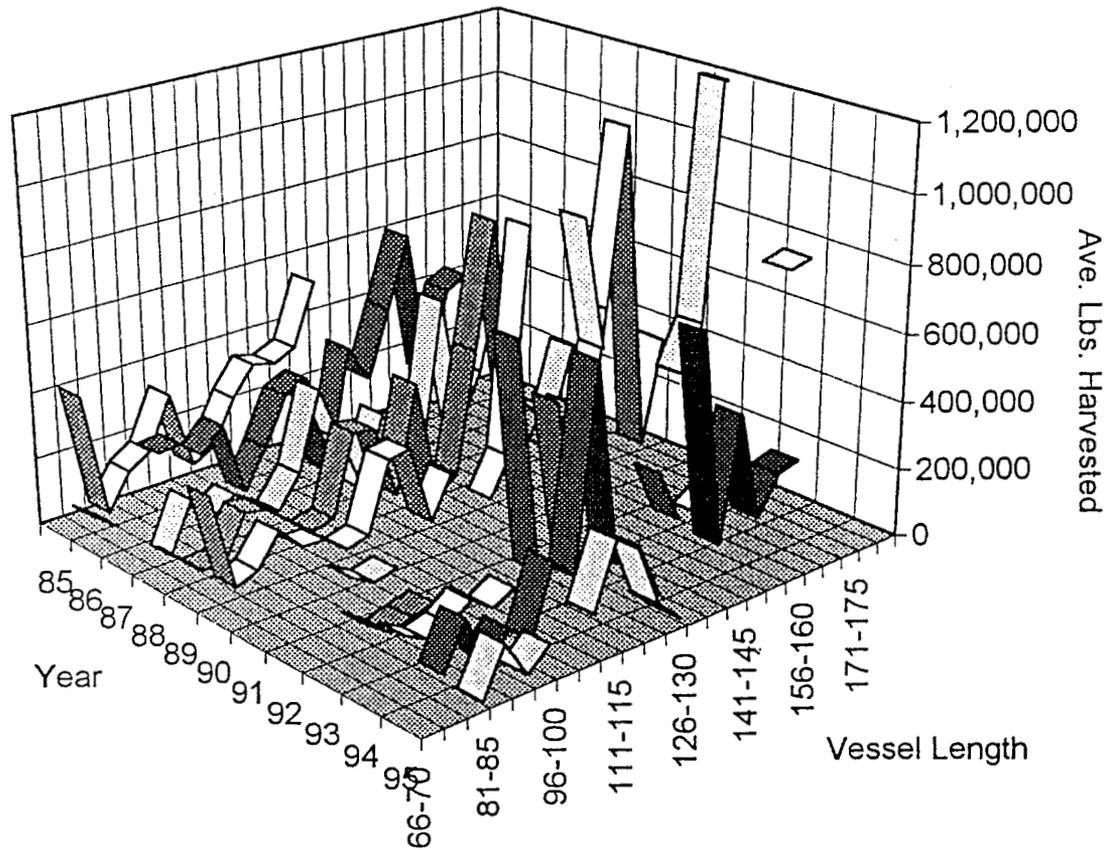
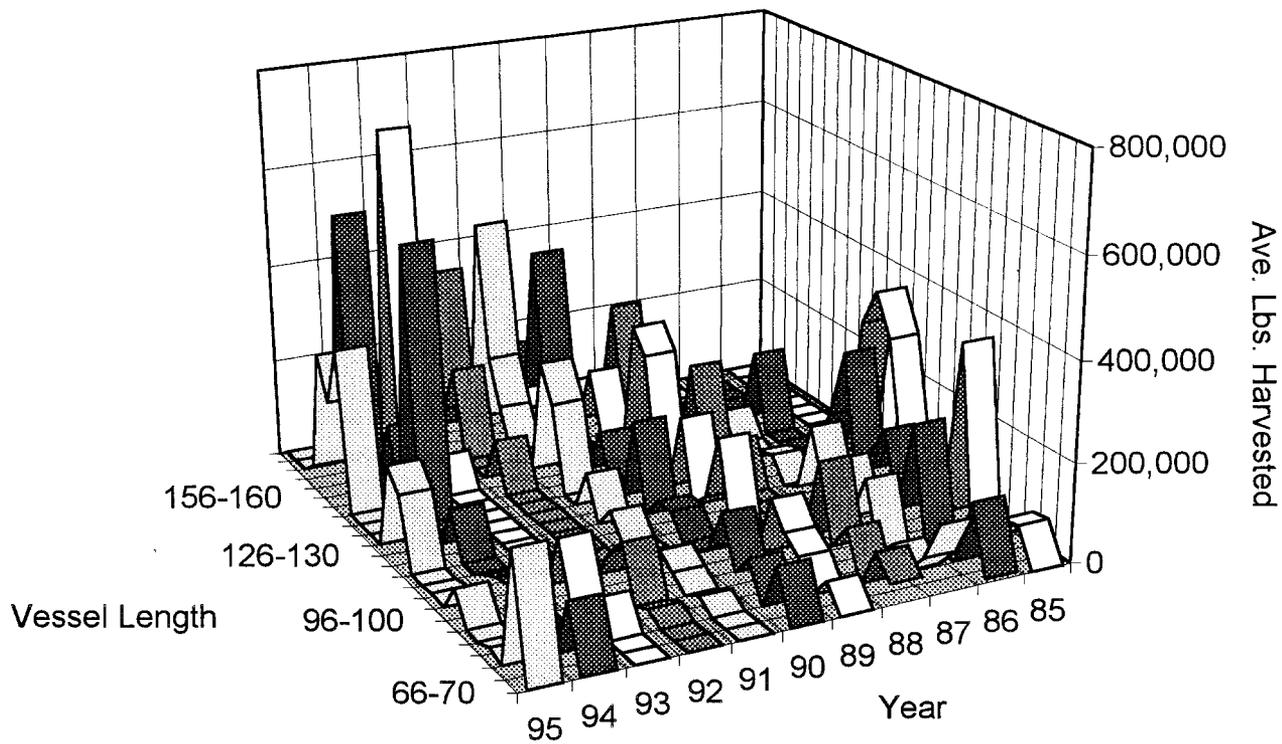


Figure 12. Average pounds harvested by vessels targeting Dutch Harbor (top) and Adak (bottom) brown king crab stocks by vessel length and year. Note the X and Z axis switch between the plots for the two stocks.

### Dutch Harbor Brown King Crab



### Adak Brown King Crab

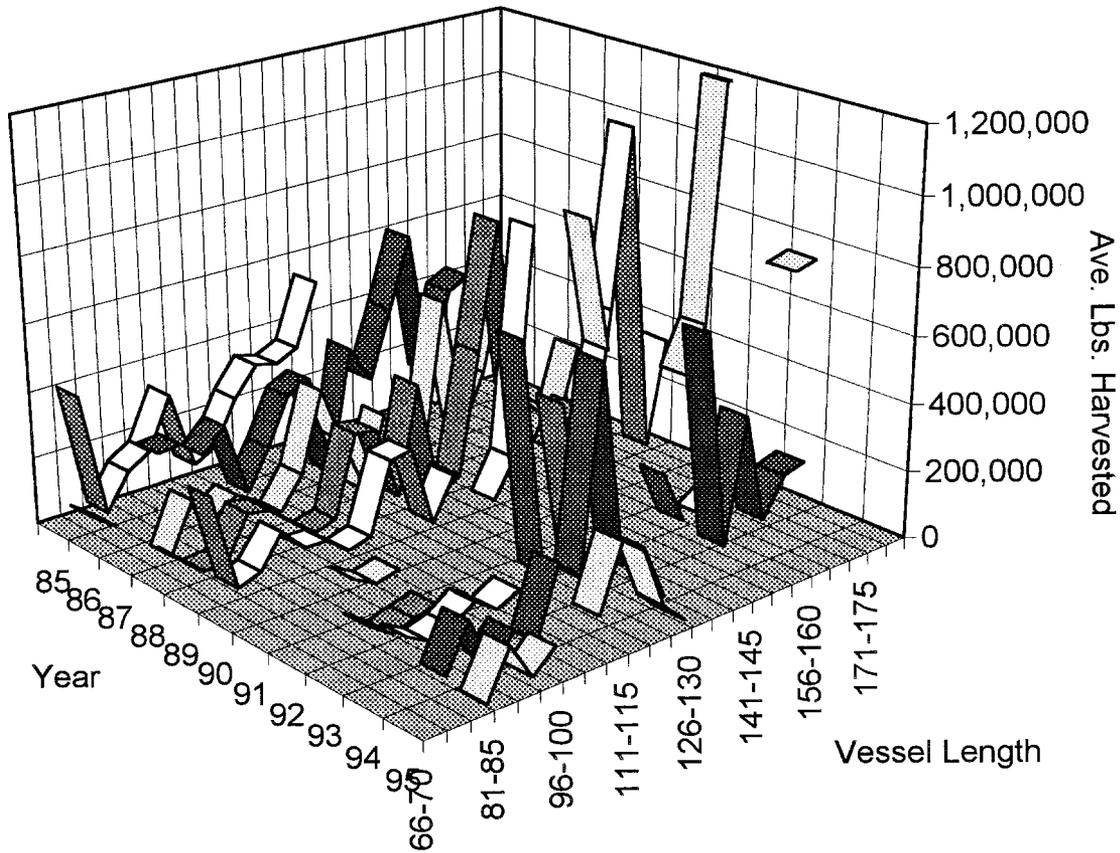


Figure 12. Average pounds harvested by vessels targeting Dutch Harbor (top) and Adak (bottom) brown king crab stocks by vessel length and year. Note the X and Z axis switch between the plots for the two stocks.

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

7.2.1 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.

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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&G1986).

Appendix Table 2. Adak, Area R, historic red king crab catch statistics, 1960/61-1995/96.

Season	Number of			Harvest <sup>a,b</sup>	Pots Pulled	CPUE <sup>c</sup>	Percent Recruits	Average		Deadloss <sup>b</sup>
	Vessels	Landings	Crab <sup>a</sup>					Weight <sup>b</sup>	Length <sup>d</sup>	
1960/61	4	41	NA	2,074,000	NA	9	NA	NA	NA	NA
1961/62	8	218	NA	6,114,000	NA	NA	NA	NA	NA	NA
1962/63	9	248	NA	8,006,000	NA	NA	NA	NA	NA	NA
1963/64	11	527	NA	17,904,00	NA	NA	NA	NA	NA	NA
1964/65	18	442	NA	21,193,00	NA	NA	NA	NA	NA	NA
1965/66	10	431	NA	12,915,00	NA	NA	NA	NA	NA	NA
1966/67	10	90	NA	5,883,000	NA	NA	NA	NA	NA	NA
1967/68	22	505	NA	14,131,00	NA	NA	NA	NA	NA	NA
1968/69	30		NA	16,100,00	NA	NA	NA	NA	NA	NA
1969/70	33	435	NA	18,016,00	115,929	NA	NA	6.5	NA	NA
1970/71	35	378	NA	16,057,00	124,235	NA	NA	NA	NA	NA
1971/72	40	166	NA	15,475,94	46,011	NA	NA	NA	NA	NA
1972/73	43	313	3,461,025	18,724,14	81,133	43	50.9	5.4	NA	NA
1973/74	41	239	1,844,974	9,741,464	70,059	26	48.5	5.3	148.6	NA
1974/75	36	97	532,298	2,774,963	32,620	16	48.6	5.2	148.6	NA
1975/76	20	25	79,977	411,583	8,331	10	67.5	5.2	147.2	NA
1976/77										
					C l o s e d					
1977/78	12	18	160,343	905,527	7,269	22	43.9	5.7	152.2	NA
1978/79	13	27	149,491	807,195	13,948	11	56.7	5.4	NA	1,170
1979/80	18	23	82,250	467,229	9,757	8	42.8	5.7	152.0	24,850
1980/81	17	52	254,390	1,419,513	20,914	12	65.2	5.6	149.0	54,360
1981/82	46	106	291,311	1,648,926	40,697	7	55.5	5.7	148.3	8,759

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Season	Number of		Crab <sup>a</sup>	Harvest <sup>a,b</sup>	Pots Pulled	CPUE <sup>c</sup>	Percent Recruits	Average		Deadloss <sup>b</sup>
	Vessels	Landings						Weight <sup>b</sup>	Length <sup>d</sup>	
1982/83	72	191	284,787	1,701,818	66,893	4	49.9	6.0	150.8	7,855
1983/84	106	248	298,948	1,981,579	60,840	5	30.4	6.6	157.3	3,833
1984/85	64	113	206,751	1,367,672	50,685	4	31.4	6.6	155.1	0
1985/86	35	89	162,271	906,293	32,478	5	40.0	5.6	152.2	6,120
1986/87	33	69	126,146	712,243	29,189	4	NA	5.6	NA	500
1987/88	71	109	211,712	1,213,933	43,433	5	65.3	5.7	148.5	6,900
1988/89	73	156	266,053	1,567,314	64,374	4	39.0	5.9	153.1	557
1989/90	56	123	196,070	1,118,566	54,513	4	NA	5.7	NA	759
1990/91	7	34	146,903	828,105	10,674	14	NA	5.6	NA	0
1991/92	10	35	165,356	951,278	16,636	10	NA	5.7	NA	0
1992/93	12	30	218,049	1,286,424	16,129	13	NA	6.0	NA	5,000
1993/94	12	21	119,330	698,077	13,575	9	NA	5.8	NA	7,402
1994/95	20	31	30,337	196,967	18,146	2	NA	6.5	NA	1,430
1995/96	4	12	6,880	38,941	1,986	3.5	NA	5.7	NA	235

<sup>a</sup>Includes deadloss.<sup>b</sup>In pounds.<sup>c</sup>Defined as catch per pot pull.<sup>d</sup>In millimeters.

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Appendix Table 3.

Historic Adak red king crab economic performance, 1980/81-1995/96.

Year	Season Total <sup>a</sup>	Number of		Landings	Number of Pots		Value		Season Length	
		Vessels <sup>b</sup>	CP'S		Registered	Pulled	Exvessel	Total <sup>c</sup>	(Days)	Dates
1980/81	1.4	17	N/A	52	2,471	20,914	\$ 0.92	\$ 1.3	( 72)	01/15-03/28
1981/82	1.6	46	N/A	106	8,698	40,697	\$ 2.01	\$ 3.2	(107)	11/01-02/15
1982/83	1.7	72	N/A	191	13,111	66,893	\$ 3.44	\$ 5.9	( 76)	11/01-01/15
1983/84	2.0	106	N/A	248	19,407	60,840	\$ 3.43	\$ 6.9	(340)	01/10-12/16
1984/85	1.4	64	N/A	113	8,876	50,685	\$ 2.10	\$ 2.9	( 97)	11/10-02/15
1985/86	.9	35	N/A	89	8,274	32,478	\$ 2.15	\$ 1.9	(107)	11/01-02/15
1986/87	.7	33	N/A	69	12,958	29,189	\$ 3.85	\$ 2.7	(107)	11/01-02/15
1987/88	1.2	71	N/A	109	17,720	43,433	\$ 4.00	\$ 4.8	(107)	11/01-02/15
1988/89	1.6	73	11	156	23,927	64,374	\$ 5.00	\$ 8.0	( 34)	11/01-12/04
1989/90	1.1	56	10	123	19,363	54,513	\$ 4.20	\$ 4.6	(107)	11/01-02/15
1990/91	.7	7	4	34	8,500	10,674	\$ 4.00	\$ 2.8	(107)	11/01-02/15
1991/92	.9	10	3	35	2,305	16,636	\$ 3.00	\$ 2.9	(107)	11/01-02/15
1992/93	1.3	12	2	30	2,716 <sup>d</sup>	16,129	\$ 5.05	\$ 6.5	( 76)	11/01-01/15
1993/94	.7	12	1	21	3,948	13,575	\$ 3.87	\$ 2.7	(107)	11/01-02/15
1994/95	.2	20	2	31	4,065	18,146	\$ 5.50	\$ 1.1	( 27)	11/01-11/28
1995/96	.4	4	1	12	3,741	1,986			( 74)	11/01-02/15

<sup>a</sup>Millions of pounds.

<sup>b</sup>Includes catcher-processors.

<sup>c</sup>Millions of dollars.

<sup>d</sup>Includes gear of vessels landing both red and brown king crab.

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Appendix Table 4.  
 Historic Dutch Harbor, Area O, brown king crab catch, 1981/82-1995.

Season	Number of		Crab <sup>a</sup>	Harvest <sup>a,b</sup>	Pots Pulled	CPUE <sup>c</sup>	Percent Oldshell	Average		Deadloss <sup>b</sup>
	Vessels	Landings						Weight <sup>b</sup>	Length <sup>d</sup>	
1981/82	6	16	22,666	115,715	2,906	8	3.8	5.1	158.1	8,752
1982/83	49	136	227,471	1,184,971	29,369	8	3.9	5.21	58.1	47,479
1983/84	47	132	328,353	1,810,973	29,595	11	NA	5.5	NA	45,268
1984 <sup>e</sup>	13	67	327,440	1,521,142	24,044	14	NA	4.6	161.2	70,362
1985	13	67	410,977	1,968,213	34,287	12	16.0	4.7	155.7	38,663
1986	17	71	400,389	1,869,180	37,585	11	NA	4.7	NA	9,510
1987	22	77	299,734	1,383,198	43,017	7	25.0	4.6	149.6	24,210
1988 <sup>f</sup>	21	57	323,695	1,545,113	40,869	8	23.0	4.8	154.3	22,960
1989/90	13	70	424,067	1,852,249	43,345	10	30.0	4.4	150.9	17,421
1990/91	16	68	395,502	1,718,848	54,618	7	3.0	4.3	147.5	42,800
1991/92	11	50	335,647	1,447,732	40,604	8	4.0	4.3	147.9	45,100
1992/93	10	44	330,159	1,357,048	37,718	9	4.0	4.3	147.8	37,200
1993/94	4	14	217,788	915,460	22,490	10	NA	4.2	NA	7,324
1994	14	45	384,353	1,750,267	67,537	6	NA	4.6	NA	29,908
1995	17	42	431,867	1,993,980	65,030	6	NA	4.6	NA	14,676

<sup>a</sup>Deadloss included.

<sup>b</sup>In pounds.

<sup>c</sup>Defined as catch per pot pull.

<sup>d</sup>In millimeters.

<sup>e</sup>Six inch permit season opened July 1.

<sup>f</sup>September 1 established as season opening date.

Appendix Table 5.

Historic Dutch Harbor brown king crab economic performance, 1981/82-1995.

Year	Season Total <sup>a</sup>	Number of		Number of Pots		Value		Season Length	
		Vessels	Landings	Registered	Pulled	Exvessel	Total <sup>b</sup>	(Days)	Dates
1981/82	0.1	6	16	0 <sup>c</sup>	2,906	\$ 2.05	\$ 0.2	(75)	11/01-01/15
1982/83	1.1	49	136	0	29,369	\$ 3.00	\$ 3.3	(105)	11/01-02/15
1983/84	1.8	47	132	4,514	29,595	\$ 3.05	\$ 5.5	(105)	11/01-02/15
1984/85	1.5	13	67	1,394	24,044	\$ 1.35	\$ 2.0	(229)	07/01-02/15
1985	1.9	13	67	1,479	34,287	\$ 2.00	\$ 3.8	(121)	07/01-10/31
1986	1.8	17	71	1,575	37,585	\$ 2.85	\$ 5.1	(182)	07/01-12/31
1987	1.4	22	77	3,591	43,017	\$ 2.85	\$ 4.0	(62)	07/01-09/02
1988	1.5	21	57	4,215	40,869	\$ 3.00	\$ 4.5	(93)	09/01-12/04
1989	1.8	13	70	5,635	43,345	\$ 3.50	\$ 6.3	(104)	09/01-12/15
1990	1.7	16	68	5,225	54,618	\$ 3.00	\$ 5.1	(68)	09/01-11/09
1991	1.4	11	50	3,760	40,604	\$ 2.00	\$ 2.8	(74)	09/01-11/15
1992	1.3	10	44	4,222	37,718	\$ 2.50	\$ 3.3	(76)	09/01-11/17
1993/94	.9	5	14	2,334	22,490	\$ 2.15	\$ 1.9	(212)	09/01-03/31
1994	1.7	14	45	7,378	67,537	\$ 4.00	\$ 6.9	(57)	09/01-10/28
1995	1.9	17	42	10,325	65,030	\$ 2.60	\$ 5.0	(38)	09/01-10/09

<sup>a</sup>Millions of pounds, deadloss not included.<sup>b</sup>Millions of dollars.<sup>c</sup>Incidental catches to red king crab fishery.

Appendix Table 6.

Adak, Area R, historic brown king crab catch statistics, 1975/76-1995/96.

Season	Number of		Crabs <sup>a</sup>	Harvest <sup>a,b</sup>	Pots Pulled	Average Weight <sup>b</sup>	CPUE <sup>c</sup>	Deadloss <sup>b</sup>
	Vessels	Landings						
1975/76				C O N F I D E N T I A L				
1976/77				C O N F I D E N T I A L				
1977/78				C O N F I D E N T I A L				
1978/79				N O R E P O R T E D C A T C H				
1979/80				C O N F I D E N T I A L				
1980/81	4	4	11,523	58,914	700	5.1	17	5,000
1981/82	14	76	217,700	1,194,046	24,627	5.5	9	22,064
1982/83	99	501	1,509,001	8,006,274	150,103	5.3	10	220,743
1983/84	157	1,002	1,534,909	8,128,029	226,798	5.3	7	171,021
1984/85	38	85	643,597	3,180,095	64,777	4.9	10	125,073
1985/86 <sup>d</sup>	49	386	2,052,048	11,124,759	202,401	4.5	12	5,304
1986/87	62	525	2,923,947	12,798,004	392,185	4.4	7	276,736
1987/88	46	386	1,908,989	8,001,177	267,705	4.2	7	165,415
1988/89	74	455	2,165,508	9,080,196	280,732	4.2	8	122,251
1989/90	64	505	2,520,786	10,162,400	324,153	4.0	8	100,724
1990/91 <sup>e</sup>	13	167	1,312,116	5,250,687	160,960	4.0	8	176,583
1991/92	16	206	1,511,751	6,254,409	192,949	4.1	8	96,848
1992/93	18	130	1,198,169	4,916,149	165,503	4.1	7	104,215
1993/94	21	147	1,393,742	4,635,683	212,164	4.2	6	165,358
1994/95	34	247	1,539,866	6,378,030	319,006	4.1	5	242,065
1995/96	25	139	1,134,270	4,896,911	226,463	4.3	5	338,223

<sup>a</sup>Deadloss included.<sup>b</sup>In pounds.<sup>c</sup>Defined as catch per pot pull.<sup>d</sup>Size limit reduced from 6.5 to 6 inches.<sup>e</sup>Partial closure August 7.

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Appendix Table 7.  
 Historic Adak brown king crab economic performance, 1980/81-1995/96.

Year	Season Total <sup>a</sup>	Number of			Number of Pots		Value		Season Length	
		Vessels <sup>b</sup>	CP's	Landings	Registered <sup>c</sup>	Pulled	Exvessel	Total <sup>d</sup>	Days	Dates
1980/81	0.05	4	N/A	4	581	700	\$ 0.90	\$0.05	(72)	01/15-3/28
1981/82	1.2	14	N/A	76	2,647	24,627	\$ 2.06	\$ 2.4	(227)	11/01-6/15
1982/83	7.8	99	N/A	501	13,111	150,103	\$ 3.01	\$23.4	(166)	11/01-4/15
1983/84	8.0	157	N/A	1,002	17,406	226,798	\$ 2.92	\$23.2	(157)	11/10-4/15
1984/85	3.1	38	N/A	85	5,270	64,777	\$ 2.00	\$ 6.1	(240)	11/10-7/08
1985/86	11.1	49	N/A	386	7,057	202,401	\$ 2.50	\$27.8	(288)	11/01-8/15
1986/87	12.5	62	N/A	325	12,958	392,185	\$ 3.00	\$37.6	(288)	11/01-8/15
1987/88	7.8	46	N/A	386	10,687	267,705	\$ 3.00	\$23.5	(289)	11/01-8/15
1988/89	9.0	74	13	455	23,627	280,732	\$ 3.20	\$28.7	(288)	11/01-8/15
1989/90	10.1	64	15	505	14,724	324,153	\$ 3.00	\$30.2	(288)	11/01-8/15
1990/91	5.1	13	6	167	7,380	160,960	\$ 3.00	\$15.2	(288)	11/01-8/15
1991/92	6.2	16	7	206	7,635 <sup>e</sup>	192,949	\$ 2.50	\$15.4	(289)	11/01-8/15
1992/93	4.8	18	4	130	8,236 <sup>e</sup>	165,503	\$ 2.05	\$ 9.9	(288)	11/01-8/15
1993/94	4.5	21	1	147	11,970	212,164	\$ 2.50	\$11.2	(288)	11/01-8/15
1994/95	6.1	34	2	247	15,604	319,006	\$ 3.33	\$20.4	(288)	11/01-8/15
1995/96	4.6	25	1	139	14,213	226,463	\$ 2.10	\$ 9.6	(289)	11/01-8/15

<sup>a</sup>Millions of pounds, deadloss not included.

<sup>b</sup>Includes catcher-processors.

<sup>c</sup>No separate registration from red king crab.

<sup>d</sup>Millions of dollars.

<sup>e</sup>Gear directed fishing on brown king crab.

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ALEUTIAN RED AND BROWN KING CRAB POT LIMITS:

A REPORT TO THE ALASKA BOARD OF FISHERIES



By

Margaret C. Murphy and Kenneth L. Griffin

Regional Information Report No. 5J97-0  
Alaska Department of Fish & Game  
Commercial Fisheries Management and Development Division  
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March 9, 1997

DRAFT

## EXECUTIVE SUMMARY

Aleutian 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* (FMP) (NPFMC 1989). Management measures are frameworked within the FMP meaning they can be specified by the Alaska Board of Fisheries (Board) by considering specific factors and standards. This report reviews previous Board actions on pot limits, summarizes the FMP factors and standards relevant to pot limits, and outlines benefits and drawbacks of pot limits for Aleutian area red and brown king crab fisheries with regard to FMP requirements. The Aleutian red king crab stocks are in poor condition. The commercial fishery on the Dutch Harbor stock of red king crab has been closed since the 1983/84 season and the fishery on the Adak stock was closed in 1996. Survey results for the Dutch Harbor red king crab stock indicate no commercial fishery is likely in the foreseeable future. The Adak red king crab stock is not surveyed so a small exploratory fishery with controlled effort could yield information on stock status. Given the closure of Aleutian red crab fisheries, and lack of comparable data between the Dutch Harbor and Adak stocks due to the long closure of the Dutch Harbor fishery comparison of fishery statistics for an evaluation of pot limits for Aleutian red king crab stocks is difficult. Additionally, the closure of the Aleutian red crab fisheries questions the usefulness of pot limits at this time. The brown crab stocks have maintained relatively constant harvest levels. However, effort has varied with the advent of longlining of pots, fluctuations in abundance of other crab stocks, and refinement of gear and fishing strategy. Observer data and a survey of Aleutian brown king crab in 1997 should provide guidance on how viable commercial fisheries for brown king crab will be in upcoming years. Transfer of fishing effort to Aleutian brown king crab as a result of other crab fishery closures raises concerns for an excessive number of pots within limited areas, increased potential for lost gear and possibly preemption of grounds. Pot limits in the Aleutian brown king crab fishery would be effective only if low vessel participation is maintained or number of vessels is regulated.

## INTRODUCTION

The Aleutian Islands king crab registration area "O" was established in 1996 by combining the Dutch Harbor and Adak king crab registration areas, "O" and "R" (Figure 1). Historically, 5 districts were defined for harvest of red king crab in the Dutch Harbor area and six for the Adak area. Red king crab have not been harvested in the Dutch Harbor area since 1983 and the Adak fishery was closed in 1996 (Table 1). Productivity of red king crab stocks throughout the Aleutian area is depressed and no commercial fishery is anticipated in the foreseeable future. Two major stocks of brown king crab have been designated for the new Aleutians area with the division occurring at 174°W. longitude; the Seguam stock to the east of 174° W. and the Adak stock to the west of 174° W. These stocks have maintained commercial fisheries

since full exploitation was reached in 1982. Data from onboard observers and a survey during summer 1997 will be used to evaluate status of Aleutian area brown king crab stocks.

Aleutian red and brown king crab fisheries are managed by the Alaska Department of Fish and Game under the terms of the *Fishery Management Plan for the Commercial King and Tanner Crab Fisheries in the Bering Sea/Aleutian Islands* (NPFMC 1989). Current management measures used in the Aleutian king crab fisheries are limits on size, sex and season and observer coverage is mandatory. Minimum size of male red king crabs is 6.5 inches. Red king crab may be harvested from November 1, when opened by emergency order until the fishery is closed by emergency order. Male brown crab 6.0 inches and greater may be taken from September 1 until the season is closed by emergency order. Over the history of harvests in the Aleutian area, managers have used the option to close fisheries on the red king crab stocks if the catch exceeded a harvest limit equaling the average historical catch. The duration of the commercial fishing season for the Adak brown king crab stock remained the same from 1985 to 1995 but the fishing season length for the Dutch Harbor stock has been abbreviated in recent years as harvests exceeded the average historical catch.

Legal red king crab may also be retained in the directed brown king crab fishery from depths greater than 100 fathoms when the red crab fishery is open. Red and brown king crab inhabit dissimilar depths and topography resulting in separate fishing grounds and distinct pot gear. 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 brown king crab fisheries in the Aleutian area were adopted by the Board for the 1993/94 season. Beginning with the 1995/96 fishing season the Board required vessels participating in the Aleutian area red and brown king crab fisheries to carry observers during all fishing activities. Since these fisheries are managed under the terms of a federal FMP, regulations adopted by the Alaska Board of Fisheries (Board) must adhere to the guidelines established within the FMP.

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.

We summarize available information pertinent to the FMP factors and standards for deliberations of proposed pot limits in Aleutian red and brown king crab fisheries. Red and brown king crab are addressed separately because fisheries on each of these species are characterized by vastly different fishing grounds and gear. Additional information on impacts of pot limits on industry and economic burden imposed by pot limits for the brown king crab fishery targeting the Adak stock are addressed under a separate report. We refer the reader

to the report titled *An economic discussion of proposed pot limits for the Adak brown king crab fishery* by Drs. J. Greenberg, M. Hermann, and K. Criddle (1997).

## METHODS

Historic data needed for comparison of Dutch Harbor and Adak red king crab fishery performance data is limited. The Commercial Fisheries Entry Commission has maintained vessel characteristic data since 1978. Vessel keel length provided in these data are needed to associate harvest and number of registered pots to the proposed vessel length classes for pot limits. Vessel keel length data from 1978 were applied to the 1977 list of registered vessels that harvested Dutch Harbor red king crab to expand the data for analysis an additional year.

Number of pots a vessel fishes is recorded at the time a vessel registers for a fishery. Number of pots registered was not available for the Adak red king crab fishery prior to 1980 so only three years data are available for comparison of average pots registered between the two fisheries.

During the early years of Aleutian area king crab fisheries the average pots fished in the red and brown king crab were similar. The number of pots fished per vessel began to increase with the advent of longlining pot gear in the brown king crab fisheries in 1983. Ten years later in 1993, vessels fishing king crab in the Aleutian area were required to register separately for red and brown king crab fisheries because the number of pots fished by vessels in the two fisheries differed significantly. Vessels are allowed to harvest red and brown king crab as long as the red king crab fishery is open. Until 1993 a vessel targeting both species registered the number of pots longlined for brown king crab plus the number of single lined pots for fishing red crab. The number of pots registered by vessels employing this fishing strategy would exceed the actual number of pots fished for either species. Therefore the average number of pots registered for vessels landing brown or red king crab may be biased high prior to 1993.

Fishery diversification data are based on a calendar year compared to fishery characteristic data that are reported by fishing season. No vessel diversification data is available for the Aleutian brown king crab fisheries other than the subset of information presented for vessels that targeted the Adak red king crab stock and also fished brown king crabs.

There are no estimates of handling mortality for red or brown king crab. Pot sampling data by observers in the Aleutian brown king crab fisheries are summarized for 1990-1995 to outline concerns for bycatch of sublegal male and female crabs. Information on bycatch in the fishery targeting Adak red king crab stock is confidential prior to the 1995/96 fishing season due to the limited number of catcher processor vessels that targeted Adak red king crab exclusively. The 1995/96 observer data are too limited to summarize and insure confidentiality of vessels.

## **PREVIOUS AND PROPOSED BOARD OF FISHERIES ACTIONS ON POT LIMITS**

The Board rejected pot limit proposals for Adak king crab fisheries in 1993 when they were first considered for other Bering Sea and Aleutian Island crab stocks because they were not needed to manage the fisheries at the current effort levels. Pot limits were established in 1993 for 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 levels so fisheries could be opened and managed with an acceptable risk of overfishing; 2) extend season length for sufficient time to accumulate adequate fishery performance data required to validate the preseason guideline harvest level (GHL) and reduce risk of overfishing; and 3) limit pot loss by achieving reasonable control of a vessel's aggregate of crab pots. These pot limits were set for two vessel size class categories supported by industry,  $\leq 125$  ft and  $>125$  ft. Additionally, these size categories are consistent with the NPFMC vessel size classes under the vessel moratorium. Pot limits for vessels  $\leq 125$  ft and  $>125$  ft. were based on a 20% difference in gear performance between the size classes (Greenberg et al. 1992). In 1994 the Board was petitioned by industry to establish pot limits in the Adak king crab fisheries, but the petition was rejected as they found no pressing concerns to limit pots fished per vessel in these fisheries at that time (ADF&G 1995). Proposals for Adak and Dutch Harbor king crab registration areas were considered by the Board in 1996 but a proposal for Adak red and brown king crab pot limits was not approved. However, the Board indicated a willingness to consider pot limits for the new Aleutian area again during its 1996/97 meeting cycle, pending completion of an economic analysis to satisfy requirements of the federal FMP. Pot limits were proposed by industry as a means to minimize gear saturation in fishing areas and resultant increases in pot loss, and deter preemption of fishing grounds. The proposed pot limits differ for red and brown king crab fisheries and were structured by vessel size: limits of 80 pots for vessels  $\leq 125$  ft and 100 pots for vessels  $>125$  ft in fisheries targeting red king crab; and limits of 480 pots for vessels  $\leq 125$  ft and 600 pots for vessels  $>125$  ft in fisheries targeting brown king crab.

## **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 two 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:

- 1) pot limits that are a function of vessel keel length; and
- 2) 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. The second standard warrants pot limits to:

- 1) restrict deployment of excessive amounts of gear;
- 2) advance the biological conservation objective; and
- 3) to address depressed stock conditions that result in small guideline harvest levels and harvests that would be at 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 the Adak and Dutch Harbor red king crab stocks. The area is managed by:

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

2) Comparison of cumulative inseason catch to average historic catch with a biological closure of February 15. In the past 10 years, the Adak fishery has been closed 2 times prior to February 15 when the historical average harvest was reached. The fishery was closed after 27 days in 1994/95 because of poor fishery performance compared to the previous two seasons. The Aleutian red king crab fishery was not opened for the 1996/97 season.

B. The majority of vessels harvesting red king crabs in the Dutch Harbor and Adak red king crab fisheries during the late 1970's were  $\leq 125$  ft (Figure 2). Overall larger vessels participated in the Adak red king crab fishery than the Dutch Harbor king crab fishery. Over the history of the Aleutian Islands red king crab fisheries the smaller vessels averaged higher harvests than large vessels (Figure 3). In recent years the opposite is true and large vessels averaged higher harvests than small vessels. Number of vessels harvesting red king crab in each fishery by five foot vessel length intervals are shown in Figure 7. Fishery catch statistics for both stocks and economic performance of the Adak red king fishery are available in Appendix Tables 1, 2, and 3.

2. Probable concentration of pots by area:

A. Historically the Aleutian red king crab fisheries occurred throughout most of the Dutch Harbor and Adak registration areas. Catches were reported from 42 statistical areas in the 1988/89 Adak fishery when 1.6 million pounds was landed. From 1991 to 1995, fishing effort 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.

B. In early years of the Aleutian red king crab fisheries vessels registered on average between 100 and 200 pots with slightly more pots being registered by vessels  $>125$  ft. (Figure 2). More recently in the Adak fishery the difference between number of pots registered by small and large vessels is greater. Average pots registered in the Aleutian king crab fisheries by five foot vessel length intervals are shown in Figure 8.

C. 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 Aleutian red 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 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 number of vessels fishing, average pots registered, and average harvests by vessel size class over time provides baseline data for evaluation of pot limits.

#### *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 Aleutian red king crab fisheries specifies different numbers of pots for vessels  $\leq 125$  ft and vessels  $>125$  ft. Derivation of pot limits using the 20% difference in gear performance between these vessel size categories based on the Board's previous actions in establishing pot limits in the Bristol Bay and Bering Sea crab fisheries is feasible for Aleutian red king crab fisheries because the unit of effort, a single line pot is the same. Assuming the same 20% difference in gear performance demonstrated for the two vessel size classes for Bristol Bay red king crab applies to Aleutian red king crab fisheries, then one would assume that the percent difference in average pots registered per vessel and the average catch per vessel would also be similar. The Average percent difference in average pots registered between vessel size classes was 30% for Bristol Bay red king crab from 1986 to 1990. The average percent difference in average pots registered between vessel size classes was 27% for the Dutch Harbor red king crab fishery from 1980 to 1981 and 3% for the Adak red king crab fishery from 1991 to 1994. The Average percent difference in average pounds harvested between vessel size classes was 22% for Bristol Bay red king crab from 1986 to 1990. The average % difference in average pounds harvested between vessel size classes was 72% for Dutch Harbor and -2% for Adak red king crab fisheries from 1977 to 1982. More recently, the average % difference in average pots registered and average pounds harvested between vessel size classes targeting the Adak red king crab stock in recent years was 30% and 62% for the years 1991 to 1994. The years 1991 to 1994 are believed most representative of recent fishery performance.

### Conservation Concerns:

The Aleutian red king crab stocks are considered severely depressed. The fishery targeting the Dutch Harbor red king crab stock has been closed since 1983 and no catch of red king crab during the 1995 survey of the Dutch Harbor stock indicates it is in poor condition and abundance extremely low (Gish et. al. 1996). The 1996/97 fishery targeting the Adak red king crab stock was not opened due to poor fishery performance in the 1995/96 fishery which produced a catch of only 39,000 pounds. Historical catch peaked at 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 Adak red king crab 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.

### Excessive Amounts of Gear:

When the Bering Sea crab fisheries experience large GHLS, little effort has targeted the Adak red king crab stock due to its remoteness and distance from processing facilities. With recent declines and closures in the Bering Sea king and Tanner crab fisheries, The Aleutian area might experience a surge in effort if the viability of red king crab stocks should they show any improvement. Since geographic distribution of a stock contracts as abundance declines, a stock beginning to rebuild also occupies a reduced geographic range and would be vulnerable to overharvest if excessive effort concentrated on the limited 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 on the Adak red king crab stock 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 harvesting Adak red king crabs derived from other crab fisheries each calendar year are presented in Table 2, Figure 4. Interpretation is best facilitated by means of an example: of the vessels targeting red king crab in 1983, 12% of their earnings came from the Adak red king crab fishery, 26% of their earnings came from the Adak brown king crab fishery, 29% of their earnings were from the Bering Sea Tanner crab fishery and 28% of their earnings came from statewide Tanner crab fisheries.

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 pot fisheries could be expected.

## **BROWN KING CRAB**

### *Seven FMP Factors*

#### 1. Total vessel effort relative to GHL:

A. There are no regular surveys of Aleutian brown king crab stocks and preseason GHL's were announced for the first time for the 1996/97 fishery. The area is managed by:

1) 3-S management; and

2) Historic catch averages in the fishery. In the history of fisheries on Aleutian brown king crab stocks, 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 targeting the Adak brown king crab stock opens November 1 concurrent with the Bristol Bay red king crab fishery and has a regulatory closure of August 15. The fishery targeting the Dutch Harbor brown king crab stock opens September 1, two weeks before the Bering Sea king crab fisheries and has a regulatory closure of January 15.

B. When the Bering Sea crab fisheries declined during the 1980's, interest and effort in the Aleutian brown king crab fisheries increased. Number of vessels registering for Aleutian fisheries by proposed vessel length categories by year (Figure 5). The bulk of vessels fishing brown king crab in the Aleutians have been  $\leq 125$  ft. Over the history of these fisheries larger vessels have averaged higher harvests than small vessels (Figure 12). Number of vessels harvesting brown king crab and average harvests by five foot length intervals are shown in Figures 10 and 11. Fishery catch statistics for Aleutian brown king crab stocks and economic performance are available in Appendix Tables 4, 5, 6, and 7.

#### 2. Concentrations of gear:

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

(1) Due to the narrow shelf along the Aleutian Islands, the brown king crab fisheries concentrate on very localized stocks on specific grounds.

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

B. Single pots were initially used in Aleutian brown king crab fisheries, 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.

C. Average number of pots registered by vessels targeting the Dutch Harbor and Adak brown king crab stocks by the proposed vessel length categories by fishing season are presented in Figure 5. Average pots registered by large vessels has increased steadily over the history of these fisheries. Smaller vessels  $\leq 125$  ft have on the average registered fewer pots than vessels  $>125$  ft. Average pots registered by vessels harvesting Aleutian brown king crab by 5 ft vessel length intervals over time are presented in Figure 11.

### 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 fisheries;

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

B. Some conflict of longline gear could occur if vessels were concentrated on productive grounds and one vessel laid gear over another vessels gear. Grounds could also be preempted by vessels deploying excessive amounts of gear. Excessive 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 may result in greater bycatch of sublegal male and female brown king crabs if soak times are also reduced. Information from industry indicates long soak times are common in the Aleutian brown king crab fisheries.

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.

C. Target and non-target catches of commercial crab species have been accurately enumerated by observers in the fishery targeting the Adak brown king crab stock since 1990 (Table 4). 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.

D. 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.

E. Preemption of grounds means 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 Aleutian brown king crab fisheries and the 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 targeting the Adak brown king crab stock 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 pot limit proposal originated from industry and specified pot limits for fisheries targeting the Adak red and brown king crab fisheries.

B. Comparison of number of vessels fishing, average pots registered, and average harvests by vessel size class over time provides baseline data for evaluation of pot limits.

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. In 1995, the Board required 100% observer coverage for vessels operating in the Aleutian 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 the Aleutian brown king crab fisheries 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 Aleutian brown king crab fisheries specifies different numbers of pots for vessels  $\leq 125$  ft and vessels  $>125$  ft. Derivation of pot limits using the 20% difference in gear

performance between these vessel size categories based on the Boards previous actions in establishing pot limits in the Bristol Bay and Bering Sea crab fisheries is difficult for Aleutian brown king crab fisheries primarily because the unit of effort differs. 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. However, if the same 20% difference in gear performance demonstrated for the two vessel size classes for Bristol Bay red king crab was valid for Aleutian brown king crab, then one would assume that the percent difference in average pots registered per vessel and the average catch per vessel would also be similar. The Average percent difference in average pots registered between vessel size classes was 30% for Bristol Bay red king crab from 1986 to 1990. The average % difference in average pots registered between vessel size classes was 15% for Dutch Harbor and 31% for Adak brown king crab fisheries from 1991 to 1995. The Average percent difference in average pounds harvested between vessel size classes was 22% for Bristol Bay red king crab from 1986 to 1990. The average % difference in average pounds harvested between vessel size classes was -141% for Dutch Harbor and 72% for Adak brown king crab fisheries from 1991 to 1995.

#### Conservation Concerns:

No population estimates exist for Aleutian brown king crab stocks. A single survey of brown king crab in the Aleutian Islands was conducted in 1991 but covered a small portion of the habitat occupied by this species. The fisheries are managed on size, sex and season. Harvest levels remain well below historical highs. Observer data now indicates that the fisheries rely primarily on recruit-sized crabs that enter the fishery at legal size for the first time. Beginning with the 1995/96 fishing season all vessels participating in Aleutian brown king crab fisheries are required to carry an observer. Coverage of the fisheries 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 and evaluating status of the stocks.

#### Excessive Amounts of Gear:

Compared to the high effort levels experienced prior to the 1990/91 season, the Aleutian brown king crab fisheries have experienced low vessel effort for the past 5 seasons. This may be attributed to the high volume, consistent market fisheries in the Bering Sea and the lower value and distance to shore based processors for the Aleutian brown king crab fisheries. With fewer vessels participating in the fishery, total pots fished has remained low. However effort increased in the 1994/95 fishery apparently due to the continued closure of the Bristol Bay red king crab and a decline in GHs for snow and Tanner crabs. Reduced fishing opportunities in the Bering Sea may continue for some time, and participants in the fishery targeting the Adak brown king crab stock are concerned that individual vessels may fish excessive numbers of pots throughout the registration area preempting more productive grounds. Lacking the ability

to regulate the total number of pots that may be placed on the fishing grounds, and the fact that the Aleutian brown king crab fisheries have supported a small fleet over a long period of time, an influx of vessels into the fishery may justify closing fishing seasons earlier to insure conservation.

## **CONCLUSION**

The Aleutian red king crab stocks are in poor condition as reflected by recent fishery closures. The distribution of crab has contracted as indicated by the limited area last fished compared to the historical fishery. Pot limits in the Aleutian red king crab fishery could lessen problems of saturating the limited fishing grounds with excessive numbers of pots if the stock status merits a fishery. However, this study indicates that the results from the Greenberg et. al. (1982) study of economic impacts of pot limits on the Bristol Bay red king crab fishery may not be applicable to the Aleutian red king crab stocks because the percent change in vessel performance between size categories is not comparable. Therefore, information to evaluate the economic impacts and non-discriminatory nature of proportional pot limits for the Aleutian red king crab fisheries is not available at this time.

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. Though a significant increase in vessel participation may be predicted if reduced fishing opportunity in other Bering Sea crab fisheries occurs; it should be viewed as a low likelihood given the stock condition and dynamics of longlining pots. Effort may not increase in the brown king crab fishery as gearing up to participate may be cost prohibitive for many vessels. Longline of pots in the brown king crab fisheries makes application of the Greenberg et al. study on Bristol Bay red king crab to the Aleutian brown king crab fisheries questionable due to the difference in gear. This study supports that conclusion. Therefore, an economic analysis of pot limit impacts on the Aleutian brown king crab was completed and presented under separate title. As with the Aleutian red king crab fishery, a pot limit will be effective in the Aleutian brown king crab fishery only if the number of vessels participating in the brown king crab fishery continues at low levels or is regulated.

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