Alaska
Fisheries Science
Center

National Marine
Fisheries Service

U.S DEPARTMENT OF COMMERCE

# AFSC PROCESSED REPORT 95-07

# Community Development Quota (CDQ) and Open Access Pollock Fisheries in the Eastern Bering Sea: A Comparison of Groundfish Utilization and Prohibited Species Bycatch

November 1995

# ERRATA NOTICE

This document is being made available in .PDF format for the convenience of users; however, the accuracy and correctness of the document can only be certified as was presented in the original hard copy format.

Inaccuracies in the OCR scanning process may influence text searches of the .PDF file. Light or faded ink in the original document may also affect the quality of the scanned document.

# COMMUNITY DEVELOPMENT QUOTA (CDQ) AND OPEN ACCESS POLLOCK FISHERIES IN THE EASTERN BERING SEA: A COMPARISON OF GROUNDFISH UTILIZATION AND PROHIBITED SPECIES BYCATCH

Prepared by Kent Lind and Joe Terry

Resource Ecology and Fisheries Management Division
Alaska Fisheries Science Center
National Marine Fisheries Service
7600 Sand Point Way NE, BIN C15700
Seattle, WA 98115-0070

For additional information concerning this report contact:

Dr. Joe Terry
Resource Ecology and Fisheries Management Division
Alaska Fisheries Science Center
7600 Sand Point Way N.E., BIN C-15700
Seattle WA 98115-0070
(206) 526-4253
jterry@afsc.noaa.gov

CONTENTS

LIST OF TABLES

LIST OF FIGURES

## INTRODUCTION

The Community Development Quota (CDQ) Program, which began in 1992, allocates 7.5% of the Bering Sea/Aleutian Islands (BSAI) pollock total allowable catch (TAC) to six groups of Alaskan Native communities located primarily along the Bering Sea coast. Typically, each CDQ group has entered into a partnership with an existing fishing company to harvest and process its share of the CDQ. With respect to the incentives provided to fishermen, there are two important differences between the CDQ pollock fishery and the open access pollock fishery. First, each fishing company participating in the CDQ pollock fishery pays for the right to harvest a given amount of pollock. Second, each such company is relatively free to choose when and how to harvest that amount of pollock. It has been suggested that such differences would result in a more efficient use of resources in the pollock fishery and could be particularly effective in addressing the problems of discards and catch utilization in the groundfish fisheries. Since all vessels that participate in the CDQ pollock fishery also participate in the BSAI open access pollock fishery, the CDQ program provides an excellent opportunity to examine how these two characteristics of the CDQ fishery affect the performance of individual vessels.

The purpose of this report is to examine the different economic incentives present in these two pollock fisheries, and to develop and test several hypotheses as to the expected differences in vessel performance under both types of systems. Due to limitations in the data, this analysis is restricted to the offshore (catcher processor and mother ship) sector of the CDQ fleet which has been responsible for harvesting over 95% of the CDQ catch. Because the purpose of this analysis was to examine the differences in individual vessel performance in the CDQ and open access fisheries, this analysis was further restricted to those vessels that participated in both the CDQ and open access fisheries. Therefore, no comparison was made between the CDQ fishery and the open access pollock fishery as a whole.

National Marine Fisheries Service (NMFS) observer and weekly production report data were used to compare the performance of vessels in the CDQ pollock fishery to the performance of those same vessels in the open access pollock fishery. Among the measures of performance examined were: groundfish discard rates, prohibited species bycatch rates, product value per unit of catch, and pollock catch per unit of fishing effort (CPUE). The results of this comparison indicate that pollock and other groundfish species discard rates are lower when vessels operate in the CDQ fishery. In the area of prohibited species bycatch, the comparison between the CDQ and open access fisheries, as expected, is less conclusive. CDQ vessels produced higher king crab and Tanner crab bycatch rates in the open access fishery, while in the CDQ fishery those same vessels produced higher Pacific herring bycatch rates. Vessel bycatch rates for Pacific halibut and Pacific salmon in the open access and CDQ fisheries were roughly comparable.

The final two measures of performance compared the relative productivity of vessels in each fishery. The first measure of productivity compared the value of products in dollars per metric ton of pollock catch. During the 1993 and 1994 "A" seasons and the 1993 "B" season, vessels in the CDQ fishery produced substantially higher product values per metric ton (t) of pollock than those same vessels produced in the open access fishery. However, during the

1994 "B" season, the average value per metric ton of pollock catch was basically the same in the CDQ and open access pollock fisheries. The second measure of productivity compared pollock catch per hour of fishing effort. In the open access fishery, vessels harvest significantly more pollock per hour than in the CDQ fishery.

## THE COMMUNITY DEVELOPMENT QUOTA PROGRAM

### CDQ Program Overview

The CDQ Program for the BSAI pollock fishery was established by Amendment 18 to the BSAI groundfish fishery management plan. Amendment 18 apportioned the pollock total allowable catch (TAC) between the inshore and offshore processing sectors and reserved 7.5% of the pollock TAC for a CDQ fishery. The CDQ program was implemented in late 1992 and is now expected to be extended through the end of 1998. The implementing regulations for Amendment 18 identified the coastal communities in Western Alaska that were eligible to receive CDQs, and established the process to be used to apportion pollock CDQs among groups of eligible communities. The initial CDQ pollock fishery occurred in December of 1992.

Under the CDQ program, six community development associations (CDQ groups) representing 56 predominantly Alaskan Native communities have received CDQ allocations. Each CDQ group decided to enter into partnerships with existing fishing companies to harvest and process its CDQ, and each group selected its industry partner(s) through a bidding process. The industry bids contained different mixes of payments, training, employment opportunities, and assistance with other regional fishing ventures. CDQ groups and industry partners typically agreed either to a specific price per metric ton for CDQ pollock or to a base price plus some form of profit sharing. One CDQ group has extended the partnership further by investing in vessels owned by its industry partner. In limited instances, CDQ shares have been resold on the open market to vessels that have no partnership agreement with a CDQ group.

The Bering Sea CDQ fishery, like the Bering Sea open access pollock fishery, is divided up into "A" (roe) and "B" (non-roe) seasons. In both 1993 and 1994, CDQ groups were allowed to harvest 45% of their CDQ during the "A" season, and the remaining 55% at any time during the rest of the year. Vessels participating in the CDQ fishery typically begin CDQ fishing immediately after the open access "A" and "B" seasons close or before the 15 August start of the open access "B" season. Although vessels are free to conduct CDQ fishing operations while the open access pollock fishery is open, with few exceptions, CDQ vessels have chosen instead to participate in the open access pollock fishery and conduct CDQ fishing only when the open access pollock fishery is closed.

Due to the increased importance of accurate estimates of total pollock catch by vessel in the CDQ fishery, more intensive catch monitoring has occurred in the CDQ fishery. During the 1993 season, some CDQ partnerships voluntarily agreed to provide two observers on each vessel in an effort to improve total catch monitoring. CDQ participants or harvesters have also worked with NMFS to develop improved methods of measuring total catch such as calibrated bins and on-board flow scales. NMFS has increased the sampling and total catch measurement requirements for vessels participating in CDQ fisheries. In June 1994, NMFS required that vessels maintain two NMFS-certified observers while conducting CDQ fishing operations, and in August 1994, NMFS required all CDQ vessels to provide either on-board scales or certified bins to improve total catch estimates.

## Profile of the CDQ Fleet

During 1993, 13 catcher processors, 1 shore plant and 1 mothership participated in the CDQ fishery. The offshore sector was responsible for harvesting almost 100% of the CDQ total. In the offshore sector, 11 vessels fished in both the "A" and "B" season open access, and "A" and "B" season CDQ fisheries. The remaining three vessels participated in only one of the two CDQ seasons.

During 1994, 17 catcher processors, 3 shore plants and 1 mother ship participated in the CDQ fishery. The offshore sector was responsible for harvesting 91.6% of the CDQ total. In the offshore sector, 12 vessels fished in both the "A" and "B" season open access, and "A" and "B" season CDQ fisheries. The remaining seven vessels participated in only one of the two open access or CDQ seasons.

While both bottom trawl and pelagic trawl gear were used during the 1993 and 1994 CDQ fisheries, most fishing was done with pelagic trawl gear. According to NMFS target data (which is based on catch composition data not actual gear type observations) 93% of the 1993 CDQ total was considered pelagic trawl target. In 1994, 89% of the CDQ total was considered pelagic trawl target.

For the purposes of this analysis, vessels participating in the CDQ fisheries are grouped according to their predominant primary product. In 1993, six vessels produced surimi as their predominant primary product in both CDQ and open access fisheries, six vessels produced fillets as their predominant primary product during both CDQ and open access fisheries, and two vessels produced surimi as their predominant primary product during open access fishing operations and fillets as their predominant primary product during CDQ fishing operations. In 1994, eight vessels produced surimi as their predominant primary product, nine vessels produced fillets as their predominant primary product, and one vessel produced surimi as its predominant primary product in the open access fishery and fillets as its predominant primary product in the CDQ fishery.[1]

---

[1] Some vessels produce both surimi and fillets at the same time. For the purposes of this analysis, vessels are categorized as surimi or fillet vessels according to which type of product represents the greatest production during a particular fishery on the basis of product tonnage (Tables 3-4).

## HYPOTHESIZED DIFFERENCES BETWEEN CDQ AND OPEN ACCESS FISHERIES

As noted above, there are two potentially important characteristics of the CDQ pollock fishery in terms of the incentives provided to fishermen. It has been suggested that these two characteristics may be very useful in solving the groundfish bycatch and catch utilization problems in the groundfish fisheries. The nature and sources of these problems are discussed and used to develop hypotheses concerning expected differences between the open access and CDQ pollock fisheries.

### The Nature and Sources of the Bycatch Problem

The nature and source of the bycatch problem are explained by the answers to the following five questions;

1. What is bycatch?
2. Why does bycatch occur?
3. When is bycatch a problem?
4. What is the appropriate level of bycatch?
5. Why are there currently excessive levels of bycatch?

#### What is bycatch?

In this report, bycatch is defined as total fishing mortality excluding that accounted for directly by the retained catch of target species. Therefore, in the pollock fishery, bycatch includes the discarded catch of all species and the retained catch of groundfish species other than pollock.

#### Why does bycatch occur?

Bycatch occurs because fishing methods are not perfectly selective and because fishermen often have a sufficient incentive to catch more fish than will be retained. Although some methods of fishing are more selective than others, there are few examples of methods that are perfectly selective for species, size, quality, or sex. An incentive exists to catch more fish than will be retained if the fisherman's cost of the additional catch is less than the expected benefit and the latter depends on the probability that the catch will be retained.

When is bycatch a problem?

When fish are taken as bycatch in a specific fishing operation and fishery, other uses of those fish are precluded. The alternative uses of fish include: 1) retained target catch by that fishing operation, 2) catch and bycatch in the same commercial fishery but by another fishing operation, 3) catch and bycatch in another commercial fishery, 4) catch and bycatch in subsistence and recreational fisheries, and 5) contributions to the stock and other components of the ecosystem.

The value to the Nation of a specific use for fish is determined by the net benefit of that use and the distribution of the net benefit. The net benefit of a use is the difference between the value of the outputs from that use and the value of all the inputs associated with that use. The inputs used in a commercial fishery include fish taken as target catch and bycatch; other living marine resources; the fishing vessels, gear, and bait used in harvesting; the plants or vessels, equipment, and materials used for processing; the fuel and labor used throughout the production process; and all the inputs used to manage the commercial fishery. The cost of each input should be measured in terms of its opportunity cost which is its value in its highest valued alternative use.

Bycatch is a problem if it precludes higher valued uses of fish and other living marine resources and if the cost of reducing bycatch is significant. If the former condition is not met, there is not a better use of the fish taken as bycatch; therefore, the bycatch is not excessive and there is not a problem. If the latter condition is not met and if higher-valued uses exist, the solution to the problem is trivial, all bycatch would be eliminated at an insignificant cost.

What is the appropriate level of bycatch?

Basically, it makes sense to reduce bycatch in a cost-effective manner to the level at which further reductions would increase costs more than benefits. Both costs and benefits should be defined broadly from the Nation's perspective to include those that accrue to direct and indirect participants in the fishery as well as to other members of society. Those who harvest or process fish, those who provide support services to the harvesting and processing sectors of the fishing industry, and consumers of the fishery products are examples of direct and indirect participants in the fishery and of other members of society, respectively. "Cost-effective" refers to the lowest cost method of achieving a given reduction in the level of bycatch.

The marginal benefit and marginal cost curves in Figure 1 present graphically the concept of the optimum level of bycatch. The marginal benefit and cost curves, respectively, depict the benefit and cost of reducing bycatch by one unit for a given level of bycatch. For example, when the level of bycatch is 5,000 units, the marginal cost is about $15 and the marginal benefit is about $4. One unit would be one fish if bycatch is measured in the number of fish taken as bycatch or one unit would be 1 t if bycatch is measured in metric tons. For the groundfish fisheries, salmon and crab bycatch is measured in numbers of salmon and crab, respectively, but halibut, herring, and groundfish bycatch is measured by weight, usually in metric tons or kilograms.

The following two definitions can be used to ensure that each change in benefits and costs is accounted for in either the marginal benefit or marginal cost curve but not in both. First, marginal benefit equals the sum of the increases in benefits and the decreases in costs of a reduction in bycatch. Second, marginal cost equals the sum of the increases in costs and decreases in benefits of a reduction in bycatch. Other definitions can be used to assure that all benefits and costs are accounted for once, but only once, without changing the conclusions presented below.

Given these two definitions, marginal benefit includes the decrease in the total opportunity cost of using fish as bycatch, the decrease in the cost of sorting the catch, and any other decrease in fishing costs. Marginal cost includes the increase in fishing costs and the decrease in benefits from any reduction in retained catch.

The marginal benefit is expected to increase, but not necessarily steadily, as bycatch increases. At very low levels of bycatch, most of the fishing mortality of the species taken as bycatch is accounted for by other uses and the value of some of the other uses probably are quite low; therefore, the opportunity cost of bycatch and the marginal benefit of reducing bycatch are low. However, at very high levels of bycatch, much of the fishing mortality is accounted for by bycatch and the lower valued uses would have been eliminated; therefore, the opportunity cost of bycatch and the marginal benefit of reducing bycatch are high. Consider, for example, pollock bycatch (i.e., discards) in the pollock fishery. When it is very low, the per unit opportunity cost of pollock bycatch is low because much of the discarded pollock would be accounted for by damaged, contaminated, and diseased fish that are of limited value in the production of fishery products. However, at high levels of pollock bycatch, a substantially larger percent of the discards would be accounted for by fish that are discarded because 1) they are not of the optimum size for processing, 2) catch exceeded processing capacity, and 3) catch in the last tow of a trip exceeded the amount that is retained due to storage capacity, safety, or product quality imposed trip limits. The opportunity cost per unit of discard for such fish would be much higher.

The opposite trend is expected for marginal cost; that is, marginal cost is expect to decrease as bycatch increases, but again not necessarily steadily. When there are high levels of bycatch and little has been done to control bycatch, there are probably some simple and low-cost actions that can be taken to reduce bycatch. However, eventually, increasingly difficult and costly methods would be necessary and often very costly methods would be required to eliminate the last few units of bycatch. In the pollock fishery, fishermen might only have to implement low-cost measures such as reducing their catch to match their factory's processing capacities or have to make a smaller last tow to stay within a trip limit. When vessels already have low discard rates, they may be required to initiate more costly measures to reduce discards such as slowing factory lines, processing low-value products, or converting to more selective fishing gear or techniques.

If the marginal benefit and cost curves include all the benefits and costs to the Nation, the optimum level of bycatch, in terms of total net benefits, is the level at which marginal cost and marginal benefit are equal. In the hypothetical example depicted in Figure 1, marginal cost and marginal benefit both equal $10 when bycatch equals 10,000 units. At lower levels of bycatch, the marginal cost of reducing bycatch is greater than $10 and the marginal benefit is less than $10; therefore, reducing bycatch below 10,000 units would decrease net benefit. However, at higher levels of bycatch, the marginal cost is less than $10 and the marginal benefit is greater than $10; therefore, net benefit would be increased by decreasing bycatch.

The implications of not using cost-effective methods of controlling bycatch are depicted in Figure 2. Curves MC1 and MC2 in Figure 2, respectively, are the marginal cost curves when cost-effective methods are and are not used. In this example, the optimum level of bycatch is 10,000 units when the cost-effective methods are used, but it is 15,000 units when they are not used.

<u>Why are there currently excessive levels of bycatch?</u>

A common response to this question is that the greed or lack of concern by the fishermen results in excessive bycatch. Perhaps a more productive response is that excessive bycatch is but one symptom of flawed fisheries management which substantially reduces the net benefits generated by the commercial fisheries.

More specifically, excessive bycatch is the result of the following set of circumstances: 1) the level of bycatch and the methods used to reduce bycatch are determined by individual fishermen in response to a variety of incentives and constraints that reflect the economic, social, regulatory, biological, and physical environments in which they operate; 2) an individual fisherman will tend to control bycatch to the point at which further reductions would increase his cost more than his benefit; 3) a fisherman will define cost-effective methods of reducing bycatch in terms of the costs he pays; 4) the fisherman's benefit from reducing his bycatch is less than society's; and 5) in an open access fishery for which there is a quota, the fisherman's cost of reducing his bycatch is greater than society's. These circumstances result in an individual fisherman making inadequate and non-cost-effective efforts to control bycatch. Basically, due to the existence of external benefits and costs, individual fishermen receive the wrong signals or incentives and make the wrong decisions from society's perspective, as well as from the perspective of the fishermen as a group. There are external benefits (costs) when there are differences between the benefits (costs) to the fisherman and to society as a whole as the result of an action taken by a fisherman.

This set of circumstances and the results are depicted by curves MBF, MBS, MCF, and MCS in Figure 3, which are, respectively, the marginal benefit curves for a fisherman and for society at large including the fisherman and the corresponding marginal cost curves. In this case, the marginal cost and benefit are for a one unit reduction in bycatch by a specific fisherman or fishing operation.

The MBS curve includes the reduction in the opportunity cost of using fish as bycatch and the decrease in sorting costs for the fisherman. However, because the fisherman does not pay the opportunity cost of the bycatch, the MBF curve includes principally the reduction in sorting cost. That is, because the opportunity cost of bycatch is an external cost, the MBS curve is above the MBF curve.

In an open access fishery with a catch quota, the MCF curve is above the MCS curve due to the external cost caused by the race for fish. This externality exists because, although the cost to the fisherman includes a reduction in his catch if his attempts to reduce bycatch decrease his rate of harvest relative to that of the rest of the fleet, the reduction in the fisherman's catch is not a cost to society. For the fleet as a whole, there is a redistribution of catch among fishermen, not a reduction in catch. This externality also results in a fisherman selecting methods to control bycatch that are not cost-effective from society's perspective. The externality does this by creating a bias in favor of methods that do not decrease a fisherman's catch. As a result of non-cost-effective methods being used by fishermen to reduce bycatch, the MCS curve is higher than it would otherwise be.

From the fisherman's perspective, it makes sense to control bycatch to the point at which the MBF and MCF curves intersect. For the hypothetical example depicted in Figure 3, the MBF and MCF curves intersect when bycatch for this one fishing operation is about 285 units. However, the MBS and MCS curves intersect when bycatch is 150 units. Therefore, in this example, the optimum level to the fisherman exceeds the optimum level to society by 135 units and it is the optimum level to the fisherman that determines what bycatch will be. In addition, the fisherman's use of non-cost-effective methods to decrease bycatch results in the MCS curve being unnecessarily high. Therefore, had cost-effective methods been used, the optimum level of bycatch for this fisherman from society's perspective would have been less than 150 units.

## Hypotheses

The concepts of the marginal cost and benefit of decreasing bycatch and the optimum level of bycatch can be used as the basis for hypotheses concerning the effects of the two aforementioned characteristics of the CDQ fishery with respect to the discards of pollock and other groundfish and the bycatch of prohibited species.

### Pollock discards

First, the MBF curve for pollock shifts up when a fisherman has to pay for the pollock that he catches. Second, the MCF curve for pollock shifts down because a fisherman's pollock catch is not decreased when he takes more time to either reduce the catch or increase the retention of pollock that would have otherwise been discarded. Therefore, the two characteristics of the CDQ fishery are expected to result in decreased catch of pollock that normally would be discarded and increased retention and more effective use of the pollock catch that does occur.

Therefore, the first two hypotheses are as follows:

Hypothesis 1: Pollock discard rates are lower in the CDQ fishery.

Hypothesis 2: Product value per metric ton of pollock catch is higher in the CDQ fishery.

In the case of the "A" season (roe) fishery, it is recognized that, although the catch of a CDQ vessel is not reduced if it reduces its rate of harvest, the value of its catch would be reduced because pollock roe is at the optimum stage of maturity for a relatively short period of time. Therefore, the opportunity cost of time for a vessel may not differ substantially in the CDQ and open access roe fisheries.

The bycatch and discards of other species

After pollock, which accounts for over 90% of the groundfish discards in the pelagic pollock fishery, Pacific cod is the dominant discard species in the pollock fishery. The CDQ vessels do not pay for the cod they harvest. Therefore, the MBF curve for cod is not higher in the CDQ fishery, but the MCF curve for cod is lower for the same reason why it is lower for pollock. Therefore the next hypothesis is as follows:

Hypothesis 3: Pacific cod discard rates are lower in the CDQ fishery.

With respect to the benefit and cost of decreasing the bycatch of prohibited species, the MCF curve is expected to be lower in the CDQ fishery because vessels are less constrained by time and area. The MBF curve is not expected to change unless the CDQ groups provide incentives to decrease bycatch. If the MCF curve continues to be above the MBF curve, the downward shift of the MCF curve alone would not be expected to change the level of bycatch. Therefore, the final hypothesis is as follows:

Hypothesis 4: The levels of prohibited species bycatch will not differ between the CDQ and open access pollock fisheries.

Catch per unit of effort

A comparison was also made of the pollock catch per hour of trawling. However, no hypothesis was developed concerning the expected difference between the CDQ and open access pollock fisheries. The comparison is presented principally to provide information concerning the presence of factors, other than the two aforementioned characteristics of the CDQ pollock fishery, that may influence the performance of each fishery.

The implicit qualification

For each of the hypotheses listed above, there is an implicit qualifier. To make it explicit, the following could be added at either the beginning or the end of each hypothesis: "as the result of the two characteristics of the CDQ fishery and everything else being constant". Because everything else was not constant, the tests of the hypotheses can not be definitive. That is, the comparisons of vessel performance for the CDQ and open access pollock fisheries may support a hypothesis concerning the effects of the two characteristics of the CDQ fishery because there were other factors that caused the expected differences in performance. Similarly, a hypothesis may appear to be refuted because some other difference between the fisheries more than offset the expected effects of the two characteristics of the CDQ fishery. Therefore, in the absence of strict controls or adjustments for other factors, the comparisons of the two fisheries are only suggestive concerning the validity of the four hypotheses listed above.

## Measures of Performance

The above hypotheses were tested by comparing the individual performance of vessels that participated in both the CDQ and open access pollock fisheries. In addition, aggregate comparisons of performance were made for groups of vessels that participated in both fisheries. The comparisons were made separately for the "A" (roe) and "B" (non-roe) seasons and for 1993 and 1994. The measures of performance used are as follows:

1. pollock discard rate (pollock discards/pollock catch);
2. percent of pollock used for meal and oil only;
3. Pacific cod discard rate (cod discards/cod catch);
4. other groundfish discard rate (groundfish discards other than pollock and cod/groundfish catch other than pollock and cod);
5. non-pollock groundfish bycatch rate (non-pollock groundfish catch/total groundfish catch);
6. bycatch rates for halibut, herring, crab, and salmon;
7. pollock wholesale product value per metric ton of pollock catch; and
8. CPUE (pollock catch per hour of tow duration).

## DATA SOURCES AND LIMITATIONS

### Databases Used in this Analysis

The two primary sources of data used in this report are the NMFS weekly observer reports and the NMFS weekly production reports. In both the open access and CDQ pollock fisheries, observers make weekly reports of total catch, discards, prohibited species bycatch, and fishing effort. In the CDQ fishery, observers also provide NMFS with daily estimates of total pollock catch. In both the CDQ and open access fisheries, all processors must keep daily records of catch, discards and factory production and must make weekly production reports to NMFS. For management purposes, NMFS combines these two sources of data to produce a third database, known as the blend database, which is considered the "official" record of groundfish catch.

NMFS uses the blend estimates of catch for in-season management of the open access groundfish fisheries. However, in the CDQ fishery, NMFS uses only observer estimates to manage the fishery, and the daily observer reports are considered the "official" record of CDQ pollock catch. Because CDQ vessels must now carry two observers, and install either scales or certified bins for calculating catch estimates, observer estimates are considered to be the most reliable record of CDQ fishing operations. For this reason, the weekly observer database, rather than the blend database, is the primary source of groundfish catch and discards estimates used in this report. However, there is one instance where differing estimates of pollock catch significantly affect a measure of performance used in the analysis, it is the measure of product value per unit of pollock catch. For comparison purposes, this measure of performance was calculated separately using all three estimates of pollock catch.

Weekly observer reports are also the sole source of prohibited species bycatch information used in this report. In fact, observer estimates of prohibited species bycatch rates are the only source used for management purposes by NMFS. In addition, processor weekly production reports are the sole source of product information, and the Alaska Department of Fish and Game/National Marine Fisheries Service annual groundfish processor survey is the sole source of wholesale price data used in this report. Because the 1994 product price survey has not yet been completed, 1993 survey prices were used to estimate product values for both 1993 and 1994.

### Report Scope

For most of 1993, the observer and weekly production report databases do not distinguish between CDQ and open access fishing activity. Therefore, information on the timing of the open access "A" and "B" seasons, the daily observer CDQ reports, and the week of each observation were used to differentiate between CDQ and open access fishery observations. Observations that occurred during a week in which a processor participated in both the CDQ and open access fisheries were dropped for 1993 because it was not possible to differentiate between CDQ and open access fishery activities for those processor weeks. The observations that were excluded from this analysis were primarily in the reporting weeks ending 27 February, 21 August, and 25 September, which are the weeks that correspond to the "A" season open access closure, the "B" season open access opening, and the "B" season open access closure, respectively. In 1994, both databases included separate records for CDQ and open access fishery activity; and it was therefore not necessary to exclude any 1994 observations from this analysis.

This analysis was also restricted to 1993 and 1994 when most "A" and "B" season CDQ fishing operations, respectively, were conducted immediately following the "A" and "B" season open access fisheries or just prior to the opening of the open access "B" season. Fishing under the CDQ program began in December 1992. However, data from the 1992 CDQ fishery were not included in this analysis. Because of the time gap between the 1992 open access and 1992 CDQ fisheries, it was felt that discard, bycatch, and production information from those two fisheries may not be directly comparable.

This analysis was further restricted to the offshore processing sector which accounted for over 95% of the CDQ catch during 1993-94. Comparisons between the CDQ and open access fisheries are most easily made in the offshore sector because observer and weekly production reports for the same vessel and report week can be compared directly. It is more difficult to make meaningful comparisons between CDQ and open access fishing operations in the inshore sector because each processing plant receives deliveries from a group of vessels that changes throughout the year. Some vessels in the inshore sector are below the 100% observer coverage size limit of 125 feet. As a result, there is less complete observer data for the inshore sector.

## Limitations on the Comparison Between Open Access Fisheries

There are three principal reasons why the comparisons of the various measures of fishing performance between the CDQ and open access fisheries provide only a limited test of the hypotheses developed in this paper. First, there are a variety of factors that may explain differences in performance between the CDQ and open access fisheries; therefore, it is not possible to know with certainty what differences in the nature of these two fisheries caused any apparent difference in performance. Second, the comparisons are made using estimates of performance; therefore, apparent differences in performance may be due to measurement errors rather than real differences. Third, because participation in the CDQ pollock fishery is on a part-time and potentially short-term basis, some of the changes in fishing and processing strategies that would occur with a permanent program that included the two characteristics of the CDQ fishery are not economically feasible under the current CDQ program.

Two examples of other factors that complicate the comparison are temporal and regulatory differences between the open access and CDQ fisheries. The fact that the "A" and "B" season CDQ fisheries, respectively, occur primarily after the "A" and "B" season open access fisheries or prior to the "B" season open access fishery may either contribute to or partially offset the effects of the two characteristics of the CDQ fishery that were identified above. For example, industry sources suggested that in 1993 the roe season did not peak until after the closure of the open access fishery. Consequently, CDQ vessels may have had access to pollock with both a higher quantity and quality of roe.

Similarly, the fact that factory trawlers can operate in the catcher vessel operating area (CVOA)[2] during the CDQ "B" season but not during the open access "B" season may explain some of the differences in performance between the "B" season CDQ and "B" season open access fisheries. Industry sources have suggested that vessels fishing inside the CVOA were able to catch a higher percentage of large pollock than vessels fishing outside the CVOA. Because both weekly observer reports and weekly processor reports are made by NMFS reporting area, and because the CVOA crosses multiple report area boundaries, it was not possible in this report to isolate the vessel performance effects of fishing inside or outside the CVOA.

The quality of the data used in generating the estimates of performance can also confound the comparisons. The following discussions of the estimates of discard rates and product value provide two examples of this problem. Because the principal objective of the observers is to estimate total catch, species composition, and prohibited species bycatch rather than to track the disposition of catch, the estimation methods used concentrate on providing good estimates of catch and bycatch at the expense of better estimates of groundfish discards.[3] The disparity between the quality of the estimates of catch and discards is thought to be greatest for individual observations. Therefore, estimated differences in discard rates among processors may be due more to estimation errors than to actual differences in discard rates.

The industry-wide average wholesale product prices were used to calculate the product values used in this report. As such, these are very rough estimates of the value of products produced by an individual vessel during the CDQ and open access pollock fisheries. Accurate prices by

---

[2] The CVOA is an area of the Bering Sea intended to be within easy traversing distance to processors in Dutch Harbor and Akutan. The CVOA is the area bounded by the Aleutian Islands, 56° N latitude, 172° W longitude and 163° W longitude. This area includes all of NMFS reporting area 519 and portions of reporting areas 509, 517 and 518.

[3] The 1995 NMFS Groundfish Observer Manual includes the following instructions to observers related to the calculation discards: "There is no clear scientific way for observers to arrive at the percent retained by species group figure because of the variability in discarding that occurs on vessels, and the many different places discard takes place. Recognizing these limitations, we want observers to make an approximation based on what they see happening on their particular vessel. Because this is an approximation, corresponding time and effort given to obtaining it should be minimized and complex mathematical approaches to this task avoided....In most instances, this estimate will only be a visual approximation based on the observer's best judgment and observations of what is going on in the factory. For this figure, it is acceptable to make your best guess." (pgs. 6-16).

product type, period, and processor would be needed to eliminate this problem. In the case of pollock roe, prices would be needed for a number of very short periods or product weight and price data would be required by grade. Despite these limitations and complications, there are sufficient observations for the comparisons that are presented below to provide useful information concerning some of the potential short-run effects of having fishermen pay for the fish they harvest and of allowing fishermen to determine when and how to catch fish. The long-run effects of these changes in the incentives for fishermen would be expected to be substantially greater because the ability to respond to the change in incentives is limited in the short run. For example, changes in the type of vessel and processing equipment used are much more limited in the short run.

## COMPARISONS OF GROUNDFISH DISCARDS AND PROHIBITED SPECIES BYCATCH

### Discards of Pollock and Other Groundfish Species

Mean discard rates for pollock and other groundfish species were calculated using weekly observer estimates of groundfish catch and discards. Pollock discard rates were calculated as a percentage of the total pollock catch; Pacific cod discard rates were calculated as a percentage of the total Pacific cod catch; "other" groundfish species discard rates were calculated as a percentage of "other" groundfish catch.[4] Since pollock is the only groundfish species of interest to most vessels participating in both open access and CDQ pollock fisheries, the percentage of non-pollock groundfish in the total catch was also measured to provide an estimate of the level of groundfish bycatch. Discard and bycatch rates for each species were estimated by vessel, fishery, and season (Tables 1 and 2). Individual vessels were assigned random codes to preserve confidentiality and were grouped according to primary product (surimi or fillets) based upon which product type represented the greatest product tonnage on an annual basis.

#### Pollock discards

With respect to pollock discards, two trends are evident. First, due in part to a decrease in the relative abundance of smaller pollock, discard rates for both the CDQ and open access fisheries declined from 1993 to 1994 (Figs. 4, 5 and 6). Second, with the exception of the 1993 "B" season, pollock discard rates were consistently lower during CDQ fisheries than the same season open access fishery. It should be noted that over 80% of the total pollock discards during 1993 CDQ fisheries were made by just 2 vessels (vessels P and R in Table 1 and Fig. 4). Those same 2 vessels were responsible for 50% of the pollock discards made by CDQ vessels in open access fishing operations. Many of the vessels participating in the CDQ

---

[4]For the purposes of this report, "other" groundfish species refers to all groundfish species other than pollock or cod. This should not be confused with the "other" groundfish reporting category used by NMFS in some observer and weekly production reports.

fishery discarded less than 1% of their total catch in both CDQ and open access fisheries (Figs. 4 and 5). When both years are combined, 5 vessels had lower pollock discard rates in the open access fishery, 13 vessels had lower pollock discard rates in the CDQ fishery, and 1 vessel had no reported pollock discards in either fishery. These results tend to support Hypothesis 1.

It has been suggested that because fish meal is such a low-value product, whole pollock processed into fish meal (as a primary product) should be considered underutilized in a similar category to discards. Eight vessels reported processing some whole pollock into fish meal as a primary product at some time during 1993 and 1994. When each year and season is examined separately, there are seven instances when a vessel processed a greater percentage of the pollock catch into fish meal as a primary product in the open access fishery and two instances when a vessel processed a greater percentage of the pollock catch into fish meal as a primary product in the CDQ fishery (Table 3). This may indicate a greater tendency among those vessels with fish meal capacity to process whole fish into fish meal during open access fisheries as compared with CDQ fisheries. These results also tend to support Hypothesis 1.

Pacific cod discards

Pacific cod is the only other groundfish species of commercial interest taken in significant quantities during CDQ and open access pollock fishing operations. The aggregate cod discard rate over both years was 87.3% in the open access fishery and 53.0% in the CDQ fishery (Fig. 7). Industry sources suggest that several vessels (particularly the smaller fillet vessels) may have combined CDQ pollock fishing and open access cod fishing during the 1993 and 1994 "A" seasons which could account for the higher cod utilization rate during those seasons. Five vessels had lower cod discard rates in the open access fishery, 10 vessels had lower cod discard rates in the CDQ fishery, and 4 vessels discarded 100% of their cod catch in both fisheries. These results tend to support Hypothesis 3.

Other groundfish species discards

Most vessels participating in the CDQ and open access pollock fisheries discarded virtually all other groundfish species (Fig. 8). These species include rock sole, yellowfin sole, arrowtooth flounder, Pacific ocean perch and assorted other rockfish. Because bycatch rates for these other groundfish species were insignificant (between zero and 1%) for all vessels and fisheries examined, these other groundfish species were grouped together to simplify our analysis. Vessels participating in the CDQ fishery exhibited slightly lower rates of other groundfish species discards at 93.6% versus 98.6% over both years. One vessel had lower discard rates in the open access fishery, 8 vessels had lower discard rates in the CDQ fishery, and 10 vessels discarded 100% of other groundfish species in both fisheries.

Non-pollock total catch

Since most vessels examined in this analysis only utilize pollock, all other groundfish species may be considered bycatch. A comparison of the level of non-pollock groundfish catch in both the CDQ and open access fisheries provides a measure of how "clean" each fishery is with respect to groundfish bycatch. However, such a comparison did not uncover any consistent difference between CDQ and open access fisheries (Fig. 9). In addition, this comparison may be further distorted by the fact that at least one vessel reportedly combined CDQ pollock fishing with open access cod fishing during the 1993 and 1994 "A" seasons. The aggregate non-pollock catch rate over both years was 2.2% in the open access fishery and 2.6% in the CDQ fishery. Eight vessels had lower average rates of non-pollock groundfish catch in the open access fishery, and 11 vessels had lower average rates of non-pollock groundfish catch in the CDQ fishery.

## Prohibited Species Bycatch

The mean bycatch rates of prohibited species in the CDQ and open access pollock fisheries were estimated using weekly observer estimates. The rates were estimated by vessel, season, and fishery for those vessels that participated in the 1993 and 1994 CDQ fisheries (Tables 1 and 2). Bycatch rates for Pacific halibut and Pacific herring were calculated as the average kilograms of bycatch per metric ton of groundfish. Bycatch rates for Pacific salmon, king crab and Tanner crab were calculated as the average number of individuals caught per metric ton of groundfish. The rates for Pacific salmon were calculated for chinook salmon and other salmon; other salmon include chum, coho, sockeye, pink salmon, and steelhead.[5] The rates for crab species were calculated for *C. bairdi* Tanner crab and red king crab (the only two crab species for which there are bycatch limits), and for other Tanner crab and other king crab. Other Tanner crab include *C. opilio, C. angulatus, C. tanneri,* and the *C. bairdi* X *C. opilio* hybrid. Other king crab include blue king crab, golden (brown) king crab and cousei king crab.

With the exception of Pacific herring, *C. bairdi* Tanner crab, and other Tanner crab, there does not appear to be significant differences between prohibited species bycatch rates in the CDQ fisheries compared with open access fisheries over both years and seasons. Mean CDQ bycatch rates were expressed as a percentage of mean open access bycatch rates to determine the extent to which bycatch rates were higher or lower in the CDQ fishery (Table 4). However, because bycatch rates approach zero within the CDQ fleet for some species, fisheries, or seasons, comparisons of this nature tend to exaggerate the differences between two rates. Finally, it should be emphasized that the open access figures in this comparison

[5]Observer estimates for all groundfish fisheries in the BSAI and Gulf of Alaska indicate that chum salmon account for about 99% of the "other" salmon group. See Narita, R., M. Guttormsen, J. Gharrett, G. Tromble, and J. Berger. 1994. Summary of observer sampling of domestic groundfish fisheries in the northeast Pacific Ocean and eastern Bering Sea, 1991. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-48, 540 p.

include only those vessels that participated in the CDQ fishery and do not reflect prohibited species bycatch rates of the open access fleet as a whole.

These results tend to suggest that the differences in the times of year and areas in which the open access and CDQ fisheries are conducted may be more responsible for the differences in prohibited species bycatch rates than any changes in vessel behavior resulting from different economic incentives in the open access and CDQ fisheries. This may be especially true for the bycatch of salmon and herring which traditionally fluctuate on a seasonal and geographical basis. The differences in fishing areas are expected to be a factor particularly during the "B" season when open access vessels are excluded from the CVOA but CDQ vessels are allowed to fish within it. These results tend to support Hypothesis 3, but also indicate that the two characteristics of the CDQ fishery are clearly not the only factors causing differences in performance between the CDQ and open access pollock fisheries.

Pacific halibut

Bycatch rates for Pacific halibut varied significantly from a high of 1.65 kg/t in the 1993 "A" open access fishery to a low of 0.09 kg/t in the 1993 "B" open access fishery. In both the CDQ and open access fisheries, halibut bycatch rates declined from 1993 to 1994. In addition, the aggregate halibut bycatch rates for both years and seasons were nearly identical at 0.77 kg/t in the CDQ fishery and 0.76 kg/t in the open access fishery (Fig. 10). Over both years, 8 vessels had lower average halibut bycatch rates in the open access fishery and 11 vessels had lower average halibut bycatch rates in the CDQ fishery.

Pacific herring

In the case of Pacific herring, vessels exhibited significantly higher bycatch rates during both the 1993 and 1994 "B" season CDQ fisheries (Fig. 11). This may be due either to the timing of the "B" season CDQ fishery or to the fact that many vessels participating in the "B" season fishery fished within the CVOA during CDQ operations but were excluded from the CVOA during open access operations. Most vessels experienced their highest herring bycatch rates in the 1994 "B" season CDQ fishery (Table 2). The aggregate herring bycatch rate for both years was 0.36 kg/t in the open access fishery and 1.06 kg/t in the CDQ fishery. Over both years, 9 vessels had lower average herring bycatch rates in the open access fishery, 9 vessels had lower herring bycatch rates in the CDQ fishery and 1 vessel had no reported herring bycatch in either fishery.

Chinook salmon

Bycatch rates of chinook salmon in the CDQ and open access fisheries are strikingly similar when both years and seasons are combined (Fig. 12). The aggregate bycatch rate for chinook salmon over both years was 0.025 individuals/t in the open access fishery and 0.022 individuals/t in the CDQ fishery. Four vessels had lower chinook salmon bycatch rates in the open access fishery, 14 vessels had lower chinook salmon rates in the CDQ fishery, and 1 vessel had no reported chinook salmon bycatch in either fishery.

Other salmon

In general, bycatch rates were higher for other salmon as compared with chinook salmon. However, bycatch rates for both chinook salmon and other salmon declined from 1993 to 1994 in both the open access and CDQ fisheries (Figs. 12 and 13). The aggregate bycatch rate for other salmon over both years was 0.097 individuals/t in the open access fishery and 0.113 individuals/t in the CDQ fishery. Seven vessels had lower average other salmon bycatch rates in the open access fishery, 10 vessels had lower other salmon bycatch rates in the CDQ fishery, and 1 vessel had no reported other salmon bycatch in either fishery.

Red king crab

The red king crab bycatch rate was highest in the 1993 "A" open access fishery at 0.054 individuals/t In all other cases, the red king crab bycatch rate was extremely low at less than 0.01 individuals/t (Fig. 14). The aggregate bycatch rate for red king crab over both years was 0.012 individuals/t in the open access fishery and 0.002 individuals/t in the CDQ fishery. Five vessels had lower average red king crab bycatch rates in the open access fishery, 4 vessels had lower average red king crab bycatch rates in the CDQ fishery and 10 vessels had no reported red king crab bycatch in either fishery.

Other king crab

Bycatch levels of other king crab are not significant in either the CDQ or open access fisheries (Fig. 15). Observer reports estimate only 2 individuals were caught during the entire 1993 CDQ fishery and 234 individuals were caught during the entire 1994 CDQ fishery (229 individuals were attributed to just 2 vessels). In fact, 13 vessels had no reported bycatch of other king crab in either fishery, 4 vessels had higher other king crab bycatch rates in open access fishery, and 2 vessels had higher other king crab bycatch rates in the CDQ fishery.

*C. bairdi* Tanner crab

Vessels participating in the open access fishery exhibited significantly higher *C. bairdi* bycatch rates, especially during the "A" season (Fig. 16). *C. bairdi* bycatch rates were highest in the 1993 "A" open access fishery at 1.52 individuals/t. The aggregate bycatch rate for *C. bairdi* over both years was 0.47 individuals/t in the open access fishery and 0.12 individuals/t in the CDQ fishery. Five vessels had lower average *C. bairdi* bycatch rates in the open access fishery and 14 vessels had lower *C. bairdi* bycatch rates in the CDQ fishery.

Other Tanner crab

Vessels participating in the open access fishery exhibited significantly higher other Tanner crab bycatch rates. Other Tanner crab bycatch rates were highest in the 1994 "B" open access fishery at 1.64 individuals/t (Fig. 17). The aggregate bycatch rate for other Tanner crab over both years was 0.61 individuals/t in the open access fishery and 0.07 individuals/t in the CDQ fishery. Five vessels had lower average other Tanner crab bycatch rates in the open access fishery, 13 vessels had lower average other Tanner crab bycatch rates in the CDQ fishery, and 1 vessel had no reported other Tanner crab bycatch in either fishery.

## COMPARISONS OF PRODUCTIVITY

### Overview of Production in the CDQ and Open Access Fisheries

For the CDQ fleet, fillets and surimi are the two primary products that represent the bulk of primary product production. During both years and seasons, vessels consistently increased fillet production and decreased surimi production during CDQ fishing operations. In 1994, many vessels also began to process a new product, deep skin fillets, in place of the traditional skinless, ribless pollock fillet (Fig. 18). When the total value of all products is considered, roe represented over 50% of total product value during the 1993 "A" season and over 40% of total product value during the 1994 "A" season in both the CDQ and open access fisheries (Fig. 19).[6]

### Product Values per Metric Ton of Pollock Landed

NMFS weekly production reports were used to compare the value of pollock products generated per metric ton of pollock catch in the CDQ and open access fisheries. Product values per metric ton were calculated by dividing the total value of pollock products produced in a given week by the estimates of total catch of pollock for that week. Product price information from the 1993 cooperative Alaska Department of Fish and Game (ADF&G)/NMFS annual groundfish processor survey was used to calculate the total value of products produced in a given week. Consequently, these figures represent an estimate of the value of products produced by an individual vessel and not the actual wholesale prices received by that vessel. The following prices were used: fillets, no skin or ribs, $0.86/lb.; deep skin fillets, $1.41/lb.; surimi, $0.76/lb.; roe, $5.56/lb.; minced fish, $0.40/lb.; fish meal, $0.23/lb.; and fish oil, $0.10/lb.

---

[6] Although roe represents the most valuable product harvested during the CDQ fishery, it is always reported as an ancillary product in pollock fisheries. All vessels processing roe during the CDQ "A" season list either surimi or fillets as their primary product and roe as an ancillary product in their weekly production reports.

Product values by vessel and fishery

Tables 5 and 6 display total pollock product values per metric ton of pollock catch and the breakdown of primary products for vessels participating in the 1993 and 1994 CDQ fisheries. Because inconsistencies exist between the observer, blend, and weekly production report databases, product values per metric ton were calculated separately using pollock tonnage totals obtained from each of three databases. One significant source of discrepancy between the observer and weekly processor databases is the lag time between when fish are caught and processed. For example, fish caught at the end of a week will be attributed to that week's catch tonnage in the observer database. However, because those fish may not be processed for 24 to 48 hours, they may be attributed to the following week's production total. Consequently, the observer and weekly production databases may not be directly comparable on a week-by-week basis (but should be in closer agreement on a season-by-season basis).

Figures 20 and 21 display the average value of products per metric ton for each vessel participating in the 1993 and 1994 CDQ fishery, and Figure 22 displays the CDQ fleet average product values by fishery, season, and product type. For all three figures, observer data was the source of total pollock catch. Most vessels generated at least twice the value of pollock products per metric ton of pollock caught during the "A" (roe) season as compared with the "B" (non-roe) season. This difference in product value per metric ton is due largely to the high value of pollock roe which is produced as an ancillary product by all vessels during the "A" season (Fig. 22).

CDQ versus open access fisheries

The comparison between the CDQ and open access fisheries is made first using weekly observer data as the source of total pollock catch. That is followed by similar comparisons using blend data and then weekly production data as the source of total pollock catch.

During the "A" season, most vessels generated significantly higher product values per metric ton during the CDQ fishery as opposed to the open access fishery. In 1993, nine vessels had higher product values per metric ton of pollock catch in the "A" season CDQ fishery and two vessels had higher product values in the "A" season open access fishery (Fig. 23). In 1994, eight vessels had higher product values per metric ton of pollock catch in the "A" season CDQ fishery and, five vessels had higher product values in the "A" season open access fishery (Fig. 24). For all vessels combined in the 1993 "A" season, the estimate was $557 in the open access fishery compared with $677 for the CDQ fishery. The comparable estimates for 1994 are $687 and $749, respectively.

During the 1993 "B" season, average product value per metric ton of pollock catch was substantially greater for the CDQ fishery. Although five vessels had higher product values per metric ton of pollock catch in the CDQ fishery, six vessels had higher values in the open access fishery (Fig. 23). In 1994, the average product value was basically the same in the CDQ and open access pollock fisheries. Although eight vessels had higher product values per metric ton of pollock catch in the CDQ fishery, five vessels had higher values in the open access fishery (Fig. 24). For all vessels combined in the 1993 "B" season, the estimate was $339 in the open access fishery compared with $439 for the CDQ fishery. The comparable estimates for 1994 are $529 and $532, respectively.

One factor may account for much of the higher average value for the CDQ fishery during the "A" season. Industry sources have suggested that the peak of the 1993 roe season did not occur until after the closure of the "A" season offshore pollock fishery.[7] Vessels participating in the "A" season CDQ fishery may have had the advantage of fishing when the quantity of pollock roe was at the peak. Because one industry-wide average price for roe was used throughout this analysis, only differences in the total quantity of roe produced, not differences in the quality of roe between CDQ and open access fisheries are accounted for. Much of the increase in production per metric ton during the "A" season CDQ fishery is attributable to higher roe production, however production of other products such as surimi and fillets also increased during the CDQ fishery (Fig. 22). These results based on weekly observer estimates of total pollock catch tend to support Hypothesis 2.

The results are not substantially different when blend estimates of total pollock catch are used. During the 1993 "A" season, 10 out of 11 vessels generated higher, often substantially higher, product values per metric ton in the CDQ fishery (Table 5). In 1994, 10 vessels had higher product values per metric ton of pollock catch in the "A" season CDQ fishery and 5 vessels had higher product values in the "A" season open access fishery. For all vessels combined in the 1993 "A" season, the estimate was $559 in the open access fishery compared with $679 for the CDQ fishery. The comparable estimates for 1994 are $520 and $553, respectively.

During the "B" season, average product value per metric ton of pollock catch was higher during the 1993 CDQ fishery but lower during the 1994 CDQ fishery. In 1993, 9 of 12 vessels had higher product values in the CDQ fishery. In 1994, eight vessels had higher product values per metric ton of pollock catch in the "B" season CDQ fishery and five vessels had higher product values per metric ton of pollock catch in the "B" season open access fishery. For all vessels combined in the 1993 "B" season , the estimate was $339 in the open access fishery compared with $425 for the CDQ fishery. The comparable estimates for 1994 are $376 and $349, respectively. Therefore, when total pollock catch is based on the blend estimates, the results support Hypothesis 2.

The third comparison of product value per metric ton of pollock catch was made using weekly production reports as the source of total pollock catch. The results are not substantially different for this third source of catch data. During the "A" season, most vessels generated significantly higher product values per metric ton during the CDQ fishery as opposed to the open access fishery. In 1993, nine vessels had higher product values per

---

[7]For a discussion of the timing of the 1993 roe season see NMFS Alaska Region, "EA/RIR/IRFA for a regulatory amendment to change the Bering Sea and Aleutian Islands area pollock roe season start date (28 June, 1994).

metric ton of pollock catch in the "A" season CDQ fishery and two vessels had higher product values in the "A" season open access fishery (Table 5). In 1994, 11 vessels had higher product values per metric ton of pollock catch in the "A" season CDQ fishery, 2 vessels had higher product values in the "A" season open access fishery, and 2 vessels had the same values in the CDQ and open access fisheries (Table 6). For all vessels combined in the 1993 "A" season, the estimate was $659 in the open access fishery compared with $846 for the CDQ fishery. The comparable estimates for 1994 are $486 and $597, respectively.

During the "B" season the differences between the CDQ and open access fishery were similar to those with the other two measures of value per metric ton on pollock catch. In 1993, nine vessels had higher product values per metric ton of pollock catch in the "B" season CDQ fishery and three vessels had higher product values per metric ton of pollock catch in the "B" season open access fishery (Table 5). In 1994, five vessels had higher product values per metric ton of pollock catch in the "B" season CDQ fishery and eight vessels had higher product values per metric ton of pollock catch in the "B" season open access fishery (Table 6). For all vessels combined in the 1993 "B" season, the estimate was $303 in the open access fishery compared with $369 for the CDQ fishery. The comparable estimates for 1994 are $343 and $382, respectively. Therefore, the results also tend to support Hypothesis 2 when the comparisons of pollock product value per metric ton of pollock catch are made using the weekly production report estimates of total pollock catch.

## Other Possible Differences Between the CDQ and Open Access Product Values

Industry sources suggest that there may be other differences in the value of products produced in the CDQ fishery as compared with the open access fishery. Vessels in the CDQ fishery may have some market advantages over vessels in open access fisheries. Some secondary processors have indicated that they prefer to purchase products from CDQ partnerships for several reasons. First, the CDQ fishery increases the ability of secondary processors to rely on a particular supplier because the CDQs allow vessels to guarantee that a certain quantity of fish will be harvested and delivered. Second, inventory costs are potentially lower for firms purchasing products produced in the CDQ fishery because they can inventory fish in the water requesting delivery only when products are needed. For some secondary processors, inventory and storage costs may be significant. At present, most vessels participating in the open access fishery make the majority of their deliveries during February/March and October/November at the end of the "A" and "B" season open access fisheries. Because vessels participating in the CDQ fishery are free to fish at any time, they may spread out their deliveries to the times when products are in highest demand.

Despite the possible market advantages inherent in the CDQ fishery, one secondary processor contacted during this study indicated that they do not pay any additional price for products caught in the CDQ fishery. This secondary processor also noted that they have neither looked for nor observed any differences in product quality between CDQ and open access fisheries.

## Catch per Unit of Effort

Observer tow duration estimates were matched with observer pollock catch estimates to generate a measure of CPUE. Figures 25 and 26 display the average pollock catch per hour of tow duration for each vessel and fishery. Several observations can be made with respect to fishing effort. First, vessels which produced surimi as a primary product tended to catch more pollock per hour than vessels which produced fillets as a primary product. This difference may be due to differences in vessel size rather than type of product as vessels with surimi processing capacity tend to be larger in size. Second, vessels in the open access fishery tended to catch more pollock per hour of fishing effort than in the CDQ fishery (Fig. 27). Although catch per day or week would be expected to be higher in the open access fishery due to both characteristics of the CDQ fishery, the reason for the difference in CPUE between the CDQ and open access pollock fishery is not obvious.

# CONCLUSIONS

The results of this comparison of the performance of vessels participating in both the open access and CDQ pollock fisheries offer support for the four hypotheses detailed previously. Pollock and other groundfish discard rates were lower in the CDQ fishery. For the "A" and "B" seasons for both years together, the pollock discard rate was 2% in the CDQ fishery compared with 4% in the open access fishery. With respect to prohibited species, the open access fishery produced higher king crab and Tanner crab bycatch rates while the CDQ fishery produced higher herring bycatch rates. Bycatch rates for halibut and salmon in the open access and CDQ fisheries were roughly comparable. The differences in prohibited species bycatch rates between the CDQ and open access fisheries suggest that the two characteristics of the CDQ fishery that are the basis for the hypotheses are not the only factors that result in differences in the performance of the CDQ and open access pollock fisheries. Differences in pollock product values generated per metric ton of pollock caught were substantial during the 1993 and 1994 "A" seasons and 1993 "B" season. In these three cases, CDQ vessels generated higher product values. During the 1994 "B" season, there was basically no differences in product values between the CDQ and open access fisheries.

One final point to emphasize is that all of the vessels participating in CDQ fisheries continue to conduct the bulk of their activity in open access fisheries, and consequently are still governed by the economics of open access fishing conditions. As a result, investments that might make economic sense for vessels participating exclusively under the two characteristics of the CDQ fishery may not make sense for vessels that harvest the preponderance of their fish in open access fisheries.

Because of the absence of strict controls or adjustments for the other factors listed previously, the comparisons presented in this paper are only suggestive of the differences in fishing under CDQ and open access conditions. Nevertheless, the results of this study suggest that conditions in a CDQ fishery support a more efficient utilization of resources in the pollock fishery and could be effective in addressing the problems of discards and bycatch in the groundfish fisheries off Alaska.

Table 1. Groundfish discard and prohibited species bycatch rates for vessels participating in the 1993 CDQ fishery.

| | | | | | | kg/metric ton | | Individuals/metric ton | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Vessel and fishery* | *Primary product*[1] | *Pollock disc rate*[2] | *Cod disc. rate*[3] | *Oth. target disc.rate*[4] | *Non-poll. total catch*[5] | *hal* | *herr* | *Chin* | *Osal* | *Redk* | *Btan* | *Otan* |
| | | | | | *Surimi vessels* | | | | | | | |
| Vessel A | | | | | | | | | | | | |
| "A" open access | Surimi | 0% | 100% | 100% | 4% | 1.41 | - | 0.11 | - | - | 0.45 | 0.19 |
| "A" CDQ | Surimi | 0% | 100% | 100% | 1% | 0.04 | - | - | - | - | 0.01 | - |
| "B" open access | Surimi | 2% | 100% | 100% | 0% | - | 3.95 | 0.00 | 0.95 | - | - | - |
| "B" CDQ | Surimi | 2% | 100% | 100% | 0% | - | 1.08 | 0.06 | 0.41 | - | - | - |
| Vessel B | | | | | | | | | | | | |
| "A" open access | Surimi | 2% | 100% | 100% | 1% | 0.38 | - | 0.06 | - | - | 0.09 | - |
| "A" CDQ | Surimi | 0% | 0% | 100% | 0% | - | - | - | - | - | - | - |
| "B" open access | Surimi | 0% | 59% | 100% | 0% | 0.02 | 0.03 | 0.01 | 0.20 | - | - | - |
| "B" CDQ | Surimi | 0% | 100% | 100% | 0% | 0.02 | 0.07 | 0.04 | 0.05 | - | - | - |
| Vessel D | | | | | | | | | | | | |
| "B" open access | Surimi | 0% | 100% | 100% | 0% | 0.25 | 0.30 | 0.01 | 0.18 | - | - | - |
| "B" CDQ | Surimi | 0% | 100% | 100% | 0% | - | - | 0.03 | - | - | - | - |
| Vessel G | | | | | | | | | | | | |
| "A" open access | Surimi | 2% | 100% | 100% | 0% | 0.17 | 0.00 | 0.08 | 0.00 | - | 0.11 | 0.07 |
| "A" CDQ | Surimi | 0% | 0% | 100% | 0% | - | - | 0.01 | - | - | - | - |
| "B" open access | Surimi | 2% | 100% | 100% | 1% | 0.06 | 0.14 | 0.01 | 0.06 | - | - | 0.00 |
| "B" CDQ | Surimi | 0% | 100% | 100% | 0% | 0.11 | 0.41 | 0.03 | 0.46 | - | - | - |
| Vessel H | | | | | | | | | | | | |
| "A" open access | Surimi | 1% | 67% | 100% | 1% | 0.76 | - | 0.01 | 0.00 | - | 0.18 | 0.05 |
| "A" CDQ | Surimi | 1% | 10% | 100% | 0% | 0.14 | 0.01 | 0.00 | 0.01 | - | - | - |
| "B" open access | Surimi | 0% | 100% | 100% | 0% | 0.02 | 0.02 | 0.01 | 0.47 | - | - | - |
| "B" CDQ | Surimi | 0% | 100% | 100% | 0% | - | 0.89 | 0.02 | 0.01 | - | - | - |
| Vessel I | | | | | | | | | | | | |
| "A" open access | Surimi | 10% | 99% | 100% | 6% | 1.69 | - | 0.00 | - | 0.378 | 4.39 | 1.47 |
| "A" CDQ | Fillets | 4% | 10% | 100% | 0% | - | - | - | - | - | 0.26 | - |
| Vessel K | | | | | | | | | | | | |
| "B" open access | Surimi | 0% | 100% | 97% | 0% | - | 0.01 | 0.10 | 0.07 | - | - | 0.00 |
| "B" CDQ | Surimi | 0% | 100% | 100% | 0% | - | 1.72 | 0.04 | 0.22 | - | - | - |

Table 1. Cont.

| Vessel and fishery | Primary product[1] | Pollock disc rate[2] | Cod disc. rate[3] | Oth. target disc.rate[4] | Non-poll. total catch[5] | kg/metric ton | | Individuals/metric ton | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | hal | herr | Chin | Osal | Redk | Btan | Otan |
| | | | | | *Fillet vessels* | | | | | | | |
| Vessel L | | | | | | | | | | | | |
| "A" open access | Fillets | 10% | 77% | 100% | 9% | 3.62 | - | 0.06 | - | 0.001 | 0.28 | 0.15 |
| "A" CDQ | Fillets | 1% | 45% | 99% | 7% | 2.61 | 0.03 | 0.01 | 0.54 | - | 0.06 | - |
| "B" open access | Fillets | 5% | 100% | 100% | 0% | 0.01 | 0.08 | 0.03 | 0.57 | - | - | - |
| "B" CDQ | Fillets | 2% | 100% | 100% | 0% | - | 35.49 | 0.06 | 0.21 | - | - | - |
| Vessel M | | | | | | | | | | | | |
| "A" open access | Fillets | 5% | 100% | 100% | 9% | 4.68 | - | 0.22 | - | - | 0.46 | 0.00 |
| "A" CDQ | Fillets | 5% | 98% | 100% | 3% | 1.22 | 0.20 | 0.00 | 0.17 | - | 0.72 | 0.12 |
| "B" open access | Fillets | 0% | 100% | 100% | 1% | 0.02 | 0.08 | 0.02 | 0.37 | - | - | - |
| "B" CDQ | Fillets | 0% | 100% | 100% | 0% | 0.20 | 0.53 | 0.11 | 0.21 | 0.004 | 0.13 | 0.07 |
| Vessel O | | | | | | | | | | | | |
| "A" open access | Surimi | 3% | 82% | 100% | 6% | 1.05 | - | - | - | - | 1.71 | 0.69 |
| "A" CDQ | Fillets | 0% | 100% | 100% | 2% | 0.77 | 0.08 | 0.01 | 0.47 | - | 0.09 | 0.01 |
| "B" open access | Fillets | 1% | 93% | 100% | 0% | 0.02 | 0.12 | 0.00 | 0.12 | - | - | - |
| "B" CDQ | Fillets | 0% | 36% | 100% | 0% | 0.09 | - | 0.01 | 0.05 | - | - | - |
| Vessel P | | | | | | | | | | | | |
| "A" open access | Fillets | 34% | 100% | 100% | 7% | 1.45 | - | - | - | - | 2.58 | 3.35 |
| "A" CDQ | Fillets | 25% | 100% | 100% | 11% | 0.91 | - | - | - | - | 0.36 | 1.42 |
| Vessel Q | | | | | | | | | | | | |
| "A" open access | Fillets | 9% | 98% | 100% | 4% | 0.99 | - | 0.01 | - | - | 2.98 | 2.22 |
| "A" CDQ | Fillets | 1% | 9% | 99% | 0% | 0.19 | 0.05 | 0.00 | 0.24 | - | - | 0.00 |
| "B" open access | Fillets | 0% | 92% | 100% | 0% | 0.02 | 0.05 | 0.00 | 0.16 | - | - | - |
| "B" CDQ | Fillets | 3% | 100% | 100% | 1% | 0.10 | - | 0.08 | 0.00 | - | - | - |
| Vessel R | | | | | | | | | | | | |
| "A" open access | Fillets | 52% | 100% | 100% | 11% | 5.42 | 0.01 | - | - | 0.000 | 2.12 | - |
| "A" CDQ | Fillets | 38% | 93% | 100% | 18% | 4.63 | 0.08 | 0.00 | - | 0.027 | 1.58 | 2.07 |
| "B" open access | Fillets | 5% | 100% | 100% | 1% | 0.18 | 0.10 | 0.02 | 0.08 | - | 0.00 | 0.00 |
| "B" CDQ | Fillets | 22% | 100% | 100% | 3% | 0.42 | - | 0.38 | 0.01 | - | - | - |
| Vessel S | | | | | | | | | | | | |
| "B" open access | Fillets | 11% | 100% | 100% | 1% | 0.17 | 0.03 | 0.00 | 0.09 | - | 0.00 | - |
| "B" CDQ | Fillets | 0% | 100% | 100% | 11% | 35.11 | - | - | - | - | 1.53 | - |

Table 1. Cont.

| Vessel and fishery | Primary product[1] | Pollock disc rate[2] | Cod disc. rate[3] | Oth. target disc.rate[4] | Non-poll. total catch[5] | kg/metric ton | | Individuals/metric ton | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | hal | herr | Chin | Osal | Redk | Btan | Otan |
| Total | | | | | | | | | | | | |
| "A" open access | - | 10% | 95% | 100% | 5% | 1.65 | 0.00 | 0.04 | 0.00 | 0.054 | 1.52 | 0.75 |
| "A" CDQ | - | 4% | 82% | 100% | 3% | 0.90 | 0.06 | 0.01 | 0.20 | 0.002 | 0.24 | 0.22 |
| "B" open access | - | 3% | 97% | 100% | 0% | 0.09 | 0.48 | 0.02 | 0.26 | - | 0.00 | 0.00 |
| "B" CDQ | - | 1% | 100% | 100% | 1% | 1.64 | 1.41 | 0.06 | 0.13 | 0.001 | 0.10 | 0.02 |
| Surimi vessels | | | | | | | | | | | | |
| "A" open access | - | 3% | 98% | 100% | 3% | 0.94 | 0.00 | 0.05 | 0.00 | 0.093 | 1.24 | 0.42 |
| "A" CDQ | - | 1% | 86% | 100% | 0% | 0.03 | 0.00 | 0.00 | 0.00 | - | 0.04 | - |
| "B" open access | - | 1% | 94% | 100% | 0% | 0.07 | 0.80 | 0.02 | 0.33 | - | - | 0.00 |
| "B" CDQ | - | 0% | 100% | 100% | 0% | 0.02 | 0.76 | 0.03 | 0.16 | - | - | - |
| Fillet vessels | | | | | | | | | | | | |
| "A" open access | - | 20% | 94% | 100% | 8% | 2.63 | 0.00 | 0.03 | - | 0.000 | 1.90 | 1.21 |
| "A" CDQ | - | 6% | 82% | 100% | 5% | 1.32 | 0.08 | 0.01 | 0.29 | 0.002 | 0.34 | 0.32 |
| "B" open access | - | 6% | 99% | 100% | 1% | 0.11 | 0.07 | 0.01 | 0.15 | - | 0.00 | 0.00 |
| "B" CDQ | - | 2% | 100% | 100% | 2% | 3.18 | 2.02 | 0.09 | 0.10 | 0.002 | 0.19 | 0.03 |

[1]Primary product calculated as a percentage of all primary product tonnage for each vessel and fishery. Vessels are categorized as surimi or fillet according to which product represents the greatest production on an annual basis.
[2]Pollock discard rate expressed as a percentage of the total catch of pollock.
[3]Cod discard rate expressed as a percentage of total catch of cod.
[4]Other target species (non-pollock or cod) discard rate expressed as a percentage of other target species total catch.
[5]Non-pollock groundfish catch expressed as a percentage of the total groundfish catch.

Source: Weekly observer reports, National Marine Fisheries Service, Alaska Region, Juneau, AK.

Table 2. Groundfish discard and prohibited species bycatch rates for vessels participating in the 1994 CDQ fishery.

| Vessel and fishery | Primary product[1] | Pollock disc rate[2] | Cod disc. rate[3] | Oth. target disc.rate[4] | Non-poll. total catch[5] | kg/metric ton hal | kg/metric ton herr | Individuals/metric ton Chin | Individuals/metric ton Osal | Individuals/metric ton Redk | Individuals/metric ton Btan | Individuals/metric ton Otan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | *Surimi vessels* | | | | | | | |
| Vessel A | | | | | | | | | | | | |
| "A" open access | Surimi | 17% | 100% | 100% | 2% | 0.00 | - | 0.069 | 0.000 | - | - | - |
| "A" CDQ | Surimi | 0% | 100% | 100% | 2% | 0.00 | 0.00 | 0.070 | - | - | - | - |
| "B" open access | Surimi | 1% | 0% | 100% | 1% | 0.03 | 0.05 | 0.011 | 0.611 | - | - | - |
| "B" CDQ | Surimi | 1% | 100% | 100% | 1% | - | 1.24 | 0.001 | 1.462 | - | - | - |
| Vessel B | | | | | | | | | | | | |
| "A" open access | Surimi | 0% | 61% | 92% | 1% | 0.50 | 0.00 | 0.052 | - | - | 0.04 | 0.00 |
| "A" CDQ | Surimi | 1% | 100% | 93% | 1% | 0.23 | - | 0.019 | - | - | - | 0.01 |
| "B" open access | Surimi | 1% | 77% | 60% | 0% | 0.17 | 0.42 | 0.003 | 0.041 | 0.000 | 0.04 | 0.00 |
| "B" CDQ | Surimi | 13% | 81% | 35% | 0% | 0.10 | 5.44 | 0.001 | 0.244 | - | - | - |
| Vessel D | | | | | | | | | | | | |
| "B" open access | Surimi | 3% | 77% | 61% | 7% | 3.81 | 0.24 | - | 0.036 | - | 0.83 | 1.22 |
| "B" CDQ | Surimi | 0% | 100% | 100% | 4% | 2.39 | - | - | - | - | 0.78 | 0.04 |
| Vessel F | | | | | | | | | | | | |
| "B" open access | Surimi | 3% | 92% | 71% | 2% | 1.43 | 1.31 | 0.002 | 0.042 | - | 0.65 | 2.71 |
| "B" CDQ | Surimi | 0% | 22% | 100% | 0% | - | 0.01 | - | 0.135 | - | - | 0.01 |
| Vessel H | | | | | | | | | | | | |
| "A" open access | Surimi | 0% | 100% | 100% | 0% | 0.16 | 0.00 | 0.039 | 0.000 | - | 0.00 | 0.00 |
| "A" CDQ | Surimi | 0% | 100% | 100% | 1% | 1.46 | - | 0.024 | 0.006 | - | 0.00 | - |
| "B" open access | Surimi | 0% | 100% | 100% | 1% | 0.03 | 1.46 | 0.002 | 0.012 | - | 0.00 | - |
| "B" CDQ | Surimi | 0% | 100% | 100% | 1% | 0.25 | 2.53 | 0.001 | 0.201 | - | - | - |
| Vessel I | | | | | | | | | | | | |
| "B" open access | Surimi | 0% | 100% | 100% | 3% | 0.91 | 1.87 | 0.004 | 0.085 | - | 0.70 | 3.56 |
| "B" CDQ | Surimi | 0% | 100% | 100% | 1% | 0.07 | 4.14 | 0.000 | 0.052 | - | 1.83 | 0.00 |
| Vessel K | | | | | | | | | | | | |
| "A" open access | Surimi | 1% | 100% | 100% | 2% | 1.54 | 0.00 | 0.054 | - | - | 0.01 | 0.01 |
| "A" CDQ | Surimi | 0% | 100% | 92% | 2% | 2.19 | - | 0.023 | 0.002 | - | 0.12 | - |
| "B" open access | Surimi | 4% | 100% | 98% | 1% | 0.02 | 3.98 | 0.004 | 0.030 | - | 0.03 | 0.00 |
| "B" CDQ | Surimi | 1% | 100% | 100% | 0% | 0.00 | 4.67 | 0.004 | 0.122 | - | - | - |
| Vessel O | | | | | | | | | | | | |
| "A" open access | Surimi | 3% | 100% | 100% | 1% | 0.13 | - | 0.125 | - | - | - | - |
| "A" CDQ | Surimi | 1% | 72% | 100% | 1% | 0.45 | - | 0.008 | - | 0.002 | 0.04 | - |
| "B" open access | Surimi | 1% | 93% | 47% | 2% | 0.31 | 0.11 | 0.001 | 0.066 | - | 0.04 | 0.02 |
| "B" CDQ | Surimi | 0% | 100% | 100% | 1% | 0.07 | 0.29 | - | 0.003 | - | - | - |

Table 2. Cont.

| Vessel and fishery | Primary product[1] | Pollock disc rate[2] | Cod disc. rate[3] | Oth. target disc.rate[4] | Non-poll. total catch[5] | kg/metric ton hal | kg/metric ton herr | Individuals/metric ton Chin | Individuals/metric ton Osal | Individuals/metric ton Redk | Individuals/metric ton Btan | Individuals/metric ton Otan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | *Fillet vessels* | | | | | | | |
| Vessel C | | | | | | | | | | | | |
| "A" open access | Fillets | 0% | 98% | 100% | 9% | 3.92 | 0.00 | 0.005 | - | - | 1.25 | 0.02 |
| "A" CDQ | Fillets | 17% | 1% | 40% | 22% | 2.60 | 0.02 | 0.251 | - | 0.074 | 0.10 | 0.33 |
| Vessel E | | | | | | | | | | | | |
| "A" open access | Fillets | 2% | 100% | 100% | 5% | 4.75 | - | - | - | 0.286 | 0.17 | - |
| "A" CDQ | Fillets | 0% | 1% | 41% | 37% | 2.54 | - | - | - | - | 0.46 | 0.09 |
| Vessel J | | | | | | | | | | | | |
| "A" open access | Surimi | 0% | 2% | 100% | 5% | 2.33 | 0.00 | 0.008 | - | - | 1.20 | 0.10 |
| "A" CDQ | Fillets | 0% | 0% | 100% | 39% | 3.25 | - | - | - | 0.155 | 1.81 | 0.96 |
| Vessel L | | | | | | | | | | | | |
| "A" open access | Fillets | 49% | 100% | 100% | 4% | 2.22 | - | 0.037 | 0.002 | - | 0.03 | - |
| "A" CDQ | Fillets | 1% | 58% | 42% | 11% | 3.88 | 0.00 | 0.020 | - | - | 0.14 | - |
| "B" open access | Fillets | 0% | 100% | 100% | 2% | 0.93 | 1.25 | 0.012 | 0.045 | - | 0.01 | - |
| "B" CDQ | Fillets | 1% | 100% | 100% | 0% | 0.04 | 9.84 | 0.016 | 0.032 | - | 0.00 | - |
| Vessel M | | | | | | | | | | | | |
| "A" open access | Fillets | 3% | 100% | 100% | 0% | - | 0.00 | 0.052 | 0.002 | - | - | - |
| "A" CDQ | Fillets | 1% | 100% | 100% | 0% | 0.00 | 0.00 | 0.010 | - | - | - | 0.00 |
| "B" open access | Fillets | 0% | 100% | 100% | 1% | 0.23 | 2.72 | 0.144 | 0.155 | - | - | 0.00 |
| "B" CDQ | Fillets | 1% | 97% | 95% | 1% | 0.01 | 2.18 | 0.029 | 0.077 | - | - | 0.00 |
| Vessel N | | | | | | | | | | | | |
| "B" open access | Fillets | 6% | 100% | 100% | 7% | 3.99 | 0.14 | 0.000 | 0.005 | - | 0.17 | 4.41 |
| "B" CDQ | Fillets | 0% | 0% | 100% | 1% | 1.13 | - | - | - | - | - | - |
| Vessel P | | | | | | | | | | | | |
| "A" open access | Fillets | 0% | 100% | 100% | 2% | 0.62 | - | 0.014 | - | - | 0.03 | - |
| "A" CDQ | Fillets | 0% | 100% | 100% | 7% | 0.89 | - | - | - | - | 0.59 | - |
| "B" open access | Fillets | 0% | 100% | 85% | 5% | 3.09 | 0.42 | 0.001 | 0.106 | - | 4.15 | 10.48 |
| "B" CDQ | Fillets | 0% | 98% | 100% | 1% | 0.06 | 1.06 | - | 0.004 | - | 0.06 | 0.10 |
| Vessel Q | | | | | | | | | | | | |
| "A" open access | Fillets | 1% | 100% | 100% | 1% | 0.00 | 0.00 | 0.042 | - | - | - | - |
| "A" CDQ | Fillets | 1% | 2% | 100% | 1% | 2.97 | 0.00 | 0.024 | - | - | - | - |
| "B" open access | Fillets | 6% | 100% | 100% | 3% | 0.23 | 1.41 | 0.008 | 0.054 | - | 0.02 | 0.15 |
| "B" CDQ | Fillets | 0% | 100% | 96% | 3% | 0.18 | 1.01 | 0.001 | 0.002 | - | 0.08 | 0.11 |

Table 2. Cont.

| Vessel and fishery | Primary product[1] | Pollock disc rate[2] | Cod disc. rate[3] | Oth. target disc.rate[4] | Non-poll. total catch[5] | kg/metric ton hal | kg/metric ton herr | Individuals/metric ton Chin | Individuals/metric ton Osal | Individuals/metric ton Redk | Individuals/metric ton Btan | Individuals/metric ton Otan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vessel R | | | | | | | | | | | | |
| "A" open access | Fillets | 10% | 86% | 100% | 1% | 0.34 | - | 0.022 | - | - | 0.01 | - |
| "A" CDQ | Fillets | 10% | 46% | 100% | 4% | 0.18 | - | 0.022 | - | 0.012 | 0.04 | - |
| "B" open access | Fillets | 2% | 100% | 100% | 5% | 2.64 | 0.37 | 0.007 | 0.126 | 0.000 | 5.29 | 7.82 |
| "B" CDQ | Fillets | 0% | 100% | 100% | 6% | 2.91 | 0.09 | - | 0.409 | - | 2.11 | - |
| Vessel S | | | | | | | | | | | | |
| "A" open access | Fillets | 0% | 100% | 100% | 0% | 0.11 | - | - | - | - | - | - |
| "A" CDQ | Fillets | 0% | 0% | 100% | 0% | - | - | - | - | - | - | - |
| Surimi Vessels | | | | | | | | | | | | |
| "A" open access | - | 3% | 95% | 100% | 1% | 0.28 | 0.00 | 0.06 | 0.011 | - | 0.00 | 0.00 |
| "A" CDQ | - | 0% | 92% | 39% | 2% | 0.54 | 0.00 | 0.03 | 0.004 | 0.001 | 0.02 | 0.00 |
| "B" open access | - | 2% | 72% | 91% | 2% | 0.73 | 0.82 | 0.00 | 0.117 | 0.000 | 0.25 | 0.75 |
| "B" CDQ | - | 2% | 91% | 98% | 1% | 0.09 | 2.31 | 0.00 | 0.198 | - | 0.05 | 0.00 |
| Fillet vessels | | | | | | | | | | | | |
| "A" open access | - | 7% | 74% | 100% | 3% | 1.14 | 0.00 | 0.010 | 0.000 | 0.020 | 0.14 | 0.01 |
| "A" CDQ | - | 2% | 19% | 98% | 8% | 1.06 | 0.00 | 0.022 | - | 0.009 | 0.17 | 0.07 |
| "B" open access | - | 3% | 95% | 100% | 4% | 1.45 | 0.79 | 0.012 | 0.066 | 0.000 | 1.40 | 3.50 |
| "B" CDQ | - | 1% | 95% | 100% | 1% | 0.06 | 3.21 | 0.023 | 0.059 | - | 0.03 | 0.02 |
| All Vessels | | | | | | | | | | | | |
| "A" open access | - | 4% | 82% | 100% | 2% | 0.59 | 0.00 | 0.042 | 0.007 | 0.007 | 0.05 | 0.00 |
| "A" CDQ | - | 1% | 27% | 86% | 5% | 0.81 | 0.00 | 0.023 | 0.002 | 0.005 | 0.10 | 0.04 |
| "B" open access | - | 2% | 82% | 96% | 3% | 0.97 | 0.81 | 0.006 | 0.101 | 0.000 | 0.62 | 1.64 |
| "B" CDQ | - | 2% | 94% | 99% | 1% | 0.07 | 2.78 | 0.012 | 0.126 | - | 0.04 | 0.01 |
| Grand Total (1993-1994) | | | | | | | | | | | | |
| open access | - | 4% | 87% | 99% | 2% | 0:76 | 0.36 | 0.025 | 0.097 | 0.012 | 0.47 | 0.61 |
| CDQ | - | 2% | 53% | 94% | 3% | 0.77 | 1.06 | 0.022 | 0.113 | 0.002 | 0.12 | 0.07 |

[1]Primary product calculated as a percentage of all primary product tonnage for each vessel and fishery. Vessels are categorized as surimi or fillet according to which product represents the greatest production on an annual basis.
[2]Pollock discard rate expressed as a percentage of the total catch of pollock.
[3]Cod discard rate expressed as a percentage of total catch of cod.
[4]Other target species (non-pollock or cod) discard rate expressed as a percentage of other target species total catch.
[5]Non-pollock groundfish catch expressed as a percentage of the total groundfish catch.

Source: Weekly observer reports, National Marine Fisheries Service, Alaska Region, Juneau, AK.

Table 3. Round weight equivalent of primary product fish meal production (expressed as a percentage of total pollock catch).

| | *1993* | | | | *1994* | | | |
|---|---|---|---|---|---|---|---|---|
| | *"A" season* | | *"B" season* | | *"A" season* | | *"B" season* | |
| *vessel* | *open access* | *CDQ* | *open access* | *CDQ* | *open access* | *CDQ* | *open access* | *CDQ* |
| Vessel A | | 0% | | | | | | |
| Vessel B | 18% | 33% | | | 1% | 2% | 5% | |
| Vessel C | | | | | | | | |
| Vessel D | | | 9% | | | | | |
| Vessel E | | | | | 3% | | | |
| Vessel F | | | | | | | 1% | 1% |
| Vessel G | | | | | | | | |
| Vessel H | | | 9% | | 4% | | 3% | 1% |
| Vessel I | | | | | | | | |
| Vessel J | | | | | 12% | 5% | | |
| Vessel K | | | | | 11% | | | |

Source: Weekly observer reports and weekly production reports, National Marine Fisheries Service, Alaska Region, Juneau AK.

Table 4. CDQ discard and bycatch rates expressed as a percentage of open access discard and bycatch rates.

| *Year and fishery* | *Pollock disc rate* | *Cod disc rate* | *Oth. groundfish disc. rate* | *Non-pollock total catch* | *Halibut* | *Herring* |
|---|---|---|---|---|---|---|
| 1993 "A" | 42% | 86% | 100% | 66% | 55% | 5659% |
| 1993 "B" | 25% | 122% | 100% | 29% | 182% | 2518% |
| 1994 "A" | 32% | 33% | 86% | 273% | 138% | 185% |
| 1994 "B" | 82% | 114% | 103% | 34% | 8% | 343% |
| Total | 50% | 61% | 95% | 117% | 101% | 295% |

| *Year and fishery* | *Chinook* | *Oth. salmon* | *Red king* | *Bairdi Tanner* | *Other Tanner* |
|---|---|---|---|---|---|
| 1993 "A" | 13% | 85771% | 3% | 16% | 29% |
| 1993 "B" | 1241% | 67% | 57% | 40% | 7% |
| 1994 "A" | 55% | 28% | 67% | 187% | 964% |
| 1994 "B" | 207% | 125% | 0% | 6% | 1% |
| Total | 91% | 116% | 16% | 25% | 12% |

Source: Weekly observer reports, National Marine Fisheries Service, Alaska Region, Juneau AK.

Table 5. Product value per metric ton of pollock catch, and breakdown of primary products for vessels participating in the 1993 CDQ fishery.

| | *Total product value / metric ton of pollock*[1] | | | *Primary products (percent of primary product tons)* | | | |
|---|---|---|---|---|---|---|---|
| *Vessel and fishery* | *Observer* | *Blend* | *Processor* | *Surimi* | *Fillets* | *Minced fish* | *Fish meal* |
| Vessel A | | | | | | | |
| "A" open access | $ 434 | $ 555 | $ 452 | 100% | - | - | - |
| "A" CDQ | $ 899 | $ 792 | $ 800 | 100% | - | - | 0.3% |
| "B" open access | $ 329 | $ 329 | $ 250 | 100% | - | - | - |
| "B" CDQ | $ 294 | $ 519 | $ 251 | 100% | - | - | - |
| Vessel B | | | | | | | |
| "A" open access | $ 588 | $ 588 | $ 534 | 81% | 0.0% | - | 19% |
| "A" CDQ | $ 658 | $ 658 | $ 763 | 62% | - | - | 38% |
| "B" open access | $ 231 | $ 236 | $ 263 | 97% | 3% | 0.2% | - |
| "B" CDQ | $ 280 | $ 280 | $ 273 | 91% | 9% | - | - |
| Vessel D | | | | | | | |
| "B" open access | $ 297 | $ 369 | $ 281 | 71% | 22% | - | 8% |
| "B" CDQ | $ 352 | $ 352 | $ 288 | 100% | - | - | - |
| Vessel G | | | | | | | |
| "A" open access | $ 461 | $ 520 | $ 402 | 100% | - | - | - |
| "A" CDQ | $ 731 | $ 731 | $ 681 | 100% | - | - | - |
| "B" open access | $ 307 | $ 385 | $ 247 | 100% | - | - | - |
| "B" CDQ | $ 296 | $ 435 | $ 244 | 100% | - | - | - |
| Vessel H | | | | | | | |
| "A" open access | $ 540 | $ 540 | $ 535 | 100% | 0% | - | - |
| "A" CDQ | $ 555 | $ 598 | $ 713 | 94% | 6% | - | - |
| "B" open access | $ 282 | $ 334 | $ 234 | 92% | 0% | - | 8% |
| "B" CDQ | $ 255 | $ 269 | $ 252 | 100% | 0% | - | - |
| Vessel I | | | | | | | |
| "A" open access | $ 525 | $ 531 | $ 623 | 75% | 25% | - | - |
| "A" CDQ | $ 954 | $ 894 | $1,669 | - | 75% | 25% | - |
| Vessel K | | | | | | | |
| "B" open access | $ 284 | $ 284 | $ 259 | 95% | 5% | - | - |
| "B" CDQ | $ 313 | $ 409 | $ 260 | 97% | 3% | - | - |

Table 5. Cont.

| Vessel and fishery | Total product value / metric ton of pollock[1] | | | Primary products (percent of primary product tons) | | | |
|---|---|---|---|---|---|---|---|
| | *Observer* | *Blend* | *Processor* | *Surimi* | *Fillets* | *Minced fish* | *Fish meal* |
| Vessel L | | | | | | | |
| "A" open access | $ 729 | $ 729 | $1,208 | - | 90% | 10% | - |
| "A" CDQ | $ 642 | $ 747 | $1,001 | - | 80% | 20% | - |
| "B" open access | $ 332 | $ 452 | $ 483 | - | 74% | 26% | - |
| "B" CDQ | $ 325 | $ 630 | $ 488 | - | 100% | - | - |
| Vessel M | | | | | | | |
| "A" open access | $ 519 | $ 543 | $ 602 | - | 100% | - | - |
| "A" CDQ | $ 416 | $ 416 | $ 574 | - | 76% | 24% | - |
| "B" open access | $ 322 | $ 423 | $ 434 | - | 75% | 25% | - |
| "B" CDQ | $ 303 | $ 486 | $ 490 | - | 67% | 33% | - |
| Vessel O | | | | | | | |
| "A" open access | $ 578 | $ 580 | $ 613 | 66% | 34% | - | - |
| "A" CDQ | $ 619 | $ 784 | $ 841 | 23% | 69% | 8% | - |
| "B" open access | $ 343 | $ 343 | $ 306 | 49% | 51% | - | - |
| "B" CDQ | $ 360 | $ 553 | $ 494 | | 100% | - | - |
| Vessel P | | | | | | | |
| "A" open access | $ 322 | $ 322 | $ 807 | - | 76% | 24% | - |
| "A" CDQ | $ 811 | $ 811 | $1,275 | - | 91% | 9% | - |
| Vessel Q | | | | | | | |
| "A" open access | $ 394 | $ 428 | $ 567 | - | 58% | 42% | - |
| "A" CDQ | $ 498 | $ 556 | $ 691 | - | 62% | 38% | - |
| "B" open access | $ 435 | $ 439 | $ 457 | - | 83% | 17% | - |
| "B" CDQ | $ 365 | $ 473 | $ 454 | - | 70% | 30% | - |
| Vessel R | | | | | | | |
| "A" open access | $ 262 | $ 277 | $1,002 | - | 77% | 23% | - |
| "A" CDQ | $ 643 | $ 628 | $1,453 | - | 84% | 16% | - |
| "B" open access | $ 320 | $ 318 | $ 408 | - | 82% | 18% | - |
| "B" CDQ | $ 258 | $ 258 | $ 404 | - | 76% | 24% | - |

Table 5. Cont.

| | Total product value / metric ton of pollock[1] | | | Primary products (percent of primary product tons) | | | |
|---|---|---|---|---|---|---|---|
| *Vessel and fishery* | *Observer* | *Blend* | *Processor* | *Surimi* | *Fillets* | *Minced fish* | *Fish meal* |
| Vessel S | | | | | | | |
| "B" open access | $ 307 | $ 312 | $ 378 | 31% | 64% | 5% | - |
| "B" CDQ | $ 333 | $ 333 | $ 913 | - | 100% | - | - |
| Total | | | | | | | |
| "A" open access | $ 557 | $ 559 | $ 659 | 64% | 27% | 7% | 2% |
| "A" CDQ | $ 677 | $ 679 | $ 846 | 25% | 57% | 17% | 1% |
| "B" open access | $ 339 | $ 339 | $ 303 | 59% | 34% | 5% | 2% |
| "B" CDQ | $ 439 | $ 425 | $ 369 | 35% | 47% | 18% | - |

[1]Product values per metric ton are calculated separately using three sources of total pollock catch data; weekly observer reports, weekly processor reports, and the "best blend" combination of the two.

Source: Weekly observer reports, blend estimates, weekly production reports and 1993 wholesale price survey, NMFS Alaska Region, Juneau AK

Table 6. Product value per metric ton of pollock catch, and breakdown of primary products for vessels participating in the 1994 CDQ fishery.

| *Vessel and fishery* | *Total product value / metric ton of pollock*[1] | | | *Primary products (percent of primary product tons)* | | | |
|---|---|---|---|---|---|---|---|
| | *Observer* | *Blend* | *Processor* | *Surimi* | *Fillets* | *Minced fish* | *Fish meal* |
| Vessel A | | | | | | | |
| "A" open access | $ 735 | $ 563 | $ 505 | 100% | - | - | - |
| "A" CDQ | $ 661 | $ 661 | $ 649 | 100% | - | - | - |
| "B" open access | $ 285 | $ 283 | $ 303 | 100% | - | - | - |
| "B" CDQ | $ 302 | $ 267 | $ 302 | 100% | - | - | - |
| Vessel B | | | | | | | |
| "A" open access | $ 625 | $ 576 | $ 462 | 97% | 2% | - | 1% |
| "A" CDQ | $ 437 | $ 437 | $ 462 | 95% | 2% | - | 3% |
| "B" open access | $ 263 | $ 265 | $ 306 | 86% | 8% | - | 6% |
| "B" CDQ | $ 290 | $ 271 | $ 321 | 92% | 7% | 1% | - |
| Vessel C | | | | | | | |
| "A" open access | $ 792 | $ 561 | $ 472 | - | 77% | 23% | - |
| "A" CDQ | $ 668 | $ 680 | $ 598 | - | 68% | 32% | - |
| Vessel D | | | | | | | |
| "A" open access | $ 484 | $ 450 | $ 425 | 84% | 16% | - | - |
| "A" CDQ | $ 747 | $ 747 | $ 839 | 100% | - | - | - |
| "B" open access | $ 396 | $ 387 | $ 337 | 74% | 26% | - | - |
| "B" CDQ | $ 398 | $ 1,076 | $ 318 | 89% | 11% | - | - |
| Vessel E | | | | | | | |
| "A" open access | $ 813 | $ 628 | $ 585 | 45% | 52% | - | 3% |
| "A" CDQ | $ 1,115 | $ 1,115 | $ 880 | 47% | 53% | - | - |
| Vessel F | | | | | | | |
| "B" open access | $ 344 | $ 318 | $ 327 | 99% | - | - | 1% |
| "B" CDQ | $ - | $ 235 | $ 310 | 100% | - | - | 0% |
| Vessel H | | | | | | | |
| "A" open access | $ 341 | $ 342 | $ 461 | 93% | - | - | 7% |
| "A" CDQ | $ 500 | $ 475 | $ 527 | 100% | - | - | - |
| "B" open access | $ 399 | $ 290 | $ 299 | 98% | - | - | 2% |
| "B" CDQ | $ 319 | $ 317 | $ 304 | 99% | - | - | 1% |

Table 6. Cont.

| *Vessel and fishery* | *Total product value / metric ton of pollock*[1] | | | *Primary products (percent of primary product tons)* | | | |
|---|---|---|---|---|---|---|---|
| | *Observer* | *Blend* | *Processor* | *Surimi* | *Fillets* | *Minced fish* | *Fish meal* |
| Vessel I | | | | | | | |
| "A" open access | $ 567 | $ 546 | $ 451 | 82% | 18% | - | - |
| "A" CDQ | $ 847 | $ 788 | $ 989 | 100% | - | - | - |
| "B" open access | $ 410 | $ 355 | $ 312 | 77% | 23% | - | - |
| "B" CDQ | $ 379 | $ 379 | $ 311 | 82% | 18% | - | - |
| Vessel J | | | | | | | |
| "A" open access | $ 655 | $ 505 | $ 424 | 65% | 26% | - | 9% |
| "A" CDQ | $ 1,251 | $ 790 | $ 823 | - | 93% | - | 7% |
| Vessel K | | | | | | | |
| "A" open access | $ 610 | $ 388 | $ 417 | 91% | 1% | - | 8% |
| "A" CDQ | $ 405 | $ 381 | $ 449 | 97% | 3% | - | - |
| "B" open access | $ 307 | $ 282 | $ 310 | 99% | 1% | - | - |
| "B" CDQ | $ 328 | $ 314 | $ 297 | 96% | 4% | - | - |
| Vessel L | | | | | | | |
| "A" open access | $ 664 | $ 662 | $ 594 | - | 99% | 1% | - |
| "A" CDQ | $ 647 | $ 553 | $ 782 | - | 95% | 5% | - |
| "B" open access | $ 561 | $ 497 | $ 440 | - | 100% | 0% | - |
| "B" CDQ | $ 570 | $ 359 | $ 457 | - | 100% | - | - |
| Vessel M | | | | | | | |
| "A" open access | $ 1,172 | $ 709 | $ 563 | - | 93% | 7% | - |
| "A" CDQ | $ 818 | $ 501 | $ 565 | - | 80% | 20% | - |
| "B" open access | $ 476 | $ 397 | $ 434 | - | 88% | 12% | - |
| "B" CDQ | $ 587 | $ 369 | $ 431 | - | 91% | 9% | - |
| Vessel N | | | | | | | |
| "B" open access | $ 385 | $ 380 | $ 364 | - | 72% | 28% | - |
| "B" CDQ | $ 343 | $ 343 | $ 376 | - | 79% | 21% | - |
| Vessel O | | | | | | | |
| "A" open access | $ 624 | $ 596 | $ 551 | 89% | 11% | - | - |
| "A" CDQ | $ 739 | $ 656 | $ 589 | 86% | 14% | - | - |
| "B" open access | $ 412 | $ 383 | $ 334 | 64% | 36% | - | - |
| "B" CDQ | $ 598 | $ 373 | $ 415 | 20% | 80% | - | - |

Table 6. Cont.

| Vessel and fishery | Total product value / metric ton of pollock[1] | | | Primary products (percent of primary product tons) | | | |
|---|---|---|---|---|---|---|---|
| | *Observer* | *Blend* | *Processor* | *Surimi* | *Fillets* | *Minced fish* | *Fish meal* |
| Vessel P | | | | | | | |
| "A" open access | $ 623 | $ 508 | $ 499 | - | 84% | 16% | - |
| "A" CDQ | $ 566 | $ 566 | $ 591 | - | 73% | 27% | - |
| Vessel Q | | | | | | | |
| "A" open access | $ 806 | $ 581 | $ 485 | - | 79% | 21% | - |
| "A" CDQ | $ 424 | $ 423 | $ 485 | - | 62% | 38% | - |
| "B" open access | $ 307 | $ 307 | $ 323 | - | 75% | 25% | - |
| "B" CDQ | $ 309 | $ 288 | $ 308 | - | 66% | 34% | - |
| Vessel R | | | | | | | |
| "A" open access | $ 512 | $ 512 | $ 511 | - | 79% | 21% | - |
| "A" CDQ | $ 582 | $ 582 | $ 567 | - | 68% | 32% | - |
| "B" open access | $ 373 | $ 373 | $ 359 | - | 69% | 31% | - |
| "B" CDQ | $ 305 | $ 254 | $ 321 | - | 65% | 35% | - |
| Vessel S | | | | | | | |
| "A" open access | $ 661 | $ 614 | $ 528 | 81% | 19% | - | - |
| "A" CDQ | $ 838 | $ 838 | $ 805 | 100% | - | - | - |
| Total | | | | | | | |
| "A" open access | $ 687 | $ 520 | $ 486 | 61% | 32% | 5% | 2% |
| "A" CDQ | $ 749 | $ 553 | $ 597 | 46% | 42% | 12% | 0% |
| "B" open access | $ 529 | $ 376 | $ 343 | 62% | 31% | 7% | 1% |
| "B" CDQ | $ 532 | $ 349 | $ 382 | 32% | 60% | 8% | 0% |

[1]Product values per metric ton are calculated separately using three sources of total pollock catch data; weekly observer reports, weekly processor reports, and the "best blend" combination of the two.

Source: Weekly observer reports, blend estimates, weekly production reports and 1993 wholesale price survey, NMFS Alaska Region, Juneau AK

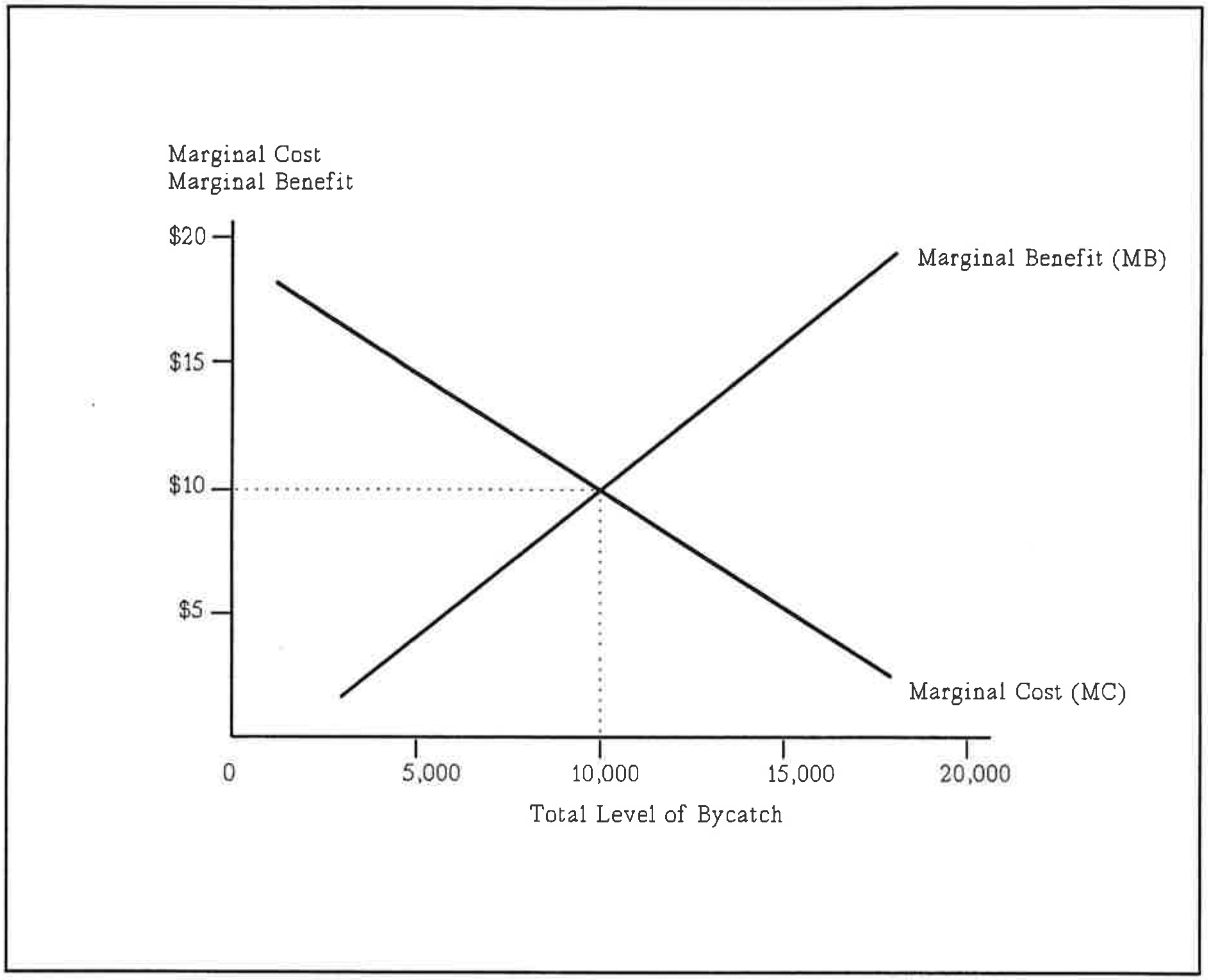


Figure 1. The marginal benefit and marginal cost of reducing bycatch and the optimum level of bycatch.

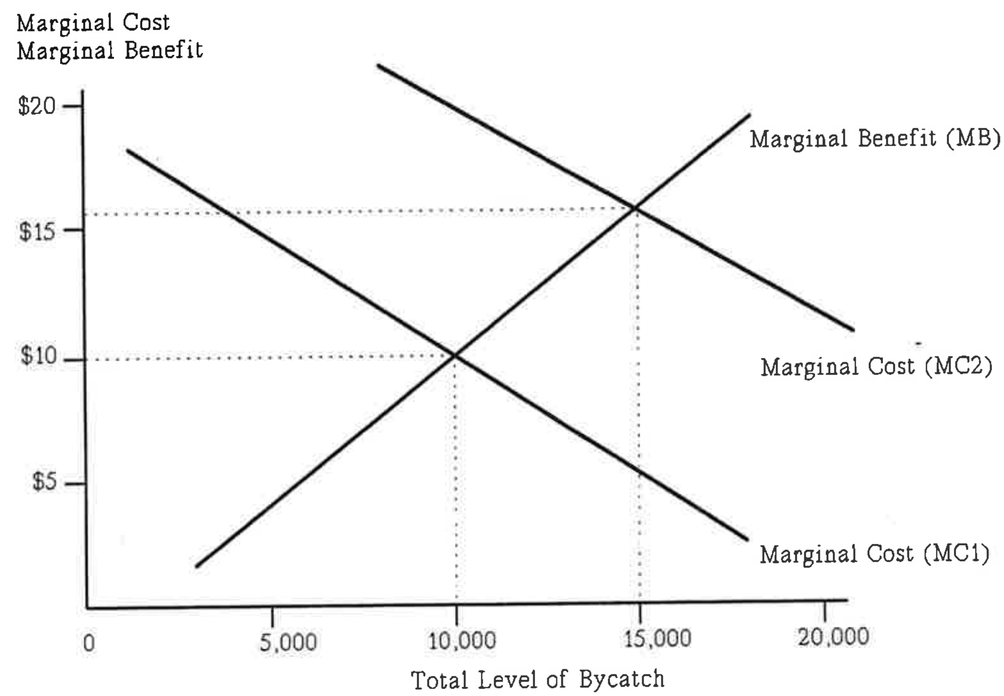


Figure 2. The marginal benefit, marginal cost of reducing bycatch with cost-effective methods (MC1), marginal cost of reducing bycatch without cost-effective methods (MC2), and the optimum levels of bycatch with and without cost-effective methods of reducing bycatch.

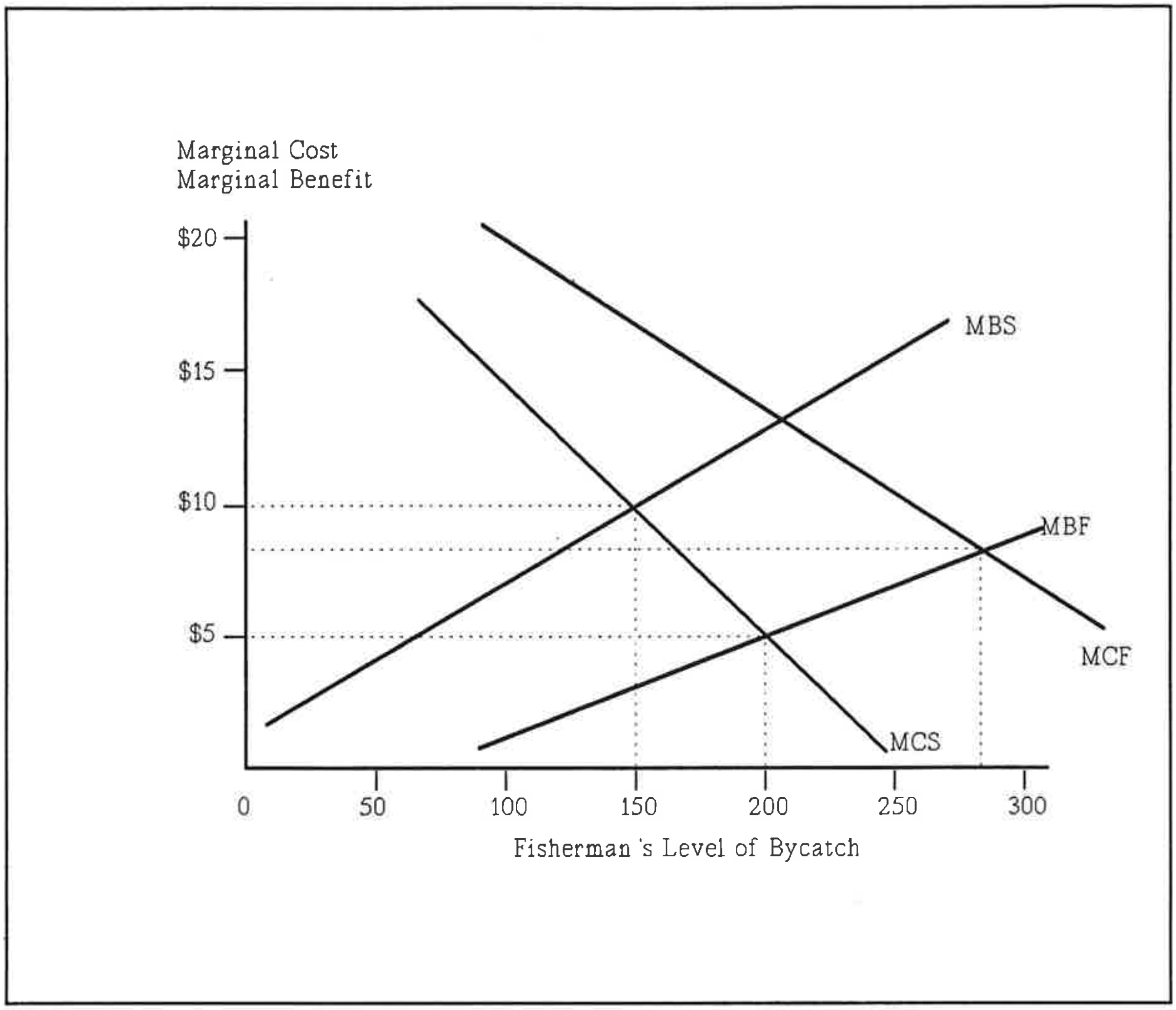


Figure 3. The marginal benefit to the fisherman (MBF), marginal benefit to society including the fisherman (MBS), marginal cost to the fisherman (MCF), marginal cost to society (MCS) of reducing bycatch, and the optimum levels of bycatch, respectively, for the fisherman and for society.

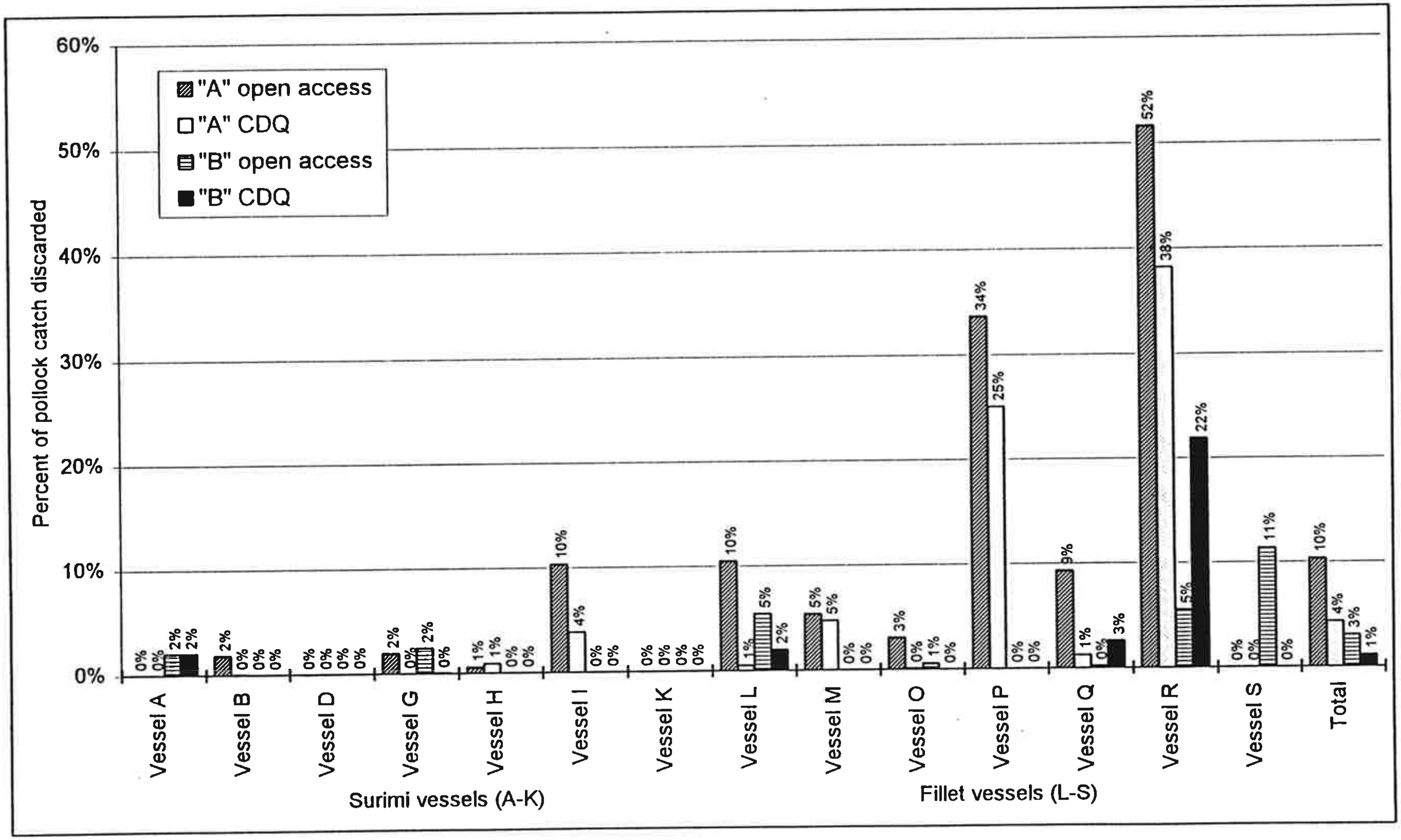


Figure 4. Pollock discard rates in the 1993 CDQ fleet by vessel, fishery and season (expressed as a percentage of pollock catch).

Source: Weekly observer reports, National Marine Fisheries Service, Alaska Region, Juneau, AK.

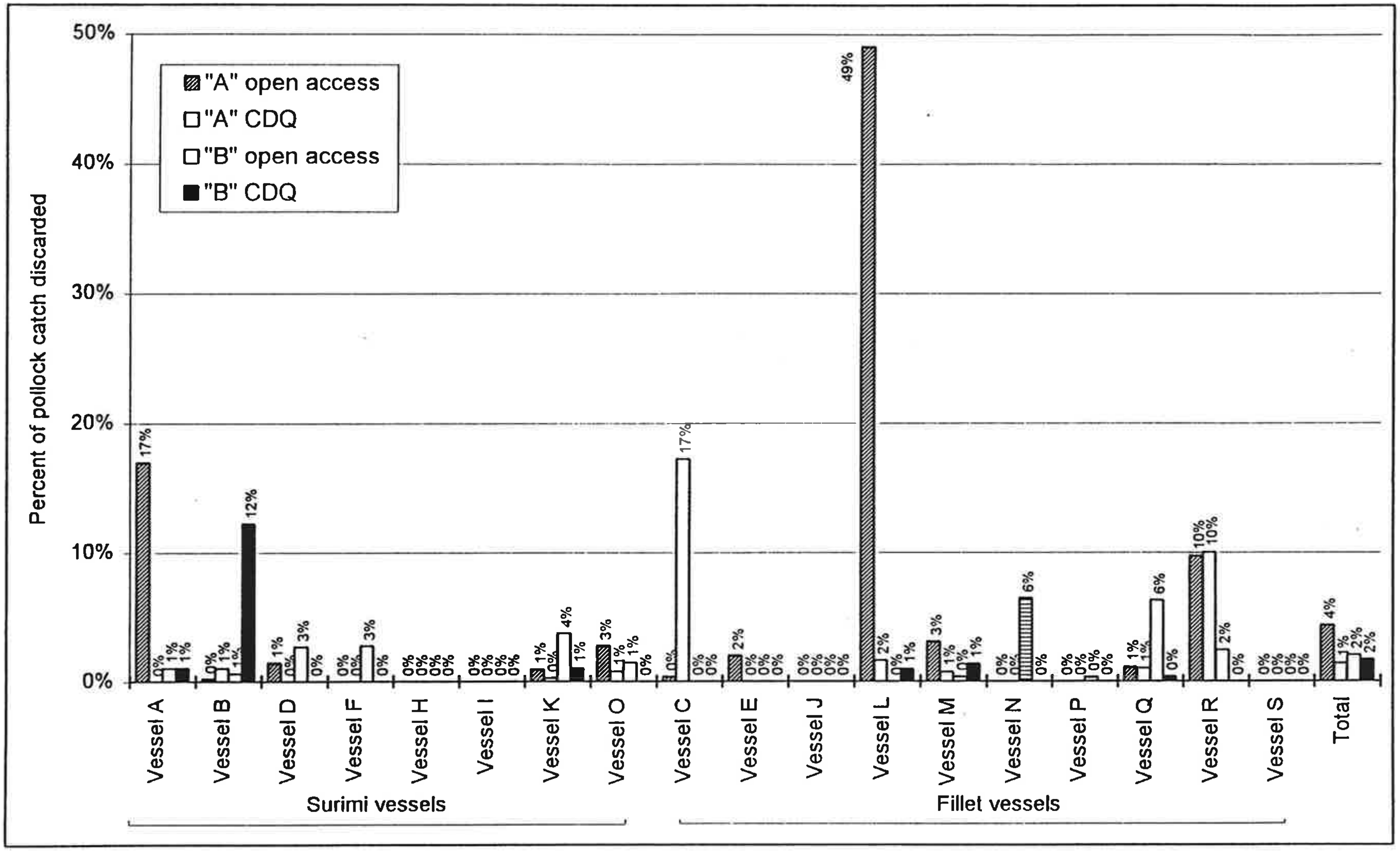


Figure 5. Pollock discard rates in the 1994 CDQ fleet by vessel, fishery and season (expressed as a percentage of pollock catch).

Source: Weekly observer reports, National Marine Fisheries Service, Alaska Region, Juneau, AK.

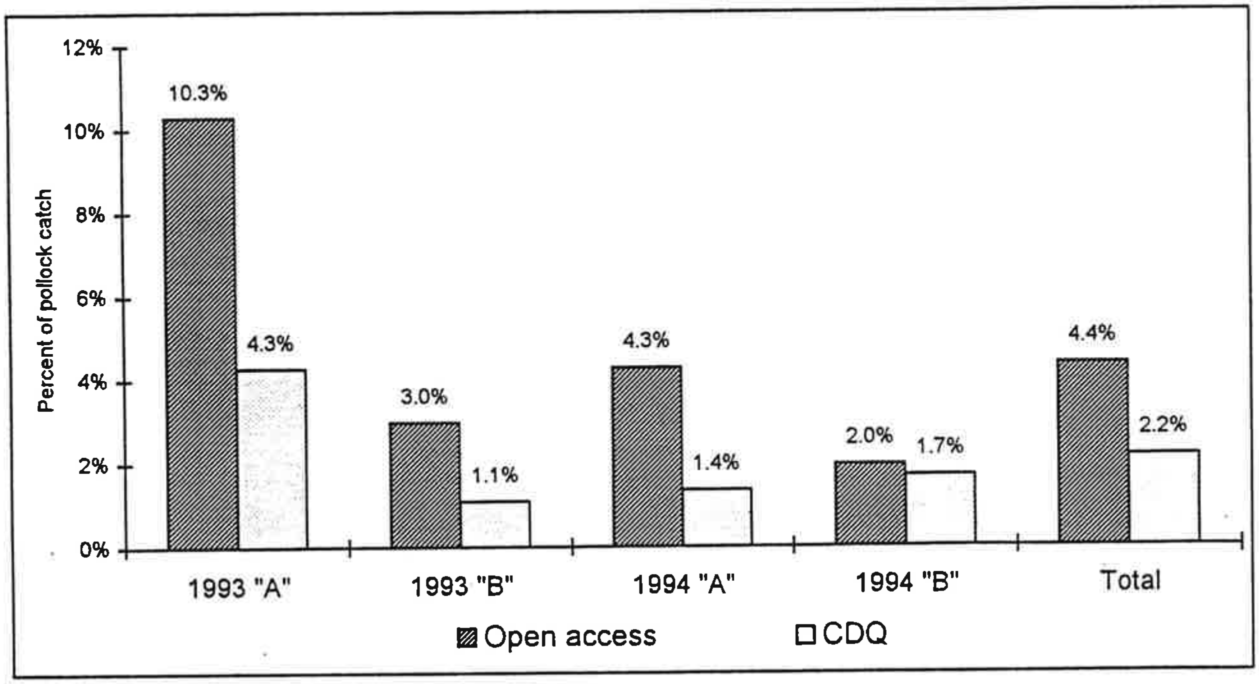


Figure 6. Pollock discard rates in the CDQ fleet expressed as a percentage of total pollock catch.

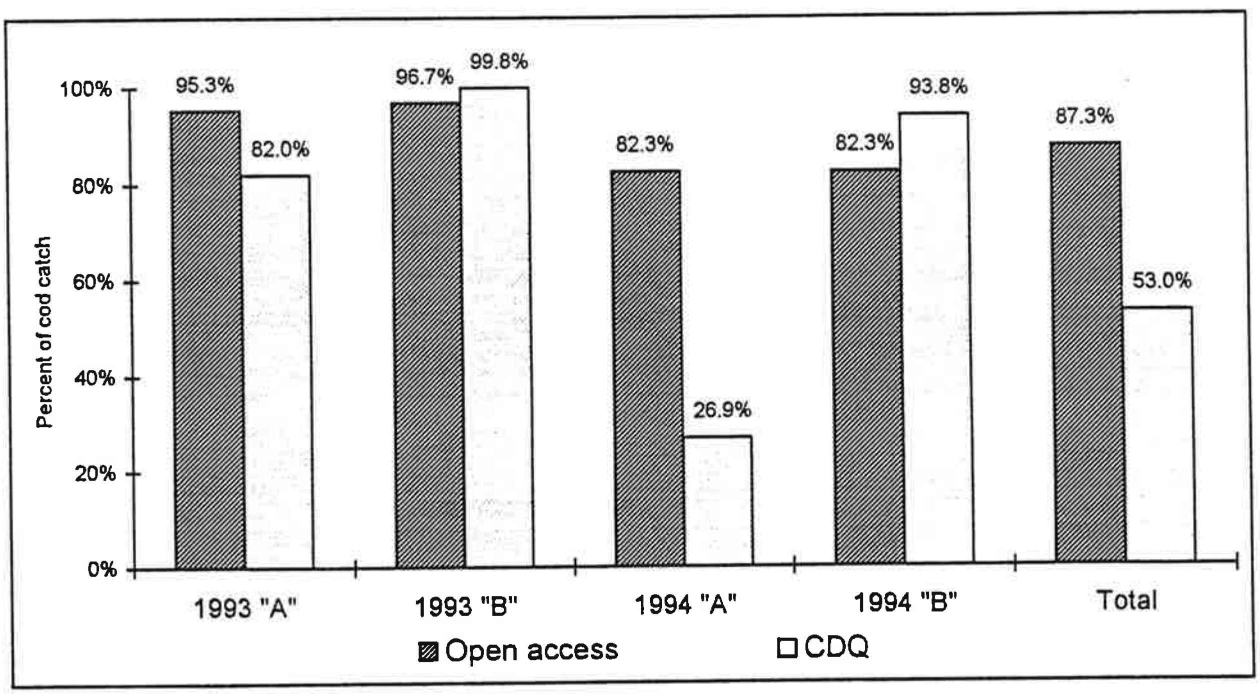


Figure 7. Pacific cod discard rates in the CDQ fleet expressed as a percentage of Pacific cod catch.

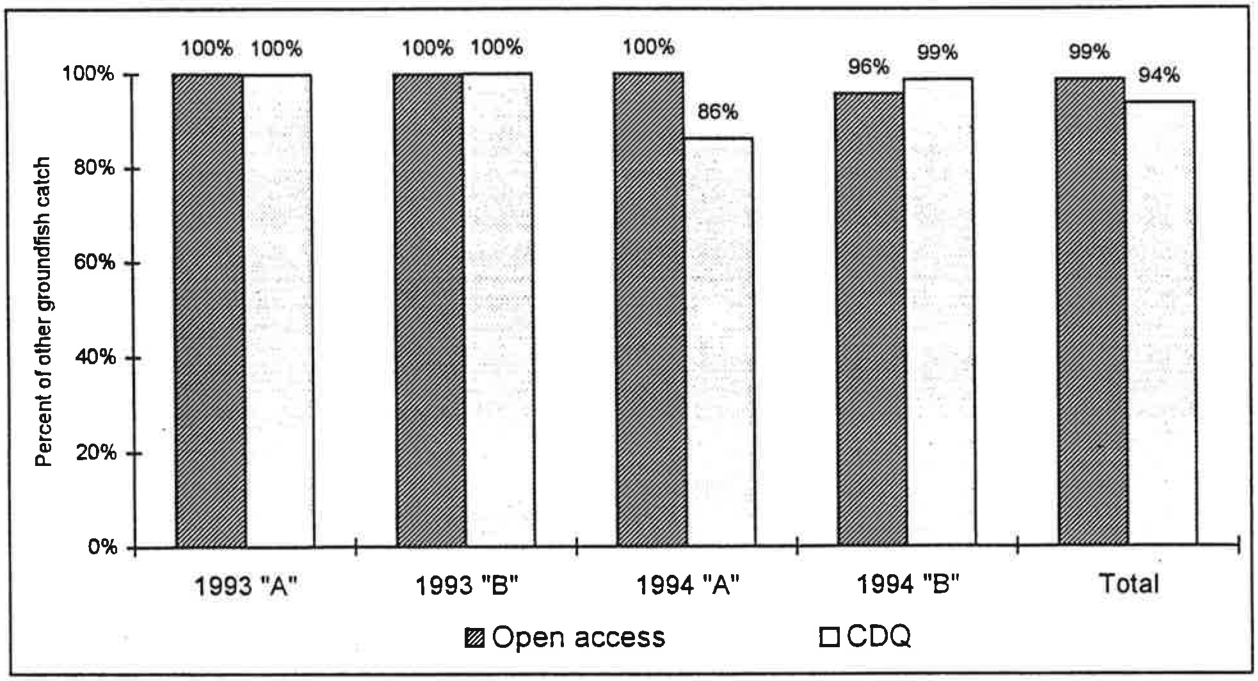


Figure 8. Other groundfish species (not pollock or cod) discard rates in the CDQ fleet expressed as a percentage of the total catch of other groundfish.

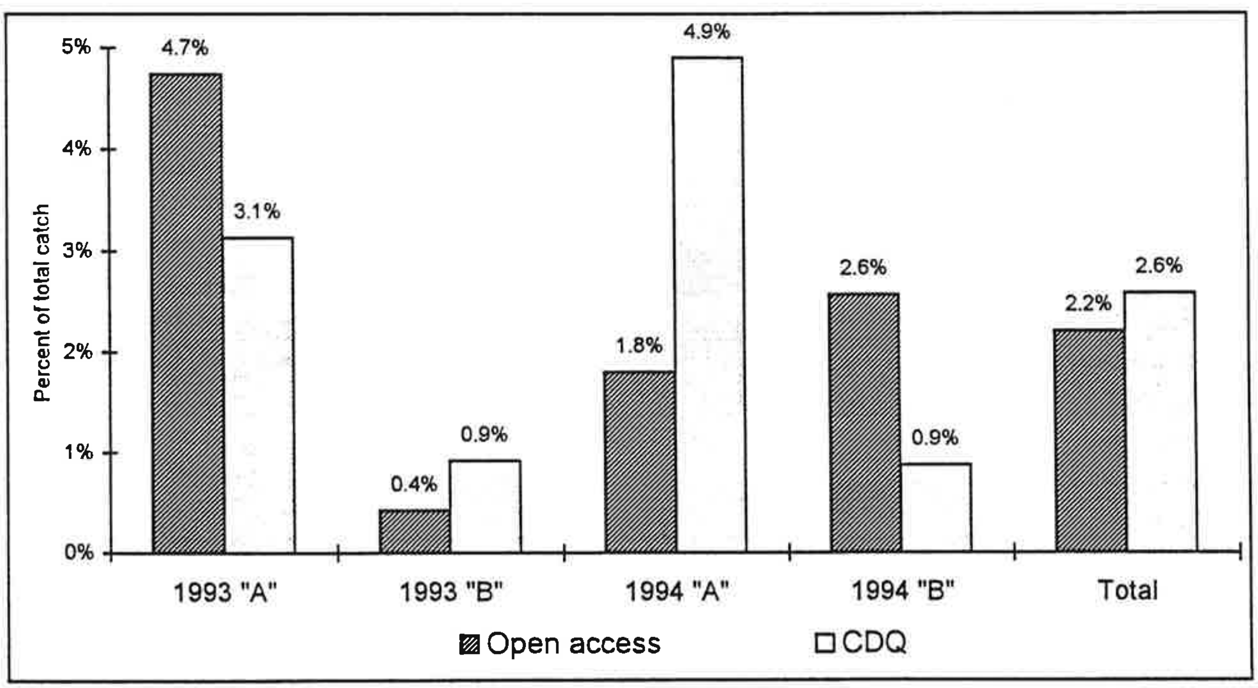


Figure 9. Percentage of total groundfish catch in the CDQ fleet consisting of species other than pollock.

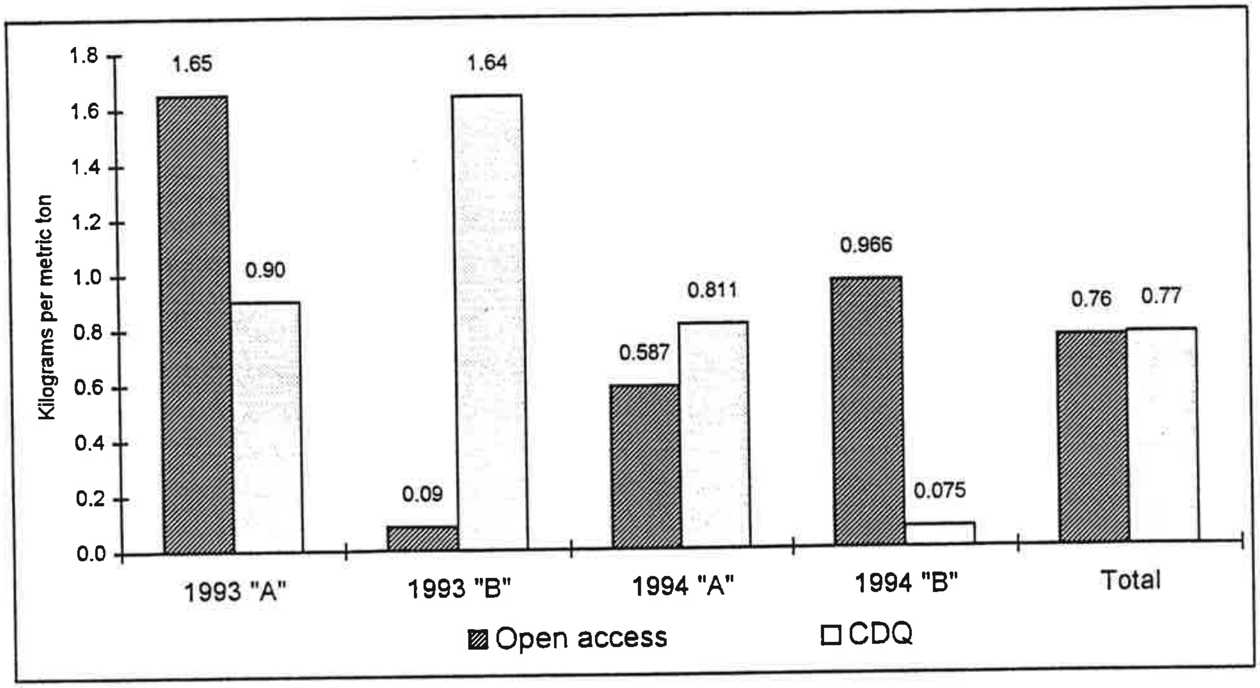


Figure 10. Pacific halibut bycatch rates in the CDQ fleet by fishery, year and season.

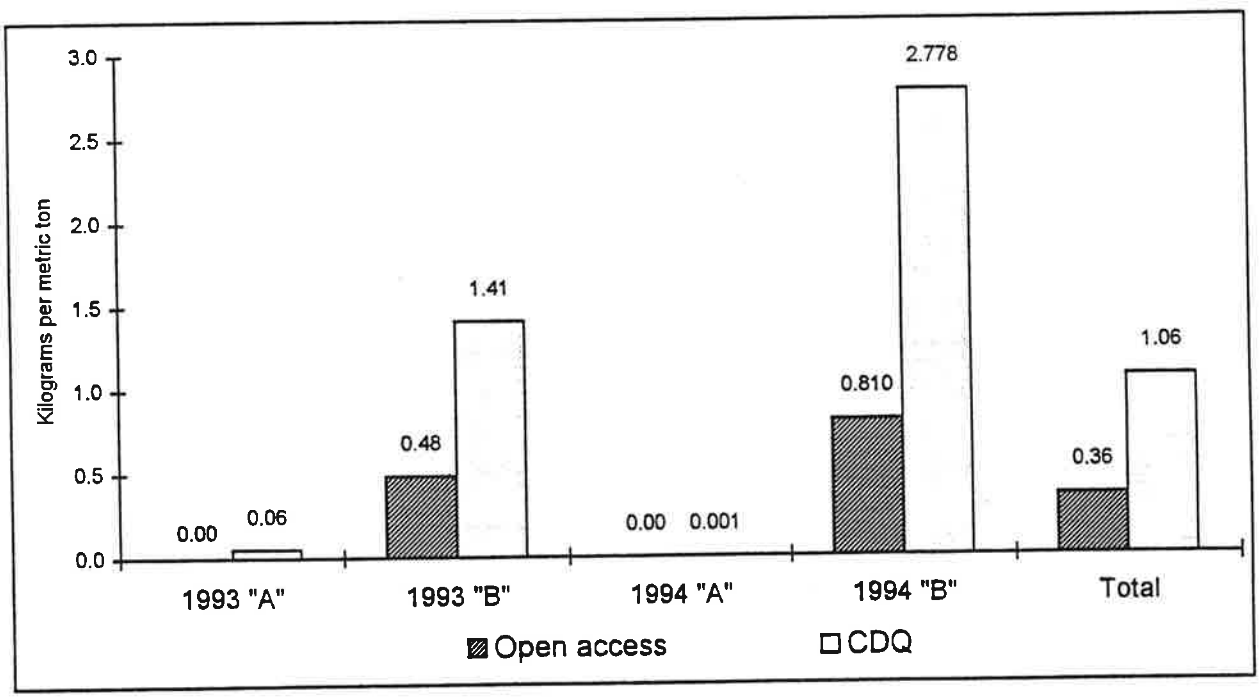


Figure 11. Pacific herring bycatch rates in the CDQ fleet by fishery, year and season.

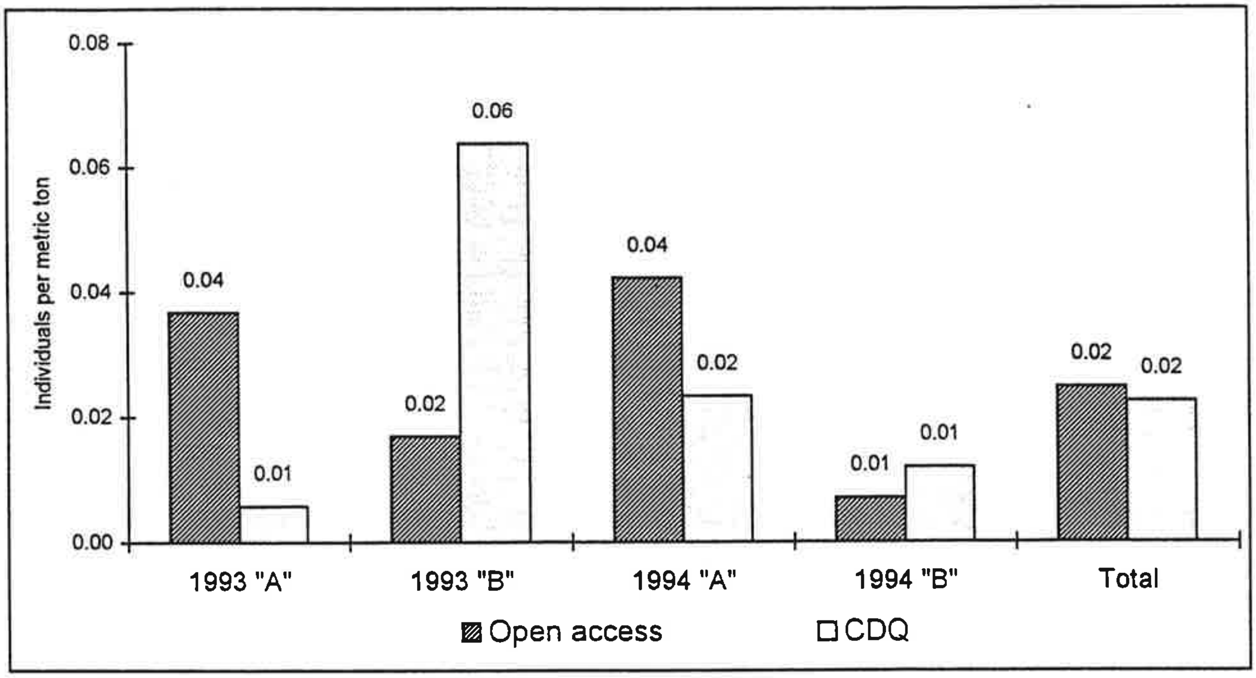


Figure 12. Chinook salmon bycatch rates in the CDQ fleet by fishery, year and season.

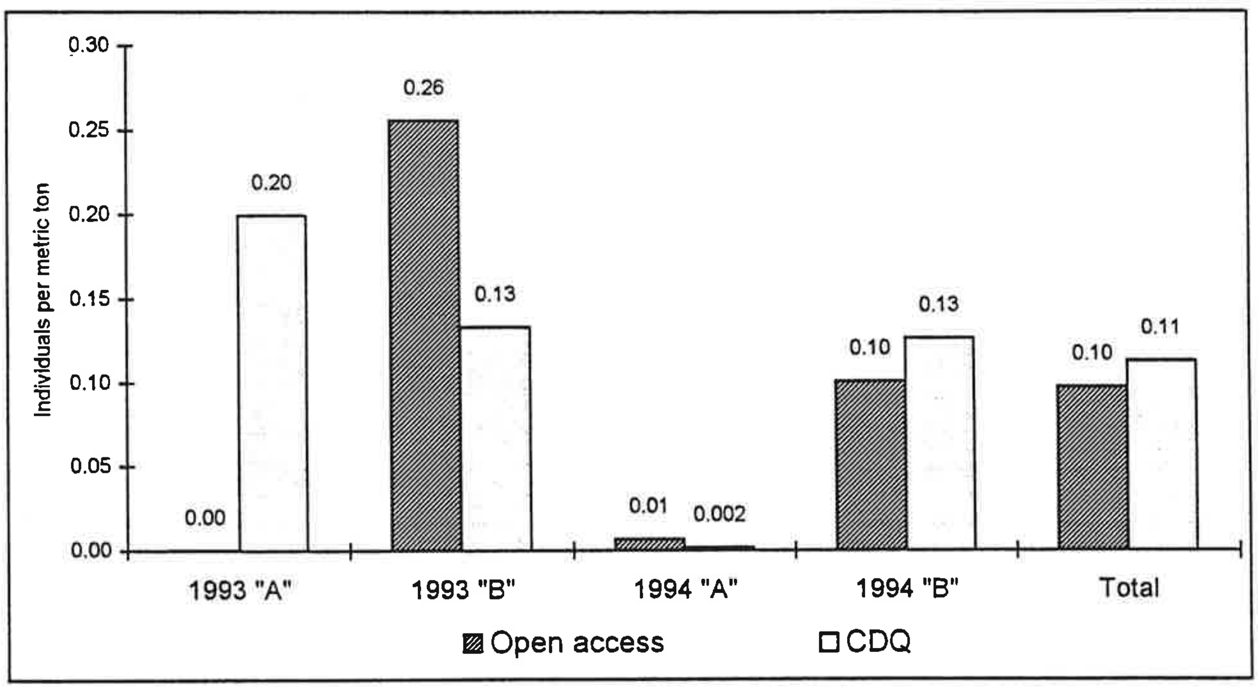


Figure 13. "Other" salmon bycatch rates in the CDQ fleet by fishery, year and season.

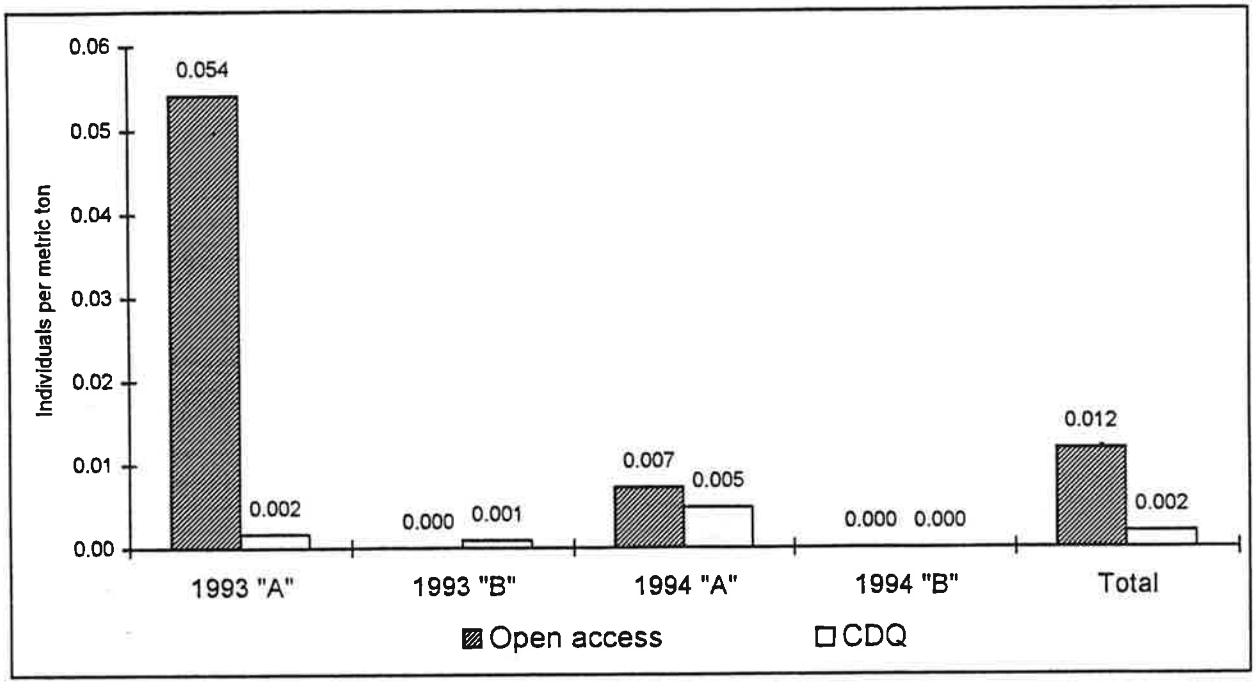


Figure 14. Red king crab bycatch rates in the CDQ fleet by fishery, year and season.

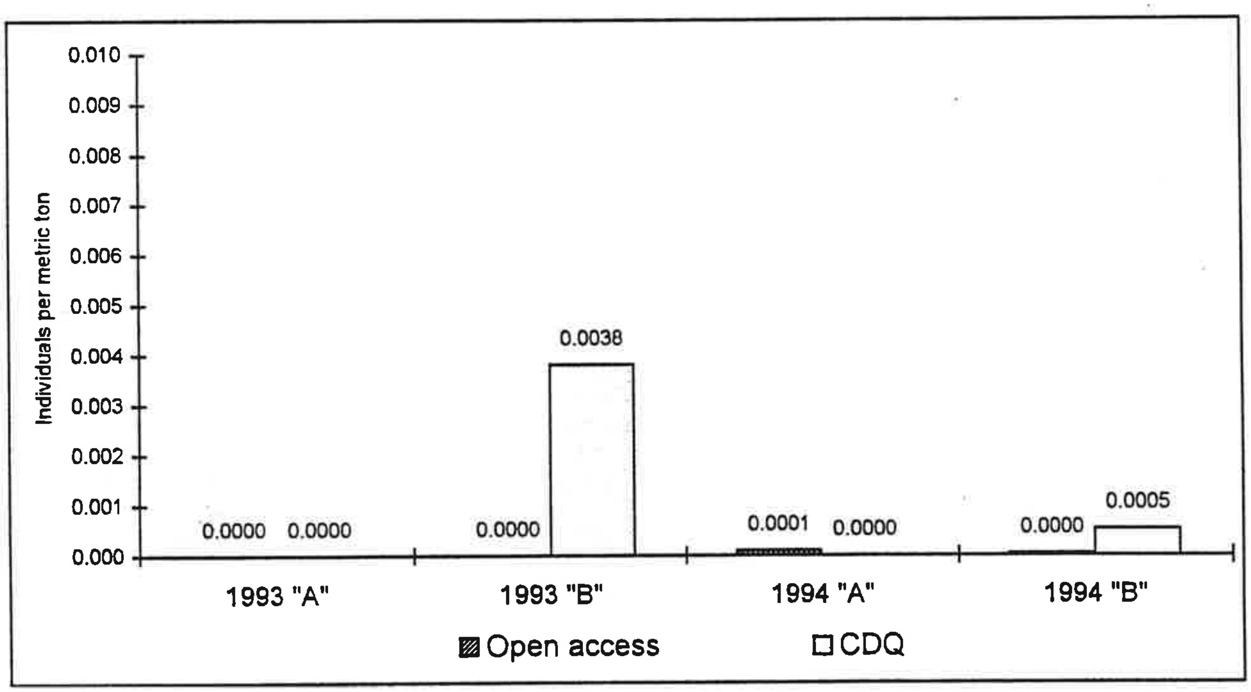


Figure 15. "Other" king crab bycatch rates in the CDQ fleet by fishery, year and season.

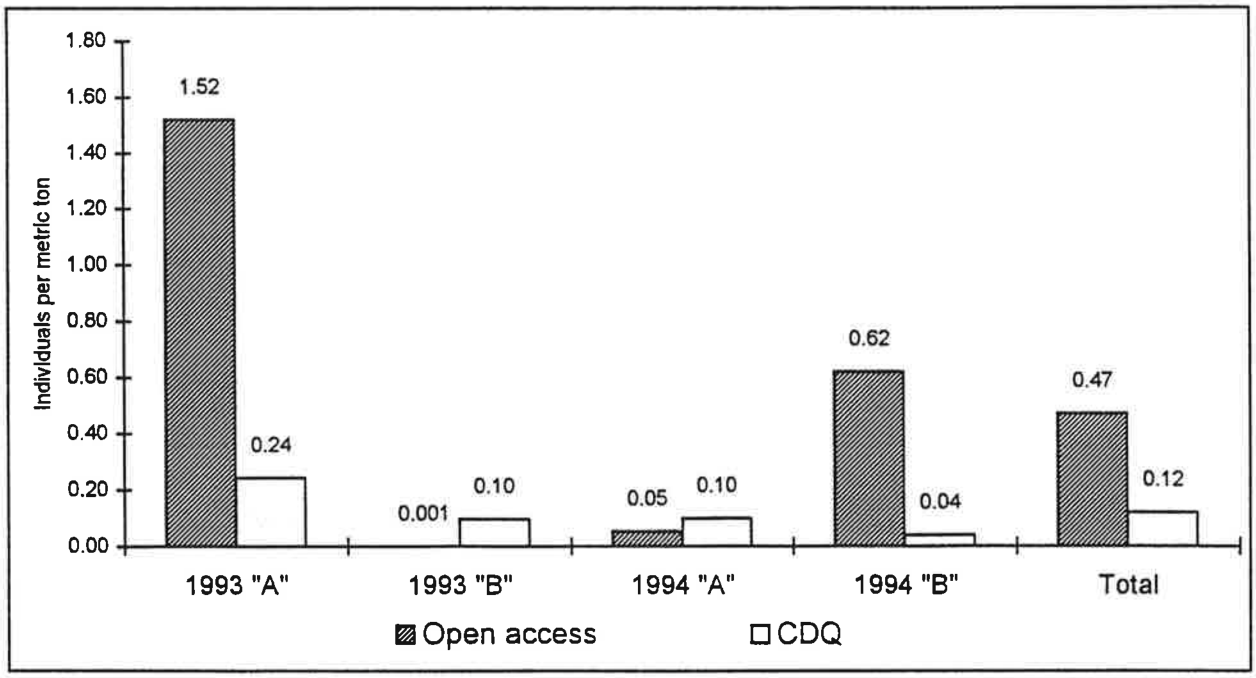


Figure 16. Bairdi Tanner crab bycatch rates in the CDQ fleet by fishery, year and season.

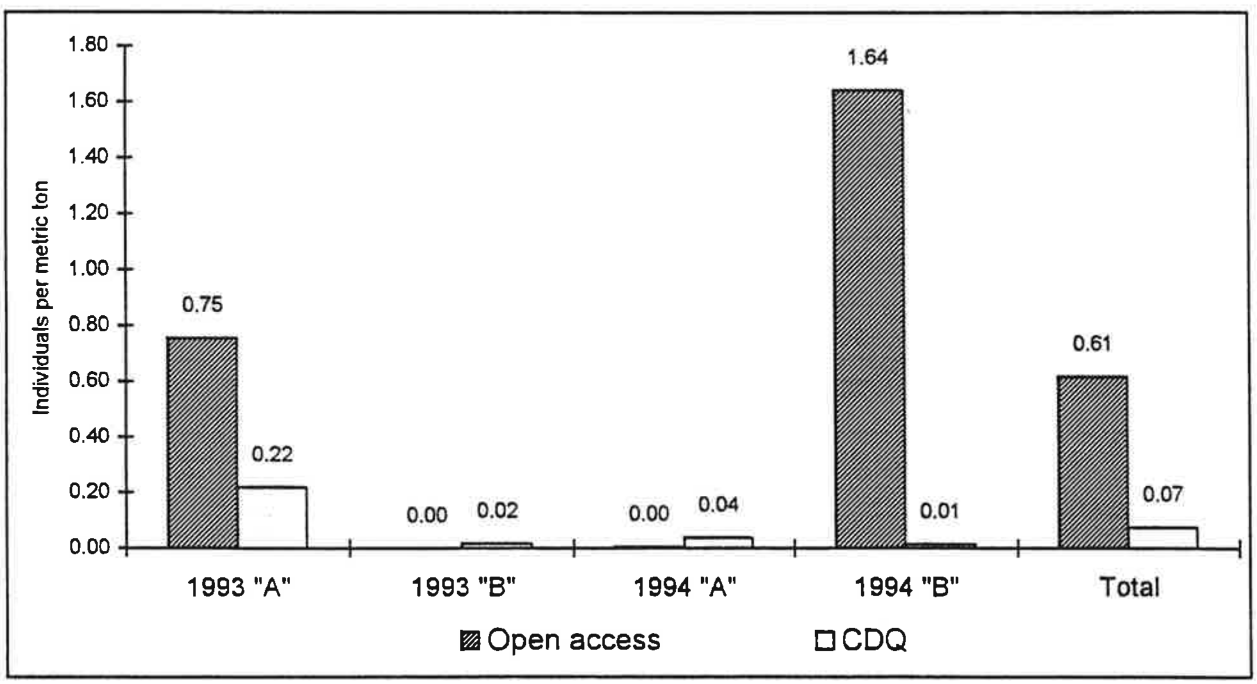


Figure 17. "Other" Tanner crab bycatch rates in the CDQ fleet by fishery, year and season.

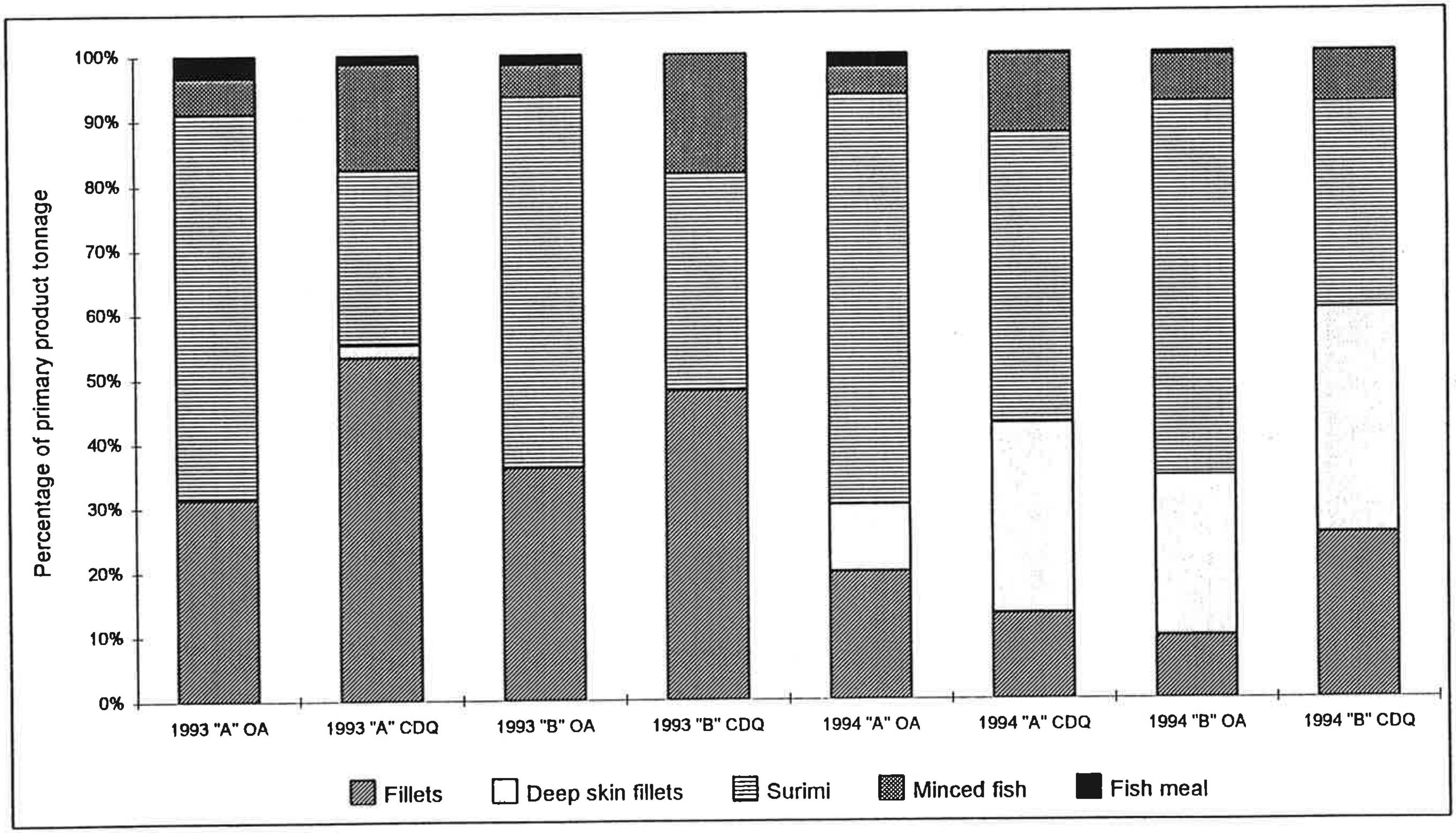


Figure 18. Primary products expressed as a percentage of total primary product tonnage for vessels that participated in the 1993 and 1994 CDQ fisheries.

Source: Weekly production reports, National Marine Fisheries Service, Alaska Region, Juneau AK.

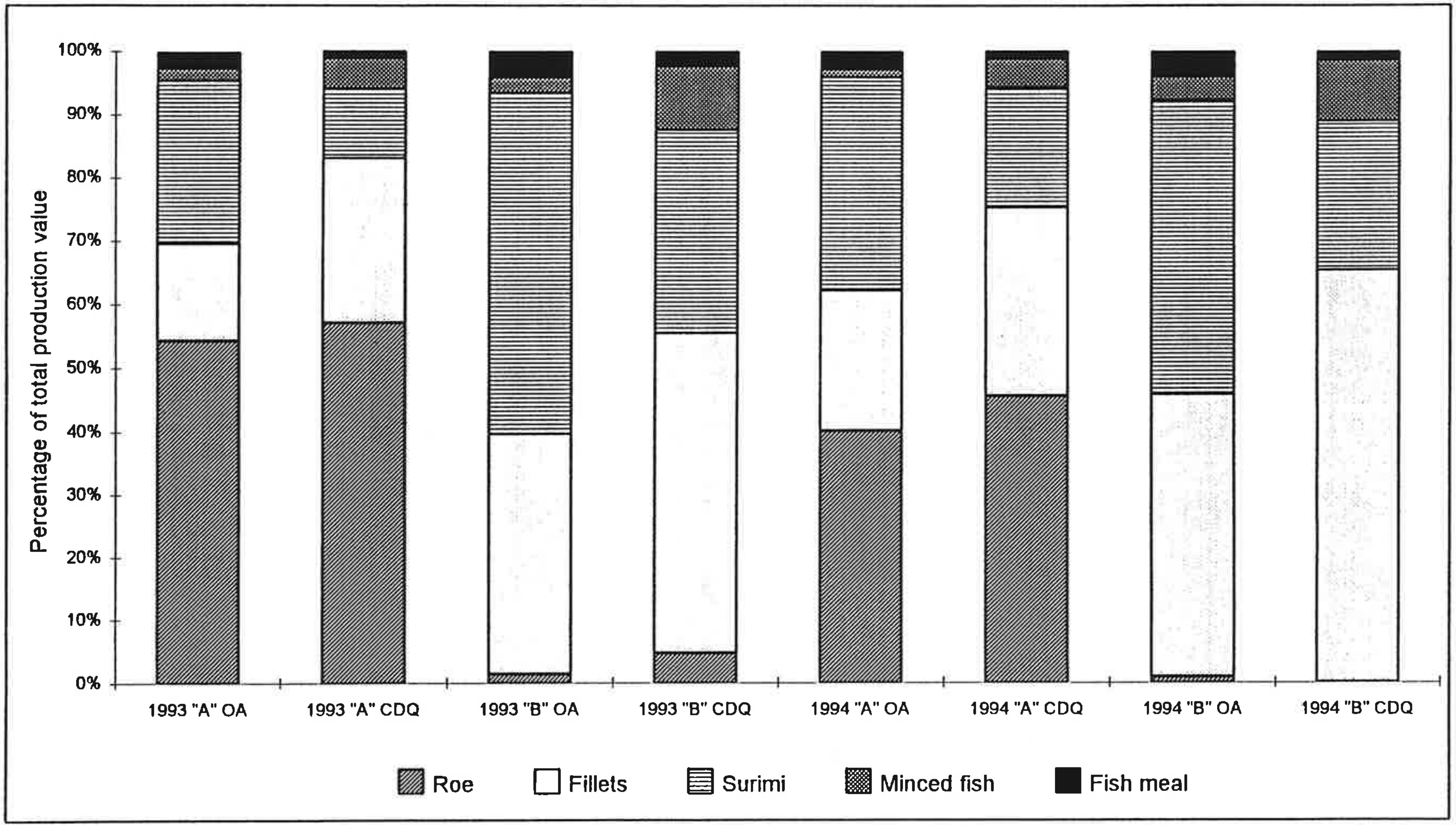


Figure 19. Individual product values expressed as a percentage of total production value for vessels that participated in the 1993 and 1994 CDQ fisheries.

Source: Weekly production reports and 1993 wholesale price survey, NMFS Alaska Region, Juneau, AK.

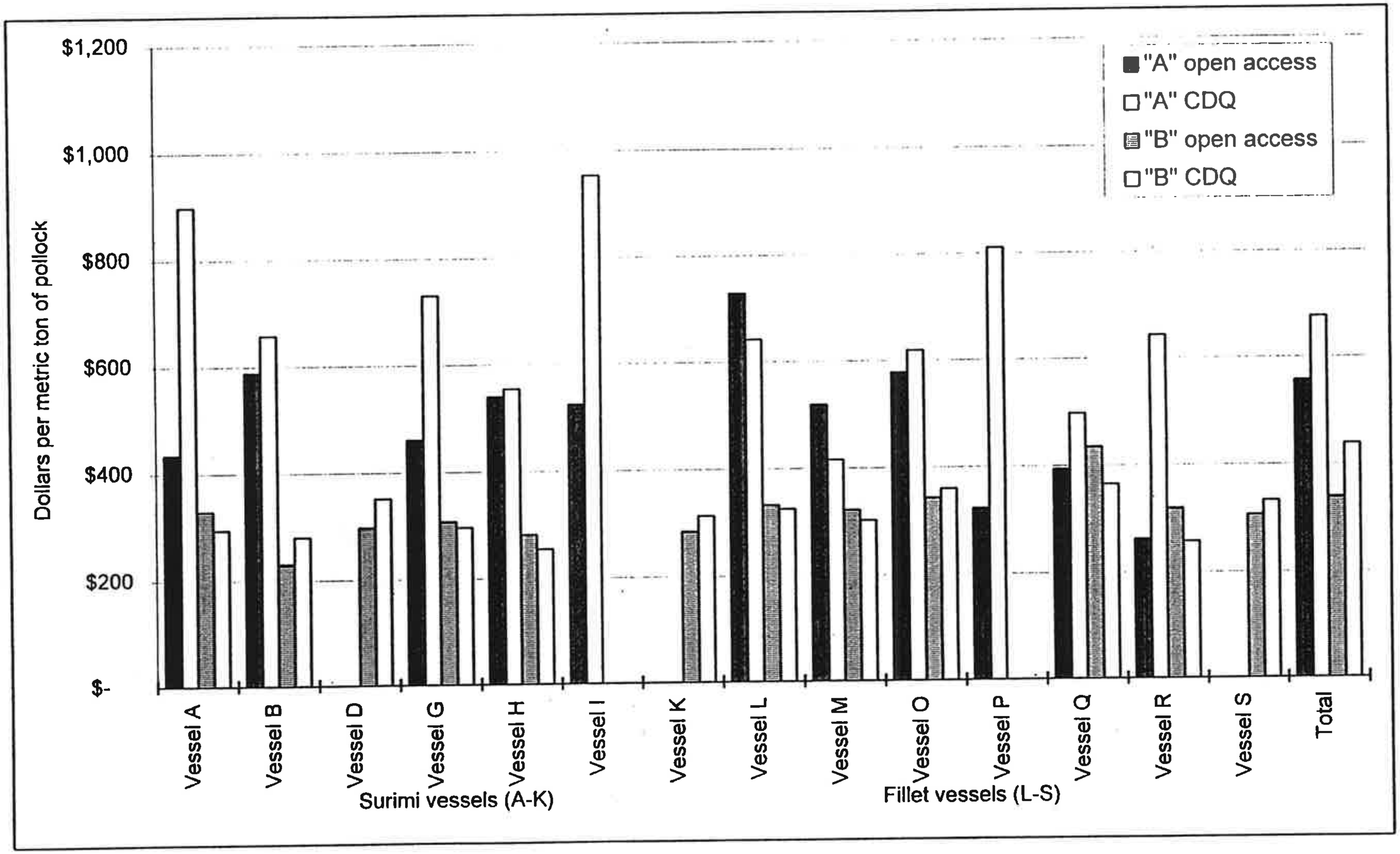


Figure 20. Total value of products produced per metric ton of pollock catch in the 1993 CDQ fleet by vessel, fishery and season.

Source: Weekly observer reports, weekly production reports and 1993 wholesale price survey, NMFS Alaska Region, Juneau, AK.

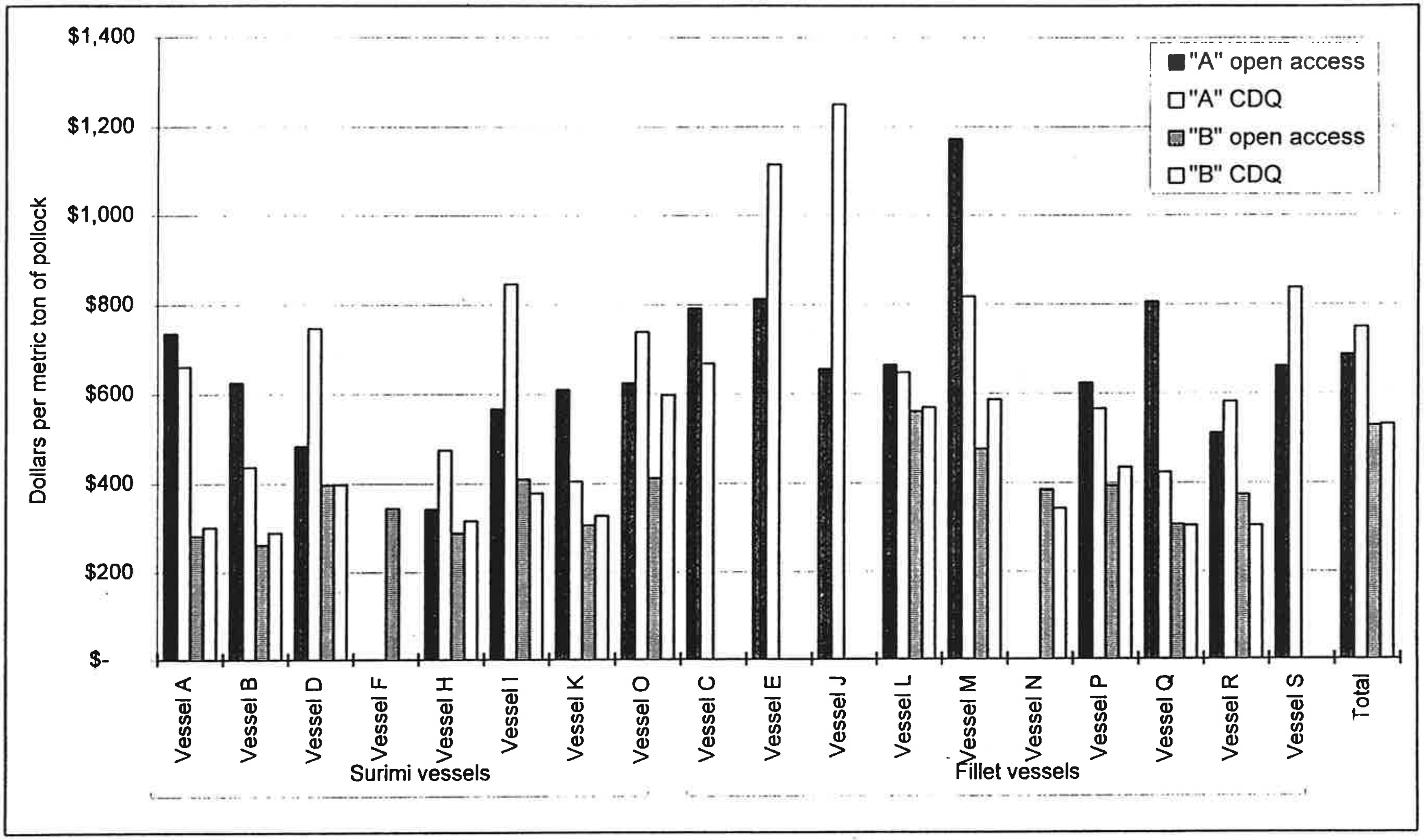


Figure 21. Total value of products produced per metric ton of pollock catch in the 1994 CDQ fleet by vessel, fishery and season.

Source: Weekly observer reports, weekly production reports and 1993 wholesale price survey, NMFS Alaska Region, Juneau, AK.

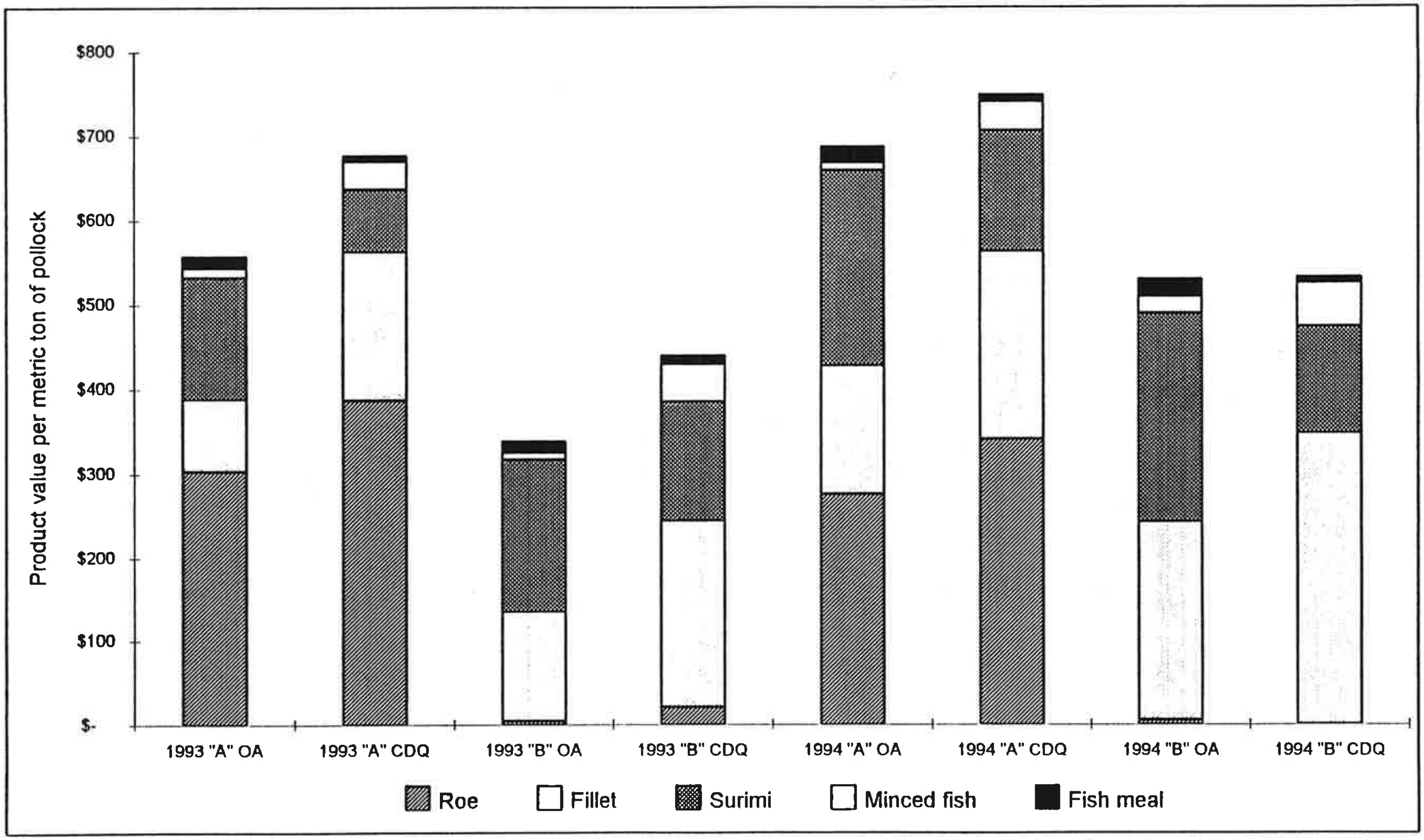


Figure 22. Product values per metric ton of pollock catch by product type, year and fishery for vessels that participated in the 1993 and 1994 CDQ fisheries.

Source: Weekly observer reports, weekly production reports and 1993 wholesale price survey, NMFS Alaska Region, Juneau, AK.

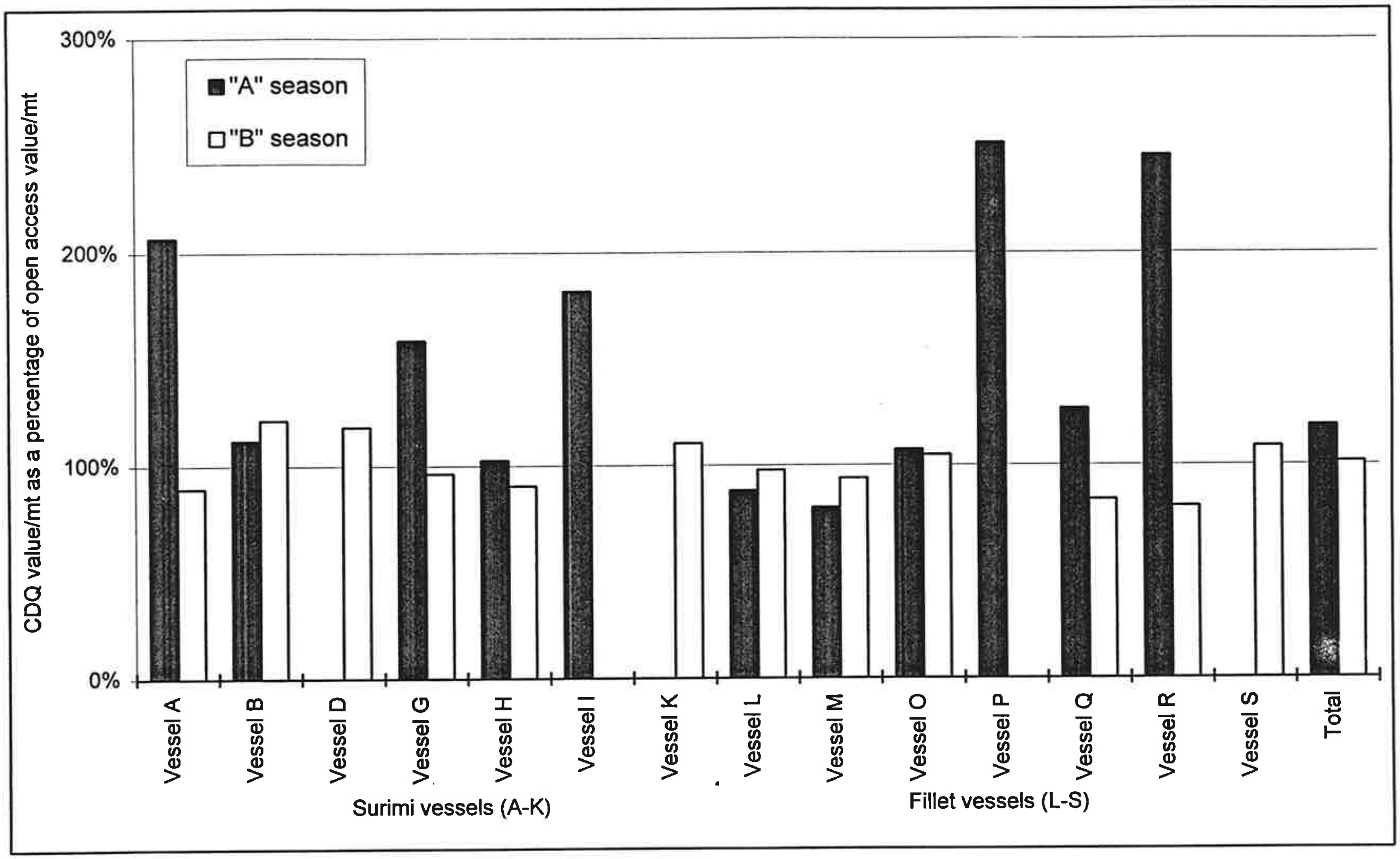


Figure 23. Value of products produced per metric ton of pollock catch in the 1993 CDQ fishery expressed as a percentage of the value of products produced per metric ton of pollock catch in the 1993 open access fishery by vessel and season.

Source: Weekly observer reports, weekly production reports and 1993 wholesale price survey, NMFS Alaska Region, Juneau, AK.

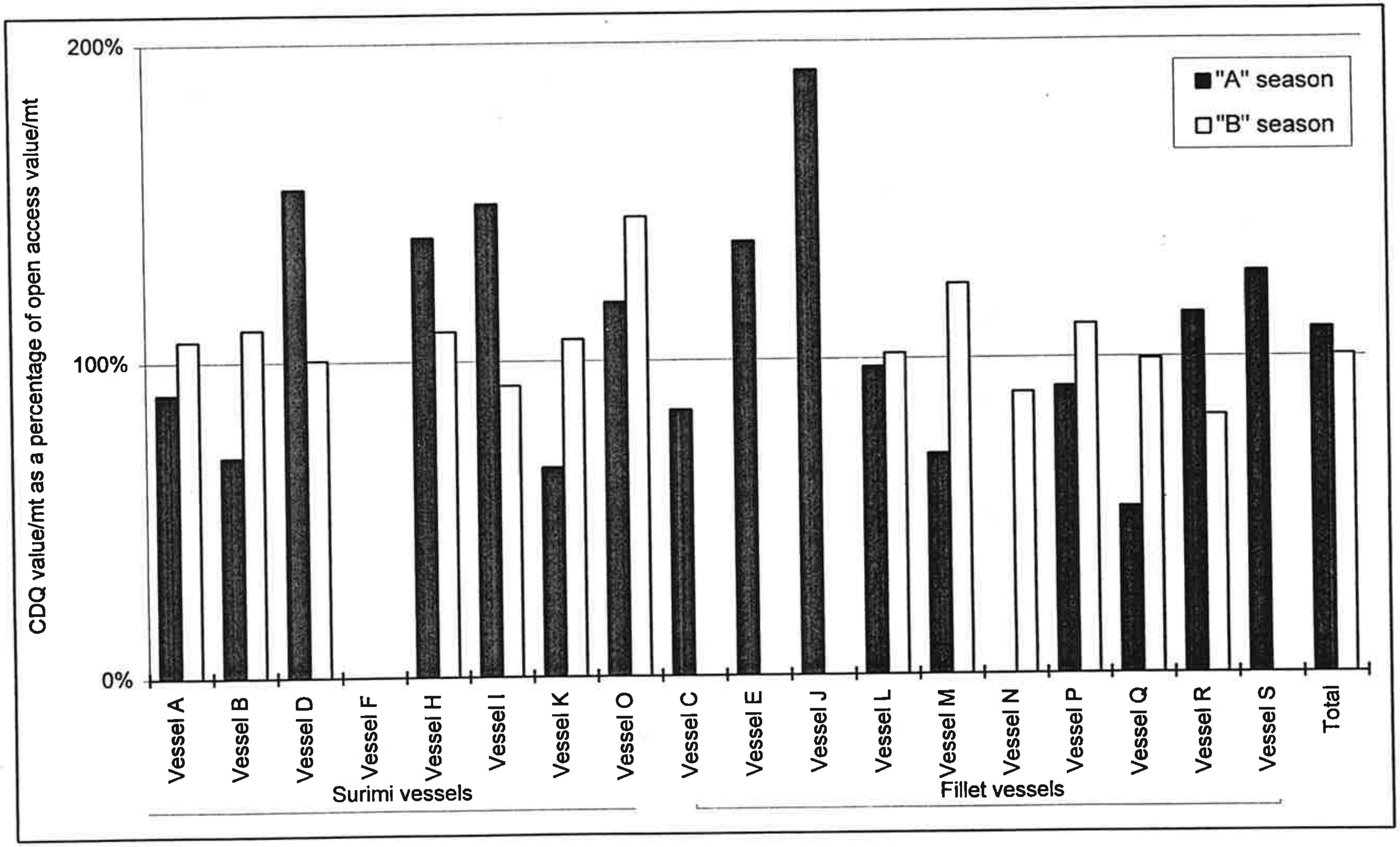


Figure 24. Value of products produced per metric ton of pollock catch in the 1994 CDQ fishery expressed as a percentage of the value of products produced per metric ton of pollock catch in the 1994 open access fishery by vessel and season.

Source: Weekly observer reports, weekly production reports and 1993 wholesale price survey, NMFS Alaska Region, Juneau, AK.

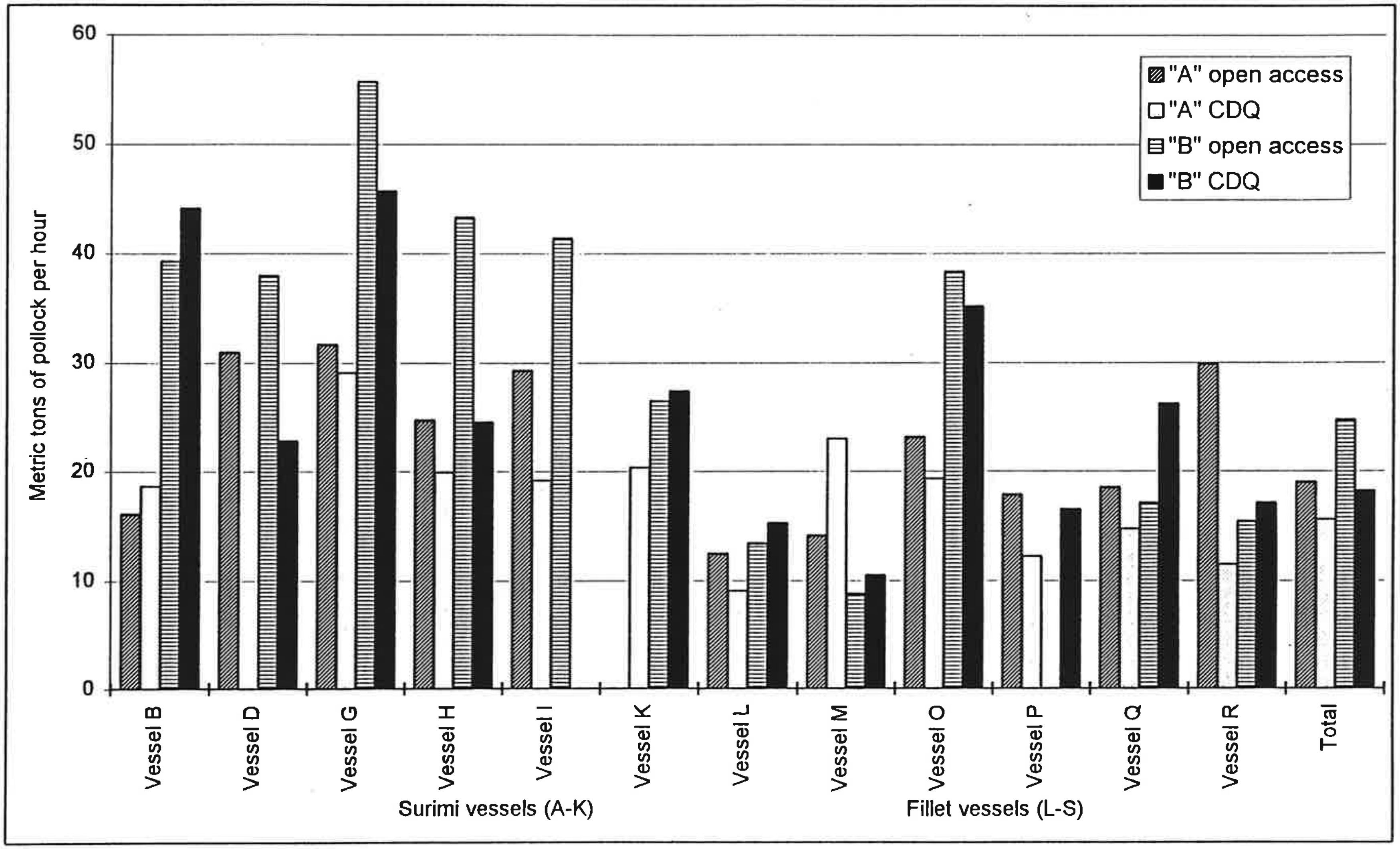


Figure 25. Pollock catch per hour of fishing effort for vessels that participated in 1993 CDQ fisheries.

Source: Weekly observer reports, NMFS Observer Program, Seattle WA.

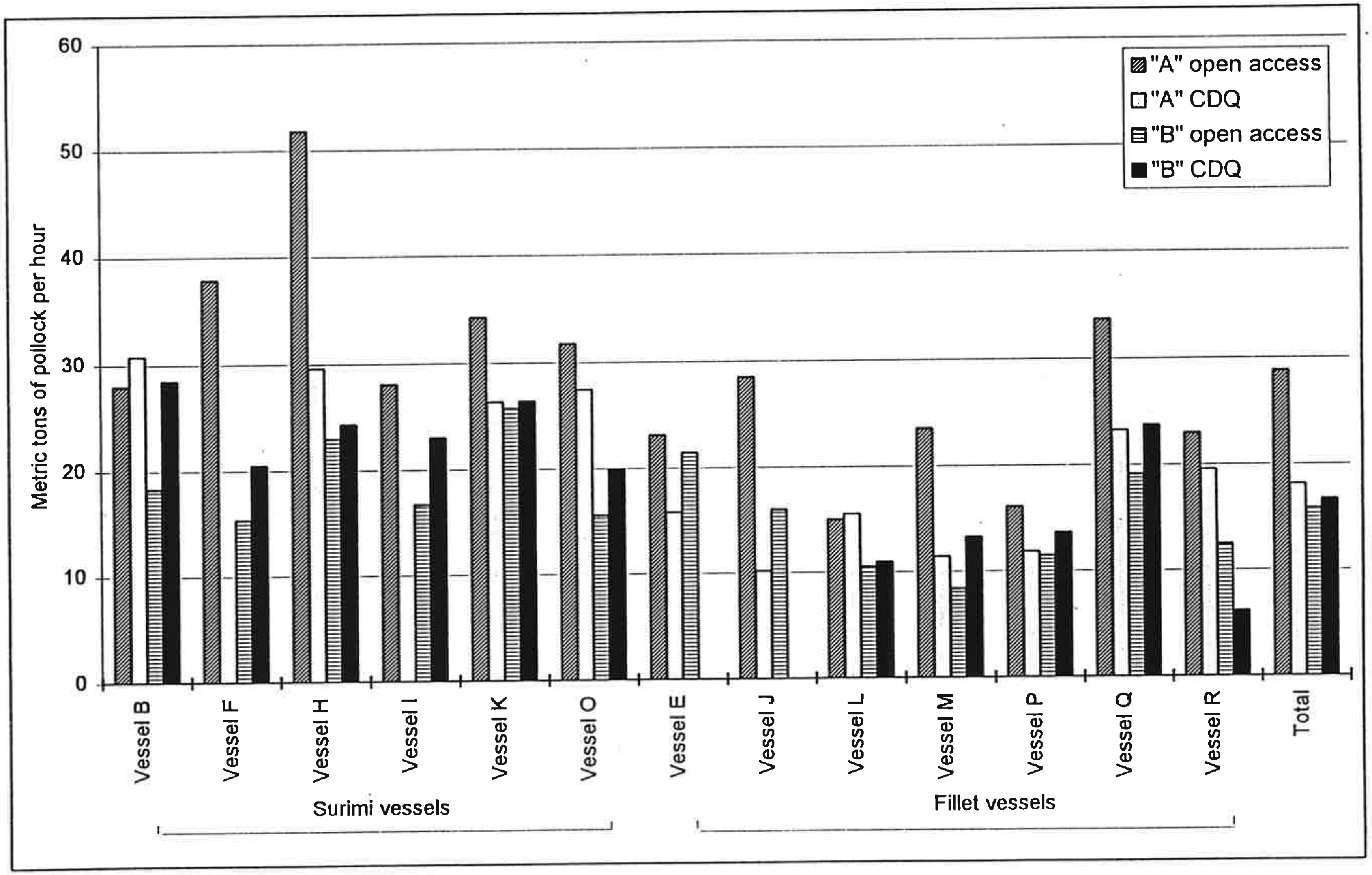


Figure 26. Pollock catch per hour of fishing effort for vessels that participated in 1994 CDQ fisheries.

Source: Weekly observer reports, NMFS Observer Program, Seattle WA.

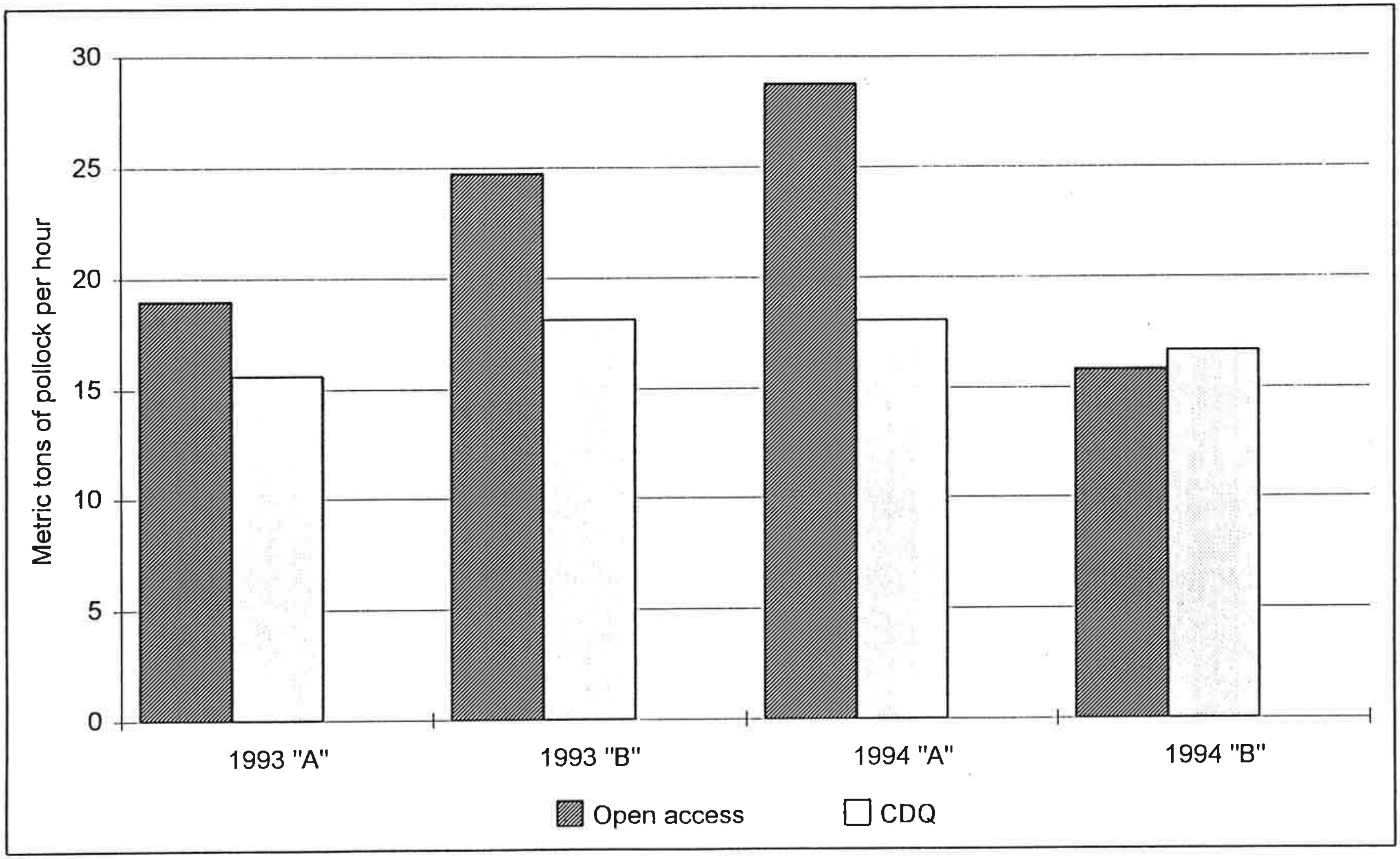


Figure 27. Average pollock catch per hour by fishery for vessels that participated in the 1993 and 1994 CDQ fisheries.

Source: Weekly observer reports, NMFS Observer Program, Seattle WA.