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

NOV 21 1996

To All Interested Government Agencies and Public Groups:

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

TITLE: Amendment 46 to the Fishery Management Plan for the Groundfish Fishery of the Bering Sea and Aleutian Islands Area

LOCATION: Federal waters off Alaska

SUMMARY: Amendment 46 establishes the following management measures: (1) Allocation of the Bering Sea and Aleutian Islands Management Area (BSAI) Pacific cod total allowable catch (TAC) 47 percent to vessels using trawl gear, 51 percent to vessels using fixed gear (hook-and-line and pot), and 2 percent to vessels using jig gear; (2) seasonal allowances of the fixed gear allocation of Pacific cod; and (3) procedures for unused portions of one gear's allocation to be reallocated to other gear types.

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

Sincerely,

Donna Wieting

Donna Wieting
Acting Director, Office of Ecology and Conservation

Enclosure

ENVIRONMENTAL ASSESSMENT / REGULATORY IMPACT REVIEW

(EA/RIR)

for

AMENDMENT 46 to the BSAI FMP

PACIFIC COD ALLOCATIONS

Prepared by staff of the North Pacific Fishery Management Council
and the NMFS Alaska Fisheries Science Center

October 17, 1996

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

The Council selected a range of alternatives to be considered when allocating Pacific cod between fixed, trawl, and jig gear. This allocation will replace BSAI Amendment 24 which allocates 54% of the Pacific cod TAC to trawl gear, 44% to fixed gear (hook and line and pots), and 2% to jig, but will sunset on December 31, 1996. Alternatives under consideration by the Council are:

Alternative	Trawl	Fixed	Jig
1	No Action-Current allocation will expire at the end of 1996.		
2	54%	44%	2%
3	44%	54%	2%
4	59%	39%	2%
5	39%	59%	2%
6	49%	49%	2%

Under each of the main alternatives listed above, the Council is also considering splitting the trawl portion of the TAC between catcher vessels and catcher processors. The splits being contemplated are 60% CV / 40% CP, 40/60, and 45/55.

Environmental Impacts

Chapter 2 concluded that none of the alternatives under consideration is likely to significantly affect the quality of the human environment. It was also determined that none of the alternatives is likely to have any adverse impact on endangered or threatened species or on marine mammals.

Review of 1992-95 Fisheries

Chapter 3 provided a summary of the 1992-95 Pacific cod fisheries. Some of the important findings from that chapter are:

* The trawl halibut mortality cap caused a redistribution of the TAC from trawl vessels to fixed gear in both 1994 and 1995.

* In 1995, fixed gear vessels were unable to harvest all of the 10,000 mt reallocation from trawl vessels, because they reached their halibut mortality cap.

* Pot vessels increased their total catch from about 8,000 mt in 1994 to 18,700 mt in 1995. Preliminary catch reports for 1996 indicated about a 50% increase over 1995 rates.

* Trawl catcher vessels averaged 25.7 kg of halibut mortality per metric ton of Pacific cod target catch, and catcher processors averaged 19.1 kg/mt in 1995.

* Halibut mortality rates and crab bycatch rates tended to be quite variable across years.

* Discards of cod are highest in the non-cod target fisheries. This is especially true for the trawl catcher processor fleet. Overall in 1995, 17.68% of cod taken was discarded. That same year, 51.39% of the cod taken in non-cod targets (as bycatch), and 6.03% of the cod taken in cod target fisheries was discarded.

* Trawl catcher vessels tend to catch a higher percentage of their total cod in the cod target fishery than catcher processors.

* Fixed gear vessels had little cod bycatch in non-cod target fisheries.

* Pot vessels had higher bycatch rates of *C. opilio* and red king crab than any of the other gear groups (though mortality rates are uncertain).

* Cod fillets are mainly sold in the U.S. Roe, milt, salt cod, and whole cod are exported. H&G cod have important markets in Asia, Europe, and North America. These different markets suggest that ignoring benefits beyond primary processing tends to introduce a bias that favors the freezer longliners.

Analytical Methodologies

Chapter 4 provides a description of the model used to project total catches under each of the Council's alternatives. The present model no longer uses gross revenue as the "maximand" - it *calculates* gross revenues for each alternative but is not *driven* by gross revenues. It also incorporates a set ratio of CV catch rates to CP catch rates within the trawl sector, which further reduces its reliance on gross revenue and makes its operation consistent with actual fisheries observations. Total cod catches in other groundfish fisheries (other than midwater pollock) are fixed, which provides an estimate of bycatch needs of cod by these fisheries, therefore enabling reasonable estimates of cod remaining for target fisheries. Essentially, this model is a deterministic model - it is a convenient tool for calculating a variety of necessary mathematical equations, utilizing a necessary minimum of assumptions regarding the prosecution of the fisheries.

Analytical Findings

Major findings from Chapter 5 of the analysis are summarized next. Model Run #1 contains the most relevant basic findings. This model run represents the best estimate of how the current fisheries are managed and prosecuted. Other model runs are provided to show the effects of sensitivity analyses or the effects of various sets of assumptions such as CDQ allocations, splitting the trawl halibut PSC apportionment between catcher vessels and catcher/processors, and the Improved Retention and Utilization initiative.

Findings From Model #1 (Base Case Resnlts):

* Because pot vessels do not have a cap on PSC halibut mortality, fixed gear overall will not be constrained by existing halibut PSC caps.

* Within the fixed gear group, the longline target fishery is constrained by their halibut PSC caps under every Alternative at 94,112 mt as estimated by the model. Therefore, the alternatives will have little impact on the longline fleet, unless some change in the halibut PSC caps is made.

* Trawl gears are constrained by PSC caps in any alternative which allocates 49% or greater to that sector, but are constrained by the Pacific cod apportionment in alternatives which allocate less than 49%. Because they are constrained by halibut under the current program (Alternative 2), and by any alternative

which increases the trawl apportionment, the trawl sector would not realize gains in Pacific cod catch under any of the alternatives under consideration, unless changes are made to the PSC caps.

* The primary beneficiary of an increase in the fixed gear allocation will be pot vessels - this is because longline gear is constrained by the current PSC cap.

* Pacific cod catches in other trawl groundfish target fisheries are stable at around 53,000 mt under each alternative. This represents between 40% and 50% of the total trawl catch under any of the alternatives. Under current regulations Pacific cod in catches in other trawl groundfish fisheries will be largely unimpacted by the apportionments.

* Trawl catcher processor catches of Pacific cod in other groundfish fisheries are likely to be about 35,000 mt under each alternative. Pacific cod catches in other groundfish fisheries by trawl catcher vessels are approximately 18,000 mt. Neither of the fixed gears have significant bycatch of Pacific cod in other groundfish fisheries.

* Discards are estimated to decrease with increases in allocations to the fixed gear sector, assuming current management regulations, though no major differences occur across alternatives. Approximately 75% of all Pacific cod discards occur in trawl fisheries for targets other than Pacific cod. These discards will be largely unaffected by the allocation.

* Total halibut bycatch mortality from the cod fisheries decreases in allocations favoring fixed gear. Within the trawl sector, halibut mortality is reduced in allocations favoring catcher processors.

* Crab bycatch generally increases under alternatives which allocate a higher percentage to fixed gear. This is because cod trawl target fisheries have generally lower crab bycatch rates than pot gear fisheries for cod (other trawl groundfish targets take the vast majority of crab bycatch). This finding does not take into account differential mortality rates associated with each gear type.

* Total product from the cod fisheries is greatest under Alternative 7, where fixed gear receives the highest allocation percentage. This is due to higher utilization rates (production of whole and H&G product as opposed to fillets, for example).

* The total amount of cod going to domestic markets will likely remain unchanged, assuming current halibut PSC caps. This is because any change in the apportionment appears to affect only trawl and pot gear, which produce similar products for the same markets.

* Gross revenue per ton of target catch is greatest for trawl catcher processors. However, because much of their catch of Pacific cod occurs in other groundfish fisheries, overall gross revenue impacts of the alternatives are relatively small. The difference between the alternative with highest gross revenue estimate and that with lowest is $4.6 million dollars, approximately 2.5% of overall gross revenues in the Pacific cod target fisheries of all gears.

* Gross revenue estimates assume that the pot fleet will be able to harvest the Pacific cod made available to it by the apportionments. If the pot fleet is unable to catch their share, and the other sectors are constrained by either halibut or by the Pacific cod apportionment, then gross revenue will fall from the projected amounts by $833 for each ton "left on the table." If for example 1,000 mt of Pacific cod are left unharvested, then overall gross revenues will be $833,000 less than projected. If 5,500 mt are left unharvested then overall gross revenues will fall by $4.6 million which was the total range seen in the alternatives, under the assumption that all Pacific cod would be caught.

* Gross revenue measures ignore costs of production and do not necessarily reflect the greatest net return to the Nation. Reliable cost information is unavailable, but as discussed in Chapter 3 would tend to indicate that net revenue is higher in trawl fisheries than in pot fisheries. Since pot fisheries are the primary beneficiary of a reallocation to fixed gears it would appear that net revenue decreases would be likely, under this scenario.

* Opportunity costs as represented by reduced gross revenue amounts generally decrease with increases in the fixed gear allocation. This finding is heavily influenced by the reduced gross revenue impacts which would be felt by the groundfish fisheries themselves, rather than in impacts on the halibut fishery, or on the crab fisheries. There is a direct (albeit partial) tradeoff between revenues in the Pacific cod trawl target fisheries and revenues in the pollock fisheries. In alternatives which increase revenues for the trawl Pacific cod fisheries, revenues are reduced (i.e., reduced gross revenues are higher) in the pollock fisheries.

General Assessment of the Alternatives Under Model Run #1 (Base Case):

Alternatives 1, 2, and 4 and Sub Options:

* Under these alternatives, which keep the apportionment at the current levels or increase the apportionment to the trawl sector, the trawl fleet is constrained by their catch of halibut rather than by the Pacific cod apportionment. Therefore, little or no change from the current situation can be expected, for either sector. Under the 'C' sub-options of these alternatives target catches are expected to shift from the Trawl CP to the Trawl CV sector. Because trawl catcher vessels appear to have a higher halibut PSC mortality rate, overall trawl catches decrease under the 'C' options, which allocate 40% to Trawl Catcher Processors and 60% to Trawl Catcher Vessels.

Alternative 3 and Sub-Options:

* Under Alternative 3 which reverses the current apportionment allocating 44% to the trawl sector and 54% to the fixed gears, the pot fleet is expected to have over 51,000 mt available to it, assuming the longline fleet will be constrained by their halibut PSC catch. This is an increase of 33,000 mt from their 1995 catch.

* Under 3A (no CP/CV split), the ratio of catch between the CP and CV groups is projected to be the same as under the current allocation. Overall trawl target catches decrease by 10,673 mt., and halibut PSC mortality drop with it to 1,447 mt, 238 mt less than the current trawl halibut PSC mortality cap. Under options B and D more Trawl CP target catches increase and halibut PSC mortality drops to a low of 1426 mt under option 3B. Under option 3C Trawl CV target catches increase, and halibut PSC mortality is projected to be 1,573 mt.

Alternative 5 and Sub Options:

* Under all options of Alternative 5 which allocates 59% of the Pacific cod to fixed gears, projected catches by the pot fleet are over 65,000 mt. This exceeds their 1995 catch by approximately 46,000 mt. Since the longline fleet is constrained by their halibut PSC mortality cap, capacity in the pot fleet will have to increase in order to harvest the entire Pacific cod TAC, if it stays at current levels.

* Target fishing for Pacific cod by catcher processors is estimated to fall to very low levels (6,000 mt) under Alternative 5C. This Alternative allocates 39% of the Pacific cod to the trawl sector, with 60% of that going to catcher vessels. Under this alternative, target catches of the trawl catcher vessels are

projected to be higher than under the current apportionment. Under other Sub-Options target catches are much more evenly distributed between the Trawl CV and Trawl CP groups.

Alternative 6 and Sub-Options:

* Under Alternative 6, which is a 49/49 split between trawl and fixed gear, the pot fleet is projected to have between 39,896 mt (under 6B) and 45,936 mt (under 6C) available to it. This is an increase of over 20,000 mt from their 1995 catch.

* Under Alternative 6, the total trawl target catch (an average of 48% under the four options) is just below the level which can be taken by their cod apportionment. The trawl target catch is still constrained by their overall trawl halibut PSC mortality cap, but with a small decrease in their bycatch rates, they would instead be constrained by the cod apportionment. Total trawl catches are highest under option 6B, 48.4% of the TAC, and lowest under option 6C at 46.1% of the TAC.

Model Run #2 and #3 - Sensitivity Analysis Which Changes (± 10%) the Ratio of CV to CP Catch Rates

* Increasing the ratio of trawl CP to CV target catch increases the target catch going to trawl catcher processor under each alternative. With increased CP target catch, more trawl Pacific cod is caught per ton of halibut, and therefore, the overall trawl total catch will tend to increase. Decreasing this ratio will result in an opposite directional effect.

Model Run #4 - Sensitivity Analysis Which Uses 1994 (as opposed to 1995) Halibut Bycatch Rates

This model run simply uses the 1994 halibut bycatch mortality rates for each fishery, as opposed to the 1995 rates used in the "Base Case." Because PSC caps are an important constraint on the fisheries (other than pot gear), the results under each alternative are significantly influenced by halibut bycatch mortality rates. In this case, because the mortality rate for longline gear was 50% higher than in 1995, the resulting catch of cod by this sector is reduced by about 50%. Additional catch is accrued to the pot gear sector. Trawl mortality rates were higher also, but only slightly so. If the reverse occurs (halibut bycatch mortality rates decrease for longline and/or trawl gear), then the amount of cod catch available for the pot gear sector would be decreased.

Model Run #5 - Assumes a Pro-rata Apportionment of the Trawl Halibut PSC Cap Between Catcher Vessels (CV) and Catcher Processors (CP)

* The findings under this scenario are similar to the "Base Case," with the following notable exceptions:

* Splitting the trawl PSC cap favors catcher processors (CP) under the current percentage split, its reciprocal, or a 49/49 split - this sector gains cod harvest from the CV sector which reaches its PSC cap relatively sooner.

* A split PSC cap is neutral under alternatives which significantly increase the fixed gear allocation, because TAC will be the constraining factor anyway.

* Splitting the PSC cap proportional to the cod quota reduces overall halibut mortality, relative to having a common cap for the two trawl sectors. This results because under the current apportionment the catcher vessels take 51% of the trawl target catch but account for 58% of the total trawl halibut PSC mortality catch in the Pacific cod fisheries. If the catcher vessel were to catch 60% of the target cod they would end up with 68% of the halibut mortality. Therefore if they receive only 60% of the halibut, they

will not be able to catch 60% of the cod, and the total halibut mortality will decrease, but only if the catcher processors bave low enough halibut bycatch rates to first use their cod allocation.

* These results are primarily due to two factors: (1) the catcher vessels have a higher percentage of their cod catch in cod target fisheries, and (2) the catcher vessels have a higher bycatch rate of halibut, in cod targets, than catcher/processors.

Model Run #6 - Assumes a 7.5% TAC Reduction for CDQs

* This model run was made with the assumption of 7.5% of the TACs, including cod, being set aside as CDQs. Essentially, this reduction in TAC, because it is accompanied by a 7.5% reduction in the halibut PSC caps for each fishery, does not alter the basic outcomes other than to proportionally reduce the catch and gross revenues for the longline and trawl sectors. Pot gear, unconstrained by PSC caps, would continue to harvest any of the 'excess' quota (above 49%) allocated to fixed gear.

Model Runs #7 and #8 - Release the Halibut PSC Constraints for Longline and Trawl Gear and Sets the Pot Gear Catch at a Maximum of 25,000 mt and 35,000 mt Respectively

* The primary purpose of these model runs is to examine what would be required, in terms of halibut PSC allowances, by each sector under the full range of allocation alternatives.

* Because longline gear no longer has a cap in this model run, pot gear catch was arbitrarily constrained at 25,000 mt in order to make the model work (i.e., tell us how much halibut might be needed by the other sectors to prosecute their quota allocations). This is a 33% increase over the 1995 catch by pot gear.

* In order to catch the full cod quota under the <u>current</u> allocation, an additional 376 mt of halibut mortality would be required. Of the total amount needed (2,861 mt) to fully take the cod TAC, 797 mt would be for the longline sector (just below their actual cap of 800 mt) with 2,050 mt by trawl gear (365 mt over their actual eap of 1,685 mt) and pot gear would account for 14 mt. If the trawl allocation is split 60% to the catcher vessel sector, the total increase would be only 516 mt (with the trawl CV sector accounting for 1,759 mt).

* Under a reciprocal of the current split (allocating 54% to fixed gear), and assuming a 25,000 mt catch by pot vessels, the longline sector would need a total of 1,027 mt of PSC, 227 mt over their existing cap. The trawl sector would be constrained by the cod quota in this case and would take 1,447 mt, 238 mt <u>short</u> of their existing cap, for a net 'savings' of 11 mt.

* Under a 49/49 split, the longline sector would need 912 mt of total halibut PSC, and the trawl sector (assuming no sub-split) would need a total of 1,749 mt of PSC to cover cod catch in directed (target) cod fisheries. This is, as in Alternative 2, above the existing caps.

* Under the most extreme allocation alternative which would reduce overall PSC mortality (Alternative 5 which allocates 59% to fixed gear), the total potential halibut 'savings' would be 197 mt, which is the total savings from the trawl sector minus the additional halibut needed for the longline sector.

* A final model run was performed which raises the pot gear sector's cod catch to 35,000 mt, which is double their 1995 catch. In this case, the total PSC needed by the trawl and longline sectors decreases. The lowest amount of potential halibut bycatch in this case is 2,222 mt (again from Alternative 5), for an overall potential 'savings' of 282 mt.

* Potential 'savings' of halibut from the trawl sector can be reapportioned to other trawl groundfish fisheries during the annual specifications process (thereby negating the 'savings'), or allowed to be reapportioned to the directed halibut fisheries, or 'banked' to enhance future halibut biomass (the latter two options are at the discretion of the IPHC). A change in the overall caps for longline or trawl fisheries would require a separate FMP/regulatory amendment.

Model Runs #9 and #10 - Evaluates Interaction With IR/IU Program and Assumes a 10% Decrease in the Catch of Cod in Other Groundfish Fisheries (25% reduction assumed in #10)

* This model run was made to examine potential interactions with the Council's proposed Improved Retention and Utilization (IR/IU) program. Obvious impacts are that discards would be reduced to zero (other than regulatory discards). Less obvious impacts are derived by making an assumption regarding the avoidance of cod bycatch in other groundfish target fisheries. Two scenarios are developed: (1) assumes that bycatch of cod in other fisheries will decrease by 10%, and (2) assumes that bycatch of cod in other fisheries will decrease by 25%.

* The primary impact is to make more cod available to all target fisheries, of which gains accrue primarily to the trawl fisheries since fixed gear fisheries take nearly all of their cod in targets anyway.

* Under the assumption of a 25% decrease in cod caught in other fisheries, Alternative 3A (which is a flip of the current percentage splits) shows an increase in the target catch of cod for both the CV and CP trawl sectors (about 5,000 mt each), so that their total target catch is equal to the target catch under the current allocation percentage; i.e., the percentage allocations could be reversed and the target catch of cod by trawlers would remain unchanged relative to Alternative 2. [This comparison is assuming the IR/IU program is in place - the total target catch would be lower than Alternative 2 <u>without</u> IR/IU in place, so would represent a decrease in catch for trawlers in at least 1997.]

Overall Findings

* Given the current halibut bycatch rates in the trawl fishery, the current allocation of Pacific cod (Alternative 2: 54% to trawls and 44% to fixed gear) could not be harvested without an inseason reallocation from the trawl sector to the fixed gear sector of at least 12,000 mt.

* Under a 49%/49% allocation between fixed and trawl gear (Alternative 6), both fixed and trawl Pacific cod catch could be accommodated within the existing halibut PSC caps without inseason reallocation.

* Due to bycatch constraints on both longline and trawl gear, the primary beneficiary of any increase in the fixed gear allocation above 49% will be pot gear. To the extent pot gear is unable to take the additional allocation, there will be foregone harvest of Pacific cod.

* If an increase is made to the trawl gear sector, then foregone harvest of Pacific cod would be expected as they are constrained by halibut bycatch, unless some halibut is reapportioned from other target trawl fisheries in the annual specifications process. They are currently constrained at about 49% of the TAC. If it were re-apportioned in the fall to fixed gear, pot gear may or may not be able to take that 'excess' fish, depending on the size of the unused quota and the amount of pot gear effort exerted.

* Overall halibut mortality and overall cod discards tend to decrease under Alternatives favoring fixed gear.

* Within the trawl fleet, the CV trawl sector has higher halibut bycatch mortality rates, while the CP sector has higher cod discard rates.

* Reduction in the trawl gear allocation will tend to be at the expense of the trawl cod target fisheries, since bycatch needs in other fisheries will still be accommodated. Since the CV sector targets cod at a relatively higher rate, they will be most impacted, barring sub-allocations between the two trawl sectors.

* Based on available information for this analysis, differences between the alternatives, in terms of total gross revenues, will not be significant. Primary impacts will be distributional; i.e., the different allocations will create benefits for the pot sector at the expense of the trawl sector. The trawl sector is unable to benefit from increases in the trawl apportionment due to the halibut mortality cap.

* All findings in the document should be made, bearing in mind the assumptions and caveats of the analysis. In particular, we remind the readers the 1995 bycatch rates are an important determinant of the results. These rates have varied widely over the years included in the analysis, and are expected to continue to vary. Finally, we remind the reader that gross revenues ignore all costs of production and may be misleading as a predictor of overall benefits to the Nation.

Specific Issues in the Council's Problem Statement

Although much of the proceeding summary touched on specific items in the Council's Problem Statement, an additional summary is provided in this section which explicitly refers to issues raised in that Problem Statement - the Problem Statement is shown again below for reference:

> *The Bering Sea/Aleutian Islands Pacific cod fishery continues to manifest many of the problems that led the NPFMC to adopt Amendment 24 in 1993. These problems include compressed fishing seasons, periods of high bycatch, waste of resource, and new entrants competing for the resource due to crossovers allowed under the NPFMC's Moratorium Program. Since the apportionment of BSAI cod TAC between fixed gear, jig, and trawl gear was implemented on January 1, 1994, when Amendment 24 went into effect, the trawl, jig, and fixed gear components have harvested the TAC with demonstrably differing levels of PSC mortality, discards, and bycatch of non-target species. Management measures are needed to ensure that the cod TAC is harvested in a manner which reduces discards in the target fisheries, reduces PSC mortality, reduces non-target bycatch of cod and other groundfish species, takes into account the social and economic aspects of variable allocations and addresses impacts of the fishery on habitat. In addition, the amendment will continue to promote stability in the fishery as the NPFMC continues on the path towards comprehensive rationalization.*

The following specific issues are identified and discussed below:

<u>Compressed Fishing Seasons</u>

Fishing seasons for each industry sector involved were discussed in some detail in Chapter 3. None of the alternatives being considered will directly address the issue of compressed fishing seasons overall, though there are implications for season length, in the form of trade-offs between the industry sectors involved. For example, a growth in participation in the cod fisheries by pot vessels, which is evident currently and could expand due to downturns in the crab fisheries, has the potential to further compress fishing seasons for the fixed gear fisheries overall. This would occur under allocation alternatives which retain the existing percentages or those very close to the existing percentages. An increase in the allocation to fixed gear has the potential to mitigate this trend, though it would be at the expense of the trawl sector, whose seasons would be further compressed by a change in the allocation percentages favoring fixed gear. The reciprocal is also true, though any further compression of trawl fishing seasons could be mitigated to some extent by those alternatives which tend to increase the relative amount of cod taken in target fisheries, as opposed to being taken as bycatch in other groundfish fisheries.

Periods of High Bycatch

Halibut bycatch in general will greatly affect both the longline trawl sectors' ability to take their overall TAC, as well as the length of the seasons. Specific periods of high bycatch may still be unavoidable, though trimester allocations of the longline fishery may help avoid periods of higher bycatch, though these options exist regardless of the percentage allocations between gear types. Trawl fisheries for cod typically occur in the spring of the year and are completed, due to attainment of either the TAC or the PSC cap, by the end of April. This is largely a function of the derby nature of the fishery and will be unaffected by any of the allocation alternatives, other than to slightly shorten, or lengthen, the period of fishing activity.

Halibut bycatch in the cod target fisheries tends to be reduced overall in allocation alternatives which favor fixed gear. These savings occur because trawl fisheries become constrained by their smaller cod quota allocation (at more extreme allocation percentages) and never achieve the PSC caps *currently* allocated to the cod fishery. Though the overall BSAI trawl PSC cap is fixed in regulation, the cod portion of that cap is set during the annual specifications process, and could be apportioned to other trawl fisheries, resulting in little or no overall halibut savings. If not reapportioned to other fisheries, then a potential savings of halibut occurs which can either be reallocated to directed halibut fisheries or 'banked' to increase future halibut biomass. Corresponding increases in the longline cap would be possible under separate amendment, if it is the desire of the Council to increase the cod catch by the longline sector. Under any given gear allocation percentage, halibut bycatch from trawling is minimized in sub-alternatives which allocate a greater percentage of the trawl apportionment to catcher processors.

Waste of Resource (Discards)

The majority of discards are from trawl fisheries, particularly catcher/processor vessels, and primarily because relatively more of their cod catch occurs in groundfish fisheries where cod is not the target (discards are generally higher in non-target fisheries). Overall discards are not expected to change significantly under any of the alternatives, though alternatives which allocate a greater percentage to fixed gear result in the fewest discards, particularly of discards in target fisheries. If an Improved Retention and Utilization (IR/IU) program is implemented (which includes BSAI cod fisheries), the total discards, other than regulatory, will be eliminated for *all* fisheries, and there will be no difference among any of the alternatives in terms of discards. More of the fish will be taken in target fisheries, due to avoidance reactions of vessels in other groundfish fisheries.

New Entrants From Moratorium Crossover Provisions (Growth of Pot Gear Sector)

The provisions of the moratorium, coupled with the recent downturn in crab fisheries, will likely increase participation in the cod fisheries, particularly of pot gear vessels. Recent data show a doubling of pot gear catch from 1994 to 1995 (from 8,000 mt to 18,000 mt), and a 50% increase so far in 1996 relative to 1995. For example, 1996 catch by pot gear may be as high as 28,000 mt given current catch rates. Given current (1996) cod quotas, and given the fact that trawl and longline gear are currently constrained by PSC caps, all of the alternatives under consideration would accommodate that level of pot gear catch and more. Under the current allocation percentages, the projected pot catch is 41,051 mt, which assumes current PSC caps for the other gear types, and assumes that the pot gear sector could catch that much cod. As an additional reference point, a reversal of the current split, such that fixed gear is allocated 54% of the quota, would result in 51,688 mt available to pot gear.

Unless pot gear catch exceeds those amounts, all of the alternatives would appear to allow for substantial growth in the pot sector, without impacting the catch by the longline sector. If overall cod quotas decrease in the future, then alternatives which allocate a greater (than current) percentage to fixed gear would be necessary to accommodate the growth of the pot sector, without impacting the longline share. In that case, the reallocation would be at the expense of the trawl sector.

Non-target Bycatch of Cod

Bycatch of cod in other groundfish fisheries occurs primarily in trawl fisheries, and the catcher/processor has a relatively higher percentage of non-target catch than catcher vessels. Fixed gear catch occurs almost entirely in target fisheries. As mentioned above, discards of cod are much higher in non-target fisheries than in target fisheries. Because bycatch needs in other fisheries will still be provided for in the management system, any reduction in quota to the trawl sector will mostly be felt by the target cod fisheries. Total amounts taken in other fisheries will remain largely unaffected. An exception to this occurs under an assumption of IR/IU, where it is likely that bycatch of cod in other fisheries will be reduced, thereby providing additional fish for the directed (target) cod fisheries. Although total non-target cod catch remains largely unaffected across alternatives, there are differences in the distribution of target catch between catcher vessels and catcher processors. For example, sub-alternatives which allocate 60% of the trawl sector's quota to catcher vessels result in a disproportionate distribution of the overall trawl target catch to catcher vessels (the catch of cod in targets by the CP sector is greatly reduced - most of their cod catch occurs in non-targets in these cases).

Habitat Concerns

As is described in Chapter 2 and in other existing literature, there are benthic impacts associated with all gear types, though the lack of research in the North Pacific fisheries preclude any quantitative comparisons of impacts under the alternatives being considered. To the extent that preferential allocations to fixed gear will reduce any trawl gear impacts from directed cod fishing, it is possible that effort would be transferred to other trawl fisheries, resulting in a net change of little or no reduction in overall trawling.

Stability in the Fishery and Comprehensive Rationalization

Judgements regarding stability may be very subjective and depend on the perception of stability and upon assumptions regarding potential future steps in the Comprehensive Rationalization process; further, there are the often countervailing issues of stability *across* industry sectors to be reconciled with stability *within* industry sectors. For example, maintaining the current percentage allocations may promote stability across industry sectors, as well as within industry sectors, except that it may not provide for stability within an increasing pot gear fishery which may depend heavily on the cod resource in the future. If the pot gear sector continues to grow at the current rate, it may be necessary to increase the fixed gear allocation to insure future stability of the longline sector, though that of course will be at the expense of stability to the trawl sector. Stability of the onshore processing sector may be impacted by the allocation alternatives as well, with trade-offs between it and the offshore processing sector. Finally, stability within each of the trawl sectors (CV and CP) can be affected by the sub-allocations being considered.

How the various sectors will be impacted under any allocation alternative can also be affected by future management programs which can affect both the overall cod fisheries and particular segments of the cod fisheries; these potential programs include CDQ allocations, the IR/IU program, and individual Vessel Bycatch Accounting (VBA) programs. From the analysis, it appears that any of the alternatives will provide stability to the longline fishery, in terms of maintaining its current harvest levels. Stability to the trawl sector is a bit more difficult to ascertain, because there are possible differences in the distribution of *target* catch between the CV and CP sectors. Overall, an allocation which reflects the current split (49/49) may provide the most stability across and within industry sectors, though a reciprocal of the current split (54/44 in favor of fixed gear) could provide a similar distribution of target catch, *assuming* an IR/IU program with resulting decreases in the catch of cod in other trawl groundfish fisheries.

Other Information

Chapter 6 contains limited information relative to regional distributional impacts. Vessels whose owner live in Alaska are expected to harvest as little as 16.4% of the Pacific cod caught in target fisheries (under alternatives 1A, 2A, 2B, 2D, 4A, 4B, 4D, and 6A). The most they are expected to harvest is 18.5% (Alternative 5B). Washington vessel owners are expected to harvest the greatest amount of cod, as much as 72.0% of the total under Alternative 6B. Much of this catch would be taken by the freezer longliner and trawl catcher processor fleets. Other states tend to have relatively more harvest from trawl catcher vessels and pot gear vessels. These projections do not represent any significant change from the current situation. Further detail, as well as similar information for a variety of vessel categories, is provided in this chapter.

Also in this chapter are discussions of other applicable laws, including the Regulatory Flexibility Act. No significant impacts are anticipated relative to NEPA, E.O. 12866, or the Regulatory Flexibility Act for any of the alternatives under consideration.

Preferred Alternative

At the April meeting the Council, at the request of industry, formed a committee consisting of seven industry representatives (longline, pot, trawl, and processor sectors), and tasked them with negotiating an agreement which was acceptable to all parties involved. Dave Hanson, of the Pacific States Marine Fisheries Commission and a non-voting member of the Council, served as the facilitator. The committee members are shown below:

Mothership Trawler	Bob Desautel
Shoreside Trawler	Fred Yeck
Pot Gear	Gordon Blue
Ice Longliner	John Bruce
Freezer Longliner	Thorn Smith
Factory Trawler	Sam Hjelle
Shoreside Processor	John Iani

The Committee met on May 23-24, and agreed upon the allocation of the BSAI Pacific Cod TAC. The trawl sector, in a separate negotiation, agreed to split their apportionment 50/50, between catcher processors and catcher vessels.

At their June 1996 meeting the Council chose as its preferred alternative the allocation agreed upon by the affected industry groups. Under the agreement 51% of the Pacific cod TAC in the BSAI will be allocated to fixed gears, 47% to trawl gears and 2% to jig gear. The specific provisions of the preferred alternative are shown in the on the following page. Chapter 7 discusses the projected impacts of the preferred alternative, the summary of which are reproduced below.

Pacific Cod Allocations in the Bering Sea and Aleutian Islands

1) TAC Apportionments:

a) The trawl sector will be allocated 47% of the Bering Sea and Aleutian Islands Pacific cod TAC.

b) The trawl apportionment will be split between catcher vessels and catcher processors 50/50.

c) The Fixed gear sector will be allocated 51% of the Bering Sea and Aleutian Islands P. cod TAC.

d) The jig gear sector will be allocated 2% of the Bering Sea and Aleutian Islands Pacific cod TAC.

2) Rollovers:

On September 15 of each year, the Regional director shall reallocate 100% of any projected unused amount of the Pacific cod allocated to jig vessels to the fixed gear vessels. If during a fishing year the Regional Director determines that vessels using trawl gear or hook-and line or pot gear will not be able to harvest the entire amount of Pacific cod allocated to those vessels, then NMFS shall reallocate the projected unused amount of Pacific cod to vessels using the other gear type(s).

3) Halibut PSC Mortality Caps:

a) The trawl halibut PSC mortality cap for Pacific cod will be no greater than 1,600 mt.

b) The hook and line gear halibut PSC mortality cap for Pacific cod will be no greater than 900 mt.

4) Review:

The Council will review this agreement at 4 years following the date of implementation.

The negotiated preferred alternative (47/51) would, on paper, reapportion 7% of Pacific cod TAC from the trawl sector to the fixed gear sector. The agreed upon allocation would more closely matches what currently occurs in the Pacific cod fisheries (about 49/49) than does the existing apportionment (54/44). Because the allocation takes place at the beginning of the year rather than through in-season reallocation, it more likely that the full P. cod TAC will be taken. This assures more P. cod for the pot fleet which will likely provide a "safety net" for displaced crab vessels. Any inseason reallocations that would occur (other than from the jig allocation) are projected to come from the trawl catcher vessel apportionment. This is a result of their higher halibut bycatch rates, and greater reliance on P. cod as a target. If the TAC is reduced because of smaller ABCs, it is more likely that the trawl catcher vessels will take their entire apportionment.

In arriving at the negotiated agreement, several issues were considered, including halibut PSC impacts, cod discards, growth potential for the pot gear sector, and relative stability across and within the affected industry sectors. The preferred alternative, due to a slight reduction in the trawl allocation coupled with a limit of 1600 mt of halibut PSC, reduces the total amount of halibut mortality from the cod fisheries, relative to the status quo. The assumption of an Improved Retention/Improved Utilization program, and its attendant incentives, also means that more of the cod would be taken in cod target fisheries, as opposed to being taken as bycatch in other groundfish trawl fisheries. This leads to a secondary, yet significant impact of the Preferred Alternative - the amount of cod taken by the trawl sector <u>in cod target fisheries</u> is not adversely impacted by the reduction in their overall allocation, relative to the amount currently being taken. Thus, with the assumption of cod reduced discards, the preferred alternative allows for an increase in the fixed gear allocation, and a growth buffer for the pot gear fleet, without negatively affecting the amount of cod taken in trawl cod target fisheries. Achievement of this compromise maintains a stability within the industry overall, in terms of relative harvest share and absolute tonnage of cod taken by each sector, while allowing for expansion of the pot gear harvest.

1.0 INTRODUCTION

The groundfish fisheries in the Exclusive Economic Zone (EEZ) off Alaska are managed under the Fishery Management Plans (FMPs) for the Gulf of Alaska (GOA) and the Bering Sea and Aleutian Islands (BSAI). Both FMPs were developed by the North Pacific Fishery Management Council (Council) under the authority of the Magnuson Fishery Conservation and Management Act (Magnuson Act). The GOA FMP became effective in 1978, with the BSAI FMP effective in 1982. Action taken to amend FMPs or to implement other regulations governing the fisheries must meet the requirements of Federal laws and regulations. In addition to the Magnuson Act, the most important of these are the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), Executive Order (EO) 12866, the Regulatory Flexibility Act (RFA), and the National Standards.

NEPA Requirements

An Environmental Assessment (EA) is required by the National Environmental Policy Act of 1969 (NEPA) to determine whether the action considered will significantly impact the human environment. An Environmental Impact Study (EIS) must be prepared if the proposed action may reasonably be expected to: (1) jeopardize the productive capability of the target resource species or any related stocks that may be affected by the action; (2) allow substantial damage to the ocean and coastal habitats; (3) have a substantial adverse impact on public health or safety; (4) affect adversely an endangered or threatened species or a marine mammal population; or (5) result in cumulative effects that could have a substantial adverse effect on the target resource species or any related stocks that may be affected by the action. An EA is sufficient as the environmental assessment document if the action is found to have no significant impact (FONSI) on the human environment. An EA must include a brief discussion of the need for the proposal, the alternatives considered, the environmental impacts of the proposed action and the alternatives, and a list of document preparers.

Regulatory Impact Review

Executive Order 12866, "Regulatory Planning and Review," was signed on September 30, 1993, and established guidelines for promulgating and reviewing regulations. While the executive order covers a wide variety of regulatory policy considerations, the benefits and costs of regulatory actions are a prominent concern. Section 1 of the order deals with the regulatory philosophy and principles that are to guide agency development of regulations. The regulatory philosophy stresses that, in deciding whether and how to regulate, agencies should assess all costs and benefits of all regulatory alternatives. In choosing among regulatory approaches, the philosophy is to choose those approaches that maximize net benefits to society.

The regulatory principles in E.O. 12866 emphasize careful identification of the problem to be addressed. The agency is to identify and assess alternatives to direct regulation, including economic incentives, such as user fees or marketable permits, to encourage the desired behavior. When an agency determines that a regulation is the best available method of achieving the regulatory objective, it shall design its regulations in the most cost-effective manner to achieve the regulatory objective. Each agency shall assess both the costs and benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Each agency shall base its decisions on the best reasonably obtainable scientific, technical, economic, and other information concerning the need for, and consequences of, the intended regulation.

The National Marine Fisheries Service (NMFS) requires the preparation of a Regulatory Impact Review (RIR) for all regulatory actions that either implement a new Fishery Management Plan (FMP) or significantly amend an existing plan. The RIR is part of the process of preparing and reviewing FMPs and provides a comprehensive review of the changes in net economic benefits to society associated with proposed regulatory actions. The analysis also provides a review of the problems and policy objectives prompting the regulatory proposals and an evaluation of the major alternatives that could be used to solve the problems. The purpose of the analysis is to ensure that the regulatory agency systematically and comprehensively considers all available alternatives so that public welfare can be enhanced in the most efficient and cost-effective way. The RIR addresses many of the items in the regulatory philosophy and principle of E.O. 12866.

E.O. 12866 requires that the Office of Management and Budget (OMB) review proposed regulatory programs that are considered to be significant. A "significant" regulatory action is one that is likely to:

(1) Have an annual effect on the economy of $100 million or more, or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or state, local, or tribal governments or communities.

(2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency.

(3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof, or

(4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

A regulatory program is "economically significant" if it is likely to result in the effects described in item (1) above. The RIR is designed to provide information to determine whether the proposed regulation is likely to be "economically significant."

This EA/RIR addresses the allocations of Pacific cod by gear type (fixed gear including longline and pot gear, trawl gear, and jig gear) in the BSAI. This EA/RIR also addresses the further allocation of the trawl sector percentage between catcher vessels (CVs) and catcher/processor vessels (CPs).

1.1 Management Background and Purpose of and Need for the Action

In 1993, the Council and Secretary of Commerce (SOC) approved Amendment 24 to the BSAI FMP which established an explicit allocation of the Pacific cod Total Allowable Catch (TAC) between gear types. The percentage allocations for the 1994, 1995, and 1996 fishing seasons were: trawl gear - 54%, fixed gear - 44%, and jig gear - 2%. These percentages represented, roughly, the existing harvest percentages of the two major sectors, trawl and longline, while allocating 2% to jig gear specifically. The 2% allocation to jig gear was more than was being currently taken by that gear type, but was designed to allow for some growth in that sector. At that time, the Council was in the initial stages of developing its Comprehensive Rationalization Plan (CRP), and the allocations established were consistent with the 1993 Problem Statement shown below, which emphasized the allocation as a stabilizing mechanism and bridge to overall comprehensive rationalization:

> *The Bering Sea/Aleutian Islands Pacific cod fishery, through overcapitalized open access management exhibits numerous problems which include: compressed fishing seasons, periods of high bycatch, waste of resource, gear conflicts and an overall reduction in benefit from the fishery. The objective of this amendment is to provide a bridge to comprehensive rationalization. It should provide a measure of stability to the fishery while allowing various components of the industry to optimize their utilization of the resource.*

Since 1993, the Council has either approved, or is developing, a number of major management programs as part of the overall CRP process. These include the License Limitation/CDQ program for groundfish and crab in the GOA and the BSAI; Improved Retention and Utilization requirements for the Pacific cod and other fisheries in the BSAI; and, a Vessel Bycatch Accounting (VBA) program. Each of these programs is in various stages of development, and none will be implemented prior to the 1998 fisheries.

With the existing Pacific cod allocations scheduled to expire at the end of 1996, the Council placed discussion of this issue on the December 1995 meeting agenda, with the intent that an amendment needed to be prepared to allow an allocation beyond 1996. At the December 1995 meeting, members of the Council identified significant changes which have taken place in the Pacific cod fishery since Amendment 24 went into effect on January 1, 1994. These changes were viewed as biological, economic, and regulatory in nature. In order to respond to these changes, staff was asked to incorporate these changes in the analysis, with specific focus on PSC mortality, impacts on habitat, and discards of Pacific cod by various industry sectors, under a range of possible percentage allocations to each gear type, which would be in place for another three years, through 1999. Though basic percentages were explicitly identified, the Council could choose an allocation percentage which is not explicitly identified, but is within that range. Further, the Council also requested that the analysis examine the sub-alternatives of further dividing the trawl sector allocation between catcher and catcher/processor vessels in the Pacific cod fisheries. The range of that allocation was 60/40 and 40/60. In developing these alternatives, the Council also developed the following Problem Statement in regards to the current allocation proposals:

> *The Bering Sea/Aleutian Islands Pacific cod fishery continues to manifest many of the problems that led the NPFMC to adopt Amendment 24 in 1993. These problems include compressed fishing seasons, periods of high bycatch, waste of resource, and new entrants competing for the resource due to crossovers allowed under the NPFMC's Moratorium Program. Since the apportionment of BSAI cod TAC between fixed gear, jig, and trawl gear was implemented on January 1, 1994, when Amendment 24 went into effect, the trawl, jig, and fixed gear components have harvested the TAC with demonstrably differing levels of PSC mortality, discards, and bycatch of non-target species. Management measures are needed to ensure that the cod TAC is harvested in a manner which reduces discards in the target fisheries, reduces PSC mortality, reduces non-target bycatch of cod and other groundfish species, takes into account the social and economic aspects of variable allocations and addresses impacts of the fishery on habitat. In addition, the amendment will continue to promote stability in the fishery as the NPFMC continues on the path towards comprehensive rationalization.*

1.2 Alternatives Considered

After reviewing a draft analysis in April 1996, the Council identified the following final alternatives to be considered for the Pacific cod gear allocations:

1. No Action - the allocations would expire at the end of 1996.
2. The existing split of 54%/44%/2% (trawl/fixed gear/jig gear)
3. The reciprocal, or 44%/54%/2% (trawl/fixed gear/jig gear)
4. A 59%/39%/2% (trawl/fixed gear/jig gear) split
5. A 39%/59%/2% (trawl/fixed gear/jig gear) split
6. A 49%/49%/2% (trawl/fixed gear/jig gear) split

All of the alternatives, with the exception of Alternative 1, would continue to allocate 2% of the quota to jig gear, while covering a wide range of possible allocations between fixed gear (longline and pot gear combined) and trawl gear. In addition, the Council also requested the analysis to cover a possible further subdivision of the trawl allocation between catcher vessels and catcher/processor vessels (at 60/40; 40/60, and the three year historical average which is 45/55). The following explicit alternatives result:

Table 1.1 Alternative Allocations of Pacific Cod in the BSAI

Alternative	**Trawl**		**Fixed**	**Jig**
	Catcher Vessels	**Catcher Processors**		
1	No Action - Current allocation will expire at the end of 1996.			
2a (Current)	54%		44%	2%
2b (40/60)	21.6%	32.4%	44%	2%
2c (60/40)	32.4%	21.6%	44%	2%
2d (3 yr. avg.)	24.3%	29.7%	44%	2%
3a	44%		54%	2%
3b (40/60)	17.6%	26.4%	54%	2%
3c (60/40)	26.4%	17.6%	54%	2%
3d (3 yr. avg.)	19.8%	24.2%	54%	2%
4a	59%		39%	2%
4b (40/60)	23.6%	35.4%	39%	2%
4c (60/40)	35.4%	23.6%	39%	2%
4d (3 yr. avg.)	26.6%	32.5%	39%	2%
5a	39%		59%	2%
5b (40/60)	15.6%	23.4%	59%	2%
5c (60/40)	23.4%	15.6%	59%	2%
5d (3 yr. avg.)	17.6%	21.5%	59%	2%
6a (Defacto)	49%		49%	2%
6b (40/60)	19.6%	29.4%	49%	2%
6c (60/40)	29.4%	19.6%	49%	2%
6d (3 yr. avg.)	22.1%	27.0%	49%	2%
NOTE: The 3-year average of Trawl CP and Trawl CV results in a 45/55 split between Trawl CP and Trawl CV.				

1.3 Organization of this Document

The remainder of Chapter 1 will provide a summary of the original analysis which resulted in the implementation of Amendment 24, including the strengths and weaknesses of that analysis as they relate to the alternatives currently under consideration.

Chapter 2 provides information on Pacific cod biology and associated species encountered in the cod fisheries. Recent stock assessments and forecasts of future TACs are included, for cod, other groundfish species, and BSAI crab species. A summary of available information on gear impacts to the benthic environment is also provided, as well as current information on bycatch of crab in the various Pacific cod fisheries. This chapter also addresses the requirements of NEPA in the form of an EA, which includes discussion of marine mammals and endangered or threatened species.

Chapter 3 provides a focus on past Pacific cod fisheries. This chapter contains much of the detailed information which has been requested by industry and the Council. Catch composition, bycatch information, discard information, products produced, ex-vessel and ex-processor prices, and gross revenues are aggregated by the various Pacific cod target fisheries by each gear type/delivery mode involved. Several non-Pacific cod target fisheries are also included because they take significant amounts of Pacific cod as bycatch. The target fisheries for which the data aggregations have been made are shown below:

1. Pacific cod longline target fisheries
2. Pacific cod pot gear target fisheries
3. Pacific cod trawl catcher vessel target fisheries
4. Pacific cod trawl catcher/processor vessel target fisheries
5. All other groundfish trawl fisheries which take Pacific cod in significant quantities

This chapter also describes various vessel and processor categories for which similar descriptive data aggregations have been made. The detailed aggregations for these vessel/processor categories are contained in Appendix I to this document. The vessel/processor classes for which information is provided are shown below:

TH1: Trawl vessels generally greater than 125 feet, equipped with RSW tanks.

TH2: Trawl vessels generally greater than 90 feet, generally equipped with RSW tanks.

TH3: Trawl vessels greater than 58 feet but generally less than 90 feet.

PCP: Pot vessels of all sizes

LP: Longline catcher/processors

TP3: Trawl Catcher Processors limited to Head and Gut processing.

TP2: Trawl Catcher Processors with Head and Gut and Filleting capacity.

MP: Motherships and Floating processors.

SP: Shore plants in Dutch Harbor/Unalaska and Akutan.

LH: Longline harvester vessels

MSC: Miscellaneous vessels

Together, this information provides the basis for comparison of the alternatives. These data will also help determine the activities of the different sectors under the various alternatives, particularly in cases where the allocations are considerably different than under the current regulations. Other information included in Chapter 3 includes: (1) a description of the tax revenues associated with fishing and processing activities, (2) description of observer coverage levels for each of the vessel/processor classes and target fisheries described above, and (3) a discussion of Pacific cod markets.

Chapter 4 describes the basic methodologies, modeling, assumptions made, and limitations of the analysis. There are several key assumptions which shape the assessment—some of the more important of these are shown below:

1) The analysis assumes that NMFS will manage TACs and apportionments in the same manner they currently employ. Of primary importance is NMFS strategy of anticipating the use of Pacific cod in other target fisheries. These bycatch needs are assessed when a closure of directed fishing for a target is imminent. Using Pacific cod as an example, NMFS will close directed fishing with trawl gear at a level somewhat less than the total apportionment if it is expected that a significant amount of cod will be taken as bycatch in another fishery which is still ongoing or will occur later in the year, e.g. the pollock B-season, or the yellowfin sole fishery. In 1995, 23% of all Pacific cod taken in the Bering Sea was caught as bycatch in other trawl target fisheries, mainly in the flatfish and pollock fisheries. If the apportionment to the trawl sector was set at an extremely low level (i.e., 29%), then it is possible that NMFS would not allow trawlers to target Pacific cod, but designate it as bycatch only at the start of the year.

   The analysis also assumes that NMFS will make in-season reallocations of Pacific cod, if a gear group is unable to harvest its share because of halibut bycatch. The analysis will also assess the ability of given gear groups to harvest allocated amounts of Pacific cod given 1995 halibut bycatch rates, catch per unit effort data, and vessel numbers.

   While the analysis assumes the current (1996) halibut PSC caps for trawl and fixed gear (these are set in the FMP and in regulation and a separate amendment would be required to change them), the proposed subdivision of the trawl allocation between catcher and catcher processor vessels necessitates some assumption regarding how to apportion the halibut PSC cap in place for trawl cod fisheries. Either there would continue to be a single cap which would be common to both sectors (once the cap is attained it would close both sectors, regardless of cod catch), or that cap could be apportioned pro-rata to the cod allocation percentages. Such a proportional division could be accomplished during the annual specifications process. The analysis examines both scenarios.

2) While the analyses include information regarding the catch and processing of Pacific cod in all target fisheries by all vessels and processors, the detailed analysis will focus on the Pacific cod target fisheries and those trawl fisheries, in aggregate, which take significant amounts of cod as bycatch.

3) Forecasts of catches by each target fishery will be made with the aid of simulation model which uses catch and bycatch rates from the 1995 fishery. The model will constrain catches of the various fisheries to be within TACs and PSC caps set for the 1996 fishery and by the various alternative allocations under discussion in this Amendment.

4) Bycatch rates of other groundfish for each target fishery will be taken from the 1995 Blend Data. Bycatch rates of PSCs will be taken from 1995 observer data and combined with the blend data.

5) In determining gross revenue per target ton for each of the fisheries, the model assumes that retention rates from the 1995 Blend Data will prevail, as well as product prices from the 1994 Annual Operators Report (the best information currently available).

6) Product mixes and recovery rates will be estimated directly from the Weekly Processor Reports. Although there is not a direct correspondence between Blend Data and Weekly Processor Reports, retained catches from the former will be combined with product mix and PRRs from the latter to estimate the amount of product produced from a ton of catch of the target species in each target fishery, as well as products from retained bycatch species.

7) Estimates of impacts will include estimates of opportunity costs resulting from the bycatch of halibut, crab, and other groundfish in the target fisheries included in the model.

8) While the model will employ primarily 1995 data as inputs, sensitivity testing of the model parameters will be undertaken. Halibut bycatch mortality rates appear to be a key input in determining impact of the allocations. Changes in model outcomes which would occur under various bycatch rates will be examined.

9) Given the model results, it will be possible to infer impacts on vessel and processor classes as defined above and discussed in Chapter 3.

10) Estimates of community impacts will be primarily qualitative rather than quantitative. The information provided in terms of expected catch and delivery by various vessel/processing operations should enable the reviewers of this document to make their own inferences regarding potential downstream community impacts of the various allocation alternatives.

11) Model runs will be conducted for scenarios both with and without a 7.5% CDQ allocation off the top.

Chapter 5 will present the results of the model runs and will discuss their implications. Ten sets of model runs for each of the alternatives will be presented. The first model run will provide the 'Base Case,' and examines the various alternatives under the assumption of in-season reallocation of unused Pacific cod TAC (from one sector to another), no split of the trawl halibut PSC cap between catcher vessels (CV) and catcher/processors (CP), and uses 1995 halibut bycatch rates. The second and third model runs are a sensitivity analysis of the assumed ratio of CV to CP trawl catch during the season, while the fourth model run, also a sensitivity analysis, uses the halibut bycatch rates from the 1994 fisheries.

Model run #5 assumes a split of the trawl halibut PSC cap between CV and CP at the same ratio as the Pacific cod TAC split. Model run #6 examines outcomes under the assumption of a 7.5% reduction in the overall quota as CDQ set aside. Model runs #7 and #8 relax the PSC cap constraints in order to see how much halibut PSC would be expected for each sector to fully realize its allocation (an assumption is required as to the amount of harvest by pot gear - the two runs look at 25,000 mt and 35,000 mt respectively). Model runs #9 and #10 are made to provide information on the potential ramifications of the Council's Improved Retention and Utilization (IR/IU) initiative. These runs assume a 10% and 25% reduction, respectively, in the amount of cod taken as bycatch in other groundfish fisheries, where avoidance would be expected in response to the IR/IU initiative.

For each model run, estimates and discussion of the following are included:

1) Estimates of total catch of Pacific cod in cod target and cod non-target fisheries for each sector described in Chapter 3.

2) Estimates of discards of cod in both target and non-target fisheries for each sector described.

3) Prohibited species bycatch in the Pacific cod target fisheries and non-targets listed above. If the allocation impacts PSCs in other target fisheries, then these will be reported as well.

4) Estimated gross production and product revenue by target fisheries listed above, as well as changes in gross processing revenues.

5) Estimates of reduced gross revenues resulting from bycatch of PSCs and other groundfish. These are provided as a proxy for the "opportunity costs" of bycatch.
6) Discussions of other non-quantifiable impacts, costs, and benefits.

Reviewers of this document should be aware of the limitations of this analysis. Although National net benefit ratios are not estimated, because of severe limitations on available cost and other data, impacts to each of the major industry sectors are quantified. These impacts include costs and benefits in terms of total catch of cod and other species, PSC bycatch implications, opportunity costs, potential for growth, and overall gross revenues for each of the major sectors involved, and for the Pacific cod fisheries overall.

Because of incompatibilities in the data, estimates of gross revenue should be viewed with caution. An assessment of net economic benefits would include estimates of costs as well as revenues. Reasonable estimates of harvesting and processing costs for all of the target fisheries are unavailable at this time. While some cost information from previous analyses is available for two of the four Pacific cod fisheries, the lack of cost information for the others led to our decision to focus on changes in catches under the alternatives rather than on net economic benefits. Until such time as reasonable estimates of harvesting and processing costs, and better information regarding products and revenue are available for all of the sectors impacted by the alternatives, reliable quantitative net benefits assessments will not be possible. This may even require a change to the Magnuson Act which contains a prohibition on collection of certain economic data in Section 303(e).

The final chapter, Chapter 6, contains a comparison of the alternatives and a summary of the findings and conclusions, including a discussion of each alternative's ability to address the components of the Council's Problem Statement.

1.4 Summary of the Original Pacific Cod Gear Allocation Analysis — Amendment 24

The types of biological, economic, and social analyses that were used when the Pacific cod TAC was initially allocated by gear group are presented below by topic. For the biological analyses that have not been updated for the current evaluation of the cod allocation alternatives, the previous results are included.

1. Expected Effects on the Biological Productivity of the BSAI Cod Resource

The distribution of cod catch among the cod fisheries may affect the biological productivity of the BSAI cod resource through its effects on yield per recruit and due to the effect of fishing on pre-spawning or spawning aggregations of cod. The latter includes direct effects on stock size, equilibrium yield, spawning success, and the ability to monitor successfully the attainment of the TAC.

Effect on Yield Per Recruit

A simulation model was used to estimate whether the differences in size selectivity among the longline, pot, and trawl cod fisheries are sufficient to affect yield per recruit. The model results indicated that yield per recruit is about the same for longline and trawl gear but somewhat higher for pot gear.

Effect on Stock Size and Equilibrium Yield

The main conclusions of the theoretical model are that fishing on spawning stocks early in the year does tend to reduce equilibrium stock size, while equilibrium catch can either increase or decrease, depending on parameter values.

Effects on Spawning Success

The question of the effects of fishing on spawning fish has been raised repeatedly for various stocks of fish, most recently as part of an inquiry into the status of the northern cod stock off Labrador and Newfoundland, Canada (Harris 1990). The conclusion of that report is that there is no clear deleterious effect of fishing on spawning concentrations of cod or other marine fishes. However, as the Canadian northern cod study points out, there may be subtle effects that cannot be readily detected. Nevertheless, the history of fisheries does not indicate that fishing during the spawning period only has led to any measurable biological changes or cause reduced survival of prodigy.

Operational restrictions to limit fishing on spawning stocks have been implemented in some fisheries, including the BSAI pollock fishery. They have been implemented for a variety of reasons. Although concern for spawning success may be among the reasons, it has not always been the principal reason for such restrictions. Such restrictions are easier to justify when a stock is heavily overexploited or at very low levels for other reasons and any action that may aid in the stock's recovery is of greater benefit. The BSAI cod stocks do not meet these conditions.

Effect on the Ability to Monitor Successfully the Attainment of the TAC

Over the past few years, continuous improvements in NMFS monitoring capabilities have substantially decreased the potential for significantly exceeding a TAC for fisheries that last more than a few weeks. The BSAI cod fishery is expected to continue to be in that category of fisheries. The fact that there is very high observer coverage for the BSAI cod fisheries increases the potential for successfully monitoring catch.

2. Expected Effects on Marine Mammals and Seabirds

A change in the distribution of cod catch among fisberies that has adverse effects on marine mammals and seabirds can impose two types of economic costs. It can decrease the value of the those marine resources and it can result in more costly restrictions being placed on the commercial fisheries. However, the current cod fisheries' interactions with marine mammals and seabirds are not thought to be large enough to have statistically significant effects on their populations. The differential effects among the alternatives being considered are thought to be even smaller. Therefore, the alternatives being considered are not expected to differ significantly with respect to their effects on marine mammal and seabird populations.

3. Impacts of Trawling on the Seabed and Benthic Community

Neither the directions nor the magnitudes of alternative-specific differences in the effects on the seabed and benthic community are known. The information that is available does not indicate that significant differences should be expected.

4. Expected Effects of Changes in the Bycatch of Prohibited Species

Due to differences in bycatch rates by fishery, changes in the distribution of cod catch by fishery can change the bycatch of prohibited species in the cod fishery. However, such changes would be modified by any associated redeployment of effort to other groundfish fisheries. Although bycatch mortality rates vary by cod fishery, they also vary substantially among individual operations within each fishery. This suggests that a reallocation of cod catch from a fishery with a high average bycatch mortality rate to one with a lower average rate generally will result in operations with higher rates being replaced by operations with lower rates; however, the opposite will also occur to some extent. Therefore, reallocating cod on the basis of gear alone will not be optimal with respect to bycatch management.

5. Expected Effects on Coastal Community Stability

The alternatives being considered can affect the stability of coastal communities due to differences by gear in seasonality and in the proportion of catch that is processed on shore. Community stability can also be affected by the effect the distribution of catch has on the economic viability of existing fishing and processing operations.

6. Historical Use of the Cod Fishery

Historical cod catch distribution data were presented to put the allocation alternatives being considered in perspective.

7. Current Dependence on the Cod Fishery

Dependency on the cod fishery in terms of weeks of operation and product value was estimated for each of the fleets participating in the BSAI cod fishery. Dependency was also estimated by vessel.

8. Expected Effects on Economic Benefits to the Nation

Harvesting cod in the cod trawl, longline, pot, and jig cod fisheries are four alternative uses for cod, each of which results in the production (output) of valuable products both from cod and from the other groundfish species harvested as bycatch and retained in the cod fisheries. Each use of cod also requires the use of a variety of inputs that are of value to society. In addition to cod, the inputs used in these fisheries include groundfish and prohibited species bycatch; fishing vessels, gear, and bait used in harvesting; the plant, equipment and materials used for processing; and the fuel and labor used throughout the production process. Each cod fishery uses a different combination of these inputs to produce a different combination of cod and other groundfish products.

The difference between the values of the outputs (revenues) and inputs (costs) for a particular use provides a measure of the net benefit of that use. It is a measure that attempts to account for many of the differences among the four cod fisheries that were discussed above. Therefore, it provides a method of summarizing the overall effects of those differences. This aggregate measure addresses gear-specific differences in species mix, retention/discards, product mix, product prices and value, the opportunity cost of groundfish and prohibited species taken as bycatch, product recovery rates, and variable harvesting and processing costs.

For the purposes of the previous analysis, average net benefit per metric ton of cod catch (ANB) was defined as gross product value (F.O.B. Alaska) per metric ton of cod catch net of variable cost and the opportunity cost of the prohibited species and groundfish species taken as bycatch in the cod fisheries per metric ton of cod catch. ANB was estimated for each of three cod fisheries (longline, pot, and trawl) by year, season, and month. A number of limitations of the estimates of ANB were discussed in the analysis for the cod allocation alternatives for 1994-96. Two additional limitations for the current analysis are as follows: (1) the lack of updated estimates of variable cost, and (2) the lack of separate cost estimates for trawl catcher vessels and on-shore processors.

A subset of the estimates that were presented in Tables 11 and 13 of the June 18, 1993 Addendum to the EA/RIR for Amendment 24 are reproduced in Tables 1 and 2. Gross product value per ton of cod catch was higher for factory trawlers than for freezer longliners or pot catcher processors. Variable cost was estimated to be between 54 and 65 percent of gross product value for freezer longliners, between 51 and 68 percent for pot catcher processors, and between 52 and 60 percent for factory trawlers. Therefore, per metric ton of cod catch, gross value net of variable cost was higher for factory trawlers than for freezer longliners or pot catcher processors for two reasons, a higher gross value and variable costs that were a smaller percent of gross values. However, the opportunity costs of prohibited species and groundfish bycatch were higher for factory trawlers than for freezer longliners or pot catcher processors. When 1991 prices were used, ANB was lower for factory trawler than for the other two types of catcher processors. However, when 1992 prices were used, the rankings of the three types of operations varied by year. Freezer longliners had the lowest ANB in 1991 and 1992 but the highest ANB in 1993 for January - May. Factory trawlers were ranked second, first, and last, respectively, in 1991, 1992, and 1993. The estimates of ANB for freezer longliners varied substantially by season with a steady decline from the first to the third season.

With respect to determining the ANB rank of each of the three types of catcher processors, generally the differences in gross value and the opportunity cost of groundfish bycatch were more important than differences in variable cost and the opportunity cost of prohibited species bycatch. For example, even if the opportunity cost of prohibited species bycatch had been zero for freezer longliners, the estimated ANB would have still been higher for factory trawlers than for freezer longliners in 1991 and 1992 when 1992 prices are used (Table 1.3). Or when 1991 prices are used (Table 1.2), freezer longliners would have still had higher ANB than factory trawlers in 1991 and 1992 even if the opportunity cost of prohibited species bycatch of the factory trawlers had been reduced by 50 percent. The differences between the estimates of the variable cost per metric ton of cod catch for freezer longliners and factory trawlers are so small that the ANB rankings would not have been altered if the average variable costs had been assumed to be equal for these two user groups. If this continues to be the case, comparing gross value net of the opportunity costs of prohibited species and groundfish bycatch would be sufficient to determine whether a specific change in the allocation of cod among user groups would tend to increase or decrease net benefits to the Nation.

As gross product value, variable cost, and the opportunity cost of bycatch change over time, the ANB ranking of the longline, pot, and trawl cod fisheries can change. However, there are certain types of changes in the values of these variable that would not affect the rankings. They include the following: (1) equal rates of change for all three variables in all three cod fisheries; (2) equal rates of increase for gross value for all three fisheries accompanied either by no change in costs or by equal rates of increase in costs among the three fisheries that do not exceed the rate of increase in value; and (3) value and costs increase at the same rate within a fishery and the rate of increase for a fishery is higher for a higher ranked fishery.

The usefulness of the historical estimates of ANB by user group could be decreased substantially if other regulatory changes are expected to change ANB for one user group more than another. For example, if increased retention and utilization (IRU) regulations are implemented and if the resulting increases in ANB by user group are expected to be positively related to the current level of discards, such regulations would be expected to increase the ANB of the cod trawl fishery relative to other cod fisheries.

The fact that the ANB rankings vary by year for a given set of prices and vary between the two sets of prices suggests that it is very difficult to determine what the ranking will be in the future. In fact, the ranking is expected to change over time. Therefore, in terms of ANB, the optimal allocation will vary from year to year and cannot be attained if the allocation is fixed by regulation. A fixed allocation among user groups will also be suboptimal because regardless of the ranking of each user group as a whole, the highest ranked group is expected to include some fishing operations with low ANB and the lowest ranked group is expected to include some fishing operations with high ANB. The analysis that was done for Amendment 24 indicated that this overlap problem existed for ANB and most any other criterion that is used to rank user groups.

9. Expected Distribution Effects

The distribution effects of the alternatives were also considered.

10. Expected Effects on Consumers

Due to the relatively low importance of BSAI cod in the budgets of most consumers and due to the availability of substitutes for BSAI cod, none of the alternatives is expected to have a measurable or significant effect on domestic consumers with respect to the amount of food available or the price of that food.

11. Expected Effects on Competitiveness of the US Fishing Industry

An explicit or implicit allocation of cod to operations that are currently less profitable or that could become unprofitable if market or regulatory conditions deteriorate would tend to decrease the competitiveness of the US fishing industry in domestic and world markets. The difficulty in determining which cod fishery will tend to be the most competitive and the fact that within each cod fishery there is likely to be a range of very unprofitable to very profitable operations increase the probability that the allocation decision made will decrease competitiveness.

12. Expected Effects on Reporting, Management, Enforcement, and Information Costs

In general, the differences among the alternatives are expected to be minimal in terms of effects on reporting, management, enforcement, and information costs.

An explicit allocation of the cod TAC that decreases catch in the cod trawl fishery would be expected to increase the need to be able to differentiate between cod catch and bycatch in the trawl fisheries. The recent closures of the cod trawl fisheries have raised questions concerning the appropriate directed fishing standard for a non-cod trawl fishery. The need to resolve this issue would be increased by a small explicit allocation to the cod trawl fishery.

13. Attainment of OY with Existing PSC Limits

Given a halibut PSC limit that constrains total groundfish catch in the trawl fisheries, the opportunity cost of using halibut as bycatch in the cod trawl fishery is the net value of foregone catch in the other trawl fisheries.

14. Differences in the Quantity and Quality of Biological Data from the Cod Fisheries

Differences in the quantity and quality of biological data from the cod fisheries do not appear to provide much justification for favoring a specific allocation of the cod TAC among the cod fisheries and/or among trimesters.

15. Gear Conflicts and Vessel Safety

A reallocation of cod to the cod longline or pot fishery will tend to increase gear conflicts within the groundfish fishery because, typically, there are fewer gear conflicts among trawlers than they are either among non-trawlers or between trawlers and non-trawlers. A decrease in the size of the trawl cod fishery could decrease conflicts between the cod trawl fisheries and fixed gear fisheries for groundfish and crab. An increase in effort in the cod pot fishery could increase gear conflicts for all three cod fisheries and other fisheries as well

Because the potential for gear conflicts can be reduced substantially by better communications among fishermen and by other means, gear conflicts are not expected to have an important effect on the relative merits of allocation among the three cod fisheries. Although exclusive time/area openings by the cod fishery could be used to eliminate gear conflicts, it is not clear that such a remedy would be needed. This solution is beyond the scope of the alternatives being considered. Gear-specific differences in vessel safety have not been identified.

16. Effects on Other Fisheries

A change in the distribution of cod catch among the four cod fisheries will affect both the periods of time which the vessels that participate in the BSAI cod fisheries will have available to participate in other fisheries and the incentives these vessels will have to participate in other fisheries. Although the responses of each fleet are difficult to predict, some possible effects can be identified.

17. Fairness and Equity

The determination of what is fair is very subjective. The Council has often used the historical distribution of catch to define what is fair and has favored the traditional fishery.

Table 1.2 Estimates of average net benefit per metric ton of cod catch (ANB) and its components by fishery, season, and year for 1991 - April 1993, using 1991 halibut yield loss factors and 1991 prices ($/metric ton of cod catch).

	1991			1992			1991	1992	1993
	Jan-May	Jun-Aug	Sep-Dec	Jan-May	Jun-Aug	Sep-Dec	Jan-Dec	Jan-Dec	Jan-Dec
Cod Longline									
Gross value	1,176	1,171	957	1,063	1,020	974	1,096	1,041	1,013
Variable cost	586	642	607	550	633	723	609	592	549
PSC cost	6	18	17	11	41	28	13	23	10
Groundfish cost	11	40	21	11	20	27	22	16	11
ANB	573	471	313	491	326	196	451	410	443
Cod Pot									
Gross value	.	897	972	1,184	983	1,020	935	1,041	824
Variable cost	.	428	526	538	625	969	477	615	553
PSC cost	.	2	5	2	2	2	3	2	0
Groundfish cost	.	1	1	1	4	3	1	3	0
ANB	.	466	440	643	353	45	453	421	270
Cod Trawl									
Gross value	1,221	.	.	1,150	.	.	1,221	1,150	1,095
Variable cost	631	.	.	600	.	.	631	600	657
PSC cost	67	.	.	70	.	.	67	70	48
Groundfish cost	137	.	.	134	.	.	137	134	172
ANB	386	.	.	345	.	.	386	345	218

Note: All estimates are in dollars per metric ton of cod catch. The higher estimates of PSC costs and variable cost model 2 were used in this table. There was not sufficient catch in the trawl fishery the second and third trimesters of 1991 and 1992 or in the pot fishery the first trimester of 1991 to provide meaningful estimates of ANB.

Table 1.3 Estimates of average net benefit per metric ton of cod catch (ANB) and its components by fishery, season, and year for 1991 - April 1993, using 1991 halibut yield loss factors and selected 1992 cod prices ($/metric ton of cod catch).

	1991			1992			1991	1992	1993
	Jan-May	Jun-Aug	Sep-Dec	Jan-May	Jun-Aug	Sep-Dec	Jan-Dec	Jan-Dec	Jan-Dec
Cod Longline									
Gross value	963	884	830	882	780	846	894	841	857
Variable cost	536	573	577	508	577	693	561	545	513
PSC cost	6	18	17	11	41	28	13	23	10
Groundfish cost	11	40	21	11	20	27	22	16	11
ANB	411	253	216	352	142	98	297	257	323
Cod Pot									
Gross value	.	714	863	1,024	749	877	788	832	766
Variable cost	.	355	484	456	542	920	420	534	520
PSC cost	.	2	5	2	2	2	3	2	0
Groundfish cost	.	1	1	1	4	3	1	3	0
ANB	.	356	373	565	201	-49	364	293	245
Cod Trawl									
Gross value	1,166	.	.	1,086	.	.	1,166	1,086	1,062
Variable cost	611	.	.	579	.	.	611	579	640
PSC cost	67	.	.	70	.	.	67	70	48
Groundfish cost	137	.	.	134	.	.	137	134	172
ANB	350	.	.	303	.	.	350	303	201

Note: All estimates are in dollars per metric ton of cod catch. The higher estimates of PSC costs and variable cost model 2 were used in this table. There was not sufficient catch in the trawl fishery the second and third trimesters of 1991 and 1992 or in the pot fishery the first trimester of 1991 to provide meaningful estimates of ANB.

2.0 NEPA REQUIREMENTS: ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES

2.1 Biology and Status of BSAI Pacific Cod

Pacific cod are a widespread demersal species found along the continental shelf and upper slope of the Bering Sea and Gulf of Alaska. Adult cod are commonly found at depths of 50-200 m in the Gulf of Alaska and 80-260 m in the Bering Sea. In the Gulf of Alaska, Pacific cod are most abundant in the western Gulf, where large schools may be encountered at varying depths depending upon the season of the year. During the winter and spring, cod appear to concentrate in the canyons that cut across the shelf and along the shelf edge and upper slope between depths of 100-200 m where they overwinter and spawn. In the summer, they shift to shallower depths, usually less than 100 m.

Spawning occurs in the winter/early spring period, beginning in January in the Bering Sea. Spawning in the Gulf of Alaska has been observed from February - July, with most spawning occurring in March at depths of 150-200 m. In the Gulf of Alaska, spawners have been observed mostly along the outer continental shelf off Kodiak Island, but also in Shelikof Strait and off Prince William Sound. In the Bering Sea, female cod begin to attain maturity at about 50 cm in length and 50% reach maturity at 67 cm (5.7 years). Pacific cod are a fast-growing, short-lived species. Age determination for Pacific cod is difficult; the approximate maximum age is 10-13 years. The instantaneous rate of natural mortality for BSAI Pacific cod is estimated to be 0.37.

Recruitment of BSAI Pacific cod is highly variable from year to year (Thompson 1995). Average recruitment (mean of 203 million age 3 fish) was observed in 1989, 1990, and 1991. Above average recruitment was observed in 1992. Below average recruitment was observed in 1985-1988 which resulted in reduced biomass through 1993. The average and strong year-classes observed since 1989 have bolstered the stock to its current high level. Preliminary information suggests that the 1993 year-class is average, and the 1994 year-class is below average.

The BSAI Pacific cod stock has increased to high levels over the past few years, with the 1996 exploitable biomass at 1,640,000 mt. An $F_{40\%}$ harvest strategy (F=0.30) resulted in an ABC for 1996 of 305,000 mt. Assuming recruitment in 1996 and 1997 based on the ages 2 and 1 indices, and average recruitment over the next few years, the above time series of BSAI Pacific cod exploitable biomass and ABCs are projected based on an $F_{40\%}$ harvest strategy.

Projected biomass and ABC(mt) of Pacific cod in the BSAI.

Year	Biomass	ABC
1996	1,637,000	305,000
1997	1,522,000	284,000
1998	1,388,000	259,000
1999	1,300,000	242,000

2.2 Status of Other BSAI Target Species, by Gear Type

Reallocation of Pacific cod quotas by gear type may result in increased or decreased effort on other groundfish species. Biological and economic impacts depend to some extent on abundance of groundfish other than Pacific cod. A status report on major groundfish target species by gear type is provided below.

2.2.1 Trawl Gear

2.2.1.1 Pollock

Projected biomass and ABC(mt) of eastern Bering Sea pollock.		
Year	Biomass	ABC
1996	6,672,000	1,190,000
1997	7,341,000	1,228,000
1998	7,793,000	1,257,000
1999	8,021,000	1,300,000

Three stocks of pollock inhabit the BSAI area: the eastern Bering Sea, Aleutian Islands, and Aleutian Basin stock. Exploitation and abundance of these stocks are very different. The eastern Bering Sea pollock stock increased to a peak of 14.3 million mt in 1985, and has since declined and stabilized slightly above the Bmsy level (6.1 million mt). The 1996 exploitable biomass is 6,672,000 mt. An $F_{40\%}$ harvest strategy (F=0.30) resulted in an ABC for 1996 of 1,190,000 mt. Assuming average recruitment of 7.7 billion age 3 pollock each year, the adjacent time series of eastern Bering Sea pollock exploitable biomass and ABCs are projected based on an $F_{40\%}$ harvest strategy (Wespestad 1995).

The Aleutian Islands pollock stock is considerably smaller than the eastern Bering Sea and Aleutian Basin stock. Biomass in the Aleutian area as estimated by the bottom trawl survey has declined drastically from a peak of 778,666 mt in 1983 to only 151,444 mt in 1994. The projected 1996 exploitable biomass is 142,500 mt. An $F_{40\%}$ harvest strategy (F=0.30) resulted in an ABC for 1996 of 35,600 mt. Recruitment for this stock has not been forecasted.

The Aleutian Basin pollock stock is at low levels. Biomass in the Aleutian Basin area is estimated by the hydroacoustic survey in the Bogoslof area. Biomass in the Bogoslof area declined from 2,400,000 mt in 1988 to only 54,000 mt in 1994. An increase was observed in 1995, and the projected 1996 exploitable biomass is 1,100,000 mt. This stock has historically contributed to the Donut Hole fishery, which provided catches of 1.0 to 1.4 million mt during the years 1986 through 1989. No directed fishing has occurred on this stock since 1991. An increasing biomass is anticipated with recruitment of the 1989 and possibly the 1992 year class(es).

2.2.1.2 Flatfish

Flatfish species comprise a large proportion of groundfish exploitable biomass in the BSAI. Dominant species include yellowfin sole and rock sole. Other abundant or commercially important BSAI flatfish species include arrowtooth flounder, flathead sole, Alaska plaice, and Greenland turbot. Biomass of most BSAI flatfish stocks is relatively high and increasing as a result of good recruitment and low exploitation (Witherell 1995). Harvests of most flatfish species have remained at low levels despite high abundance. The status of BSAI flatfish stocks is summarized in the following table (numbers in metric tons).

Species	1995 catch	1996 biomass	1996 ABC	1996 TAC
yellowfin sole	125,000	2,850,000	278,000	200,000
rock sole	55,000	2,360,000	361,000	70,000
arrowtooth	9,000	576,000	129,000	9,000
flathead sole	15,000	593,000	116,000	30,000
other flatfish	20,000	590,000	102,000	35,000

Until 1984, flatfish were harvested at low to moderate levels by foreign fisheries operating in the North Pacific. After passage of the Magnuson Act, foreign fisheries were gradually replaced with joint ventures, then superseded by domestic fishermen and processors since 1980. With the exception of BSAI Greenland turbot, fisheries have been unable to fully harvest the exploitable biomass of any of the flatfish species or complexes due to halibut and crab bycatch limits and conservative quotas.

2.2.1.3 Atka Mackerel

Atka mackerel are found in quantity along the Aleutian Islands, and to a lesser extent in the western Gulf of Alaska. Biomass in the Aleutian Islands area is estimated by NMFS bottom trawl surveys. Biomass increased from 140,000 mt in 1977 to a peak of 1,170,000 mt in 1992, and has since declined. Catches increased from 15,000 mt in 1989 to 81,000 in 1995. The projected 1996 exploitable biomass is 578,000 mt, with an ABC of 116,000 mt. If recent recruitment trends continue, Atka mackerel biomass is projected to decrease to 307,000 mt, with a corresponding yield of 62,000 mt, by the year 2000.

2.2.1.4 Pacific Ocean Perch

Pacific ocean perch are the dominant species of red rockfish in the north Pacific, and are caught primarily along the Aleutian Islands, and to a lesser extent in the eastern Bering Sea and Gulf of Alaska. Biomass has greatly increased following heavy exploitation by foreign fleets prior to 1978. Above average year classes in the early 1980's has boosted the AI perch exploitable biomass from 85,000 mt in 1980 to 306,000 mt in 1994. Exploitation has been relatively low during this period, with catches less than 10,000 mt per year. The projected 1996 exploitable biomass is 309,000 mt, with an ABC of 12,100 mt. Biomass of Pacific ocean perch in the Aleutian Islands area is projected to remain stable in coming years.

2.2.2 Longline Gear

2.2.2.1 Halibut

Biomass of the Pacific halibut stock is at low levels and declining. Coast-wide, halibut exploitable biomass was estimated at 243 million pounds at the start of the 1995 season. This represents a decline of 14% between 1994 and 1995, and a 50% decline from the recent peak in 1989. Based on recruitment data for 8 year-olds, the stock decline will continue in the near future. However, the 1987 year-class appears strong in the NMFS BSAI trawl surveys, and may boost biomass in coming years. The halibut quota is managed under the IFQ program, which began in 1995.

2.2.2.2 Sablefish

Although the sablefish resource of the Bering Sea, Aleutian Islands, and Gulf of Alaska are considered one stock, the resource is managed by discrete regions to distribute exploitation throughout its range. Large catches of sablefish (up to 26,000 mt) were made in the Bering Sea during the 1960's, but have since declined. Smaller catches have been made in the Aleutian Islands area, peaking at 3,800 mt in 1987. The projected 1996 exploitable biomass is 14,100 mt in the Bering Sea, with an ABC of 1,200 mt. In the Aleutians, projected 1996 biomass is 12,000 mt with ABC specified at 1,300 mt. Biomass of sablefish in the BSAI area is projected to decline somewhat in coming years.

It is important to note that the TAC for sablefish is apportioned among gear types. In the Bering Sea, 50% of the sablefish is allocated to trawl gear, and 50% to fixed gear. In the Aleutians region, 25% is allocated to trawl gear, and 75% to fixed gear. The fixed gear apportionment of the sablefish TAC is managed under the IFQ program, which began in 1995. Twenty percent of the fixed gear allocation is reserved for use by CDQ participants.

2.2.2.3 Greenland Turbot

Greenland turbot were harvested almost exclusively (>90%) by trawl gear until the early 1990's when longlines became the dominant gear type for this species. This switch is due in part to regulation of halibut bycatch in the trawl fishery. Because no halibut bycatch has been apportioned to a directed turbot trawl fishery for 1996, turbot will be harvested predominantly by longline gear. Recent harvests (in metric tons) of BSAI Greenland turbot by gear type are listed in the table below.

Year	Trawl	Longline	Total
1991	6,897	814	7,711
1992	546	1,130	1,676
1993	1,142	7,306	8,448
1994	6,385	3,549	9,934
1995	4,041	4,415	7,385

Unlike biomass of other flatfish species in the BSAI, biomass of Greenland turbot is at low levels and declining. Greenland turbot are caught primarily along the eastern Bering Sea and Aleutian Islands slope. Biomass has declined due to poor year classes from 1981-1994. Landings have also declined from a peak of 57,000 mt in 1981 to only 7,385 mt in 1995. The projected 1996 exploitable biomass of BSAI turbot is 67,000 mt, with an ABC of 10,300 mt and a TAC of 7,000 mt. Biomass is projected to continue declining due to poor recruitment.

2.2.2.4 Rockfish

Numerous species of rockfish inhabit the BSAI, and are managed by species complex. Shortraker and rougheye rockfish are managed as one unit in the Aleutian Islands. The projected 1996 exploitable biomass of shortraker/rougheye is 45,600 mt, with an ABC of 1,250 mt. Northern and sharpchin are also managed together with a projected 1996 exploitable biomass of 96,800 mt, with an ABC of 5,810 mt. In the eastern Bering Sea, all other species are managed together as "other red rockfish." The projected 1996 exploitable biomass of other red rockfish is 29,7000 mt, with an ABC of 1,400 mt. The "other rockfish" complex is composed of thornyheads and other *Sebastes* species. The 1996 ABCs for "other rockfish" are 497 mt in the eastern Bering Sea and 952 mt in the Aleutian Islands area. Abundance trends for these species are not available.

Rockfish are harvested by both trawl and longline gear. In 1995, longliners caught 99 mt of shortraker/rougheye in the Aleutian Islands and 60 mt of red rockfish in the Bering Sea. An additional 139 mt of other rockfish were caught by longliners in the Aleutian Islands and 109 mt of other rockfish in the Bering Sea. Small quantities (20 mt) of Pacific ocean perch were also harvested by this gear type in 1995.

2.2.2.5 Other Species

The "other species" category has been established to account for species that are currently of slight economic value and upon which there is little directed fishing. However, many of these species are important components of the ecosystem as prey for commercial species, marine mammals and seabirds. The other species category includes squids, sculpins, skates, smelts, sharks, octopi, grenadiers, and others. For most of these species, only minimal assessment data are available.

Although other species are taken as bycatch in most fisheries, the hook and line fishery for Pacific cod accounts for the highest share. On average, 1991-1993, this fishery took about one-third of the other species catch. For example, in 1993, the Pacific cod hook and line fishery took 9,147 mt of other species, or 30 % of the total (30,471 mt). Skates and sculpins comprise a majority of the bycatch. Bycatch of other species in the Pacific cod target fishery, by gear type, is listed in the adjacent table. Though bycatch of these species may increase with an increased allocation to fixed gear, the totals would still be far below the level of overfishing and would not be cause for any biological concern.

The Pacific cod hook and line and pot fisheries also catch a relatively high number of octopus. Because octopus are consumed by marine mammals such as Steller sea lions, northern fur seals, harbor seals, sperm whales and other beaked whales, potential bycatch of this species was examined further. For example, the 1992 bycatch of octopus by fixed gear was 526 mt, the majority of that taken by pot gear. Any of the alternatives under consideration which allocate greater than 50% of the cod TAC to fixed gear will likely increase the pot gear harvest, due to halibut PSC constraints on longline gear; therefore, bycatch of octopus might be expected to increase under these alternatives. However, the average bycatch of octopus by fixed gear overall from 1992 through 1994 was only 225 mt. Extrapolations based on average bycatch rates indicate that only the alternatives which allocate greater than 60% of the TAC to fixed gear would result in total bycatch greater than the 1992-1994 average. Given the lack of information on octopus biomass, coupled with the lack of accurate data on directed octopus catch, it is not likely that any of the alternatives under consideration would result in any adverse impacts to the octopus resource or to marine mammals which feed on them.

Catch (mt) of other species by BSAI Pacific cod fisheries in 1992 and 1993.

Year	Gear	octopus	sharks	skates	sculpins	other	Total
1992	H&L	126	109	10,888	1,284	74	12,481
	Pot	400	-	1	592	6	999
	Trawl	71	6	737	1,314	5	2,133
1993	H&L	66	93	7,568	1,327	93	9,147
	Pot	18	-	-	43	0	61
	Trawl	44	22	548	1,257	9	1,880

2.2.3 Pot Gear

2.2.3.1 Bristol Bay Red King Crab

After declining abundance throughout the 1960s and reaching a low during the years 1970-1972, recruitment to the Bristol Bay red king crab stock increased dramatically. New all-time record landings were established in each year from 1977 to 1980. Declining recruitment, fishing pressure, and probably increased incidence of disease and predation led to an abrupt decline in fisheries in 1981 and 1982. These precipitous declines led to a closure of the Bristol Bay fishery in 1983. In 1984, the stock showed some recovery and a limited fishery was reestablished. Between 1984 and 1993, the fishery continued at levels considerably below those of the late 1970's. Landings during this period ranged from 1,900 t and 0.8 million crab (1985) to 9,240 t and 3.1 million crab (1990). Throughout the 1980s and 1990s there was little sign of a large year-class in this stock, and since 1987, very few immature crab have been captured during the trawl survey.

The 1994 abundance index for legal male Bristol Bay red king crab was 5.5 million crab as compared to 7.3 million in 1993. The abundance index for mature female crab fell from 14.2 million crab in 1993 to 7.5 million crab in 1994, and was hence below the threshold value of 8.4 million crab established pursuant to the Fishery Management Plan for King and Tanner crabs in the Bering Sea and Aleutian Islands. These declines were corroborated by the length-based assessment model that was newly developed by the Alaska Department of Fish and Game (ADF&G). Because the abundance of female crab was below threshold, the Bristol Bay red king crab fishery was closed in 1994, as was the fishery for Tanner crab in Zone 1 east of 163° West longitude. The red king crab fishery remained closed in 1995, as the 1995 NMFS survey indicated a female stock size at or below threshold. The Bristol Bay red king crab stock continues to suffer from a long period of low recruitment. The near term prospects for the Bristol Bay red king crab stock are poor.

2.2.3.2 Tanner Crab

The eastern Bering Sea Tanner crab (*C. bairdi*) stock is currently at very low abundance. The 1995 NMFS bottom trawl survey indicated relatively low levels of juveniles, pre-recruits, females, and large males. The 1995 Tanner crab season produced only 4.5 million pounds for the 196 vessels participating. This is the lowest catch since the fishery reopened in 1988. The stock is currently at historic low levels.

The Bering Sea Tanner stock has undergone two large fluctuations. Catches increased from 5 million pounds in 1965 to over 236 million pounds in 1980. The 1980 peak catch was followed by a collapse resulting in low landings (<0.5 million lbs) from 1981-1985, and finally no fishery in 1986 and 1987. The fishery reopened in 1988, and landings increased to over 51 million pounds in 1991. A decline followed, with landings reduced to the point where no fishery is expected to occur in 1996.

2.2.3.4 Snow Crab

Catch of Bering Sea snow crab (*C. opilio*) increased from under 1 million pounds in 1974 to over 315 million pounds in 1992. The 1992 peak catch was followed by reduced landings thereafter. The stock is currently at low abundance, but is expected to increase in coming years. The 1995 NMFS bottom trawl survey indicated relatively low levels of large male crab. However, the survey indicated an 88% increase in the numbers of pre-recruits, and a 44% increase in the number of large females. These promising signs indicate strong recruitment in the next few years. The 1996 opilio fishery opens on January 15 with a preseason guideline harvest level of 50.7 million pounds.

2.2.4 Jig Gear

At the present time, the only major target of the BSAI jig fishery is Pacific cod. However, fishermen have expressed interest in expanding jig target fisheries to include halibut, rockfish, and Atka mackerel.

2.3 Gear information

2.3.1 Impacts of Fishing Gear on Benthic Habitat

Studies on the potential effects of trawls, longlines, and pots as they may relate to benthic habitat are summarized below.

2.3.1.1 Trawl Gear

Jones (1992) provides an overview of available knowledge on impacts of bottom trawling on the benthic environment. For his review, bottom trawling includes otter trawls, beam trawls, dredges, and Danish seines. Jones categorizes the ways in which trawling can disrupt the habitat: (1) scraping and plowing the sea-floor, (2) sediment re-suspension, (3) damaging or removing non-target benthic organisms, and (4) dumping of processing waste. Evidence of trawling, such as furrows from the trawl doors, varies in its depth into the sea-floor and its duration depending upon the "softness" of the bottom being trawled. In terms of sediment re-suspension, the report notes that there are two facets to this issue: (1) increased, and usually temporary turbidity, and (2) vertical redistribution of sediment layers. Both of these results of bottom disturbance by trawl gear were noted to vary in their duration, primarily dependent upon the depths at which they occurred. The report also concludes that: "From the work performed under the aegis of ICES, it would appear that beam trawls, otter trawls, and dredges are all basically similar in their effects. Generally, the heavier the gear in contact with the seabed, the greater the damage. The effects vary greatly, depending on the amount of gear contact with the bottom, together with the depth, nature of the seabed, and the strengths of the currents or tides. The removal of the macrobenthos has variable effects. In shallow water areas where the damage is intermittent, recolonization soon occurs. However, where the macrobenthos is substantially removed and recovery is not permitted, the change is permanent . . . The evidence is that bottom trawling has an impact on the environment, but that the extent and duration of that impact varies depending on local conditions."

Another review of the impacts of trawling on the seabed and benthic community (Thompson 1993) concludes that: "it is clear that trawling can impact both the seabed and the benthic community. The extent of these impacts depends on the weight of the gear, the towing speed, the nature of the bottom sediments, and the strengths of tides and currents. Bottom trawl doors leave scars on the seabed that can last for minutes, hours, or years. Trawls can damage benthic organisms, thereby causing changes in community species composition and population age structure, but perhaps also leading to an increase in the availability of forage for commercial species. Whether changes in community species composition would tend to come at the expense of commercially important species such as crab is difficult to determine."

The following excerpt from the groundfish plan teams Ecosystems Considerations Chapter (NPFMC 1994), discusses observations of habitat impacts in the Gulf of Alaska. "Substrate indentations caused by trawl doors were common at many of the dive sites in submersible studies conducted by the NMFS Auke Bay Lab. The depth of the indentations ranged from a few inches on hard, pebble substrate to three feet on soft sand. Trawl marks were numerous on hard substrate. No obvious differences were noticed in kinds or amounts of fauna and flora within or without the trawl paths. Trawl marks were also common at some soft bottom sites off Yakutat (videos shown at council meeting in Sitka). These marks were probably of recent origin because silt had not filled in the furrows dug by the trawl doors, and displaced habitat was evident — boulders and cobble were displaced, silt was brushed off the habitat, and flora were knocked down or missing. Displaced habitat and flora between the trawl door marks were obvious at these sites."

2.3.1.2 Longline Gear

Very little information regarding the impacts of longlining on benthic habitat. Observations of halibut longline gear were made by NMFS scientists during submersible dives off southeast Alaska provide some information (NPFMC 1992). The following is a summary of these observations: "Setline gear often lies slack on the sea-floor and meanders considerably along the bottom. During the retrieval process, the line sweeps the bottom for considerable distances before lifting off the bottom. It snags on whatever objects are in its path, including rocks and corals. Smaller rocks are upended, hard corals are broken, and soft corals appear unaffected by the passing line. Invertebrates and other light weight objects are dislodged and pass over or under the line. Fish, notably halibut, frequently moved the groundline numerous feet along the bottom and up into the water column during escape runs disturbing objects in their path. This line motion was noted for distances of 50 feet of more on either side of the hooked fish."

2.3.1.4 Pot and Jig Gear

Pot gear may impact habitat by sediment resuspension and upending small rocks, shells, ascidians, bryozoans, and other bottom structure during the process of setting and retrieving pots; however, no literature regarding these impacts could be found. Similarly, no information on jig gear impacts to habitat was available in the literature.

2.4 Mesh Regulations for Trawl Gear

All fishing gears are selective to some extent and result in fish of certain sizes being caught more readily than others (Ricker 1975). The extent of gear selectivity may be determined by properties of the fish, properties of the gear, fishing method, and fishing area characteristics. In general, selectivity of trawl nets occurs in the codend portion of trawl nets. Some selection also occurs in the forward portion of the net as fish escape during a tow. For a particular mesh size or configuration, a selectivity curve describes the relation between retention and fish size; that is, at a given length, the proportion of the fish that are retained. Variables affecting selectivity include adjustments in mesh size, shape, construction, as well as operational factors.

Prior to 1996, minimum mesh size regulations had not been implemented under the BSAI FMP for the trawl fisheries off Alaska, and fishermen had been able to select any mesh size and configure the codend in any manner desired. Codends were usually made of multiple layers of knotted polyethylene netting. To resist bursting when loaded, it was necessary to use two, or even three, layers of netting in each codend. In addition, for greater strength, the twines used in the netting were typically doubled. The most common codend mesh sizes were around 4 inches stretched measure, hung in a diamond configuration. Because mesh openings of each layer inevitably do not line up, actual mesh openings of multi-layer nets are quite small, resulting in capture of both large and small sized fish. Undersized fish must be sorted out before they encounter the processing machinery. If the shore plant or catcher/processor has a fish meal plant, then the undersized fish can join the processing wastes and be made into a relatively low value meal product. When production exceeds the meal plant's capacity, or in the case of a catcher/processor without a fish meal plant, undersize fish are discarded.

Codends used in the recent Pacific cod trawl fishery have measured 4.0" to 5.5" mesh. A sampling of codend mesh sizes from 13 vessels participating in the 1993 Bering Sea cod fishery indicated the following usage: 31% used 4.0" mesh, 23% used 4.5" mesh, 31% used 5.0" mesh, and 15% used 5.5" mesh (Methot et al. 1994). Proportion of diamond/square mesh and single/double layer codends was not reported. However, public testimony to the Council in 1993 indicated that most vessels were using diamond mesh in the Pacific cod fishery.

In June 1993, as part of the decision on Pacific cod allocation (BSAI Amendment 24), the Council directed staff to begin study of a regulatory amendment to require a minimum 8" mesh size requirement for trawl vessels participating in the BSAI trawl cod fishery. At its meeting in September 1994, the Council voted to recommend minimum mesh sizes and configurations for the Pacific cod, pollock, and rock sole trawl fisheries. A 6" minimum mesh size was adopted for the rock sole and Pacific cod fisheries, and a 3.25" minimum mesh size was adopted for pollock fisheries. These mesh sizes are between-knot measurements, also known as the stretched measure hole size. Fishermen would be required to modify trawl codends to have a top panel of single layer square or diamond mesh that meet or exceed regulation size. At the present time, it is uncertain whether these mesh regulations will be in place by the end of 1996.

2.4.1 Effects of Mesh Regulations on Catch and Discard of Pacific Cod

The proposed mesh regulation may reduce catch rates of Pacific cod in a directed trawl fishery. The EA/RIR analysis for mesh regulations suggested that the proposed mesh sizes may reduce catch of small fish, as the 50% selection size for 6" square mesh is 65 cm. However, analysis using selectivity of Pacific cod based on morphology suggested that a 6" mesh may not result in reduced catch of small fish. On the other hand, 6" single layer mesh has larger holes in the web than currently in use, and one would expect a reduction in discards under the proposed 6" mesh size.

Because mesh regulations are also proposed for the pollock and rock sole fisheries, discarding of Pacific cod may also be reduced in these fisheries as well. In other words, less Pacific cod would be discarded from the pollock and rock sole fisheries, because fewer Pacific cod may be retained under the proposed mesh sizes for these fisheries. Overall discarding rates of these and other species may be reduced just because fewer small fish may be retained.

It should be noted that variations in year-class strength, and possibly areas fished, can affect discard rates. For example, preliminary analysis suggested that discarding of pollock was high in 1992 due to a strong 1989 year-class in the Bering Sea, particularly in the northern areas where juveniles aggregate. At the other extreme, during years of poor recruitment, catch rates of small fish may be much reduced. As such, year to year variations in bycatch rates may be expected. One potential drawback of regulating mesh size would be to remove some flexibility fishermen have to take advantage of (or avoid) a certain year class of fish.

2.4.2 Escapement Mortality of Pacific Cod from Trawls

Escapement mortality is the amount of fish that may die after encountering fishing gear. Mortality of fish escaping from trawl gear through a codend may range from none to 100%, and may depend on numerous factors including fish species, tow size and duration, and the size and type of mesh used (square or diamond). Mortality can occur due to contusions, a build-up of lactic acid, scale loss and mucus removal, and skin damage due to abrasion and collision with net walls. Although escapement mortality may occur at some level in the current fisheries, an increase in mesh size, combined with increased effort, may filter more small fish through trawl codends. Escapement mortality may offset any potential gains in yield and spawning biomass-per-recruit.

Research methodology for testing escapement mortality is in the developmental stage. Several methods have been tried, including towed codend simulators, covered codend transfer cages, and more recently, remotely released codends. Studies may or may not include holding fish in cages for extended periods to determine effects of delayed mortality. The experimental method used may also contribute to the different results obtained by these studies (Sangster 1992). Results from experiments not conducted under commercial fishing conditions remain of questionable value. A literature review of gadoid escapement mortality is provided below.

Efanov and Istomin (1988) investigated the immediate mortality of Alaskan pollock that had passed through a 50 mm diamond mesh codend. Of 15 hauls tested, only three hauls contained pollock that had died due to immediate mortality from escaping through the mesh. A total of 1,615 pollock were tested with only 27 pollock dead after passing through codend meshes. This study indicates that escapement mortality may be very low for Alaskan pollock, however, the study did not measure if any delayed mortality could occur due to stress, disease, predation, or other factors. Another unknown when relating this study to actual fishing conditions is the difference in catch rates. Escapement mortality can be related to the amount of physical damage and physiological stress associated with escaping codends (Main and Sangster 1988), and pollock escaping from a full codend could potentially be extruded under force, causing stress and scale loss resulting in delayed mortality, and therefore have higher escapement mortality rates than estimated by this study.

Soldal et al. (1993) tested the vulnerability of saithe (Pollachius virens), cod, and haddock to gear damage with laboratory and field studies. In the laboratory, net injuries were simulated by removing a relatively small amount of scales and mucous from the fish. Cod and haddock were also physically exhausted by swimming in a treadmill. Immediate mortality was observed for haddock (about 10%), but not for cod and saithe. Delayed mortality of about 10%, caused by infections, was observed for saithe and haddock, and to a lesser extent cod. Field experiments consisted of holding fish in underwater pens after they had passed through a trawl codend fished at towing speeds of about 3.7 knots. Two trials were made using 135 mm stretched diamond mesh in the codend. In the first trail, 340 haddock were held in cages for 16 days, of which 22 died (6.5%). The second trial consisted of 116 haddock held for 15 days with only one death (0.9%). Three trials of control group haddock (127-146 fish per trial) resulted in higher mortality (20.3%) after 12 to 15 days. These field trials using bottom trawl caught haddock appear to support the low mortality rates observed in the laboratory.

Main and Sangster (1988) tested both immediate and delayed mortality of haddock, whiting, and cod escaping from 70 and 80 mm (stretched measure) diamond and square mesh codends in 1985, 1986, and 1987. They also measured scale loss as a potential indicator of delayed mortality. Fish escaping from trawls were captured by divers and kept in underwater cages for extended periods, and examined and fed daily by divers. Low sample sizes preclude drawing conclusions from species other than haddock. Results indicated mortality of haddock escaping from diamond mesh codends may be high: 33% of the 56 haddock tested died after 11 days in 1985, 82% of the 28 tested died after 108 days in 1986, and 100% of the 46 haddock died after 52 days in 1987. None of the control group fish, which were captured by hook and line and transferred by divers to cages, died during the duration of the study. Delayed mortality of escapees may be somewhat attributable to scale loss, as this study indicated that haddock passing through codends lost about half of their scales on average. These studies indicate that the mortality of haddock escaping from codends may be rather high, particularly delayed mortality.

2.5 Day/Night Differences in PSC Bycatch Rates for the Pacific Cod Trawl Fishery

Research has shown that halibut and crab bycatch in the Pacific cod trawl fishery is higher at night than in the daytime. Analysis of 1986 and 1987 Bering Sea JV bottom trawl fisheries indicated day/night differences in halibut bycatch rates due to changes in relative abundance of target species and halibut (Adlerstein 1991). Walleye pollock and yellowfin sole catches were, more often than not, associated with lower bycatch rates at night, whereas catches of Pacific cod and rock sole tended to be associated with higher bycatch rates at night. Analysis of 1990 Bering Sea domestic bottom trawl fisheries indicated that bycatch of halibut would be reduced if night trawling was banned for Pacific cod in particular (Adlerstein 1992). Halibut bycatch rates were higher at night for all areas and months examined. For example, in area 511, the average halibut bycatch rate at night was 1.61 times the day rate observed in the directed trawl fishery for Pacific cod. Further analysis of the 1990 domestic trawl fisheries in area 511 indicated that day-only trawling may reduce total halibut bycatch by 13%, the bycatch of king crab by 13% and Tanner crab by 16% (Adlerstein and Trumble 1993).

2.6 Impacts of Fishing on Spawning Stocks

A review of information available on the effects of fishing on spawning cod stocks was provided in the EA/RIR for amendment 24 (NPFMC 1993). The following excerpt from the document provides a summary. "For cod there is no recorded evidence that fishing during spawning periods affects the spawning habitat in a negative manner or that fishing in other periods of the year will result in better survival of the spawned eggs. Thus, there is little if any substantial evidence supporting the claim that fishing by trawls during the spawning season damages survival of the spawning products or that such removals are more damaging that taking fish during other periods of the year." No new information is available on this subject.

2.7 Environmental Impacts of the Alternatives

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

A summary of the effects of the annual groundfish TACs on the biological environment and associated impacts on marine mammals, seabirds, and other threatened or endangered species is presented in the final EA for the annual groundfish TAC specifications.

Pacific Cod Catch and TAC

Under any of the alternatives being considered in this analysis, the TAC for Pacific cod would continue to be monitored and the fishery closed, as is currently done, upon attainment of that TAC. Some alternatives under consideration, such as those which allocate a significantly higher percentage of the TAC to either trawl or fixed gear (relative to their current percentage allocation), could result in an underharvest of the cod TAC. This would be due to current halibut PSC constraints on the longline and trawl fisheries, though it should be noted that some of the balance could be taken up by increased harvests from pot gear. Unless current halibut PSC caps for longline and trawl gear are adjusted, any major change in the allocation percentages would have this result, which would not be considered an adverse impact.

A reduction in the current allocation to trawl gear could shift effort into other groundfish fisheries, though the direction and magnitude of this effort are not quantifiable. A large reduction in the allocation to trawl gear could impact that sector's ability to prosecute other groundfish fisheries, due to certain amounts of cod being necessary as bycatch in those other groundfish fisheries. These scenarios are discussed further in Chapter 5, and in any case are not seen to have any significant biological implications for Pacific cod, or other groundfish species.

Discard rates of cod vary significantly between gear types and delivery modes in the cod fisheries. For example, overall discards of cod are higher in the trawl fisheries than in the fixed gear fisheries, and there is a further difference in discard rates between catcher vessels and catcher/processor vessels which trawl for cod. These differences are detailed and further discussed in Chapter 3. In biological terms, any and all discards are counted against the overall TAC and are not considered to present any biological or conservation concerns. The Council is currently considering, under a separate plan amendment, a mandatory retention and utilization requirement for Pacific cod and other fisheries in the BSAI.

Bycatch of Prohibited Species

Related to the above discussion is the issue of halibut and other PSC species bycatch in the various Pacific cod fisheries. Halibut PSC caps are set in the BSAI FMP, and in regulation, for both trawl and longline gear, while pot and jig gear are exempt from those caps. This analysis assumes those PSC caps would be in place at their current levels. Any change in the PSC caps, to accommodate a change in the allocation of cod, for example, would require a separate FMP amendment and is beyond the scope of this analysis. Depending on which alternative is chosen, the necessary halibut PSC to fully prosecute the cod fisheries could go up or down. An increase in the trawl allocation of cod would likely require an overall increase in the caps for the trawl sector, while an increase in the allocation to fixed gear may allow a decrease in the overall caps because the bycatch mortality is less with fixed gear.

If the fixed gear allocation is increased and the PSC cap remains unchanged, pot gear could take the incremental increase of cod by fixed gear without altering the PSC caps. The magnitude of an increased allocation to fixed gear, coupled with the unknown ability of pot gear to take that extra fish, would determine to what extent this scenario would occur. In any case, PSC caps would remain in place, at some level, and none of the alternatives is therefore considered to present any adverse biological impacts with regard to halibut.

Similarly, salmon and crab bycatch could be affected by a change from the current allocation percentages. To the extent that fixed gear (both pot and longline) have minimal mortality of those species associated with their use, any alternative which increases the fixed gear allocation has the potential to reduce overall bycatch mortality of crab and salmon. However, in the case of crab, bycatch is very high in the pot fisheries, particularly for opilio and king crab species (higher, in fact, than trawl gear). We were unable to ascertain a definitive mortality rate associated with pot bycatch of crab for purposes of this analysis, however, so it is unknown to what extent a change in the gear allocations would affect the relative bycatch mortality of crab.

Salmon bycatch in the cod fisheries is relatively low compared to other trawl fisheries, such as pollock, and the amounts currently being taken are not considered to present a biological concern. Crab bycatch in the trawl fisheries is a current concern, given the depressed status of king and Tanner crab stocks in the BSAI. Crab bycatch caps are currently in place for those fisheries, however, and those caps are being evaluated as part of a separate plan amendment analysis of crab protection measures. These crab PSC caps have the potential to constrain the cod trawl fisheries, regardless of the cod allocation percentage assigned to that sector.

Benthic Disturbances by Fishing Gear

As was summarized earlier in this chapter, each of the gear types being considered (with the exception of jig gear) has the potential to adversely impact the benthic environment. Pot gear has the potential to crush bottom flora and fauna as it is set upon the bottom, and it has the potential to ghost fish for extended periods of time when pots are lost. Longline gear has similar, though reduced, impacts. Trawl gear is commonly associated with impacts to the benthic environment, particularly in fisheries, such as cod, where it is deployed on or near the bottom. However, no studies to date have quantified the exact nature or magnitude of that benthic disturbance, or what the "downstream" implications of such disturbance are to the ecosystem. This is the case for trawl as well as longline and pot gear. To the extent that trawl vessels would shift effort into other fisheries if their allocation of cod is reduced, the overall amount of trawl effort might remain unchanged.

Impacts to Endangered or Threatened Species and Marine Mammals

Endangered or threatened species in the BSAI include several species of whales, Steller sea lions, and short-tailed albatross. Steller sea lions do prey on Pacific cod, though none of the alternatives would be expected to reduce the availability of cod as a prey species. In terms of direct interactions with gear, the original analysis for Amendment 24 noted that such interactions are more likely with trawl gear than other gear types, though incidental takes are minimal and are monitored separately under regulations pertaining to the incidental take of marine mammals.

Interaction between killer whales and longline fisheries is an issue which has been raised in the context of this and other management actions recently being considered by the Council. Information from the NMFS Protected Resources Management Division (PRMD) indicates that killer whale predation is a factor in the sablefish and turbot longline fisheries, with 79 deterrences and 1 lethal take in the sablefish longline fisheries between 1990 and 1993. The turbot fisheries experienced over 300 deterrences during that same period, while longline Pacific cod fisheries had only 13. Research and observation both indicate that killer whales exhibit selective feeding practices, and target sablefish and turbot on longline gear, while tending to avoid Pacific cod. None of the alternatives therefore is expected to create any adverse impacts relative to gear interactions with marine mammals.

Seabird interactions have also been raised as an issue of concern with longline gear, particularly with regard to short-tailed albatross, an endangered species. Similar to the killer whales however, this interaction has not been a significant problem in the Pacific cod longline fisheries. This may be due to differences in the physical nature of the gear, where sablefish longline set-ups tend to sink much slower through the water column, thereby affording a greater opportunity for interactions with sea birds (Grossman, PRMD, Personal Communication). However, under the current PSC caps, any increase in the fixed gear share of Pacific cod would likely be taken by pot gear anyway. Furthermore, to the extent bycatch of short-tailed albatross in longline fisheries ever becomes a problem, it would likely impact the fishery the same regardless of the percentage allocation of Pacific cod.

None of the alternatives under consideration is likely to have any adverse impact on endangered or threatened species or on marine mammals.

Coastal Zone Management Act

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

Finding of No Significant Impact (FONSI)

None of the alternatives under consideration is likely to significantly affect the quality of the human environment, and the preparation of an Environmental Impact Statement (EIS) for the proposed action is not required by Section 102(2)(c) of the NEPA or its implementing regulations.

Assistant Administrator for Fisheries | Date

3.0 HISTORICAL FISHERY DATA

This chapter will provide an historical overview of the Bering Sea and Aleutian Island groundfish fisheries for the years 1992 through 1995. The most detail will be provided for fisheries that target Pacific cod or take significant amounts of Pacific cod as bycatch. Target fisheries for Pacific cod will include the longline, pot, trawl catcher vessel, trawl catcher processors, and jig. All Pacific cod catch is reported in the tables contained in Chapter 3.

The catch of Pacific cod by jig gear will be discussed only briefly, because none of the alternatives selected by the Council would change their current allocation. Also, vessels in the jig fleet are not currently constrained by their portion of the TAC or by halibut mortality caps.

The chapter will be divided into several major sections. The first section will focus on the historical catch and bycatch of groundfish by fishery. A brief summary of TACs is included for the Pacific cod fisheries, and if the TAC was not attained, an explanation is provided. PSC bycatch and bycatch rates including halibut mortality, red king crab bycatch, *C. opilio* bycatch, and *C. bairdi* bycatch are then discussed. Information on the products produced by the processors is discussed next. Ex-vessel and ex-processor prices are also presented. Gross revenue is calculated using the product price and production information. The next section provides information on the 1995 catch by vessel in the various limited entry programs. This will include the Council's proposed license limitation program, even though that program has not yet been approved by the Secretary of Commerce. Because observer coverage is an important element in determining bycatch rates, a separate section will show the observer coverage levels for various fisheries and vessel classes. A section then briefly discusses employment by each industry sector. A discussion of tax structures within potentially affected boroughs and communities is included next. Finally, a summary of the chapter is provided.

3.1 Historical Catch and Groundfish Bycatch Data

Harvest data for the groundfish fleet operating off Alaska's coast are collected using Weekly Production Reports (WPR), Groundfish Observer Program data (NORPAC), and Alaska Department of Fish and Game fish tickets. Each of these data sources are needed to develop a fishing history at the catching vessel level. However, even when all three sources are incorporated, not all catch can be traced back to the harvest vessel. This is especially true for catcher vessels delivering to at-sea motherships when the haul is unobserved.

The official total catch estimate used by the NMFS Alaska Regional Office (AKR) for in-season management of the fisheries is called blend data. As the name implies, it is a blend of the "best" data from the WPR and In-season Observer reports. In-season observer reports are data submitted to AKR by observers on a weekly basis. These data have not been edited completely, and the observer has not been debriefed. Blend data have been calculated for the years 1992-95, and will serve as the baseline for developing the total catch estimates used in this analysis.

Blend data are reported at the processor level. This means that a separate record is included for the total round weight of each species that was retained or discarded by processor, week ending date, gear, and NMFS management area. When processors take deliveries from several harvesting vessels during a week, the information on how much fish was caught by each vessel is lost. This is often the case when catch is delivered to shoreside processors or motherships. To construct a data set which contains information on both the harvesting vessels and processors, the blend data must be supplemented with fish ticket and NORPAC data. The catch reported in fish tickets for shore plants and motherships operating inside state waters was adjusted to equal the blend data total by week, gear, species, and target fishery. A similar process was used to adjust the NORPAC data for harvesting vessels delivering to motherships operating outside of state waters. NORPAC data were used because processors are not required to submit fish tickets to the State of Alaska if they operate outside State waters.

Weekly Production Reports are data sets that list the total amount of each product produced by a processor. While these data are an integral part of the blend data calculation, they are also the source of product information used in this document. A weakness of this study and the WPR data in general, is that shoreside processors and motherships which take deliveries from vessels using different gear types, in a week, do not report the products produced by the gear that was used to harvest the fish. It is reported that processors pay different prices for fish caught with fixed gear versus trawl gear. Because the processor pays more or less for fish based on gear used for the harvest, it is assumed that the fish goes into different products, or products which have different levels of quality. These flows can not be traced back through the WPR data. This makes it impossible to aggregate products by the target fishery definitions in this paper or by harvest vessel classes. Therefore, this paper estimates the amount of product that was produced from each fishery, and the gross revenue attributed to vessel classes that deliver their catch onshore.

3.1.1 Bering Sea/Aleutian Islands Total Catch

This section reports the total catch of Pacific cod in the BSAI for the years 1992-95. Blend data were aggregated to determine the total catch for the longline, pot, trawl catcher vessel, trawl catcher processor fleets, regardless of whether Pacific cod was the target species. These groups, along with the jig fleet, will be directly impacted by any reallocation of the BSAI Pacific cod TAC.

Table 3.1 Total Pacific Cod Catch in all Fisheries

Year	Metric Tons					Percent of Pacific Cod Catch				
	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total
1995	94,163	18,782	50,208	68,537	231,690	40.64%	8.11%	21.67%	29.58%	100.00%
1994	87,139	8,236	43,592	56,156	195,124	44.66%	4.22%	22.34%	28.78%	100.00%
1993	66,153	2,098	41,045	57,799	167,095	39.59%	1.26%	24.56%	34.59%	100.00%
1992	102,071	13,681	30,190	60,187	206,130	49.52%	6.64%	14.65%	29.20%	100.00%

Description of table: This table reports the metric tons of Pacific cod caught in the years 1992-95 by vessel/gear type. Both retained and discarded catch are included. The percent portion of the table reports the percent of the total Pacific cod caught by each vessel/gear type. For example, in 1995 longline vessels harvested 40.64% of all Pacific cod caught in the BSAI.
Source: NMFS Blend data 1992-95

Longline vessels harvested 94,163 mt of the 231,690 mt of Pacific cod taken from the BSAI in 1995. The longline fleet accounted for 40.64% of the total. Their total catch of cod was lower in 1994 (87,139 mt), but they caught a greater percentage of the BSAI cod (44.66%). Longline vessels typically harvested between 40% and 50% of the BSAI cod between 1992-95.

Vessels harvesting cod with pot gear share the fixed gear portion of the TAC with longliners. Declines in the BSAI crab stocks have prompted pot fishermen to seek out alternatives to their traditional crab fisheries. Cod is the primary groundfish alternative for the pot boats. Increases in cod caught with pot gear are reported in 1995 when compared to the years 1992-94. These increases in pot caught cod reduce the amount available to longline vessels, because they share the fixed gear allocation. In terms of reported catch, the pot fleets cod harvest increased from 8,236 mt in 1994 to 18,782 mt in 1995. Their percent of the total BSAI cod catch also about doubled from 1994 to 1995. The pot fleet caught 4.22% of the cod taken in 1994 and 8.11% in 1995.

Recent growth in the pot fleet's cod harvest has prompted members of industry to request that the available information on the 1996 be included in this document. Anecdotal information presented at the Council's April, 1996 meeting, indicated that the pot cod catch was considerably higher in the first part of 1996 than it was in 1995. To confirm this information the 1996 blend data was queried. As of April 25, 1996, there were 11,905 mt of BSAI Pacific cod caught with pot gear. Only 7,791 mt of pot cod were harvested through April 29, 1995. The increase from 1995 to 1996 is slightly more than 50 percent. Projecting that increase out for the entire year would result in 28,700 mt of pot cod being harvested in 1996.

Summing the percent of catch taken by the pot and longline fleets yields the total for fixed gear. Currently they are allocated 44% of the TAC. In both 1994 and 1995 they took about 49% of the total catch. Their actual catch was greater than their initial 44% allocation, because part of the trawl apportionment was reallocated to fixed gear by the Regional Director.

The trawl portion of the TAC is shared by catcher vessels and catcher processors. Combined these groups are allocated 54% of the BSAI cod TAC. Because of the halibut mortality cap, trawl vessels have not been able to harvest their 54% allocation in either 1994 or 1995. In 1994, catcher vessels reported catching 43,592 mt, or 22.34% of the total. Catcher processors caught 56,156 mt of cod during 1994. Both groups increased their cod catch in 1995. The catcher vessels caught an additional 6,616 mt, and the catcher processors increased their catch by 12,381 mt.

Trawl fisheries have reached their Pacific cod halibut mortality cap in each of the years 1992-95. They were subsequently closed to directed Pacific cod fishing before taking all the TAC available to them. The hook and line fishery for Pacific cod was first closed before taking their quota, due to halibut mortality, in 1995. This was the only year between 1992 and 1995 that the BSAI Pacific cod TAC was not taken. Trawl vessels reached their halibut mortality cap and were closed to directed fishing for Pacific cod on October 28. Their unharvested quota was then reallocated to the fixed gear fleet by the Regional Director of NMFS on November 3. This additional quota allowed the hook and line fleet to fish until December 11, when their fishery was also closed due to halibut mortality. The pot and jig fishery was allowed to continue to fish but were unable to take the 18,310 mt remainder of the 250,000 ton Pacific cod TAC.

3.1.2 Total Cod Catch When Pacific Cod was the Target Fishery

This section examines only cod catch while engaged in cod target fishing. For fixed gear sectors this catch will almost equal the total catch shown in Table 3.1. In contrast, trawl sectors take significant amounts of cod as bycatch in other groundfish targets.

The catch of Pacific cod in the longline fishery was 101,718 tons in 1992 (Table 3.2). This total dropped to 65,981 tons in 1993, before returning to about 1992 levels in 1995. A similar trend existed in the Pacific cod pot fishery, except the 1995 catch was well above the 1992 level. Trawl catcher vessels had their lowest level of catch in 1992 at 20,019 tons. Their Pacific cod target catch increased during 1993 and 1994, and in 1994 reached 34,232 tons. 1995 saw a slight decline back to 30,608 tons. The trawl catcher processor fleet had similar catches in 1992 and 1995 at about the 28,000 ton level. Catch levels in 1993 and 1994 declined from those reported in 1992.

Table 3.2 Total Pacific cod Catch In Pacific Cod Target Fisheries

Year	Metric Tons					Percent of Total Pacific Cod Catch				
	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	All
1995	93,955	18,716	30,608	28,911	172,190	54.56%	10.87%	17.78%	16.79%	100.00%
1994	87,051	8,229	34,232	14,702	144,213	60.36%	5.71%	23.74%	10.19%	100.00%
1993	65,981	2,098	29,687	25,217	122,983	53.65%	1.71%	24.14%	20.50%	100.00%
1992	101,718	13,680	20,019	27,983	163,399	62.25%	8.37%	12.25%	17.13%	100.00%

Description of table: This table reports the metric tons of Pacific cod caught in Pacific cod target fisheries for the years 1992-95 by vessel/gear type. Target fisheries are determined based on catch composition by NMFS (i.e., when more cod was retained than any other species). Both retained and discarded catch are included. The percent portion of the table reports the percent of the Pacific cod caught by each vessel/gear type compared to the total cod catch. For example in 1995, longline vessels harvested 54.56% of the total cod caught in all cod target fisheries.
Source: NMFS Blend data 1992-95

The longline sector of the fixed gear fleet caught 54.56% of all cod caught when it was the target in 1995. The pot fleet took 10.87%. Trawl catcher vessels harvested 10.87% of the total cod taken when it was the target. Trawl catcher processors took slightly less cod in the target fishery (16.79% of the total) than the trawl catcher vessels.

If the Pacific cod split for trawl vessels was based on the average catch in the target fishery over the last three years, the catcher vessels would receive 58% of the trawl allocation and catcher processors 42%.

3.1.3 Total Cod Catch When Pacific Cod was not the Target Fishery

Table 3.3 reports the catch of Pacific cod when cod was not the target fishery. This table is reported for completeness. The numbers could be calculated by subtracting Table 3.2 from Table 3.1, in other words, by subtracting the catch of cod in the Pacific cod target fishery from the total catch of Pacific cod in all fisheries.

This table reinforces the fact that the fixed gear fleet catches almost all of their cod in the Pacific cod target fishery. Trawl catcher processors, however, catch most of their cod as bycatch in other target fisheries. These other fisheries are generally bottom pollock and flatfish.

Table 3.3. Total Pacific cod catch when Pacific cod was not the target fishery

Year	Metric Tons					Percent of Group's Total Pacific Cod Catch				
	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	All
1995	208	66	19,600	39,626	59,500	0.22%	0.35%	39.04%	57.82%	25.68%
1994	89	7	9,361	41,455	50,911	0.10%	0.09%	21.47%	73.82%	26.09%
1993	172	0	11,358	32,581	44,112	0.26%	0.00%	27.67%	56.37%	26.40%
1992	354	1	10,172	32,204	42,731	0.35%	0.01%	33.69%	53.51%	20.73%

Description of table: This table reports the metric tons of Pacific cod caught when Pacific cod was not the target fishery for the years 1992-95 by vessel/gear type. Both retained and discarded catch are included. The percent portion of the table reports the percent of the Pacific cod caught by each vessel/gear type in their target cod fishery. For example in 1995, longline vessels harvested 0.22% of their cod when Pacific cod was not the target fishery.
Source: NMFS Blend data 1992-95

3.1.4 Weekly Pacific Cod Target Catch in 1995

A figure for each Pacific cod target fishery that shows the catch per week and total catch of cod in 1995 has been included in this section. They provide the reader with information on when each of the fisheries took place during the year. Figure 3.1 reports the catch of Pacific cod in the Pacific cod longline fishery. The fleet had fairly consistent catches in each week, about 4,000 tons, until the fishery was closed May 7 due to halibut mortality. On September 1, the fishery reopened and had weekly catches slightly less than in the early part of the year. The fishery then closed again on October 16 when they had harvested their portion of the TAC. The fixed gear fishery remained closed until November 17, when the NMFS Regional Director reallocated 10,000 tons of cod from the trawl fleet to the fixed gear fishery. The hook and line fleet was then closed for the last time on December 11, because they reached their halibut mortality cap. When the season ended, the hook and line vessels had caught almost 94,000 tons of cod.

Figure 3.2 depicts the weekly and total catch of Pacific cod in the Pacific cod pot fishery. The pot vessels share the fixed gear Pacific cod TAC with the hook and line fleet. However, because they rely on crab for much of their income, the majority of the fleet did not start fishing Pacific cod until about March, when crab seasons end. The pot vessels then fished cod until the fixed gear TAC was taken on October 16. Catch by week was more variable in the pot fleet than the hook and line fleet. Catches were largest in the months of April and May when weekly catches were generally over 1,000 tons. From June until the end of the fishery, weekly catches were often in the 200 to 400 ton range.

The catch per week of Pacific cod by trawl catcher vessels in the Pacific cod target fishery is reported in Figure 3.3. The trawl portion of the Pacific cod TAC opened on January 20. Only small amounts of cod were taken as target catch until the BSAI inshore pollock fishery closed on March 1. Effort then moved from the inshore pollock fishery into the Pacific cod catcher vessel fishery. At this point, catch per week jumped from about 200 tons to between 3,000 and 6,000 tons per week. These levels of catch per week continued through the months of March and April until the fishery was closed on April 24. The fishery was closed because the trawl fleet had reached their halibut mortality cap. The fishery reopened for four days beginning October 25, when the remaining 100 tons of halibut mortality was made available to the trawl fishery. Only small amounts of catch were taken during this time. The fishery closed with just over 31,000 tons having been taken.

The trawl catcher processor fleet's catch of Pacific cod in the Pacific cod target fishery is presented in Figure 3.4. Like the catcher vessels, catcher processors could begin fishing cod on January 20. Most vessels chose to begin the year fishing pollock. Most of these vessels would be classified as offshore and would switch to cod when the offshore portion of the pollock TAC was harvested. This indeed was the case. When the offshore pollock fishery closed on February 21, the catch of Pacific cod increased from about 200 tons per week to over 4,000 tons per week. This level of catch continued for four weeks. The catch in the following weeks showed steady declines until the fishery was closed on April 24 due to the halibut mortality cap.

Information on the number of vessels in each of the 1995 Pacific cod fisheries, and their average catch per week, is provided in figures 3.5 through 3.8. This information will allow some rough calculations to be made on how many boats would be needed to catch the quota. Using the pot fishery as an example, Figure 3.6 indicates that, in a good week, pot vessels were averaging 40 tons of cod. Assuming the fixed gear fishery received 20,000 additional tons of cod in the upcoming allocation, and the halibut mortality caps and bycatch rates of halibut were unchanged, then all of the additional fixed gear allocation would go to pot gear. This is because the hook and line fleet reached their halibut cap in 1995. In order for the pot vessels to harvest these 20,000 tons, they would need to double their 1995 catch. With a catch rate of 40 tons per week, it would have taken 470 vessel weeks to catch the 1995 quota. The additional 20,000 tons would increase the vessel weeks to 968. If each vessel fished cod seven months a year, catching 40 mt per week, it would require 32 vessels to harvest the quota.

Figure 3.1 BSAI 1995 Catch per Week and Total Catch of Pacific Cod *Harvested with Longline* Gear in the Cod Target Fishery

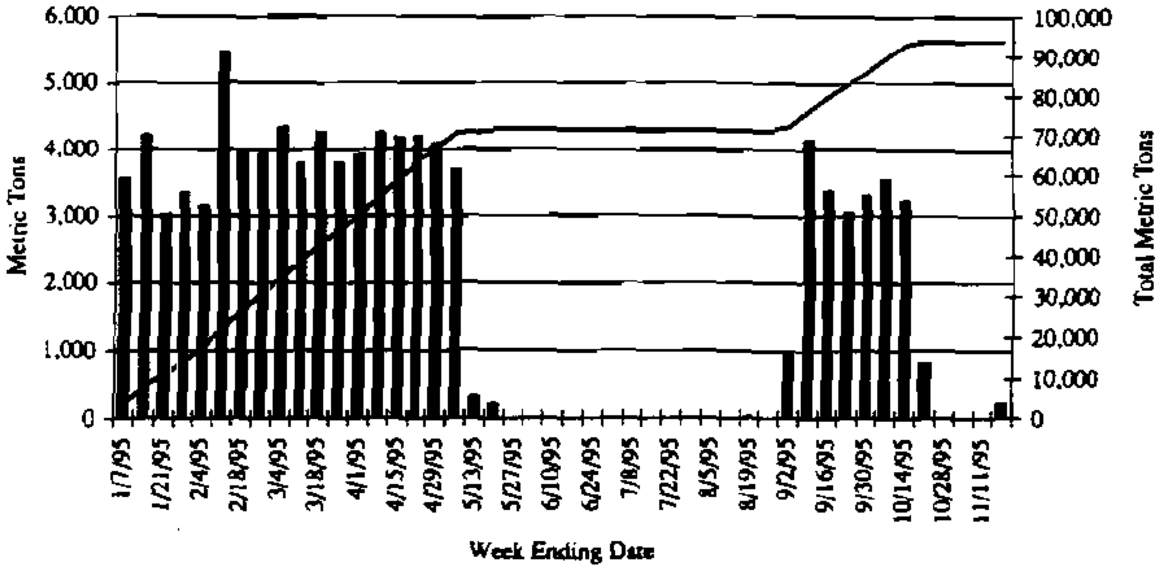


Figure 3.2 BSAI 1995 Catch per Week and Total Catch of Pacific Cod Harvested with Pot Gear in the Cod Target Fishery

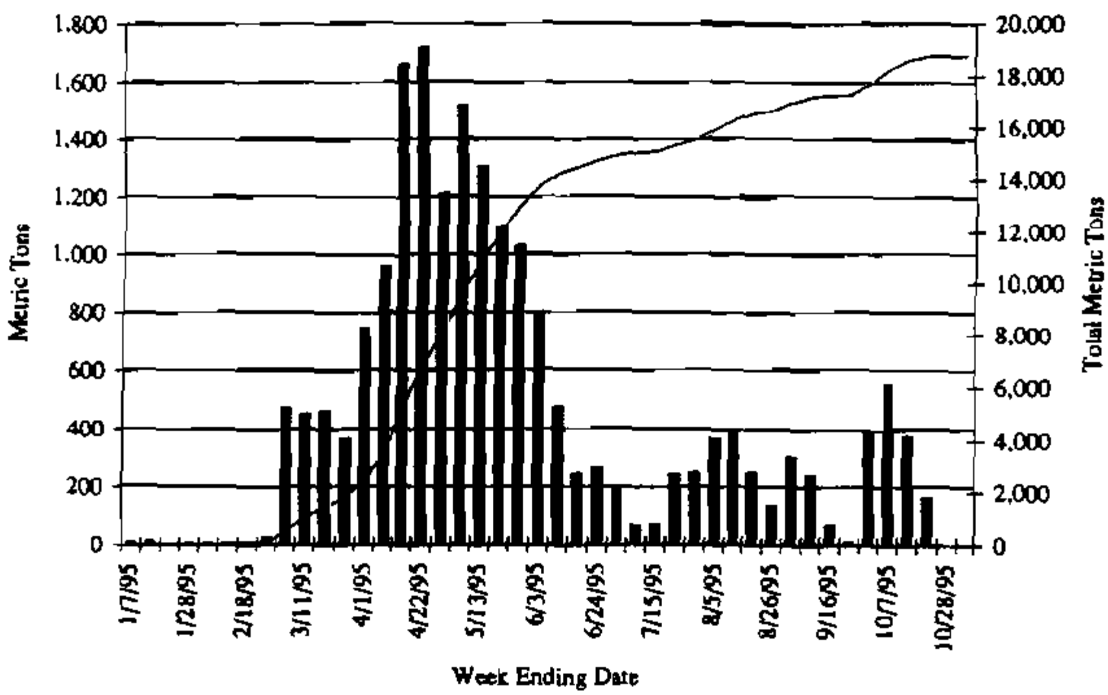


Figure 3.3 BSAI 1995 Catch per Week and Total Catch of Pacific Cod Harvested by Trawl Catcher Vessels in the Cod Target Fishery

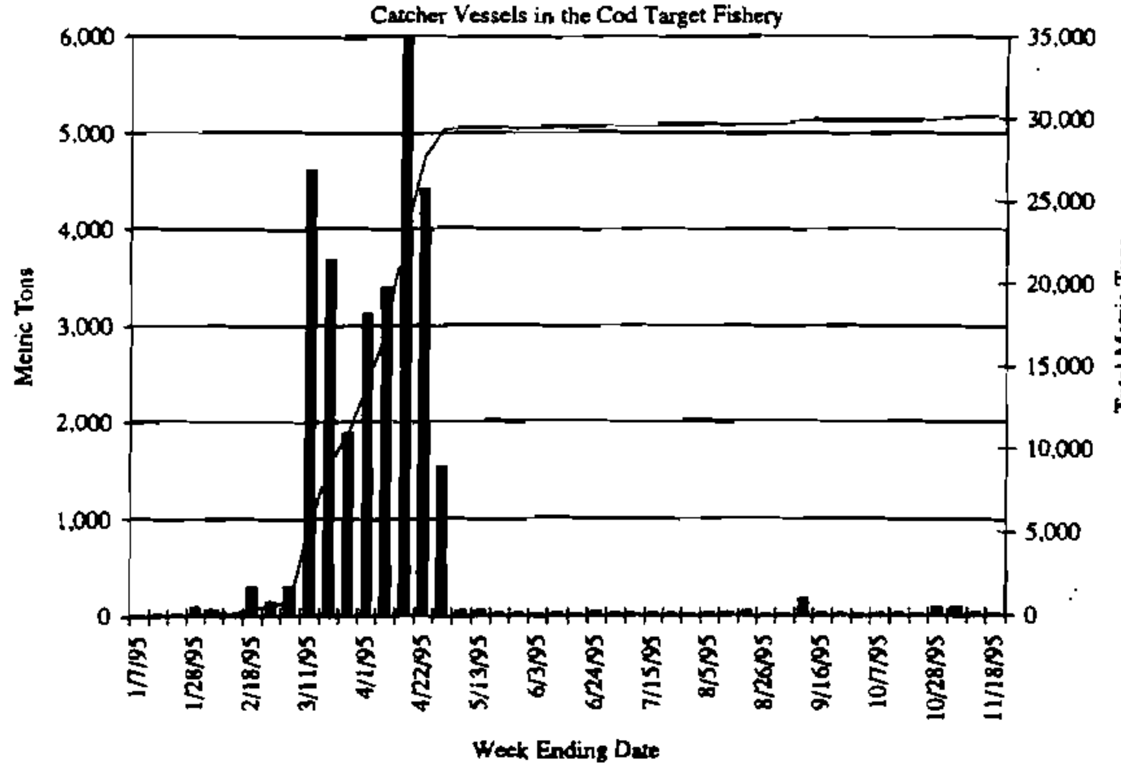


Figure 3.4 BSAI 1995 Catch per Week and Total Catch of Pacific Cod Harvested by Trawl Catcher Processors in the Cod Target Fishery

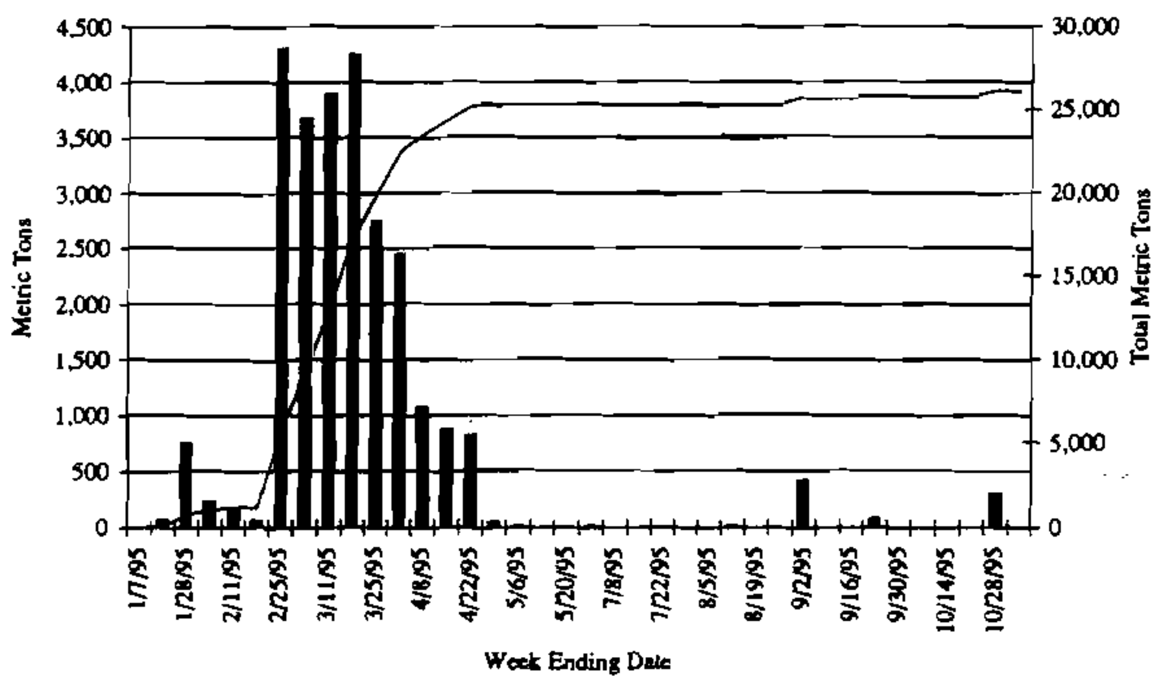


Figure 3.5 BSAI 1995 Average Catch per Vessel of PCODLGL and Number of Vessels in the PCODLGL Fishery

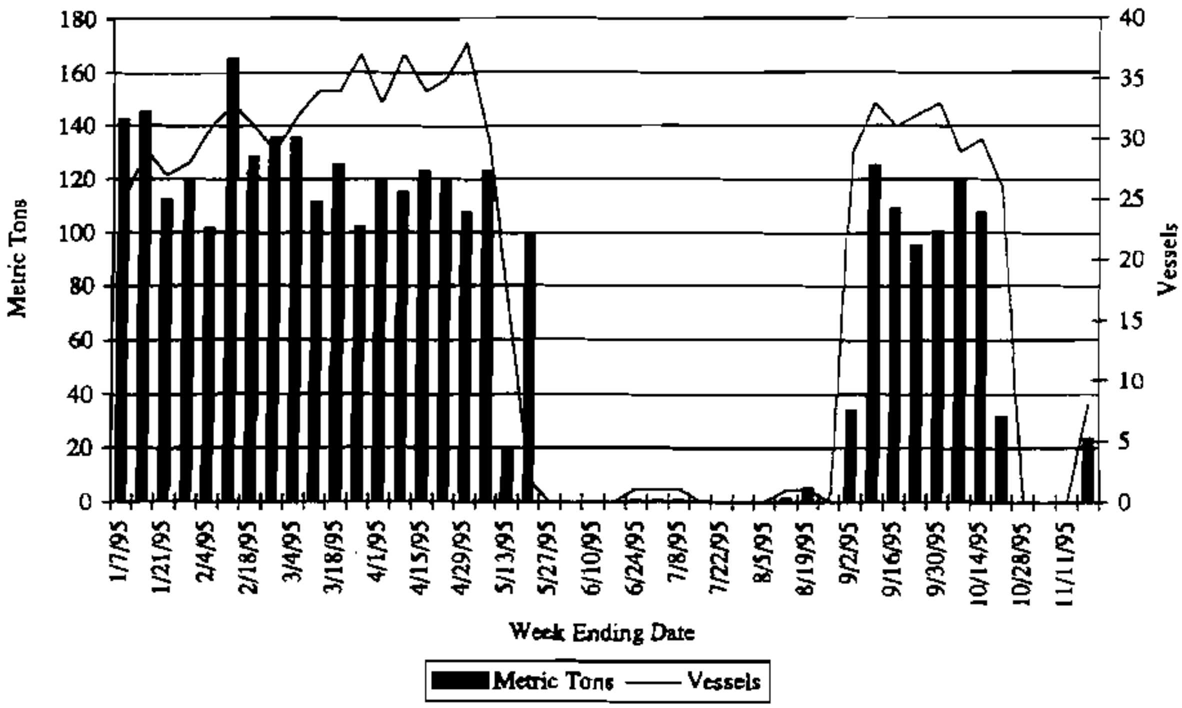


Figure 3.6 BSAI 1995 Average Catch per Vessel of PCODPOT and Number of Vessels in the PCODPOT Fishery

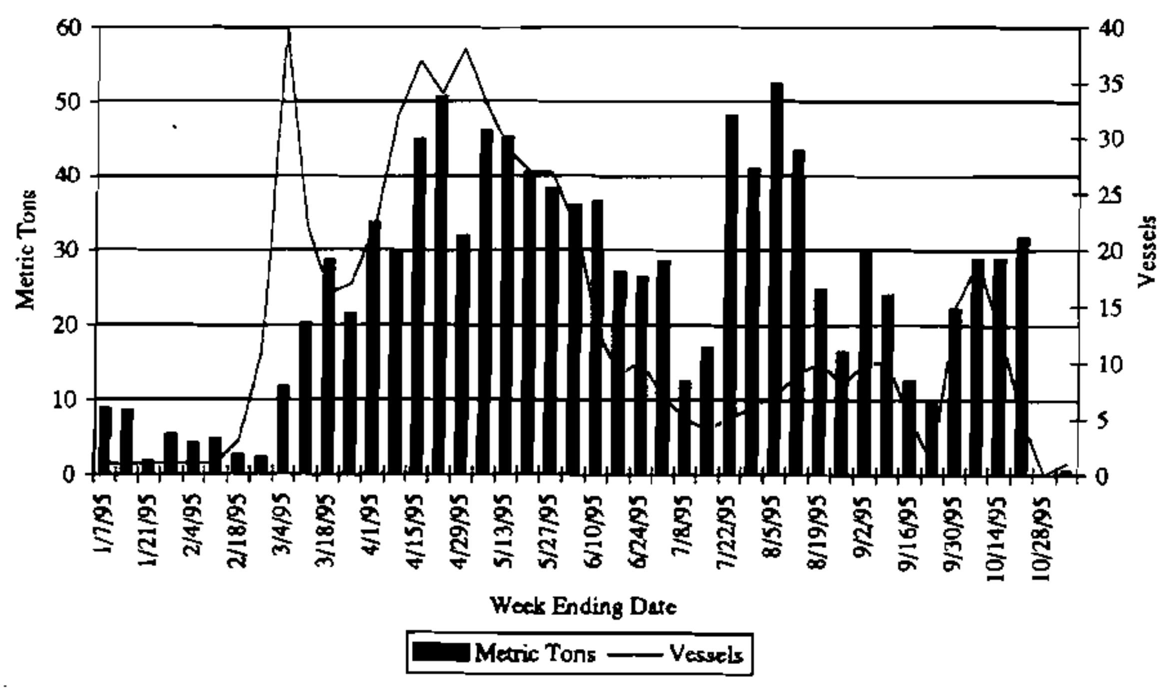


Figure 3.7 BSAI 1995 Average Catch per Vessel of PCODCA and Number of Vessels in the PCODCA Fishery

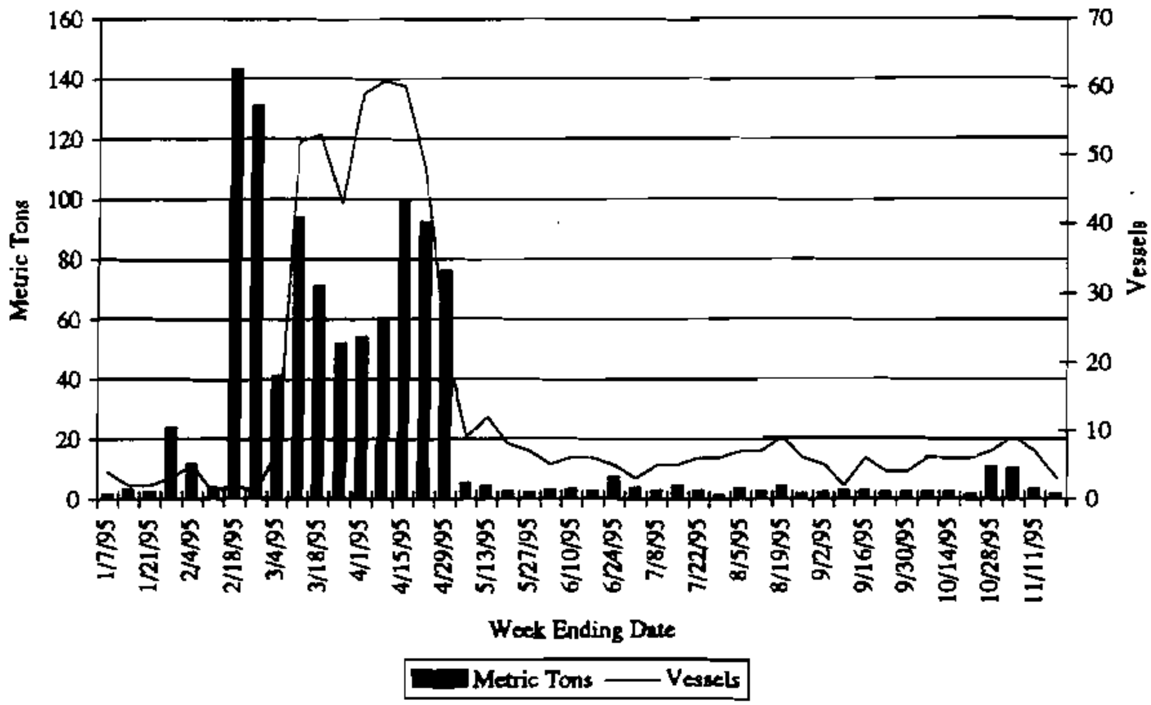
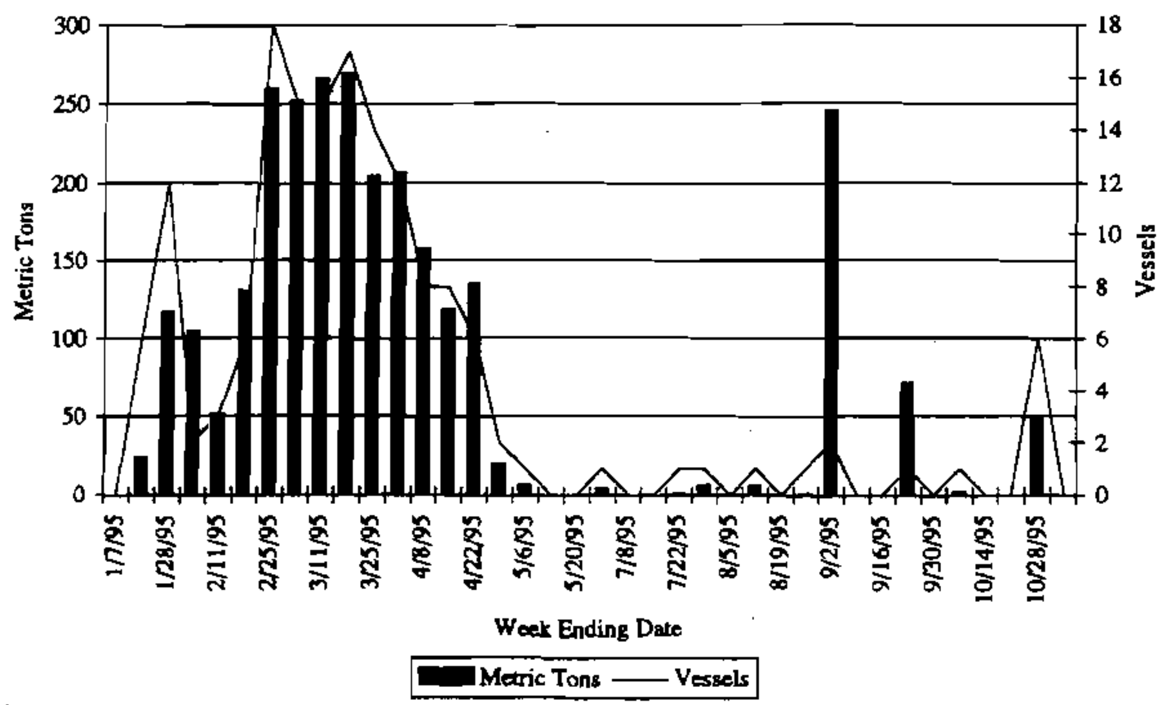


Figure 3.8 1995 BSAI Average Catch per Vessel of PCODCP and Number of Vessels in the PCODCP Fishery



3.2 Discards of Pacific Cod

The discarding of fish has become a sensitive issue in recent years. Discards are those fish that are thrown away after being caught. Because of the increased emphasis placed on discards, this section will report the amount of Pacific cod that was discarded by each sector for 1992-95. Like the catch discussion above, a separate table will be provided for total, target, and non-target Pacific cod discards. It is important to distinguish between discards in target and non-target cod fisheries, because cod is often discarded at a higher rate in non-target fisheries. It is reasonable for discards of cod to be higher when it was caught as bycatch, because the vessel may not have a market for cod, or they may not be set up to process cod.

Proposals are currently being considered by the Council that would limit the amount of fish that can legally be discarded. The Improved Retention/Improved Utilization (IR/IU) program being analyzed by NMFS Alaska Fishery Science Center economists is one such program. If regulations like IR/IU are put in place, the discard rates in future years should be much lower, and would be confined to regulatory, as opposed to "economic," discards.

3.2.1 Total Pacific Cod Discards

Table 3.4 reports the total discards of Pacific cod in the BSAI (regardless of whether cod was the target species). Discards are reported by the same vessel categories as catch was earlier. Longline vessels discarded 3,676 mt of cod during 1995. This was up about 500 mt from their 1994 total. Comparing the percent of cod discarded those two years shows only a slight increase in 1995. This is because the longline vessels caught more cod in 1995 than in 1994, and the increases in catch partially offset higher discards.

Pot Vessels discarded 311 mt of Pacific cod in 1995. This is about twice their 1994 discards (168 mt). The pot fleet's discard rate was typically 2% or less. These levels of discard are the lowest of all the sectors.

Trawl vessels had higher discard rates than fixed gear vessels. Trawl catcher vessels discarded 9,085 mt of cod during 1995. These discards accounted for 18.09% of their total cod catch. In 1994, trawl catcher vessels discarded 5,035 mt of cod, or 11.55%. So, there was a substantial increase in discards between 1994 and 1995. However, the 1995 levels were about equal those reported in 1993.

Table 3.4 Total Pacific Cod Discards

	Metric Tons					Percent of Group's Total Pacific Cod Catch				
Year	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	All
1995	3,676	311	9,085	27,893	40,965	3.90%	1.66%	18.09%	40.70%	17.68%
1994	3,167	168	5,035	24,670	33,040	3.63%	2.04%	11.55%	43.93%	16.93%
1993	4,453	25	9,056	23,315	36,849	6.73%	1.21%	22.06%	40.34%	22.05%
1992	2,171	103	3,480	18,281	24,034	2.13%	0.75%	11.53%	30.37%	11.66%

Description of table: This table reports the total amount of BSAI Pacific cod that was discarded. The left hand side of the table lists the metric tons of Pacific cod that was discarded. The right hand side of the table show the percent of the groups total catch that was discarded. For example, longline vessels discarded 3.90% of the Pacific cod they caught, and in total, 17.68% of the Pacific cod caught was discarded.
Source: NMFS Blend data 1992-95

Trawl catcher processors reported the highest discard rates. We will see later that most of these discards occurred when Pacific cod was not the target fishery. A total of 27,893 mt of Pacific cod was discarded by trawl catcher processors in 1995. This was up 3,223 mt from 1994. Trawl catcher processors also had the highest percentage of cod discards. Between 1993 and 1995 they discarded over 40% of their total cod catch.

Cod discards increased by more than 8,000 mt between 1994 and 1995. Each sector contributed to this increase. As discussed earlier, the longline, pot, trawl catcher vessels, and trawl catcher processors each reported more discards in 1995 than in 1994. Cod was discarded at a rate of 16.93% in 1994 and 17.68% in 1995.

3.2.2 Pacific Cod Discards When Pacific Cod Was The Target Species

When the retained amount of Pacific cod is greater than the retained amount of any other species, Pacific cod is considered by NMFS to be the target species. This section reports the discards of Pacific cod when cod was the target fishery (Table 3.5). Typically these discards would be due to the fish being too small, damaged, or some other factor that makes the fish unsaleable.

Table 3.5 Pacific Cod Discards in the Pacific Cod Target Fisheries

	Metric Tons					Percent of Groups Pacific Cod Catch (Target)				
Year	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	All
1995	3,546	245	2,728	3,870	10,389	3.77%	1.31%	8.91%	13.39%	6.03%
1994	3,151	161	2,901	2,286	8,499	3.62%	1.96%	8.47%	15.55%	5.89%
1993	4,388	25	4,582	2,214	11,210	6.65%	1.21%	15.44%	8.78%	9.11%
1992	1,868	103	1,110	2,240	5,321	1.84%	0.75%	5.54%	8.01%	3.26%

Description of table: This table reports the amount of BSAI Pacific cod discards when Pacific cod was the target fishery. The left-hand side of the table lists the metric tons of Pacific cod that was discarded. The right-hand side of the table show the percent of the groups total catch that was discarded. For example, longline vessels discarded 3.77% of the Pacific cod they caught while targeting cod in 1995, and in total, 6.03% of the Pacific cod caught while cod was the target was discarded.
Source: NMFS Blend data 1992-95

Most of the cod discards from the longline and pot gear vessels occurred in the cod target fishery. This is because almost all of the cod catch takes place when it is the target. In the catch sections above, the longline vessels reported catching 93,955 mt in the cod target fishery out of 94,163 mt total, in 1995. That same year longline discards in the cod target fishery were 3,546 mt. A total of 3,676 mt of cod was discarded by longline fishermen in 1995 (Table 3.4).

Unlike fixed gear vessels, trawlers discarded fewer cod when it was the target. Therefore, most of the trawlers' discarded cod was caught as bycatch in the yellowfin sole, rock sole, other flatfish, and bottom pollock fisheries. Should part of the allocation decision depend on the issue of discards, it is important to understand which fisheries discard cod. Because NMFS accounts for bycatch needs first, they will estimate the amount of cod needed as bycatch in other target fisheries later in the year. NMFS will then subtract those bycatch needs from the TAC that is available to the directed cod fishery. The resulting amount will be made available to the directed cod fishery. So, any reduction in the cod TAC available to the trawl fleet will likely come out of their directed fishery, which has lower discard rates.

Trawl catcher vessels discarded 2,728 mt of cod during 1995. That same year trawl catcher processors discarded 3,870 mt. These discards accounted for 8.91% and 13.39% of the trawl catcher vessel and trawl catcher processor fleets total cod catch, respectively. Trawl catcher vessels decreased the amount of cod they discarded between 1994 (2,901 mt) and 1995 (2,728 mt). However, because they caught less cod in the target fishery during 1995, their rate of discards increased from 3.62% in 1994 to 3.77% in 1995. Trawl catcher processors exhibited the opposite trend. They had more discards (2,286 mt versus 3,870 mt), but a lower discard rate (15.55% versus 13.39%).

3.2.3 Pacific Cod Discards When Pacific Cod Was Not the Target Species

Table 3.6 reports Pacific cod discards when cod was not the target fishery. This table is included for completeness. The metric tons of discards were calculated by subtracting the total Pacific cod discards from the discards that occurred when cod was not the target fishery. The percentages were calculated by dividing the metric tons of cod discards in the non-target Pacific cod fishery by the target cod catch in that fishery.

Table 3.6 Pacific Cod Discards in Non-Pacific Cod Target Fisheries

	Metric Tons					Percent of Group's Non-Target Pacific Cod Catch				
Year	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	All
1995	130	66	6,357	24,022	30,575	62.44%	100.00%	32.43%	60.62%	51.39%
1994	16	7	2,134	22,384	24,541	18.00%	100.00%	22.80%	54.00%	48.20%
1993	64	0	4,474	21,101	25,639	37.33%	0.00%	39.39%	64.76%	58.12%
1992	303	0	2,370	16,040	18,713	85.67%	31.30%	23.30%	49.81%	43.79%

Description of table: This table reports the amount of BSAI Pacific cod discards when Pacific cod was not the target fishery. The left hand side of the table lists the metric tons of Pacific cod that was discarded. The right hand side of the table show the percent of the groups cod catch that was taken in non-cod target fisheries and discarded. For example, longline vessels discarded 62.44% of the Pacific cod they caught while targeting species other than cod in 1995, and in total, 51.39% of the Pacific cod caught while not targeting cod was discarded.
Source: NMFS Blend data 1992-95

Trawl catcher processors had the most cod discards of any gear group. During 1995, they discarded 24,022 mt of cod that was caught in non-cod target fisheries. Those discards accounted for 60.62% of their total non-target catch of cod.

The fixed gear vessels had the smallest amount of cod discards caught as bycatch. Their total discards in the non-cod target fisheries was 196 mt compared to trawl gears 30,379 mt. However, cod that was caught as bycatch in the fixed gear fisheries was more likely to be discarded.

3.3 Catch of Pacific Cod by Jig Gear

Figure 3.9 reports the 1994 jig fleet's target catch and the number of vessels harvesting Pacific cod by month. Figure 3.10 reports the same information for 1995. May had the highest catch of cod in both years. Fourteen vessels reported over 120 ton of cod catch during May of 1994. The 1995 catch during May reached almost 200 tons, with 11 vessels reporting. Reported catch during June was about 80 tons both years. In general, the jig fleet reported less catch during the winter months. Because the jig fleet is made up of small vessels, typically under 32', they often cannot fish when weather conditions are bad. Therefore, most of the catch occurs between May and October.

Figure 3.9. Catch by month of Pacific cod in the 1994 jig fishery when Pacific cod was the target

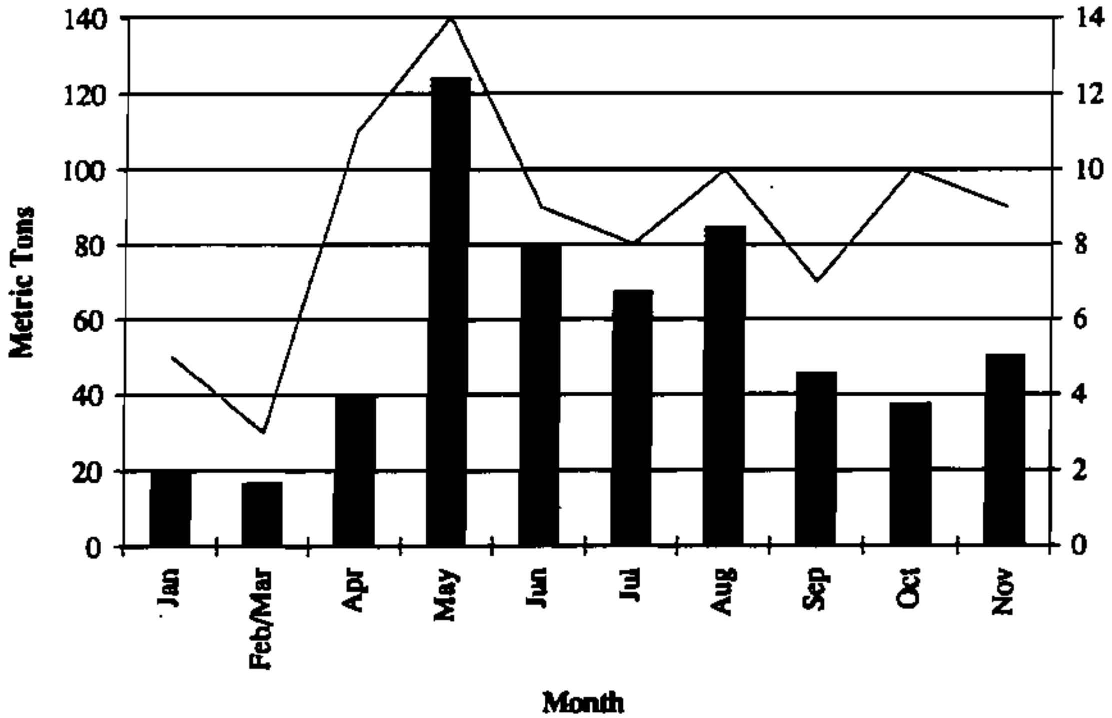
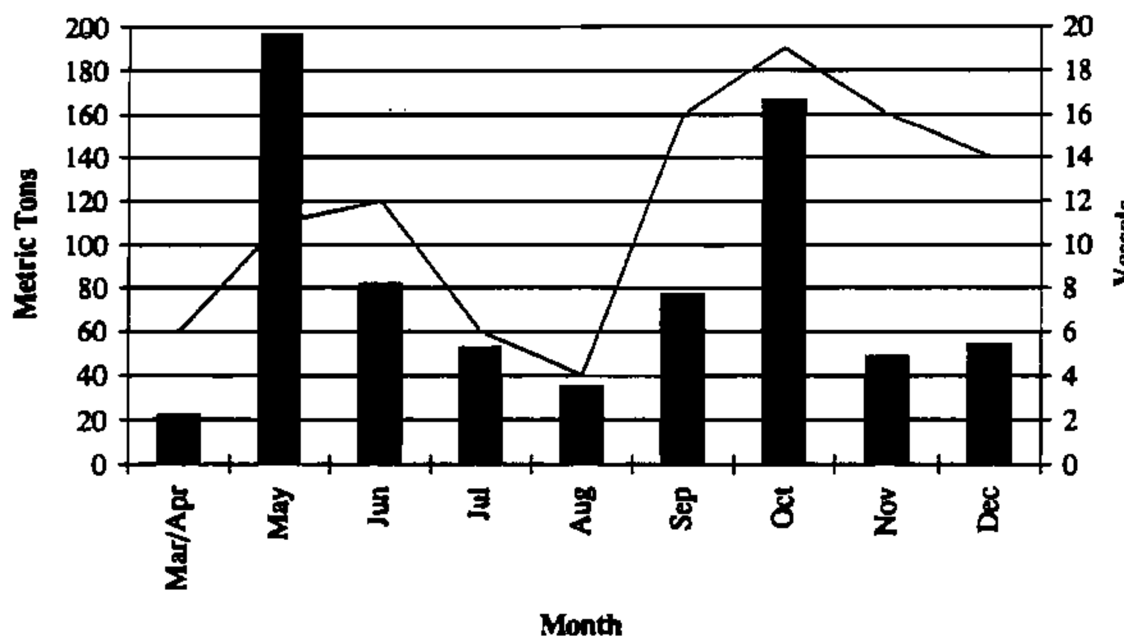


Figure 3.10. Catch by month of Pacific cod in the 1995 jig fishery when Pacific cod was the target



3.4 Other Sources of Pacific Cod Mortality

Pacific cod is often used as bait in the BSAI crab fisheries. Crab fishermen obtain bait by purchasing it, or many times they catch their own. Pacific cod taken as bycatch in the crab fishery is often used as bait. The number of cod taken as bycatch in the *C.* bairdi, *C. opilio* and red king crab fisheries are reported for the years 1993 and 1994 (Tracy 1994 & 1995). An average weight of ten pounds per cod was used to convert number of fish into metric tons. The estimated metric tons of bycatch for all fisheries was 8,452 mt in 1993, and 5,428 mt in 1994.

Units	*C. bairdi*		*C. opilio*		Red King Crab	
Year	1993	1994	1993	1994	1993	1994
Fish	712,611	224,600	1,068,150	788,200	82,344	183,750
Est. Metric Tons	3,233	1,019	4,845	3,575	374	834

The amount of cod used as bait in the crab fisheries each year is unknown. Fisherman use different amounts of cod depending on their target fishery and what has worked well for them in the past. Some fishermen may not use any cod in a fishery, preferring to use squid or herring. Other fishermen may use up to 20 pounds of cod per pull. Based on this anecdotal information, we could assume that 10 pounds of cod are used each time a crab pot is pulled. The actual average may be high or lower. But using the 10 pound average, and the number of pots pulled as reported by ADF&G, we can estimate the amount of cod used as crab bait. In 1993, there were approximately 2.7 million crab pots pulled in the BSAI. Multiplying the number of pots pulled by the ten pounds of bait average yields just over 12,000 metric tons of bait.

ADF&G fish tickets use delivery code "02" to report whole fish that were landed and used as bait. The reported landings of bait in metric tons are provided below for the years 1992-95.

Year	Hook & Line	Jig	Pot	Trawl	Total
1995	270	120	207	363	961
1994	573	72	139	210	993
1993	408	9	192	754	1,363
1992	244	16	356	206	822
Total	1,495	218	893	1,532	4,139

The reported catch of whole cod for bait was 1,363 tons. This is about 1/10th the amount of cod that estimated as being needed by crab fishermen above. Therefore, it is likely that much of cod used for bait in the BSAI is unreported.

3.5 PSC Bycatch in Pacific Cod Target Fisheries

Trawl fisheries have reached their Pacific cod portion of the halibut mortality cap in each of the years 1992-95. They were subsequently closed to directed Pacific cod fishing before taking all the TAC available to them. The hook and line fishery for Pacific cod was first closed before taking their quota, due to halibut mortality, in 1995. This was the only year between 1992 and 1995 that the BSAI Pacific cod TAC was not taken.

During 1995, trawl vessels reached their halibut mortality cap and were closed to directed fishing for Pacific cod on October 28. Their unharvested quota was then reallocated to the fixed gear fleet by the Regional Director of

NMFS on November 3. This additional quota allowed the hook and line fleet to fish until December 11, when their fishery was also closed due to halibut mortality. The pot and jig fishery was allowed to continue to fish but were unable to take the remainder of the 250,000 ton Pacific cod TAC. Because halibut mortality caps have been a limiting factor for both the cod trawl and longline fisheries, a discussion of each sector's catch is included in section 3.5.1.

Crab bycatch is estimated by the National Marine Fisheries Service through the groundfish Observer Program. Observer coverage depends on vessel length; 100% observers on vessels > 125 feet, 30% coverage on vessels 60-125 feet, and 0% coverage on vessels <60 feet. Shoreside processors have 100% coverage. 100% coverage means that an observer is always onboard; it does not mean that every haul or landing is observed.

Bycatch data for crab are available for the 1992-1995 groundfish trawl fisheries in the BSAI by target fishery and regulatory areas. Crab bycatch reported in this document is in number of animals (Table 3.8). The observer data base categorizes crab bycatch into king crab, *C. bairdi* crab, and "other" crab categories. In the Bering Sea, the "other" crab category is comprised almost entirely of *C. opilio* crab.

The bycatch numbers in this document may differ slightly from those reported in the drafts of BSAI FMP Amendments 37 and 41. These discrepancies occur because different versions of the bycatch data base were used.

Several laboratory and field studies have been conducted to determine the handling mortality of crab. These studies were summarized and reported in BSAI FMP Amendments 37 and 41. The rates used in those amendments were:

Gear	Species	Handling Mortality Rate for Crab
Trawl	Red King Crab	80%
Longline	Red King Crab	37%
Longline	*C. opilio* & *C. bairdi*	45%
Groundfish Pot	Red King Crab	8%
Groundfish Pot	*C. opilio* & *C. bairdi*	30%
Source: BSAI FMP Amendments 37 and 41.		

Using these rates, estimates of crab mortality in the Pacific cod fishery could be made. This analysis will not attempt to estimate the actual crab mortality in the Pacific cod fisheries. Future bycatch analyses, such as IR/IU, may wish to estimate the mortality and the uncertainty which surrounds them.

3.5.1 Halibut Mortality in the Pacific Cod Target Fisheries

Table 3.7 lists the halibut mortality in the Pacific cod target fishery from 1992-95. The amount of halibut bycatch is based on observer data. The bycatch is then multiplied by an assumed mortality rate to calculate the halibut that is killed by each sector. The halibut mortality rate[1] used for the trawl fleet in 1995 was 65%. Longline vessels have a rate of 11.5% and pot vessels 7%.

[1]These rates were taken from Table 6 of the December 15, 1995 Council Newsletter. This table also provides the rates for the years 1990-95 and the 1996 recommendations.

Halibut mortality has constrained the Pacific cod trawl fleet each year between 1992-95. Hook and line vessels hit their cap in 1995 before their portion of the TAC was taken. Because halibut has constrained both the hook and line and trawl fleets catch of Pacific cod in the past, it is a critical part of the analysis.

Halibut mortality in the Pacific cod hook and line fleet was reported at 799 tons in 1995. The cap for the hook and line fleet was 750 tons in 1995 before halibut was reapportioned. The 1995 mortality was down 247 tons from the 1994 total. A relatively low level (438 tons) was reported in the 1993 hook and line fishery for cod. However in 1992, 1,413 tons were reported.

The pot fishery has small amounts of halibut mortality, and is not constrained by a mortality cap. The reported mortality in 1992 was only 13 tons. They reported no mortality in 1993. Mortality in 1994 was only 5 tons and then increased to 10 tons in 1995. During this same period, their catch of Pacific cod more than doubled, so the ratio of halibut mortality to total catch actually decreased from 1994 to 1995.

Trawl catcher vessels used over 750 tons of halibut mortality in each year between 1992 and 1995. The most halibut mortality occurred in 1994, when 939 tons were reported. Catcher processors halibut mortality was the highest in 1995 when they took 553 tons. In 1994, the catcher processors accounted for 306 tons of halibut mortality.

The right side of Table 3.7 reports the halibut mortality for each industry sector in kilograms of halibut mortality per metric ton of Pacific cod taken in the directed cod fishery. Pot and longline vessels have had lower halibut mortality rates than the trawl sectors between 1992-95. In 1995, the longline fleet averaged 8.5 kg of halibut mortality per metric ton of Pacific cod caught in the directed cod fishery. Pot vessels averaged 0.5 kg/mt in 1995. Both of these rates were considerably lower than those reported for the trawl sectors.

Catcher processor and catcher vessel halibut mortality can also be compared as a ratio to total target catch. The 1995 catcher vessel fleet had 25.7 kilograms of halibut mortality per metric ton of cod catch in the co target fishery in 1995. The catcher processor fleet averaged 19.1 kg/mt. In 1994, the ratio of halibut mortality to cod was 27.4 kg/ton for the catcher vessel fleet. The catcher processor fleet averaged 20.8 kg/mt that year. Therefore, each of the trawl sectors reduced their halibut mortality rate between 1994 and 1995, but the catcher processors continued to have about 7 kg/mt less halibut mortality than the catcher vessels.

Table 3.7 Halibut Mortality in the Pacific Cod Target Fisheries

	Metric Tons					Kg of Halibut Mortality per mt of Target Pacific Cod				
Year	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	All
1995	799	10	788	553	2,149	8.5	0.5	25.7	19.1	12.5
1994	1,046	5	939	306	2,296	12.0	0.6	27.4	20.8	15.9
1993	438	0	777	370	1,586	6.6	0.2	26.2	14.7	12.9
1992	1,413	13	759	436	2,621	13.9	1.0	37.9	15.6	16.0

Description of table: This table reports the amount of halibut mortality that was a result of the BSAI Pacific cod fisheries. The left hand side of the table lists the metric tons of halibut mortality. For example, longline vessels accounted for 799 mt of halibut mortality while they were targeting Pacific cod in 1995, and in total, 2,149 metric tons of halibut mortality occurred in the Pacific cod target fisheries. The right hand side of the table show the kilograms of halibut mortality per metric ton of Pacific cod catch in the directed cod fisheries. For example, longline vessels had 8.5 kilograms of halibut mortality per metric ton of Pacific cod caught in the directed longline cod fishery.
Source: Groundfish observer reports 1992-95

3.5.2 *C. bairdi* Bycatch

Crab bycatch carapace width frequency information suggests that most trawl bycatch is smaller than legal size (140 mm), but about the size of 50% maturity for females (90 mm). Average width of *C. bairdi* crabs taken as bycatch was 125 mm for males in 1994 and 120 mm for males in 1995. Average width for females was 85 mm in 1993 and 1995. These averages indicate that *C. bairdi* crabs taken as bycatch may be larger than in previous years. Narita et al. (1994) reported that smaller *C. bairdi* crab (average carapace widths of 93 mm for males and 68 mm for females) were taken as bycatch in 1991 domestic BSAI groundfish fisheries. Observer data indicate that 75% of *C. bairdi* crab taken as bycatch in trawl fisheries are males. Length frequency data collected by observers for the BSAI groundfish pot and longline fisheries were examined. As with BSAI trawl fisheries, pot and longline fisheries catch primarily males. Average carapace width for male *C. bairdi* crabs was about 110 mm in pot fisheries and 130 mm in longline fisheries. Average width of female *C. bairdi* crabs was about 85 mm in both fisheries.

Bycatch of *C. bairdi* crab has been reduced in recent years, down significantly from 4.3 million in 1992. Most *C. bairdi* crab bycatch is taken in the trawl fisheries (about 98%), and to a lesser extent in the longline (1.5%) and groundfish pot fisheries (0.5%). Although *C. bairdi* crabs are bycaught in nearly every trawl fishery, the yellowfin sole fishery takes the largest share, followed by the rock sole and other flatfish fisheries. Bycatch is highest in NMFS statistical areas 509 and 513; and large numbers of *C. bairdi* crab area also consistently taken in areas 517 and 521.

During 1994 and 1995, the Pacific cod hook and line fleet caught 24,581 and 24,523 *C. bairdi* crab, respectively (Table 3.8). These numbers are about three times higher than was reported in 1993, but only slightly higher than 1992. Bycatch in the Pacific cod pot fishery was highly variable between years. In 1992, they reported catching 240,536 *C. bairdi* while harvesting 13,680 tons of cod. This equates to slightly under 17.6 crab/ton. However in 1993, they caught only 1,595 *C. bairdi* crab during their harvest of 2,098 tons of cod, or just over 0.75 crab/ton. This ratio went up to 2.86 crab/ton during 1994, and 3.37 crab/ton in 1995. The total number of *C. bairdi* crab taken in 1993 was 23,513, and 63,037 in 1995.

Table 3.8 *C. bairdi* Bycatch in the Pacific Cod Target Fisheries

	Animals					# of Animals Bycaught per mt of Target Pacific Cod				
Year	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	All
1995	24,581	63,037	78,573	163,983	330,174	0.26	3.37	2.57	5.67	1.92
1994	24,523	23,513	87,444	54,661	190,141	0.28	2.86	2.55	3.72	1.32
1993	8,839	1,595	88,844	140,681	239,959	0.13	0.76	2.99	5.58	1.95
1992	22,970	240,536	58,605	139,628	461,740	0.23	17.58	2.93	4.99	2.83

Description of table: This table reports the number of *C. bairdi* crab that were caught while BSAI Pacific cod was the target fishery. The left hand side of the table lists the number of animals by sector. For example, longline vessels bycaught 24,581 *C. bairdi* crab while they were targeting Pacific cod in 1995, and in total, 330,174 *C. bairdi* crab were bycaught in all BSAI Pacific cod target fisheries. The right hand side of the table show the number of *C. bairdi* crab caught per metric ton of Pacific cod catch in the directed cod fisheries. For example, longline vessels caught 0.3 *C. bairdi* crab per metric ton of Pacific cod, in the directed longline cod fishery.
Source: Groundfish observer reports 1992-95

The Pacific cod trawl catcher vessel fleet caught 58,605 *C. bairdi* crab in 1992. During 1993 and 1994, they caught about 88,000. About 10,000 fewer *C. bairdi* crab were caught in 1995 than were caught in 1994. An average of 2.6 crab/ton of cod was taken during the 1995 fishery.

Trawl catcher processors took about 140,000 *C. bairdi* crab in both 1992 and 1993. By 1994, the number of crab dropped to 54,661, but then increased to almost 164,000 in 1995.

3.5.3 *C. opilio* Bycatch

Most *C. opilio* crab bycatch in trawl fisheries is smaller than market size (102 mm), but larger than the size of 50% maturity for females (50 mm). Average width of *C. opilio* crabs taken as bycatch was 75 mm for males in 1994 and 1995. A rough estimate of average width for female *C. opilio* crab is 63 mm in 1993 and 1995 trawl fisheries. Narita et al. (1994) reported average carapace widths of 89 mm for males and 59 mm for females taken as bycatch in 1991 domestic BSAI groundfish fisheries. As with Tanner crab, observer data indicate that a vast majority of C. opilio crab taken as bycatch in trawl fisheries is males. On average, 1993-1995, about 80% of the *C. opilio* crab measured by observers were male. Average carapace width for male *C. opilio* crabs was about 90 mm in pot fisheries and 110 mm in longline fisheries.

Bycatch of *C. opilio* crab in all BSAI groundfish fisheries totaled 5.3 million crab in 1995. Bycatch has been drastically reduced since 1992, when 18.4 million *C. opilio* crab were taken in these groundfish fisheries. Most *C. opilio* crab bycatch is taken in the trawl fisheries (99%) and to a lesser extent in the longline (0.7%) and groundfish pot fisheries (0.3%). Although *C. opilio* crabs are bycaught in nearly every trawl fishery, the yellowfin sole fishery takes the vast majority (70% on average 1992-1994). Bycatch is highest in the areas north and east of the Pribilof Islands, corresponding to NMFS statistical areas 513, 514, and 521 (NPFMC 1994). Relatively few *C. opilio* crab are taken in Zone 1. On the other hand, about 75% of the *C. opilio* crab bycatch comes from the area encompassed by the existing crab protection Zone 2. Average *C. opilio* crab bycatch in Zone 2 was about 10.8 million crabs, or about 0.11% of the NMFS total population index on average, 1992-1994. Bycatch of *C. opilio* crab in 1995 was much lower than in previous years, when 12 to 18 million crabs were taken annually.

Since 1993, bycatch of *C. opilio* in the Pacific cod hook and line fishery has fallen steadily (Table 3.9). Bycatch during 1993 was 145,507 animals. The number of animals caught in 1995 was only about half that of 1993.

Table 3.9 *C. opilio* Bycatch in the Pacific Cod Target Fisheries

	Animals					# of Animals Bycaught per mt of Target Pacific Cod				
Year	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	All
1995	75,458	153,434	15,711	29,192	273,794	0.80	8.20	0.51	1.01	1.59
1994	105,842	23,061	6,065	32,887	167,855	1.22	2.80	0.18	2.24	1.16
1993	145,507	1,218	8,300	176,480	331,505	2.21	0.58	0.28	7.00	2.70
1992	102,456	135,338	13,225	76,248	327,266	1.01	9.89	0.66	2.72	2.00

Description of table: This table reports the number of *C. opilio* crab that were caught while BSAI Pacific cod was the target fishery. The left hand side of the table lists the number of animals by sector. For example, longline vessels bycaught 75,458 *C. opilio* crab while they were targeting Pacific cod in 1995, and in total, 273,794 *C. opilio* crab were bycaught in all BSAI Pacific cod target fisheries. The right hand side of the table show the number of *C. opilio* crab caught per metric ton of Pacific cod catch in the directed cod fisheries. For example, longline vessels caught 0.8 *C. opilio* crab per metric ton of Pacific cod, in the directed longline cod fishery.
Source: Groundfish observer reports 1992-95

In the Pacific cod pot fishery, the bycatch of *C. opilio* was highly variable by year, much like the *C. bairdi* bycatch in this fishery. The bycatch was lowest in 1993 when only 1,218 animals were reported. However, in 1995 the number of bycaught animals was 153,434.

Trawl catcher vessels and catcher processors generally had less *C. opilio* bycatch than the fixed gear fleet. The exception to this trend is the 1993 catcher processor fleet. That year, they caught 176,480 animals. This was the most bycatch by any gear type targeting Pacific cod in those four years.

3.5.4 Red King Crab Bycatch

Examination of crab bycatch carapace length frequency suggests that on average, the size of red king crab taken is about the minimum legal size for males (137 mm carapace length), and larger than the size of 50% maturity for females (90 mm carapace length). Previous reports suggested that red king crab taken as bycatch has averaged about 106 mm for females and 132 mm for males (Guttormson et al. 1990, NPFMC 1995). Length frequency data from the 1993 and 1995 trawl fisheries suggest that the average size may be slightly larger; 140 mm for males in 1993 and 145 mm for males in 1995. Average length for females is 120 mm in 1993 and 110 mm in 1995. Note that the legal size (165 mm carapace width) corresponds to a 137 mm carapace length for Bristol Bay red king crabs. On average, 1993 and 1995, 57% of the red king crab measured by observers were female. Only minimal length frequency data are available for red king crab taken in groundfish pot and longline fisheries; the six crab measured in 1993 ranged from 140 to 160 mm.

Bycatch of red king crab in the BSAI groundfish fisheries totaled over 44,000 in 1995, which was down significantly from a recent high of 279,108 in 1994. Most red king crab bycatch is taken in the trawl fisheries (97%) and to a lesser extent in the longline (1%) and groundfish pot fisheries (2%). Although red king crabs are bycaught in nearly every trawl fishery, the rock sole fishery accounts for a majority of red king crab bycatch. Bycatch has been consistently highest in NMFS statistical areas 509 and 516. Approximately, 80% of the red king crab bycatch has been taken from the area encompassed by the existing crab protection Zone 1. Bycatch of red king crab was significantly lower in 1995 due in part to the implementation of the Pribilof Islands Habitat Conservation Area and the Bristol Bay Red King Crab Savings Area. Even lower bycatch may occur in 1996; Zone 1 bycatch of red king crabs totaled only 12,000 crabs through 3/16/96 (NMFS Bulletin Board 3/21).

Bycatch of red king crab in the Pacific cod longline fishery has fallen from 2,986 animals in 1992 to 202 in 1995 (Table 3.10). In 1994 bycatch was even lower, with only 155 animals taken.

Table 3.10 Red King Crab Bycatch in the Pacific Cod Target Fisheries

Year	Animals					# of Animals Bycaught per mt of Target Pacific Cod				
	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	All
1995	202	2,980	407	2,584	6,174	0.00	0.16	0.01	0.09	0.04
1994	155	628	339	854	1,976	0.00	0.08	0.01	0.06	0.01
1993	428	12	512	812	1,764	0.01	0.01	0.02	0.03	0.01
1992	2,986	10,551	20	105	13,663	0.03	0.77	0.00	0.00	0.10

Description of table: This table reports the number of red king crab that were caught while BSAI Pacific cod was the target fishery. The left hand side of the table lists the number of animals by sector. For example, longline vessels bycaught 202 red king crab while they were targeting Pacific cod in 1995, and in total, 6,174 red king crab were bycaught in all BSAI Pacific cod target fisheries. The right hand side of the table show the number of red king crab caught per metric ton of Pacific cod catch in the directed cod fisheries. For example, pot vessels caught 0.2 red king crab per metric ton of Pacific cod, in the directed pot cod fishery.

Source: Groundfish observer reports 1992-95

The 1995 Pacific cod pot fishery had the most red king crab bycatch of any of the four cod target fisheries. Their red king crab bycatch of 2,980 animals was up considerably from the 628 caught in 1994, and the 12 caught in 1993. It was however, still well below the 10,551 taken in 1992.

The number of red king crab taken in the Pacific cod trawl catcher vessel fishery, during 1994 (339) and 1995 (407) is about twice the number taken by the longline vessels. Because the longline fleet's catch of Pacific cod in the target fishery was about three times that of the catcher vessels, their bycatch of red king crab per ton of cod was about six times as high.

Trawl catcher processors in the Pacific cod fishery caught 2,584 red king crab in 1995. This was less bycatch than attributed to the pot vessels, but considerably more than taken by the trawl catcher vessel or longline fleet. Catcher processors caught 854 red king crab in 1994, and 812 in 1993. Only 105 red king crab were taken as bycatch by the trawl catcher processors during 1992.

In 1995, 0.04 red king crab were taken as bycatch per ton of target Pacific cod. Pot gear vessels had the highest bycatch rate with 0.16 animals per ton of Pacific cod taken. Longline vessels had the lowest red king crab bycatch rate. Their rate was less than one-hundredth of an animal per metric ton of Pacific cod.

3.6 Pacific Cod Markets

The comparisons of the gross or net benefits of the alternatives being considered are of benefits through primary processing. Therefore, differences in benefits from secondary processing, marketing, and final consumption are ignored. From the perspective of benefits to the Nation, this will tend to result in a larger understatement of benefits for products for which there are either domestic secondary processing or domestic consumption. Although a quantitative analysis of this bias is not possible, an attempt has been made to determine which cod products tend to be exported directly after primary processing, which tend to remain in the country for secondary processing or consumption, and which are consumed domestically after being reprocessed elsewhere.

There is general agreement that: (1) basically all the cod roe, cod milt, salt cod, and whole cod are exported; (2) fillets are almost exclusively for the domestic market; and (3) for H&G cod, there are important markets in Asia, North America, and Europe. There appear to be differences in the importance of the various H&G markets for factory trawlers, freezer longliners, and on-shore processors. Industry sources from each of these user groups provided the following information concerning the importance of these various H&G markets: (1) for factory trawlers, more than 50% of the H&G products are reprocessed and consumed domestically and of the remainder that is exported a significant portion is reprocessed in Canada and re-imported for domestic consumption; (2) for freezer longliners, the percent of H&G products that is exported to Japan is decreasing but still exceeds 50%, some of the exports to Canada are reprocessed and re-imported for domestic consumption, and an increasing percent is reprocessed and consumed domestically; and (3) for on-shore processors, the Asian markets are less important than the domestic and other export markets and, as with other processors, there have been increased exports to Canada for reprocessing and often re-importing for domestic consumption. A comparison of data from the weekly production reports from all groundfish processors with export data indicates that approximately 64% of the whole and dressed cod production was exported in both 1993 and 1994. This estimate tends to understate the percent that is exported because some cod exports are no doubt misclassified as non-cod products. Therefore, although this is only a rough estimate of the importance of the export markets for whole and dressed cod, it supports the general understanding that much of the H&G cod is exported.

This information suggests that ignoring benefits beyond primary processing tends to introduce a bias that favors freezer longliners. However, neither the absolute magnitude of this bias nor its magnitude relative to other biases introduced elsewhere in the analysis is known. With the limited information that is available, any discussion concerning the significance of this bias would be highly speculative.

One example of reprocessing that occurs in Alaska is the reprocessing of frozen H&G groundfish into individual quick frozen (IQF) fillets at the Tyson Seafood plant in Kodiak. The plant has experimented with flatfish, cod, and other groundfish in an attempt to increase the utilization both of the groundfish taken as bycatch and of the plant. The quality and cost of twice frozen product determine the extent to which it is economically viable to reprocess fish. The plant has been relatively successful with some, but not all, species. The cod that it reprocesses is cod that is taken as bycatch in the other groundfish fisheries. The plant has not used cod from the cod fishery for reprocessing and has used very little of the groundfish bycatch in the cod fishery for reprocessing. Therefore, the reprocessing in Kodiak is not expected to affect the comparisons among the use of cod in the cod fisheries; however, it does result in an underestimate of the value of the cod products that are produced from cod that is taken as bycatch in other groundfish fisheries.

Information from several on-shore processors indicates that generally there are not significant differences between the quality of trawl and pot caught cod for the same landed product. For example, bled cod from trawlers and pot vessels is roughly comparable and the type of gear used generally is not a factor in determining what product will be produced. However, in some markets for processed products there is a preference for pot caught cod. Two processors reported paying the same ex-vessel price for trawl and pot caught cod and two reported paying a 2 to and 3 cent per pound premium for pot caught cod. One of the latter stated that the premium was required to assure adequate landings by pot vessels and was not due to a difference in fish quality. Halibut PSC-induced closures of the trawl or longline fishery limit the supply of cod and can result in a higher price being offered to pot fishermen. As with most fish, the type of product landed is an important factor in determining product quality and price. Therefore, both trawlers and pot boats receive a higher price for bled cod than for whole fish.

One specific potential quality difference mentioned in public testimony was the higher occurrence of worms in pot caught cod. Several processors were contacted to determine the extent of this problem. The general feeling was that worms could be a problem in some areas during the summer, but that overall, the advantages and disadvantages of cod from trawl and pot gear canceled out. Typically, once cod enters the processing plant, they are processed with minimal attention paid to the type of gear that was used to catch it.

The previous analysis indicated that both differences in product quality and the seasonality of the Japanese market for H&G cod resulted in lower prices for cod caught in June through August. The seasonal distribution of the fixed gear TAC that fixed gear fishermen have recommended in recent years is based in part on this seasonal difference in the marketability of cod. Recent comments by cod wholesalers have supported this position concerning the seasonal differences in marketability.

Product price data that are collected annually by NMFS and ADF&G indicate that there are substantial differences in prices by user group for some products. For example, for eastern cut cod, which is the dominant product for factory trawlers and an even more important product of freezer longliners and pot catcher processors, the average annual F.O.B. Alaska price per pound in 1994 was $0.81 for freezer longliners, $0.79 for pot catcher processors, $0.73 for on-shore processors, and $0.68 for factory trawlers. Recent information from a company that operates factory trawlers and freezer longliners indicates that the current price differential is about $0.12 as compared to the $0.13 price differential in 1994. For skinless and boneless fillets which were the most important cod product for on-shore processors in 1994 and which were an important product for factory trawlers, the 1994 reported prices were $1.81 for onshore processors and $1.79 for factory trawlers. The product prices that are used to analyze the effects of the alternatives being considered are presented in Table 3.11. The Council review process is expected to assist in updating and correcting the product prices that are used for the analysis of the cod allocation issues. If necessary, improved price estimates can be included in the analysis before it is forwarded for Secretarial review.

The combination of these differences in product prices, differences in product mixes, differences in retention rates, and differences in product recovery rates results in differences in gross product value per metric ton of cod catch among the user groups and among operations within each user group. The intra-group differences generally are expected to exceed the inter-group differences. Therefore, an allocation by group rather than by individual operation would not be expected to maximize the gross product value from the cod TAC.

Table 3.11 1995 Ex-processor Product Price Per Ton for Pacific Cod

Product	Longline	Pot	Trawl CV	Trawl CP
Whole	$ 908.60	$ 919.25	$ 882.70	$ 1,763.68
H&G Roe	$ -	$ -	$ -	$ -
W. H&G	$ 1,645.81	$ 1,551.81	$ 1,137.92	$ 1,360.92
E. H&G	$ 1,761.80	$ 1,696.04	$ 1,380.74	$ 1,389.21
Kirimi	$ -	$ -	$ -	$ -
Salted	$ -	$ 1,763.68	$ 1,543.22	$ -
Roe/Milt	$ 1,601.24	$ 2,891.90	$ 2,524.46	$ 1,406.86
Parts	$ 4,205.34	$ 6,613.80	$ 1,644.68	$ 2,971.76
Fillets	$ 3,479.60	$ 4,052.33	$ 3,822.15	$ 3,845.89
Surimi/Mince	$ 874.80	$ 595.24	$ 1,147.56	$ 1,252.72
Meal	$ -	$ -	$ 432.91	$ 520.52

Source: Annual Processor Survey Data for 1994

Note: 1994 prices were used because 1995 are currently not available.

3.7 Products

Pacific cod is processed into a variety of product forms. As mentioned in the market section above, skinless and boneless fillets are an important product for both shoreside and at-sea processors. However, other types of fillets are also produced from cod. To reduce the amount of information presented in this document, similar product forms have been aggregated. For example, all fillet products (i.e., fillets with skin and ribs, fillets with skin no ribs, fillets with ribs (no skin), skinless/boneless, and deep-skin) have been combined. Table 3.12 shows how each of the various product forms have been aggregated.

Table 3.12 Translation Table for NMFS to NPFMC Product Forms

NMFS Product	NPFMC Product	NPFMC Product Name
1 - Whole fish/food fish	1	Whole (-)
2 - Whole fish/bait	1	Whole (-)
3 - Bled only	1	Whole (-)
4 - Gutted only	1	Whole (-)
6 - Head and gutted, with roe	6	H&G/Roe
7 - Headed and gutted, Western cut	7	W. H&G
8 - Headed and gutted, Eastern cut	8	E. H&G
10 - Headed and gutted, tail removed	7	W. H&G
11 - Kirimi	11	Kirimi
12 -Salted and split	12	Salted
13 - Wings	15	Parts
14 - Roe	14	Roe/Milt
15 - Pectoral girdle	15	Parts
16 - Heads	15	Parts
17 - Cheeks	15	Parts
18 - Chins	15	Parts
19 - Belly	15	Parts
20 - Fillets with skin and ribs	20	Fillets
21 - Fillets with skin no ribs	20	Fillets
22 - Fillets with ribs, no skin	20	Fillets
23 - Fillets, skinless/boneless	20	Fillets
24 - Deep-skin fillet	20	Fillets
30 - Surimi	30	Surimi/Mince
31 - Minced	30	Surimi/Mince
32 - Fish Meal	32	Meal (+)
33 - Fish oil	32	Meal (+)
34 - Milt	14	Roe/Milt
35 - Stomachs	15	Parts
36 - Octopus/squid mantles	15	Parts
37 - Butterfly, no backbone	20	Fillets
39 - Bones	32	Meal (+)
97 - Other retained product	15	Parts

The estimated amount of product produced from fish caught by each industry sector is reported in Table 3.13. These data can only be estimated, because NMFS Weekly Production Reports (WPR) do not require shoreside processors to indicate the gear that was used to harvest fish that were processed into a particular product form. For example, in one week a shoreside processor takes deliveries from pot, longline, and trawl vessels. During that week the processor is making an eastern cut H&G product and fillets. The data do not indicate if all the catch from longline vessels went into H&G, fillets, or a combination of the two. Without this information, the analysts are unable to use the WPR data to trace the fish from its raw state through to the final product. To calculate net national benefits generated by harvest vessel sectors (i.e., pot, longline, and trawl vessels), this information is required.

The metric tons of product reported in Table 3.13 were estimated using the Blend and WPR data. Blend data was used to determine the amount of retained catch by each sector. WPR data was used to calculate product mixes and product recovery rates. Product mixes are the ratio of the various products a processor produces. Product recovery rates are ratios of the product produced and the amount of round fish that went into that product. These pieces of information were multiplied together to estimate the amount of product produced from catch delivered by each sector.

Table 3.13 indicates that 44,805 mt of product were produced from cod taken in the Pacific cod longline fishery during 1995. This was up about four thousand tons from 1994 and 15,000 mt from 1993. Comparing the amount of product produced to the total retained cod, it is seen that they both move in the same direction. As more cod is retained in the Pacific cod longline fishery, more product is produced.

Table 3.13 Metric Tons of Products Produced from Pacific Cod Caught in Cod Target Fisheries

Year	Metric Tons					Percent of Groups Total Pacific Cod Catch				
	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	All
1995	44,805	9,171	19,869	16,202	90,047	49.76%	10.19%	22.06%	17.99%	100.00%
1994	40,834	4,033	18,094	11,220	74,181	55.05%	5.44%	24.39%	15.13%	100.00%
1993	30,083	995	14,326	13,488	58,893	51.08%	1.69%	24.33%	22.90%	100.00%
1992	49,572	6,392	12,441	16,213	84,618	58.58%	7.55%	14.70%	19.16%	100.00%

Description: This table reports the estimated metric tons of products that were produced from Pacific cod. Catch from only cod target fisheries were included.
Source: Blend and WKP data.

The tons of product produced from the Pacific cod trawl catcher vessel fishery increased each year between 1992 and 1995. A total of 12,441 mt were produced in 1992, and 19,869 mt of product were generated in 1995.

Vessels operating in the 1995 Pacific cod trawl catcher processor fleet reported about the same total amount of retained catch as the Pacific cod catcher vessel fleet. Given the equal input weight, the amount of product produced by the catcher processors was about 3,700 mt less. This means the catcher processor fleet was making products with lower product recovery rates than the catcher vessel fleet. For example, they were making fillets instead of H&G product.

Table 3.14 is provided to show the amount of the various product forms that were produced from cod in 1995. The Pacific cod longline fishery produces mostly head and gut (H&G) products. Eastern cut H&G means the head is removed just behind the collar bone, and the viscera is removed. This product form accounted for almost 36,000 mt. Western cut H&G accounted for over 7,000 mt of product. The difference between western and eastern cut fish is that a western cut removes the head just in front of the collar bone instead of behind it. These two product forms accounted for almost 97% of the product made from longline harvested Pacific cod.

Table 3.14 Metric Tons of Product Produced in 1995, By Product Form

Product	Longline	Pot	Trawl CV	Trawl CP
Whole(-)	101	68	1,256	677
H&G/Roe	-	-	-	4
W. H&G	7,401	3,439	1,987	1,160
E. H&G	35,997	3,866	199	8,862
Kirimi	-	-	-	-
Salted	-	1,445	5,142	-
Parts	546	28	467	537
Roe/Milt	655	7	649	50
Fillets	81	223	5,366	3,551
Surimi/Mince	23	95	1,231	612
Meal (+)	-	-	3,572	749
Total	44,805	9,171	19,869	16,202

Description: This table reports the metric tons of products that were produced from Pacific cod in 1995. The product forms have been aggregated from those reported to NMFS (see table 3.12).
Source: Blend and WKP data from 1995.

The Pacific cod pot fishery's harvest of cod was also generally processed into a H&G product. The tons of eastern and western cut products were about equal, and accounted for about 80% of the production. Pot caught cod was also salted. A total of 1,445 mt of salt cod were produced. H&G and salt cod together accounted for over 95% of pot gear's products.

Trawl catcher vessels targeting Pacific cod had much of their catch made into fillets (5,366 mt). Salted cod (5,142 mt) and fish meal (3,572 mt) accounted for the second and third most products, respectively. All H&G products combined total 2,186 mt. So, while fixed gear caught Pacific cod was generally made into an H&G product, trawl catcher vessels had their catch made into a wider variety of products, with fillets accounting for the most product.

Trawl catcher processors made more H&G product (10,022 mt) than any other. Fillets were the second largest product (3,551 mt). Other cod products important to this fishery were surimi/mince, meal, and parts. Pacific cod caught as bycatch in other target fisheries was most often made into an H&G product. However, much of the cod was also made into fillets, salted, frozen whole, or made into fish meal. The product form often depended on where the catch was landed, shoreside or at-sea.

3.8 Ex-vessel Prices

The ex-vessel price data are taken from the PacFIN[2] database. Typically, price data are provided for catch taken for onshore processing, but not for catch taken for at-sea processing. The limited price data in the fish ticket database for the latter type of operations are not used by PacFIN. Therefore, PacFIN contains estimates of ex-vessel prices for landings at onshore processing plants. These prices are applied to all landings for at-sea and onshore processing to estimate the ex-vessel value of all catch in the domestic fisheries and do not include the value added by at-sea processing.

[2]PacFIN, the Pacific Fisheries Information Network is managed by the Pacific States Marine Fisheries Commission, maintains a data base on Alaskan Fisheries. The data is compiled from reports submitted from ADF&G, the Commericial Fishing Entry Commision, and from NMFS Alaska Region.

The prices reported are in terms of dollars per pound, round weight. This means, for example, if the landed weight of sablefish is, on average, 65% of its round weight, the price per pound of landed weight equals the round weight price reported in PacFIN and this report divided by 0.65.

PacFIN gear groups were used with the exception of hook and line gears. Specifically, jig, longline or setline and other hook and line gear are treated as separate gear groups. In addition, PacFIN port information was combined. For instance, all landings made in Washington State were lumped together as were the State of Alaska data. Finally, annual and trimester prices were created from monthly data.

A list of the PacFIN ex-vessel prices are provided by species and gear type in Table 3.14. Flatfish and rockfish species are not aggregated in this table. Though the rockfish species will receive little attention in this document, they have been included for completeness. Pacific cod prices by gear type will be focused on during this discussion.

Pacific cod ex-vessel prices in the trawl fishery have typically been lower than those for fixed gear. Prices in 1992 are reported to be \$0.17 for trawl caught cod, \$0.24 for longline, and \$0.20 for pot. The jig fishery did not report cod landings in 1992. By 1995, the trawl price had dropped two cents to \$0.15. Longline cod had dropped three cents to \$0.21, and pot cod fell one cent to \$0.19. The price for jig caught cod has continued to increase each year and was reported at \$0.27 in 1995.

Anecdotal information indicates that pot caught cod have a higher price than trawl cod, because pot fishermen will not fish otherwise. Processors indicated that since the pot cod fishery has such a small profit margin, pot fishermen need a higher price than trawlers to make the fishery feasible. This indicates that the cost of operating a pot vessel is higher per ton of cod catch than a trawl vessel.

Table 3.15. PacFIN Ex-vessel Prices for Bering Sea Harvests Delivered to Shore Plants

	Trawl				Longline				Pot				Jig			
Species	1992	1993	1994	1995	1992	1993	1994	1995	1992	1993	1994	1995	1992	1993	1994	1995
Atka Mackerel	0.12	0.18	0.15	0.15	-	0.04	-	0.31	0.50	-	0.15	0.15	-	-	0.15	0.15
Alaska Plaice	0.14	0.08	0.07	0.03	-	-	0.50	-	-	-	-	-	-	-	-	-
Arrowtooth	0.04	0.07	0.02	0.02	0.10	-	-	-	0.29	-	-	0.03	-	-	0.48	0.30
Black Rockfish	-	0.14	0.14	-	-	-	-	-	-	-	-	-	-	-	-	-
Blue Rockfish	-	0.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Canary Rockfish	-	-	-	-	-	0.69	-	-	-	-	-	-	-	-	-	-
Dover Sole	0.20	0.07	0.05	0.13	-	-	-	-	-	-	-	-	-	-	-	-
Dusky Rockfish	-	0.18	0.10	0.10	-	-	-	-	-	-	-	0.10	-	-	0.13	0.20
English Sole	-	-	-	0.18	-	-	-	-	-	-	-	-	-	-	-	-
Flathead Sole	0.03	0.05	-	-	-	-	-	-	0.57	-	-	-	-	-	-	-
Greenland Turbot	-	0.03	0.21	0.25	0.26	0.19	0.21	0.28	0.31	-	-	0.23	-	-	-	0.24
Northern Rockfish	0.09	0.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Flatfish	0.04	0.07	0.04	0.03	-	-	0.23	-	-	-	0.04	0.15	-	-	-	-
Other Groundfish	-	-	0.11	0.02	-	-	-	-	-	-	-	0.31	-	-	0.27	-
Other Slope Rock.	-	-	0.12	-	-	-	0.16	0.14	-	-	-	0.23	-	-	0.17	-
Pacific Cod	0.17	0.17	0.13	0.15	0.24	0.15	0.21	0.21	0.20	0.17	0.16	0.19	-	0.15	0.22	0.27
Pollock	0.12	0.07	0.08	0.10	0.45	0.23	-	-	0.08	-	0.20	0.30	-	-	0.07	0.11
POP	0.06	0.26	0.10	0.04	0.15	-	-	-	-	-	-	0.25	-	-	-	0.24
Petrale Sole	-	0.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Redbanded Rock.	-	0.36	0.18	-	-	-	-	0.14	-	-	-	-	-	-	-	-
Redstripe Rock.	-	0.31	0.23	0.21	-	-	-	-	-	-	-	-	-	-	-	-
Rex Sole	0.03	0.30	0.04	0.04	-	-	-	-	-	-	-	0.07	-	-	-	-
Rougheye Rock.	0.25	0.65	0.15	0.15	0.27	0.17	0.15	0.16	-	-	-	-	-	-	-	-
Rock Sole	0.09	0.06	0.09	0.03	0.18	-	-	-	-	-	-	0.06	-	-	-	-
Rosethorn Rock.	-	-	0.07	-	-	-	-	-	-	-	-	-	-	-	-	0.29
Sablefish	0.03	0.08	0.78	1.60	1.47	1.05	1.16	1.92	1.09	-	0.95	2.21	-	-	-	-
Sharpchin Rock.	0.07	0.57	-	-	0.36	-	-	-	-	-	-	-	-	-	-	-
Shortraker Rock.	0.08	0.49	0.06	0.08	-	0.16	0.16	0.10	-	-	-	-	-	-	0.14	0.10
Silvergrey Rock.	-	0.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Starry Flounder	0.03	0.13	0.08	0.04	-	-	-	0.41	-	-	-	-	-	-	-	-
Thornyheads	0.13	0.41	0.97	1.34	0.55	0.53	0.83	1.10	0.51	-	-	0.50	-	-	-	1.81
Yelloweye Rock.	-	-	0.17	0.19	-	-	0.10	0.17	0.15	-	-	1.19	-	-	-	0.16
Yellowfin Sole	0.09	-	0.07	0.06	-	-	0.06	-	-	-	0.06	0.06	-	-	-	-
Yellowtail Rock.	-	-	-	-	-	-	-	0.31	-	-	-	-	-	-	-	-

Description: This table reports the ex-vessel price per pound (round weight) of groundfish species. Prices are provided by for the years 1992-95.
Source: PacFIN

3.9 Ex-Processor Prices

The source of these prices is the processor price surveys from 1992 through 1994. The 1995 prices are assumed equal to the 1994 prices. A price set was created by year, processor class, BSAI/GOA regions, species and product.

Each year a survey is mailed to the processors of Alaska groundfish requesting production and ex-processor price information. When the survey is mailed by NMFS, the WPR product tons are included as a starting point for the processor. The processor is then asked to adjust the weight of the products reported by NMFS, and add quarterly price information.

A weaknesses in this data includes tracking processors across years. Without that ability, the people involved in collecting, processing, and analyzing the data cannot:

1) Compare the production of a processor across years to check accuracy for the reporting, keying, and programming of the data.

2) Check for consistency in the products and species being reported by processor in different year.

3) Determine if the processor did not report because the ownership changed and was assigned a new number.

If these potential sources of error could be checked, it would likely improve the quality of the data. Table 3.16 reports the ex-processor price per metric ton of product used in this analysis.

Prices used in this document are based on the 1994 processor survey. Prices from a processor, for a particular product, that appeared to be unreasonably low were replaced by the industry average. There could be several reasons for the price from a processor to seem low, and not reflect the value of most of the product in that category. For example, a processor may have produced very little of a product in 1994, and the product that was produced was a low grade. Then in 1995, they increased their production of that product form, and produced a high grade product. Applying the low price reported in 1994 would not reflect the true value of the product produced in 1995. Another reason the price could be too low is inaccurate reporting of the data, or entering the data inaccurately.

Table 3.16. Ex-processors Prices Per Metric Ton of Product.

Year	Product	Longline	Pot	Trawl CV	Trawl CP
1992	E. H&G	$ 1,830.38	$ 1,602.44	$ 1,201.90	$ 1,544.87
	Fillets	$ 4,446.41	$ 4,354.42	$ 4,522.18	$ 4,155.85
	H&G/Roe	$ 2,072.32	$ -	$ -	$ -
	Kirimi	$ -	$ -	$ -	$ -
	Meal (+)	$ 482.85	$ 495.56	$ 488.27	$ 587.30
	Parts	$ 1,383.47	$ 1,431.66	$ 794.07	$ -
	Roe/Milt	$ 2,372.28	$ -	$ 2,222.78	$ 2,381.23
	Salted	$ 2,827.89	$ 3,143.50	$ 3,387.05	$ -
	Surimi/Mince	$ 1,187.20	$ 1,285.76	$ 1,722.24	$ 1,123.21
	W. H&G	$ 1,726.19	$ 1,691.43	$ 1,565.27	$ 1,533.78
	Whole (-)	$ 910.40	$ 1,191.08	$ 1,330.43	$ 911.21
1993	E. H&G	$ 1,819.95	$ -	$ 1,102.30	$ 1,430.33
	Fillets	$ 3,431.71	$ 3,963.75	$ 3,990.29	$ 3,367.49
	H&G/Roe	$ -	$ -	$ -	$ 683.43
	Meal (+)	$ -	$ 433.50	$ 440.67	$ 576.95
	Parts	$ 3,399.71	$ 551.15	$ 551.15	$ 2,564.23
	Roe/Milt	$ 2,199.15	$ -	$ 1,736.98	$ 1,785.80
	Salted	$ -	$ 2,595.27	$ 2,326.19	$ -
	Surimi/Mince	$ 850.27	$ 602.61	$ 791.90	$ 925.93
	W. H&G	$ 1,358.24	$ 1,417.07	$ 1,083.72	$ 1,271.77
	Whole (-)	$ 1,170.00	$ -	$ 1,073.33	$ 617.29
1994	E. H&G	$ 1,768.92	$ 1,735.28	$ 1,485.95	$ 1,405.25
	Fillets	$ 3,631.41	$ 3,296.19	$ 3,821.12	$ 3,891.49
	H&G/Roe	$ -	$ -	$ -	$ -
	Meal (+)	$ -	$ 457.17	$ 445.83	$ 529.10
	Parts	$ 4,122.47	$ -	$ 1,130.44	$ 3,014.68
	Roe/Milt	$ 1,617.99	$ 1,689.72	$ 1,834.80	$ 1,345.20
	Salted	$ -	$ 1,763.68	$ 1,543.22	$ -
	Surimi/Mince	$ 872.84	$ 793.66	$ 760.77	$ 1,675.88
	W. H&G	$ 1,633.46	$ 1,653.45	$ 1,103.97	$ 1,357.05
	Whole (-)	$ 789.90	$ 611.62	$ 879.19	$ 607.94
1995	E. H&G	$ 1,761.80	$ 1,696.04	$ 1,380.74	$ 1,389.21
	Fillets	$ 3,479.60	$ 4,052.33	$ 3,822.15	$ 3,845.89
	H&G/Roe	$ -	$ -	$ -	$ -
	Kirimi	$ -	$ -	$ -	$ -
	Meal (+)	$ -	$ -	$ 432.91	$ 520.52
	Parts	$ 4,205.34	$ 6,613.80	$ 1,644.68	$ 2,971.76
	Roe/Milt	$ 1,601.24	$ 2,891.90	$ 2,524.46	$ 1,406.86
	Salted	$ -	$ 1,763.68	$ 1,543.22	$ -
	Surimi/Mince	$ 874.80	$ 595.24	$ 1,147.56	$ 1,252.72
	W. H&G	$ 1,645.81	$ 1,551.81	$ 1,137.92	$ 1,360.92
	Whole (-)	$ 908.60	$ 919.25	$ 882.70	$ 1,763.68

Description: This table reports the ex-processor price per metric ton by product form. These data are based on 1992-1994 annual processor surveys conducted by ADF&G and NMFS.
Source: Annual Operator Reports

3.10 Gross Revenue at the Processor Level

Calculating the gross revenue of each fishery involved several steps. First, we obtained the ex-processor price information by processor class. These classes broke shore-based processing plants out into six classes based on the plant's location. Catcher processors were divided into categories based on the gear they used and the products they produced. Finally, all motherships were grouped together. Additional information on each processor class is provided below:

Shore Plants: Shore-based processing facilities have been aggregated into a single SP class. This was done for confidentiality reasons. The processing vessel Northern Victor was also included in the shore plant class.

Motherships: All motherships have been grouped into a single class.

Pot Cod: These are all the vessels that used pots to catch Pacific cod (both catcher vessels and catcher processors).

Longline Processors: This category consists of freezer longliners (LP) which have not reported using pots or trawls to harvest fish or crab in the North Pacific.

Trawler Processors: We defined three categories of trawler processors based on their processing activities and capacities:

TP1: Vessels which reported processing significant amounts of surimi were classified in the trawler-processor 1 (TP1) category.

TP2: Vessels which reported processing significant amounts of fillets and were longer than 150' LOA were classified in the trawler-processor 2 (TP2) category.

TP3: These vessels all reported the use of trawl gear in the North Pacific. Many of these vessels have also reported the use of other gears such as longline and pots. These vessels primarily produce headed and gutted product and do not produce large amounts of fillets, and are generally less than 150' LOA.

An ex-processor price for each species, product form, and fishery was calculated using the 1992-1994 processor survey data described in Section 3.6. WPR data for each year was then aggregated by species, product, and fishery to calculate the tons of products within each category. A list of the NMFS product forms, and how they were aggregated into NPFMC products, is shown in Table 3.12. This weight was then multiplied by the ex-processor price per ton to generate the total value of products in each category. The total product value by category was then divided by the total product tons to determine the value per ton of product. We then estimated a product recovery rate. This was accomplished by dividing the tons of round fish that went into each species/product by the tons of product produced. Before the division was performed, ancillary product records were checked to make sure the product tons field was not equal to zero. If the product tons field was zero, it was replaced with a value of 0.001 tons. This allowed the division to result in a valid number. Next, a product mix was calculated for each species and product combination by fishery. The round weight of the products was divided by the total round weight for all species and product forms in that fishery. Once again, zeros in the denominator were assumed to equal 0.001 tons. Summing the results of the product mix calculation by species and fishery will always equal one. Using the Pacific cod longline fishery in 1995 as an example of the results generated from the mix calculation, we see that seven different products were produced from Pacific cod. Over 84.5% of the products were Eastern cut H&G, 14.7% were Western cut H&G, and the remaining five products made up less than 1% of the total. When these percentages are summed, they equal 100%.

Gross revenue can now be calculated using the pieces of information described in the previous paragraph. This document will be based on gross revenue calculated using round tons and a retention rate from the blend data. The actual formula used to calculate gross revenue is:

Gross Revenue = Round Weight (Blend) * Retention Rate (Blend) * Product Mix *PRR*Price Per Ton

The gross revenues estimated using this formula are reported in Tables 3.17 and 3.18.

Table 3.17 Gross Revenue Generated From All Species Caught in Pacific Cod Target Fisheries

Year	Millions of Dollars					Percent of Total Gross Revenue from PCOD				
	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	All
1995	$79.97	$15.60	$27.41	$28.18	$151.16	52.90%	10.32%	18.13%	18.64%	100.00%
1994	$73.57	$ 6.89	$28.39	$13.75	$122.60	60.01%	5.62%	23.16%	11.21%	100.00%
1993	$54.60	$ 2.10	$26.42	$20.23	$103.35	52.83%	2.03%	25.56%	19.58%	100.00%
1992	$91.70	$11.40	$24.26	$30.34	$157.70	58.15%	7.23%	15.38%	19.24%	100.00%

Description: This table reports the estimated revenues generated from Pacific cod at the ex-processor level. The metric tons of raw fish that went into each product was taken from blend data. Product mix and product recovery rates were calculated using WPR data.
Source: Estimated using Blend, WPR, and Annual Operator Report data for 1992-95.

Table 3.17 reports the gross revenue generated at the ex-processor level for all species processed in the Pacific cod target fishery. This would include pollock, flatfish, or any other species that was processed and had value, that was harvested when cod was the target fishery. Table 3.18 reports only the value of cod that was harvested and processed during a cod fishery. Cod that was caught as bycatch in another groundfish fishery and processed would not be included in this table. Therefore, the trawl fleet which has higher levels of cod bycatch in other fisheries will tend to have their total gross revenue from cod under estimated in Table 3.18. The fixed gear vessels harvest almost all of their cod in a cod target fishery, so their total gross revenue from cod will not be under estimated as much as the trawl fleet's.

Table 3.18. Estimated Gross Revenue Generated from Pacific Cod Caught in Cod Target Fisheries (Based on Blend Data)

Year	Millions of Dollars					Percent of Total Gross Revenue from PCOD				
	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	All
1995	$ 79.63	$ 15.60	$ 26.61	$ 21.63	$ 143.46	55.50%	10.87%	18.55%	15.08%	100.00%
1994	$ 73.30	$ 6.89	$ 27.78	$ 11.37	$ 119.33	61.42%	5.77%	23.28%	9.53%	100.00%
1993	$ 54.41	$ 2.10	$ 26.16	$ 18.19	$ 100.87	53.95%	2.08%	25.93%	18.04%	100.00%
1992	$ 91.61	$ 11.40	$ 23.32	$ 26.29	$ 152.63	60.02%	7.47%	15.28%	17.22%	100.00%

Description: This table reports the estimated revenues generated from Pacific cod at the ex-processor level. The metric tons of raw fish that went into each product was taken from blend data. Product mix and product recovery rates were calculated using WPR data.
Source: Estimated using Blend, WPR, and Annual Operator Report data for 1992-95.

For comparison, gross revenue was also calculated based on round tons from the WPR data. This information is included in Table 3.19. Because the same prices were used in each case, the difference in gross revenue is a result of changes in the round tons. In fact, gross revenues by fishery are quite different when based on WPR versus Blend data. However, the total gross revenues by year are not. The main reason for the differences within fisheries is that finished product data in the WPR is not gear specific. We are unable to determine if the pot vessels catch of Pacific cod in the WPR data was processed into salt cod or an H&G product, or even if the fishery should be classified as trawl catcher vessel or pot.

Table 3.19 Gross Revenue Generated From Pacific Cod Caught in All Fisheries (WKP)

	Millions of Dollars					Percent of Total Gross Revenue from PCOD				
Year	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	All
1995	$ 77.11	$ 4.97	$ 45.75	$ 20.04	$ 147.87	52.15%	3.36%	30.94%	13.55%	100.00%
1994	$ 68.40	$ 1.60	$ 31.46	$ 16.23	$ 117.69	58.11%	1.36%	26.73%	13.79%	100.00%
1993	$ 48.01	$ 4.50	$ 26.32	$ 18.82	$ 97.65	49.16%	4.61%	26.96%	19.28%	100.00%
1992	$ 83.77	$12.59	$ 27.30	$ 28.32	$ 151.99	55.11%	8.29%	17.96%	18.63%	100.00%

Description: This table reports the revenues generated from Pacific cod at the ex-processor level. The metric tons of raw fish that went into each product was taken from WPR data. Product mix and product recovery rates were calculated using WPR data.
Source: Estimated using WPR, and Annual Operator Report data for 1992-95.

Initially, it was assumed that the retained tons by fishery in each data set would be close to the same. This turned out not to be the case because we could not accurately determine the target fishery. The differences between the totals in the blend and WPR sections are a result of slight differences in the round tons reported in each data set. Changes between fishery are the result of WPR data not identifying the gear used to harvest the finished product. Using the Pacific cod pot fishery as an example, the WPR gross revenue was estimated to be $4.97 million in 1995, while the blend estimate was $15.60 million. The difference between the two estimates was due to the targets being improperly assigned due to the lack of gear data.

3.11 Harvesting and Processing Cost

The net benefit to the Nation of a particular use of cod cannot be determined without knowing the variable harvesting and processing cost associated with that use. Unfortunately, only limited and dated estimates of harvesting and processing cost are available. Estimates of variable harvesting and processing costs for factory trawlers, freezer longliners, and pot catcher processors are available from the initial analysis of the cod allocation in 1993. However, comparable estimates are not available for other types of cod operations (e.g., trawler catcher vessels or pot catcher vessels delivering to on-shore plants).

The differences among the 1993 estimates of the variable cost per metric ton of cod catch for those three types of catcher processors were quite small. Using 1992 prices, which are closer to the current prices than are the 1991 prices, the estimated costs per ton of cod catch are $545 for longliners, $534 for pot boats, and $579 for trawlers. In 1992 these differences were not large enough to affect the ranking of these three types of catcher processors in terms of estimated net benefit per metric ton of cod catch. If this continues to be the case, comparing gross value net of the opportunity costs of prohibited species and groundfish bycatch would be sufficient to determine whether a specific change in the allocation of cod among user groups would tend to increase or decrease net benefits to the Nation.

Some cost information was provided during public testimony at the April Council meeting. Specifically, a representative of the freezer longliners indicated that the 1993 cost estimates were still valid and a representative for pot catcher boats indicated that the cod fishery was not a profitable fishery for the pot vessels that principally participate in the crab fisheries. The latter comment suggests that the variable harvesting cost per metric ton of cod catch may be higher for pot catcher vessels than for trawl catcher vessels. The fact that some processors pay a higher exvessel price for pot caught cod than for trawl caught cod of comparable quality supports that possibility.

Recently, a representative for the American Factory Trawler Association indicated that there have been a number of changes in the factory trawler operations and that without more analysis it is difficult to determine if the 1993 estimates are of use in 1996. The changes include the following: (1) the use of catcher vessels to supplement the harvesting capacity of factory trawlers that produce fillets; (2) the use of filleting machines that are faster and capable of filleting a larger range of cod sizes; (3) other changes to their processing lines that have increased recovery rates and processing capacity; (4) the use of larger mesh trawls; and (5) decreased product prices. The decreases in prices provided a strong incentive for most of the other changes.

If the 1993 variable cost estimates are used for each of the three groups of catcher processors, if the variable cost for trawl catcher vessels and on-shore processors are assumed to be comparable to those of factory trawlers, and if the variable cost is assumed to be $0.02 per pound or about $44 per metric ton higher for pot caught cod than for trawl caught cod, the estimates of the variable cost per metric ton of cod catch are as follows: trawl, $579; longline, $545; pot at-sea processing, $543; and pot on-shore processing, $623. Information provided through the public comment process is expected to clarify the usefulness of these cost estimates and to identify reasonable changes to those estimates.

3.12 Opportunity Costs

When fish are taken as bycatch in one commercial fishery, other uses of those fish are precluded. The alternative uses of fish include: (1) retained target catch in the same commercial fishery; (2) catch and bycatch in another commercial fishery; (3) catch and bycatch in subsistence and recreational fisheries; and, (4) contributions to the stock and other components of the ecosystem. Although, the opportunity cost of using fish as bycatch is defined as the net value of the highest valued alternative use, in practice it is useful to consider the opportunity cost of bycatch mortality in terms of the net value of the uses that are decreased due to bycatch.

Opportunity costs are important because they are needed to estimate the net revenue to society. If the net revenue to society[2] from the production of fish products were calculated the formula would be:

Gross Revenue - Variable Cost - Opportunity Cost = Benefits From Production to Society.

In this equation, opportunity cost represents the <u>net value</u> of the alternative production uses that are decreased due to bycatch. In other words, the opportunity is the gross revenue of foregone catches in other fisheries net of the harvesting and processing costs it would have taken to produce that value, i.e.:

Opportunity Cost = Gross Revenue Reductions - Processing and Harvesting Cost Savings

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[2]This discussion focuses on the benefits of society from the perspective of production. It ignores, for the moment, the benefits to society from the perspective of the consumer. Also note that opportunity costs are not necessarily felt by the individual fishing firm. For example, a vessel that only fishes cod may not be concerned with the amount of pollock they take as bycatch because it does not reduce the gross revenue of their operation. In this case, the opportunity cost of pollock bycatch is borne by other members of industry and society in general.

Bycatch mortality in the BSAI cod fisheries results in foregone opportunities in the halibut, crab, salmon, and herring fisheries and in other groundfish fisheries. The methods used to estimate the cost of those foregone opportunities are described below.

The simplest case is that in which bycatch in one fishery results in a comparable reduction in catch in another fishery the same year. For example, if each 1,000 mt of pollock bycatch in the cod fishery results in a 1,000 mt reduction in pollock catch in the pollock fishery, the opportunity cost of that bycatch equals the net benefit foregone in the pollock fishery. The foregone net benefit is calculated as the difference between the gross product value after primary processing and the variable harvesting and primary processing costs. Foregone net benefits beyond primary processing are ignored just as the benefits of a cod fishery beyond primary processing are ignored. In the absence of the variable harvesting and processing cost data that are required to calculate foregone net benefits in the groundfish fisheries, either foregone gross value can be used as a measure of the cost of bycatch or an attempt can be made to eliminate much of the upward bias that is introduced by using foregone gross value as a proxy for foregone net value. The latter could be done, for example, by assuming that foregone net benefits are 50% of the foregone gross product value. The cost data that are available suggest that variable harvesting and processing costs generally are at least 50% of the gross product value. While this approach could be calculated, the uncertainty around the actual percentage that should be used is unknown. Therefore, an estimate of reduced gross revenue has been provided. For comparison, readers could estimate net benefits with the 50% variable cost assumption if they wish.

In this analysis, we use reductions in gross revenues as a proxy for opportunity costs of bycatch. We do not estimate the cost savings in the opportunity cost equation for two reasons: (1) cost estimates of harvesting and processing costs are unavailable for the fisheries affected by bycatch as well as for the groundfish fisheries, and (2) Comparing net value of opportunity cost against gross revenue values in the groundfish fisheries, would introduce a downward bias on the effects of bycatch. Comparing gross revenues in the groundfish fisheries to reduced gross revenues in the fisheries of opportunity is a more even-handed approach. However, the use of reduced gross revenues may tend to over estimate the opportunity cost of bycatch. Therefore, we would urge the reader to bear in mind that without cost information, the impacts of bycatch are likely to be distorted.

For each of the four groundfish species that account for the bulk of the groundfish bycatch in the cod fisheries, the potential foregone gross product value per metric ton of bycatch was estimated by multiplying the bycatch of a given target species by the estimated gross revenue per ton of target catch of that species. For example, the estimate of the potential foregone gross product value per metric ton of pollock bycatch in the cod fisheries was estimated by multiplying the bycatch of pollock in each cod target fishery by the gross revenue per ton of pollock in the appropriate pollock fisheries. This method of estimation is based on the assumption that bycatch of pollock in the cod fisheries will reduce the amount of pollock that can be taken in the pollock fisheries before the pollock fisheries are closed and that the reduction in pollock catch will be accompanied by a reduction in the catch and product value of all species in the pollock fisheries. That assumption is consistent with the in-season management of the groundfish fisheries.

If not enough of a TAC is taken to trigger a closure of the fisheries that target on that species, neither catch nor gross product value is foregone in those fisheries due to bycatch of that species in other fisheries. In this case, the foregone net benefit in other groundfish fisheries is zero and it is another use of that species that is precluded by bycatch. Generally, the other use would be the "stock benefit" resulting from the fish being left in the sea. The net benefit of this use, which is in terms of its contribution to the value of the ecosystem, is difficult to estimate. Depending on the resulting effects on the various elements of the ecosystem, the net benefits could be positive or negative. However, if the population of the species that is taken as bycatch is not affected significantly by bycatch mortality, the effects are less likely to be significant. Because the estimates of the opportunity cost of groundfish bycatch used in this report are in terms of foregone product value, it is implicitly assumed that the value of these other uses is zero. The estimates of the foregone gross and net product value per metric ton of bycatch when a TAC does limit catch in a target fishery are presented below by species. The species for which the TAC are expected to limit target catch vary somewhat among the alternatives considered. Generally, only the pollock and cod TACs are expected to limit target catch.

The value of the opportunities foregone in the halibut fishery due to halibut bycatch mortality in the groundfish fisheries is more difficult to estimate because halibut bycatch in one year can affect halibut fishery quotas in each of the next 25 years. Fortunately, a great deal of research has been undertaken over the years to assess the impact of halibut bycatch. The IPHC [Hare, 1996] has found that, for each of the three main gear types (pots, trawls, and longlines) used to harvest BSAI Pacific cod, there is a distinct pattern of future yield loss in the halibut fishery due to differences in the size composition of the halibut taken as bycatch. In the trawl fishery, for example, bycatch mortality is generally associated with juvenile halibut which have not yet recruited into the halibut fishery. In 1994, only 7.3% of the halibut caught in groundfish trawl fisheries were adults. This compares to 19.6% in the longline fishery and 20.2% in the pot fishery. These percentages change over time as well. The five-year average values are 10.3% in the trawl fishery, 37.5% in the longline fisheries, 52.5% in the pot fisheries. The IPHC has found that a lower percent of adults in the bycatch actually equates to a greater reduction in future directed halibut harvests, based on growth, recruitment and natural mortality of halibut. The IPHC estimates that the yield loss in the halibut fishery over a 25-year period per metric ton of halibut bycatch morality is on average 1.75 mt for the BSAI cod trawl fishery, 1.082 mt for the cod longline fishery, and 1.025 mt for the cod pot fishery.

As mentioned above, the reduced harvest level in the halibut fishery occurs over a 25-year period; therefore, it is necessary to discount future earnings when calculating the opportunity costs of bycatch. Discounting assumes that earnings in the future are worth less today than are earnings which occur in the present. The appropriate discount rate is controversial. The higher the discount rate, the lower the present discounted value of future earnings. A zero discount rate means that earnings in the future are valued equally with present earnings. In this analysis, we use a 5% discount rate to calculate the discounted present value of the yield loss in the halibut fishery. This rate is lower than discounts rates used in financial markets, where a 10% rate might be typical, and is somewhat conservative in that it places a rather high value on future earnings.

According to the IPHC [Trumble, 1996], the average price per pound for landed halibut in 1995 was $1.95 for Alaska. The Alaska Region of NMFS [Carey, 1996] indicated that the lease price for halibut IFQ is about $1 per pound net weight. Industry sources indicated that the F.O.B. Alaska price of halibut is about $2.50 per pound and that, with these ex-vessel and product prices, the processors are not doing much more than covering their variable costs. This suggests that the net benefit per pound of halibut in the halibut fishery is not much more than the $1 per pound that fishermen are willing to pay to lease halibut IFQs. Using gross and net product values of $2.50 and $1 per pound, a 5% discount rate, and the 25-year yield loss estimates provided by the IPHC, the discounted present values of the foregone gross and net product values in the halibut fishery per pound (round weight) of halibut bycatch mortality, respectively, are $2.54 and $1.02 for the cod trawl fishery, $1.74 and $0.70 for the cod longline fishery, and $1.70 and $0.68 for the cod pot fishery.[3]

Future catch in the halibut fishery is not the only alternative use of halibut that is taken as bycatch mortality in a cod fishery. Another alternative use is being taken as bycatch in another groundfish fishery. For example, if the halibut PSC allowance for another trawl fishery reduces the groundfish catch in that fishery, the halibut PSC allowance and catch in the cod trawl fishery reduce the opportunities in the other trawl fishery. The opportunity cost, in terms of foregone gross product value for that other trawl fishery, per metric ton of halibut PSC allowance for the cod trawl fishery is determined by the gross product value per metric ton of halibut mortality in that other trawl fishery. Estimates of the gross groundfish product value per metric ton of halibut bycatch mortality are

[3]Technically, opportunity costs occur when activity in other fisheries actually reduces the amount of harvest in the directed fishery. In other words, the TAC of the target species must be taken before an opportunity cost kicks in. In 1995, the harvest of halibut in the BSAI halibut fishery was roughly 25% [RAM, 1996] short of the quota. It could be argued that there were no opportunity costs of halibut bycatch in the Bering Sea groundfish fisheries. In this analysis, however, we assume that the harvest shortfall in the initial year of the halibut IFQ system was an anomaly, and that in the future the entire halibut quota will be taken and opportunity costs of bycatch will exist.

presented below for each of the trawl fisheries that has been constrained by its halibut PSC allowance. The total opportunity cost of halibut bycatch in the cod trawl fishery in terms of foregone product value in other trawl fisheries as a group is determined by the increase in product value for those fisheries that would be associated with the optimal redistribution of the entire cod trawl fishery halibut PSC allowance among the other trawl fisheries.

The optimal redistribution depends both on the extent to which catch is constrained in each trawl fishery by its halibut PSC allowance and on the net value per metric ton of halibut bycatch mortality in each trawl fishery. If the halibut PSC allowance for the cod trawl fishery were to be reallocated to other trawl fisheries 1 mt at a time, the reallocation should be to the other trawl fishery with the highest net value per metric ton of halibut bycatch mortality until that fishery is no longer constrained by its halibut PSC allowance and then the allocations should go to the other trawl fishery with the next highest net value per metric ton of halibut bycatch until its catch is not constrained by its halibut PSC allowance. This process would continue until either all the cod trawl halibut PSC allowance had been redistributed, or until none of the other trawl fishery is constrained by its halibut PSC allowance, which ever occurs first. Therefore, the opportunity cost per metric ton of halibut bycatch in the cod trawl fishery, in terms of foregone product value in other trawl fisheries, is not constant. It is higher for higher levels of bycatch in the cod trawl fishery. The model used to evaluate the alternatives being considered generates estimates of gross revenue per ton of halibut, but because cost information is missing, we cannot estimate the net value necessary to optimize halibut PSC across fisheries. Estimates of gross revenue may, however, provide some indication of the direction any reallocation of halibut should take if an optimal distribution were desired.

The gross revenue generated in the cod target fisheries per pound of halibut mortality are shown in Table 3.20. Since the pot fishery has relatively low levels of halibut mortality it has the highest gross revenue in the cod fishery per pound of halibut bycatch. The trawl catcher vessels, which had the highest halibut bycatch rates, have smallest amount of gross revenue generated per pound of halibut mortality.

Table 3.20. Gross Revenue in Each Target Fishery Per Pound of Halibut Mortality

	Pacific Cod Target Fisheries			
Fishery	Longline	Pot	Trawl CV	Trawl CP
1995	$45.42	$696.26	$15.79	$19.58
1994	$31.91	$666.63	$13.51	$17.42
1993	$56.56	$2,887.90	$15.41	$27.78
1992	$29.45	$385.79	$14.50	$31.57

Description: This table reports the ex-processor gross revenue in the target fishery, per pound of halibut mortality. This means that in the target fishery for cod with longline gear, $45.42 (ex-processor) was generated for each pound of halibut mortality.
Source: Blend, NORPAC, WKP, and Annual Operator Reports from 1992-95.

Bycatch of crab, salmon, and herring in the groundfish fisheries are presumed to create opportunity costs for those fisheries as well. The methods used to estimate the cost of these foregone opportunities are discussed in detail below, in an excerpt from the EA/RIR for Amendment 41. The table below reports the per unit bycatch opportunity cost estimates used in this report and in the EA/RIR for Amendment 41. The estimates are in terms of the discounted present value of foregone net product values in the crab, herring, and salmon fisheries. Net revenue values for the crab fisheries are listed on the last row of this table. These values are taken from Amendment 41.

Table 3.21 Estimates of Reduced Gross Revenue or Bycatch Value Resulting From Bycatch On a Per Unit Basis

Per Pound of Halibut Bycatch By Gear			Per Animal Caught As Bycatch For All Gear					Per Ton - All Gears
Trawl	Longline	Pot	*C. Bairdi*	*C. Opilio*	Red King	Chinook	Other Salmon	Herring
$1.88	$1.29	$1.26	$6.83	$0.72	$24.00	$30.76	$6.44	$1,183
Net values			$2.64	$0.28	$11.04			

The previous discussion focused on the methods of estimating opportunity costs resulting from bycatch in the groundfish fisheries. It also provided estimates on a per unit basis of the appropriate values to use when making these estimates. The following section uses the method and unit values discussed above to estimate annual totals of reduced gross revenues or opportunity costs of bycatch.

3.12.1 Estimates of Total Opportunity Costs of Halibut Bycatch Mortality

The revenues lost by halibut fishermen because of halibut bycatch in the groundfish fishery are provided in the first section of Table 3.22. Lost revenue is reported in millions of dollars. The right side of the table reports the percent of reduced gross revenue by gear sector. Longline vessels accounted for 29.03% of the revenue reductions in the directed halibut fishery. Pot vessels caused less than 0.36% of the total reduction. Trawl catcher vessels had the greatest impact on the directed halibut fishery (41.49%). Trawl catcher processors had about the same impact as the longline fleet (29.12%).

Table 3.22 Reduced Gross Revenue in the Directed Halibut Fishery Resulting from Halibut Bycatch in PCOD Target Fisheries

Year	Millions of Dollars					Percent of Reduced Gross Revenue				
	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	All
1995	$ 2.32	$ 0.03	$ 3.31	$ 2.32	$ 7.98	29.03%	0.36%	41.49%	29.12%	100.00%
1994	$ 3.03	$ 0.01	$ 4.01	$ 1.29	$ 5.29	57.30%	0.25%	75.72%	24.28%	100.00%
1993	$ 1.27	$ 0.00	$ 3.27	$ 1.56	$ 6.10	20.83%	0.02%	53.61%	25.54%	100.00%
1992	$ 2.32	$ 0.03	$ 3.31	$ 2.32	$ 7.98	29.03%	0.36%	41.49%	29.12%	100.00%

Description: This table reports estimates of the reduced revenues in the directed halibut fishery caused by halibut mortality in the directed Pacific cod fisheries. For example in 1995, the cod longline fishery reduced revenues in the directed halibut fishery by $2.32 million, or 29.03% of the total reductions caused by directed cod fisheries in the BSAI.
Source: Blend, NORPAC, WKP, and Annual Operator Reports from 1992-95.

It is estimated that halibut bycatch mortality in the Pacific cod longline fishery cost the directed halibut fishery $2.32 million in 1995. This is based on the $1.29 per pound bycatch value reported in section 3.3.1. The reduced revenue was greater in 1994 at $3.03 million, and 1992 at $4.10 million. Halibut fishermen had their revenue reduced the least by longline bycatch in 1993. That year, the directed longline fishery's revenue was estimated to be reduced by $1.27 million.

The Pacific cod pot fishery had less of an impact on the directed halibut fishery than the Pacific cod longliners. In 1992, they reduced the halibut fishermen's revenue by $40,000. Reduced revenues were next highest in 1995 ($30,000). Both 1993 and 1994 estimates indicate the Pacific cod pot fleet reduced the target halibut fishermen's revenue by $10,000 or less.

Halibut bycatch in the Pacific cod catcher vessel fleet reduced revenues in the directed halibut fishery by $3.19 million in 1992, and $4.01 million in 1994. Reductions of $3.27 and $3.31 million were reported in 1993 and 1995, respectively.

According to these estimates, the Pacific cod trawl catcher processor and longline fleet had exactly the same impact on the halibut fishery during 1995. Each fishery reduced the directed halibut fisheries revenues by $2.32 million. In 1993, the catcher processors ($1.56 million) had a slightly greater impact than the longliners. However, in both 1992 and 1994, the longliners had at least twice the impact of the catcher processors.

3.12.2 Estimates of Total Opportunity Cost of Crab Bycatch

Next, we will focus on the opportunity cost of crab bycatch. As reported earlier, these values are taken from the Bycatch Simulation Model developed by ADF&G. These values per unit are $6.38 for *C. bairdi*, $0.72 for *C. opilio* and $24.00 for red king crab. The mortality rates of bycaught crab in the hook and line and pot fisheries were assumed to be the same as the trawl mortality rates when estimating reduced gross revenue. These rates are different from those reported in Amendment 41 discussed below.

The Pacific cod longline fishery reduced the gross revenue generated by crab fishermen by less than $300,000 each year, 1992-95. Pot Pacific cod fishermen had the most impact in 1992 when they were estimated to reduce the crab fleet's revenue by $1.99 million. Revenues were reduced by $0.61 million or less in each of the other years, and in 1993, it was only $10,000. This large fluctuation indicates wide swings in the reported bycatch of crab by the Pacific cod pot fishermen. Trawl Pacific cod catcher vessels bycatch of crab reduced the crab fleet's revenue by about $0.60 million in each of the last three years. The Pacific cod trawl catcher processor fleet had about twice the impact of the catcher vessels. They generally impacted the crab fleet by about $1 million per year.

Table 3.23 Reduced Gross Revenue in the Directed Crab Fisheries Resulting from Crab Bycatch in Pacific cod Target Fisheries

	Millions of Dollars					Percent of Reduced Gross Revenue				
Year	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	All
1995	$ 0.23	$ 0.61	$ 0.56	$ 1.20	$ 2.60	8.73%	23.56%	21.45%	46.26%	100.00%
1994	$ 0.25	$ 0.19	$ 0.61	$ 0.42	$ 1.22	20.29%	15.77%	50.00%	34.24%	100.00%
1993	$ 0.18	$ 0.01	$ 0.63	$ 1.11	$ 1.92	9.14%	0.63%	32.56%	57.68%	100.00%
1992	$ 0.23	$ 0.61	$ 0.56	$ 1.20	$ 2.60	8.73%	23.56%	21.45%	46.26%	100.00%

Description: This table reports estimates of the reduced revenues in the directed crab fisheries caused by crab bycatch in the directed Pacific cod fisheries. For example in 1995, the cod longline fishery reduced revenues in the directed crab fishery by $0.23 million, or 8.73% of the total reductions caused by directed cod fisheries in the BSAI.
Source: Blend, NORPAC, WKP, and Annual Operator Reports from 1992-95.

The value of crab bycatch to crab fisheries was also estimated in Amendment 41 to the BSAI FMP. That assessment is included in the box below for comparison purposes. The data from Amendment 41 is based on crab bycatch in all directed groundfish fisheries. Table 3.23 was based only on crab bycatch in Pacific cod target fisheries.

It is informative to know what crab bycatch in groundfish fisheries cost the directed crab fisheries. The answer to this question can be derived from the adult equivalent exercise. The value of crab bycatch in groundfish fisheries, based on number of male adult equivalents, is shown in the adjacent table. If groundfish fisheries caught no crab incidentally, the crab fishery may increase total ex-vessel revenues by about 10.5 million dollars. Assuming there are about 275 crab vessels, these crab would equate to about $38,000 per vessel in gross ex-vessel value. Potential costs of proposed alternative crab PSC limits for trawl fisheries can be measured against potential benefits to crab fisheries.

Value of crab bycatch in groundfish fisheries to directed crab fisheries, based on 1993-1995 average bycatch and price.

	Adult male Equivalents	Adult weight	Average price/lb	Total value ($)
Red king crab	33,231	6.5	3.80	820,800
Tanner crab	920,060	2.3	2.80	5,925,000
Snow crab	1,958,138	1.3	1.50	3,818,000
Total				$10,563,800

3.12.3 Opportunity Cost of Groundfish Bycatch

Gross revenue forgone in the groundfish fishery, because of groundfish bycatch, is reported in this section. The Pacific cod pot and longline fisheries had little impact on the rest of the fleet. Just under $2.5 million was the largest annual revenue loss caused by the longline fleet, and the pot fleet never had more than a $10,000 impact. Groundfish bycatch in both the Pacific cod catcher vessel and catcher processor fleets reduced the groundfish fisheries revenue by over $15 million in 1995. These impacts were 50% greater than any of the other three years.

Table 3.24 Reduced Gross Revenue in the Groundfish Fisheries Resulting from Groundfish Bycatch in Pacific cod Target Fisheries

	Millions of Dollars					Percent of Reduced Gross Revenue				
Year	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	All
1995	$ 1.76	$ 0.01	$ 15.12	$ 16.78	$ 33.68	5.24%	0.04%	44.90%	49.83%	100.00%
1994	$ 1.68	$ 0.00	$ 9.17	$ 4.72	$ 13.88	12.10%	0.02%	66.02%	33.96%	100.00%
1993	$ 1.38	$ 0.00	$ 8.33	$ 8.32	$ 18.03	7.65%	0.00%	46.20%	46.14%	100.00%
1992	$ 1.76	$ 0.01	$ 15.12	$ 16.78	$ 33.68	5.24%	0.04%	44.90%	49.83%	100.00%

Description: This table reports estimates of the reduced revenues in the other directed groundfish fisheries caused by groundfish bycatch in the directed Pacific cod fisheries. For example in 1995, the cod longline fishery reduced revenues in the other directed groundfish fisheries by $1.76 million, or 5.24% of the total reductions caused by directed cod fisheries in the BSAI.

Source: Blend, NORPAC, WKP, and Annual Operator Reports from 1992-95.

3.12.4 Opportunity Cost of All Bycatch

The final section in this table reports the reduced gross revenue in all directed fisheries. This section basically sums the results from the three fisheries discussed earlier, and adds in the cost incurred by the salmon and herring fisheries.

Pacific cod longline fishermen's bycatch reduced the gross revenue of all other target fisheries by $4.32 million in 1995 (Table 3.25). Most of the cost ($4.10 million) was borne by the directed halibut fishery. Pacific cod pot fishermen's impact was only $0.65 million in 1995. The directed crab fisheries were most ($0.61 million) impacted. The trawl catcher vessel and catcher processor fleets reduced the gross revenue in other directed fisheries by $19.09 million and $20.40 million, respectively, in 1995. Other groundfish fisheries were most impacted by the trawl fleets.

Table 3.25 Reduced Gross Revenue in the All Directed Fisheries Resulting from Bycatch in Pacific Cod Target Fisheries

Year	Millions of Dollars					Percent of Reduced Gross Revenue				
	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	All
1995	$ 4.33	$ 0.65	$ 19.10	$ 20.43	$ 44.51	9.73%	1.47%	42.91%	45.89%	100.00%
1994	$ 4.96	$ 0.21	$ 13.90	$ 6.49	$ 20.61	24.08%	1.01%	67.48%	31.51%	100.00%
1993	$ 2.83	$ 0.01	$ 12.30	$ 11.13	$ 26.27	10.76%	0.05%	46.83%	42.36%	100.00%
1992	$ 4.33	$ 0.65	$ 19.10	$ 20.43	$ 44.51	9.73%	1.47%	42.91%	45.89%	100.00%

Description: This table reports estimates of the reduced revenues in all directed fisheries (halibut, crab, groundfish, salmon, and herring) caused by bycatch in the directed Pacific cod fisheries. For example in 1995, the cod longline fishery reduced revenues in all other directed fisheries by $4.33 million, or 9.73% of the total reductions caused by directed cod fisheries in the BSAI.
Source: Blend, NORPAC, WKP, and Annual Operator Reports from 1992-95.

3.13 Catch by Permit Fishery

The Council has approved three types of limited entry programs in recent years. Halibut and fixed gear sablefish are currently managed under an IFQ program. This program went into effect in 1995. Early in 1996, the Council's vessel moratorium went into effect. The moratorium limits the number of vessels that can participate in the Bering Sea/Aleutian Island (BSAI) and Gulf of Alaska (GOA) groundfish fisheries. The Council has also passed a license limitation program for groundfish and crab that will build on the moratorium. The Council's license program has not yet been approved by the Secretary of Commerce, but if it is made law, it should be in place by 1998.

Concerns were expressed by members of industry that reducing the Pacific cod TAC available to a sector of the fleet in the Bering Sea may increase their effort in the Gulf of Alaska. The 1995 catch distribution of Pacific cod in Table 3.26 was prepared to show the fleet's catch by permit type. This provides some indication of the number of vessels, and the historical catch of vessels that could move from the Bering Sea into the Gulf.

Table 3.26. 1995 Pacific cod catch from all Pacific cod target fisheries in the GOA and BSAI by vessels under the Council's various limited entry programs.

Program	Fished	Permit	Data	Longline	Pot	Trawl CV	Trawl CP	Grand Total
Sablefish IFQ	BSAI	NO	M. Tons	35,253	16,230	28,289	28,912	108,684
			Vessels	13	101	103	41	180
		YES	M. Tons	58,701	2,486	2,879	0	64,067
			Vessels	38	7	5	0	111
	BSAI Metric Tons			93,955	18,716	31,169	28,912	172,751
	BSAI Vessels			51	108	108	41	291
	GOA	NO	M. Tons	1,756	9,307	27,090	2,563	40,715
			Vessels	98	130	131	15	270
		YES	M. Tons	9,011	6,273	7,820	0	23,103
			Vessels	69	26	21	0	150
	GOA Metric Tons			10,766	15,580	34,910	2,563	63,819
	GOA Vessels			167	156	152	15	420
Total Metric Tons				104,721	34,296	66,078	31,475	236,570
Total Vessels				202	224	216	45	604
Moratorium	BSAI	NO	M. Tons	7,272	1,759	3,731	2,262	15,024
			Vessels	10	4	18	4	30
		YES	M. Tons	86,682	16,957	27,438	26,650	157,727
			Vessels	41	104	90	37	261
	BSAI Metric Tons			93,955	18,716	31,169	28,912	172,751
	BSAI Vessels			51	108	108	41	291
	GOA	NO	M. Tons	3,249	3,794	7,170	38	14,251
			Vessels	46	18	19	2	80
		YES	M. Tons	7,517	11,787	27,739	2,525	49,568
			Vessels	121	138	133	13	340
	GOA Metric Tons			10,766	15,580	34,910	2,563	63,819
	GOA Vessels			167	156	152	15	420
Total Metric Tons				104,721	34,296	66,078	31,475	236,570
Total Vessels				202	224	216	45	604

Table 3.26 continued

Program	Fished	Permit	Data	Longline	Pot	Trawl CV	Trawl CP	Grand Total
Groundfish Licenses	BSAI	BSA	M. Tons	23,926	3,969	2,041	15,105	45,041
			Vessels	7	52	11	16	85
		GOA	M. Tons	180	672	98	1,335	2,285
			Vessels	3	8	9	2	18
		GOA/BSAI	M. Tons	62,676	12,284	26,400	12,472	113,833
			Vessels	33	45	82	22	173
		None	M. Tons	7,173	1,790	2,629	0	11,593
			Vessels	8	3	6	1	15
	BSAI Metric Tons			93,955	18,716	31,169	28,912	172,751
	BSAI Vessels			51	108	108	41	291
	GOA	BSA	M. Tons	4	1,171	559	98	1,831
			Vessels	2	20	3	1	24
		GOA	M. Tons	1,422	8,147	14,429	51	24,049
			Vessels	96	97	75	3	221
		GOA/BSAI	M. Tons	6,135	3,166	15,410	2,414	27,125
			Vessels	30	29	69	11	125
		None	M. Tons	3,205	3,096	4,512	0	10,813
			Vessels	39	10	5	0	50
	GOA Metric Tons			10,766	15,580	34,910	2,563	63,819
	GOA Vessels			167	156	152	15	420
Total Metric Tons				104,721	34,296	66,078	31,475	236,570
Total Vessels				202	224	216	45	604
Crab Licenses	BSAI	No	M. Tons	86,729	2,096	17,602	27,272	133,699
			Vessels	47	14	73	38	159
		Yes	M. Tons	7,225	16,620	13,567	1,640	39,052
			Vessels	4	94	35	3	132
	BSAI Metric Tons			93,955	18,716	31,169	28,912	172,751
	BSAI Vessels			51	108	108	41	291
	GOA	No	M. Tons	10,128	10,743	28,260	1,840	50,971
			Vessels	154	97	117	14	327
		Yes	M. Tons	638	4,837	6,650	723	12,848
			Vessels	13	59	35	1	93
	GOA Metric Tons			10,766	15,580	34,910	2,563	63,819
	GOA Vessels			167	156	152	15	420
Total Metric Tons				104,721	34,296	66,078	31,475	236,570
Total Vessels				202	224	216	45	604

The groundfish license section of Table 3.26 reports the catch of Pacific cod in the BSAI and GOA. Both of these catch areas are then divided into four license categories: a BSAI license only, GOA license only, GOA/BSAI license, and those who did not qualify for any license. In this example, we will focus on the trawl vessels that fished the BSAI and would hold a license for both the BSAI and GOA. These are the vessels that can move back and forth between the BSAI and GOA. The trawl catcher vessels qualified to fish both the GOA and BSAI under the license program caught 26,400 tons of the 31,169 ton BSAI total. This group of vessels will have the flexibility to move into the GOA if their Pacific cod allocation is reduced in the BSAI. In terms of number of vessels, 82 out 108 vessels qualified for both areas. The catcher processor fleet had 22 out of 41 vessels qualify for both areas. These vessels caught less than half of the total Pacific cod taken by the catcher processor fleet.

3.14 Groundfish Observer Coverage

One request from the AP in January was to include information on the various levels of observer coverage in the fisheries that catch cod. The observer coverage percentage was determined by matching records from the Observer NORPAC database to records in the NMFS Alaska Region blend data for at-sea vessels and Alaska State Fish Tickets for vessels delivering to onshore processors. The match is by vessel and date (week ending for at-sea, landing date for onshore). If an observer was on a vessel any time during a week, that week is considered observed, and the catch amount in the blend or fish ticket data is tagged as observed vessel catch. A ratio calculated on the NORPAC data of catch amounts in sampled hauls versus NORPAC catch amounts in unsampled hauls for a vessel/week is placed on the corresponding blend or fish ticket record and multiplied by the catch amounts on the blend or fish ticket record to produce the observed hauls amounts. The blend and fish ticket catch amounts are grouped by target/gear and vessel class categories and the percentages calculated.

Be aware of the following notes. A fish ticket record is included only if it delivered to an onshore processor listed in the blend data. Harvester vessels delivering to motherships are not represented, only the mothership itself. Because the match between databases is less than perfect (94% - 98%), the percent observed may be slightly low. The target designation on the fish tickets is calculated using the same algorithm as used by the NMFS Alaska Region for the blend, however, a target is calculated per catcher vessel landing date, rather than per processor week.

Harvest vessel classes are used in this document to group similar vessels. Classes like these were used in the most recent versions of the License Limitation and In-shore/Off-shore analyses. The classes in this analysis are more aggregated than those used in previously. A complete list of the classes and their definitions is included below:

Vessel Class	Definition
LH	Vessels that only used longline gear and did not processes fish.
LP	Vessels that only used longline gear and processed fish at-sea.
MSC	Vessels that did not fit in any of the other classes.
PCP	Vessels that harvested fish with pots (both catcher vessels and catcher processors), but did not use trawl gear at an time.
TH1	Trawl catcher vessels greater than 125' that may also use pots.
TH2	Trawl catcher vessels 90-125' that may also use pots.
TH3	Trawl catcher vessels 58-90' that may also used longline and pot gear.
TP1	Trawl catcher processors that can processes surimi/fillets/H&G. These vessels are generally over 200' in length.
TP2	Trawl catcher processors that can process fillets and H&G. These vessels are generally over 200' in length.
TP3	Trawl catcher processors that can process H&G. These vessels are generally less than 150'.

Table 3.27 lists the catch by vessel class and fishery for the years 1992 through 1995. This data is provided so the reader can roughly estimate the amount of catch that was observed or unobserved. Because the data used to calculate the percent of observer coverage and the total weight differ slightly, they were versions of blend data;

any estimated weights should only be considered as approximations. Confidential data has been deleted from Table 3.27, as required by law.

Table 3.27 Catch of Pacific cod by Vessel Class 1992-95

Gear	Class	1992	1993	1994	1995
Longline	LH	167	50	122	6
	LP	78,251	53,750	69,935	75,777
	MSC	5,806	2,806	3,011	4,529
	PCP	157	2	4,584	2,722
	TH2	5	-	-	-
	TH3	18	-	0	0
	TP2	4,484	1,884	2,288	436
	TP3	13,182	7,662	7,200	10,693
Sub-total		102,071	66,153	87,139	94,163
Pot	LP	-	-	-	498
	MSC	9,319	808	840	2,495
	PCP	3,632	1,290	7,273	14,779
	TH1	-	-	-	4
	TH2	104	-	-	748
	TH3	-	-	123	259
	TP3	627	-	-	-
Sub-total		13,681	2,098	8,236	18,782
Trawl CV	LH	-	-	87	32
	LP	1	-	-	14
	MSC	12,006	4,591	2,646	2,905
	PCP	-	-	108	92
	TH1	1,146	6,593	6,434	6,530
	TH2	6,959	17,100	23,890	26,411
	TH3	9,922	12,720	10,261	13,209
	TP1	20	10	80	537
	TP2	-	8	22	355
	TP3	136	22	64	121
Sub-total		30,190	41,045	43,592	50,208
Trawl CP	LP	224	-	162	0
	MSC	124	0	-	851
	TH1	-	-	1,065	-
	TP1	20,976	14,044	14,545	19,656
	TP2	21,737	19,189	14,289	18,469
	TP3	17,126	24,566	26,096	29,561
Sub-total		60,187	57,799	56,156	68,537
Total		206,129	167,095	195,124	231,690

Description: Catch of Pacific cod by harvesting vessel class. For example in 1995, LP (longline catcher/processors) caught 75,777 mt of Pacific cod, and TP3 (trawl catcher/processors that do H&G) caught 29,561 mt.
Source: Blend data for 1992-95. Observer coverage by target fishery and vessel class, BSAI, 1992.

Table 3.28 lists the observer coverage levels by vessel class for the years 1992-94. The information included in this table is the gear that was used to harvest the cod, the vessel class, the number of vessels in that class, the total number of weeks vessels in that class fished, the total number of weeks vessels in that class were observed, the percent of weeks observed, the percent of catch observed, and the percent of hauls that were observed.

Table 3.28 Observer Coverage in the 1992 BSAI Pacific cod Target Fisheries by Gear and Vessel Class

	Vessel	# of	Total Weeks		Percent Observed		
Gear	Class	Vessels	Fished	Observed	Weeks	Catch	Hauls
Longline	LP	38	814	667	82%	92%	76%
	PCP	23	125	53	42%	76%	60%
	TP2	5	66	66	100%	100%	75%
	TP3	8	169	152	90%	95%	77%
	LH	23	48	2	4%	12%	9%
	TH2	1	1	0	0%	0%	0%
	TH3	3	9	1	11%	11%	11%
	MSC	19	48	1	2%	2%	2%
Pot	PCP	60	348	224	64%	84%	48%
	TP3	5	17	14	82%	95%	51%
	TH2	4	11	3	27%	22%	19%
	MSC	4	17	8	47%	7%	7%
Trawl CV	PCP	1	1	0	0%	0%	0%
	TP2	1	1	1	100%	100%	51%
	TH1	11	38	37	97%	99%	77%
	TH2	25	85	37	44%	48%	42%
	TH3	19	137	44	32%	37%	28%
	MSC	5	12	3	25%	19%	14%
Trawl CP	TP1	7	38	36	95%	99%	61%
	TP2	15	81	79	98%	100%	55%
	TP3	18	74	66	89%	94%	55%
	MSC	4	13	2	0%	0%	0%

Notes: - Onshore targets are calculated per vessel (not per processor).
- Only 98% of the Observer records matched either the Blend or Fish Ticket data. Therefore, the proportion shown to be observed may be low.

Table 3.28 (cont.) Observer Coverage in the 1993 BSAI Pacific cod Target Fisheries by Gear and Vessel Class

Gear	Vessel Class	# of Vessels	Total Weeks Fished	Total Weeks Observed	Percent Observed Weeks	Percent Observed Catch	Percent Observed Hauls
Longline	LP	35	505	419	83%	92%	74%
	PCP	8	36	19	53%	79%	52%
	TP2	4	25	24	96%	95%	67%
	TP3	8	85	79	93%	97%	81%
	LH	3	7	0	0%	0%	0%
	MSC	2	2	0	0%	0%	0%
Pot	PCP	19	68	34	50%	67%	55%
Trawl CV	TH1	7	28	27	96%	98%	77%
	TH2	32	165	64	39%	43%	34%
	TH3	23	173	54	31%	36%	30%
	MSC	3	15	3	20%	15%	11%
Trawl CP	TP1	9	42	38	90%	90%	48%
	TP2	14	78	72	92%	97%	64%
	TP3	22	76	58	76%	86%	58%
	MSC	1	5	0	0%	0%	0%

Notes: - Onshore targets are calculated per vessel (not per processor).
- Only 94% of the Observer records matched either the Blend or Fish Ticket data. Therefore, the proportion shown to be observed may be low.

Table 3.28 (cont.) Observer Coverage in the 1994 BSAI Pacific cod Target Fisheries by Gear and Vessel Class

Gear	Vessel Class	# of Vessels	Total Weeks Fished	Total Weeks Observed	Percent Observed Weeks	Percent Observed Catch	Percent Observed Hauls
Longline	LP	34	663	502	76%	87%	71%
	PCP	5	62	47	76%	93%	62%
	TP2	2	15	13	87%	92%	65%
	TP3	5	91	75	82%	93%	74%
	LH	2	8	1	13%	14%	13%
	MSC	6	12	0	0%	0%	0%
Pot	PCP	34	176	92	52%	57%	46%
	TP3	1	5	3	60%	80%	78%
	MSC	2	2	0	0%	0%	0%
Trawl CV	TH1	11	47	44	94%	95%	77%
	TH2	36	234	177	76%	79%	64%
	TH3	19	151	105	70%	76%	64%
	MSC	4	17	2	12%	20%	18%
Trawl CP	MSC	1	1	1	100%	100%	59%
	TP1	12	34	28	82%	86%	65%
	TP2	8	32	27	84%	96%	60%
	TP3	13	42	31	74%	72%	39%

Notes: - Onshore targets are calculated per vessel (not per processor).
- Only 94% of the Observer records matched either the Blend or Fish Ticket data. Therefore, the proportion shown to be observed may be low.

3.15 Catch By Vessel Owner's State of Residence

This section will report the catch of Pacific cod by vessel owner's state of residence. States were broken down into three groups: Alaska, Washington, and Other States. These tables are provided to show which regions of the country would be impacted by specific allocations. For example, if more cod were allocated to the fixed gear pot fleet, states whose citizens own the pot vessels may be considered better off than a state whose fleet did not use pot gear.

Table 3.29. Total Tons of Pacific Cod Caught in the BS/AI By Vessel Owner's State of Residence.

Year	State of Residence	Longline	Pot	Trawl CV	Trawl CP	Grand Total
1995	Alaska	18,730	4,753	1,834	2,368	27,685
	Washington	73,440	9,664	19,349	24,797	127,249
	Other States	1,785	4,299	9,986	1,748	17,818
1994	Alaska	16,909	1,783	1,943	294	20,929
	Washington	69,117	4,554	24,669	13,779	112,119
	Other States	1,024	1,892	7,619	629	11,165
1993	Alaska	14,550	421	1,432	2,239	18,642
	Washington	50,844	1,273	15,449	22,741	90,307
	Other States	587	404	12,806	237	14,034
1992	Alaska	21,640	865	967	585	24,057
	Washington	78,861	10,851	7,613	27,338	124,662
	Other States	1,217	1,963	11,439	60	14,679

Description: This table reports the metric tons of Pacific cod caught in the BSAI by the vessel owner's state of residence, as reported in the Federal and State vessel permit files. For example in 1995, 18,730 mt of cod were harvested with longline gear by vessels who's owner resides in Alaska.
Source: Blend data 1992-95

Table 3.29 indicates that most of the Pacific cod is harvested by vessels whose owner lives in Washington. This makes sense because most of the freezer longline vessels and factory trawlers are from Washington. These two groups accounted for the largest shares of Pacific cod catches between 1992-95.

The trawl catcher vessels harvesting Pacific cod were generally owned by persons living outside of Alaska as well. Trawl catcher vessels owned by persons from Washington had the most catch in 1993-95. In 1992, persons from other states owned the vessels that reported the most catch.

The segment of the fleet that has the most potential for growth, the pot fleet, are most often owned by persons from Washington.

3.16 Employment

Information on employment by industry sector is limited. Data has been collected as part of the Annual Operators Reports in the past. These data were difficult to interpret. Often it was not known if the number of employees was being reported for the entire year or by month. Some forms were submitted with the same number of employees working each month even though the plant may not have been operating. Concerns over the usefulness and reliability of the data resulted in the data collection efforts being terminated.

Employment numbers have been reported for various industry sectors (Impact Assessment Inc., 1994). The number of full time equivalent (FTE) employees in the 1993 factory trawler fleet was reported to be 7,271. The factory longliner fleet reported to have about 16 employees on an average 115 foot vessel. If there were 40 vessels in this fleet, that would equal 640 employees. The average TH2 vessel was reported to have four crew members. A shore plant in the Bering Sea/Aleutian Islands can have a work force between 380 and 600 individuals during peak processing times. These times would be during the pollock A season when the plant is processing pollock, *C. opilio* crab, and cod.

The numbers reported by Impact Assessment, Inc. are for all groundfish species. We cannot divide employment between various species. For example, we do not know how many employees were depending on Pacific cod for their job. This is especially true for the factory trawler fleet and Shore Plants. The factory trawlers, especially TP1 vessels, rely mainly on pollock. Shore plants are also diversified in terms of the kinds of fish they utilize. These plants often process pollock, other groundfish species, crab, and salmon in addition of Pacific cod. Because factory longliners primarily target cod, it could be assumed that they depend heavily on cod for employment. This assumption cannot necessarily be made for Shore Plants and the trawl fleet.

3.17 Consideration of Community, Borough, and State Taxes Related Cod Fishing Activity

At the January Council meeting, one of the issues identified for consideration by the Council was that of tax implications to the state, boroughs, and individual communities of a reallocation of the cod resource. The State of Alaska imposes a Fisheries Business Tax (raw fish tax) on all businesses which purchase and process fish in the state. Taxes are assessed on the ex-vessel value of fish, including the actual price paid as well as any bonuses or other forms of payment to fishermen. The tax rates vary from 3% for onshore processor, to 4.5% for salmon canneries, to 5% for floating processors. These taxes are then distributed depending on the status of the borough/community in which the processing occurs; though there are variations depending on borough/ community status, the system basically shares these revenues between the municipality/city where the landings were made, the borough where the landings were made, and the state General Fund.

Appendix I to this document contains a guide to the fisheries business tax which describes the collection and distribution process in detail, for this and other applicable taxes. This appendix also contains a summary of the 1995 fish taxes for each borough, municipality, and city in the State of Alaska. Included in this summary is the recently implemented Fishery Resource Landing Tax, which contributed an additional $2.9 million to the state's coffers in FY95. The Resource Landing Tax is currently in litigation and taxes collected are therefore being held in escrow pending the outcome of that litigation. The raw fish tax generated a total of $18.6 million statewide in 1995. As would be expected, the major beneficiaries of this $18.6 million were the major fish processing ports, and include the following:

Aleutians East Borough -	$ 1.2 million
Bristol Bay Borough -	$ 2.7 million
Kenai Peninsula Borough-	$ 0.9 million
Kodiak Island Borough -	$ 1.0 million
Lake and Peninsula Borough -	$ 0.95 million
Sitka-	$ 0.7 million
Kodiak -	$ 0.65 million
King Cove-	$ 0.5 million
Petersburg -	$ 0.83 million
St. Paul -	$ 2.5 million
Unalaska -	$ 2.2 million

The city of Unalaska (Dutch Harbor) also received the greatest share (87%) of the total Resource Landings Tax for an additional $ 2.5 million.

These taxes represent a considerable source of income and support for the communities and boroughs involved in the fisheries off Alaska. A detailed analysis of the implications of the cod allocation alternatives is beyond the scope of this study. Such an analysis would entail breaking out Pacific cod deliveries by each of the major processing plants, estimating a price and subsequent tax revenue, and further prorating the resulting tax revenues among the various boroughs, municipalities, and cities within which those plants operate. This would then need to be compared to what might occur under each of the allocation alternatives being considered. What might occur under each of the alternatives would be a complex predictive exercise in itself, necessitating assumptions regarding where each gear type might make its deliveries. For example, fixed gear deliveries of Pacific cod may represent a much larger share of overall onshore cod deliveries in the GOA than in the BSAI. Further, the relative importance of fixed gear vs trawl gear deliveries will vary between individual processing plants. Some of these assumptions would be obvious to allocation alternatives in question, while others will be less obvious.

In most cases, Pacific cod represents a relatively small portion of the total tax revenues generated, when taken into consideration with other fish processed such as pollock and salmon. As an example of the tax revenues attributable to Pacific cod processing, let us assume a 10% change (either up or down) in the amount of cod processed onshore, without regard to where it would be processed and which borough would benefit (this is postulated as a ballpark percentage which could occur with some of the percentage splits being considered). With a TAC of 270,000 mt to work with, and assuming a price of 18 cents per pound, the change in revenues generated could be on the order of $320,000 (270,000 X 10% X 2,205 X .18 X .03 = $321,489). However, the Resource Landings Tax noted above, which is applied to offshore caught and processed fish at a similar rate of 3%, would represent an offset to the change in raw fish tax revenues from the example above. The net effect in this case would be zero, overall, though the specific location (community or borough) of the tax benefits may change depending on the allocation alternative chosen. It is anticipated that the detailed information in Appendix III, coupled with the analytical results for the various alternatives in Chapter 5, will allow the reviewer to make his/her own inferences as to the potential, incremental tax implications of a change in the allocations of BSAI Pacific cod.

3.18 Summary

This section will provide a brief summary of the information provided in Chapter 3. It will recap the closures in the 1994 and 1995 directed cod fisheries, and discuss why those closures occurred. Halibut mortality has caused a redistribution of the TAC in both 1994 and 1995. This redistribution will be summarized. Annual cod harvests will then be given. This will include both cod taken in the directed cod fishery and cod taken as bycatch in other targets. Retention rates in the cod fisheries will be listed next. The a summary of cod markets will be presented. Finally, a discussion of the cod pot fleet's ability to harvest additional TAC will conclude this section.

The time lines of the 1995 directed Pacific cod fisheries were as follows. The cod hook and line fishery was closed May 7, 1995 due to halibut mortality. On September 1, the fishery reopened. The fishery then closed again on October 16 when they had harvested their portion of the TAC. The fixed gear fishery remained closed until November 17, when the NMFS Regional Director reallocated 10,000 tons of cod from the trawl fleet to the fixed gear fishery. The hook and line fleet was then closed for the last time on December 11, because they reached their halibut mortality cap. When the season ended, the hook and line vessels had caught almost 94,000 tons of cod. Pot vessels fished cod until the fixed gear TAC was taken on October 16. The trawl portion of the Pacific cod TAC opened on January 20, and was closed on April 24. The fishery was closed because the trawl fleet had reached their halibut mortality cap. The fishery reopened for four days beginning October 25, when the remaining 100 tons of halibut mortality was made available to the trawl fishery.

In 1994, the Pacific cod trawl fleet was closed on May 7, because of halibut mortality. On August 18, 1994, the NMFS Regional Director reallocated 8,000 metric tons of unused Pacific cod from the trawl TAC to fixed gear.

Because halibut mortality plays an important role in closing directed Pacific cod fisheries, it is a focal point in this analysis. The 1992 through 1995 rates are reported in section 3.2.5 by target fishery. The 1995 halibut mortality in the Pacific cod fisheries was 799 tons in the cod hook and line fishery, 10 tons in cod pot fishery, 788 tons in the cod trawl catcher vessel fishery, and 553 tons in the cod trawl catcher processor fishery.

Table 3.29 provides a summary of the information presented earlier in this chapter. The first section of the table reports the total catch of Pacific cod by gear group for the years 1992-95. Harvests of cod in target and non-target cod are included in this section. Total catch has increased for every gear type between 1993-95, except for the trawl catcher processor fleet in 1994. This reflects the increases in TACs over recent years.

The second section of the table reports the amount of cod that was retained. The first column in this section is the metric tons of retained cod. Cod retention has increased from 130,246 mt in 1993 to 190,725 mt in 1995. The second column shows the percent of all harvested cod that was retained. The third column reports the cod retained in the cod target fisheries, and the fourth column is the retained cod caught in non-cod target fisheries. More cod is retained when it is caught in cod target fisheries. In 1995, 93.97% of cod taken was retained. That same year, only 48.61% of the cod taken in non-cod targets (as bycatch) was retained. This trend is consistent across all years.

Because the percent of cod retained varies between target and non-target fisheries, it is important to remember how NMFS manages these fisheries in-season. To avoid going over the TAC, NMFS takes bycatch needs into account at the start of the fishing season. The cod TAC minus the expected bycatch cod needed in other target fisheries is then made available to the various cod target fisheries. Since trawl vessels have more cod bycatch in other target fisheries than fixed gear vessels, we will use trawl gear as an example. Assume that 100,000 mt of cod are allocated to trawl gear, and NMFS projects that 30,000 mt of cod are needed as bycatch in other target fisheries throughout the year. Therefore, 70,000 mt are available to the cod target fisheries. If only 50,000 mt of cod were allocated to trawl gear, then 30,000 mt would be set aside for bycatch needs and 20,000 mt would be available to the cod target fisheries. Because of the differences in retention rates, it is likely that a higher percentage of cod will be retained by trawlers in the first example. These examples do not take into account the IR/IU program the Council is currently considering. This program would increase retention rates of cod in both the target and non-target fisheries.

The third section of the table reports total cod discards. The general trend has been an increase in the amount of cod discarded. Cod discards have almost doubled between 1992 (24,034 mt) and 1995 (40,965 mt).

Total halibut mortality is listed in the next section. In 1995, 2,149 mt of halibut mortality occurred in the directed cod fisheries. Halibut mortality caps closed down both the trawl and longline fleets in 1995 before they could harvest all of the TAC available.

Total crab bycatch in cod target fisheries are shown in the next section. The number of crab bycaught are listed. Increases in the number of bycaught crab were reported in 1995. Increased participation of the pot fleet in the cod fishery accounts for some of higher crab bycatch. Pot vessels had higher bycatch rates of *C. opilio* and red king crab than any of the other gear groups.

The final section of this table is gross revenue. This is an estimate of the ex-processor revenues generated by cod. Gross revenues increased each year between 1993 and 1995.

Table 3.29 Summary of Pacific cod catch, Retention, Bycatch, and Gross Revenue for the years 1992-95

	Total Pacific Cod Catch (mt)				Total Cod	% of Cod	% of Target	% of Non-Target
Year	Longline	Pot	Trawl CV	Trawl CP	Retained	Retained	Cod Retained	Cod Retained
1995	94,163	18,782	50,208	68,537	190,725	82.32%	93.97%	48.61%
1994	87,139	8,236	43,592	56,156	162,084	83.07%	94.11%	51.80%
1993	66,153	2,098	41,045	57,799	130,246	77.95%	90.89%	41.88%
1992	102,071	13,681	30,190	60,187	182,095	88.34%	96.74%	56.21%

Table 3.29 (Cont.)

	Total Cod	Halibut	Total Crab Bycatch (# of Animals)			Gross Revenue	
Year	Discarded (mt)	Mortality (mt)	*C. bairdi*	*C. opilio*	Red King	($ Million)	
1995	40,965	2,149	330,174	273,794	6,174	$	143.46
1994	33,040	2,296	190,141	167,855	1,976	$	119.33
1993	36,849	1,586	239,959	331,505	1,764	$	100.87
1992	24,034	2,621	461,740	327,266	13,663	$	152.63

[1] Total discards of cod in both cod Target and Non-Target fisheries.
[2] Mortality and bycatch are from the cod Target fisheries only.
[3] Gross revenue is based on cod caught in the cod Target fishery.

Cod are sold in different product forms in many countries. Fillets are mainly sold in the U.S. Roe, milt, salt cod, and whole cod are exported. H&G cod have important markets in Asia, Europe, and North America. These different markets suggest that ignoring benefits beyond primary processing tends to introduce a bias that favors the freezer longliners.

The pot gear vessels reported 18,716 tons of cod catch in their 1995 target fishery. If halibut mortality caps continue to close the hook and line and trawl cod fisheries, pot vessels will be allowed to catch the remaining cod TAC. We do not know the harvesting capacity of the pot cod fleet. However, current levels of catch in 1996 are over 50% ahead of those reported in 1995 (see section 3.1.1). Assuming that increase for the entire year the pot fleet will catch about 28,700 mt of cod in 1996. Even at these catch levels it is unlikely that the pot fleet could harvest all of the TAC available to them under some allocation scenarios.

4.0 METHODOLOGIES FOR THIS ANALYSIS

4.1 Introduction

Before describing the specifics of the model which is used in this analysis, it is useful to discuss the context in which this model is being employed. When the initial draft of this analysis was reviewed by the Council, and the Council's Scientific and Statistical Committee (SSC) and Advisory Panel (AP) in April 1996, considerable concern was expressed, particularly by the SSC, regarding the Linear Programming (LP) model used in that analysis. The SSC felt that is was inappropriate to cast that model as the centerpiece of the analysis due to concerns about LP models in general and concerns over its structure and specification. For example, the LP model was largely driven to optimize gross revenue, which has been consistently identified as a poor indicator of allocational choices, and further, caused that original model to operate in a manner inconsistent with the realities of the fisheries. Other concerns included data deficiencies and the model's dependence on halibut bycatch rates to predict overall catch of Pacific cod, and halibut bycatch, by industry sectors. The SSC noted that a "qualitative" analysis would be adequate for a simple rollover of the existing split, and that quantitative assessments of net benefits would likely be impossible.

While it is true that a quantitative analysis of net benefits is not part of this analysis, and is not possible given current cost data limitations, there are quantitative projections which can be made from a mathematical model which will be useful in making *qualitative* judgements of the various alternatives under consideration. For example, the relative catch rates of cod, discard rates of cod in targets and non-targets, and bycatch rates of prohibited species are quantifiable (based on previous years' fisheries data) and can be used to project resulting distributions of catch and bycatch among the various industry sectors which will be affected by this amendment. More qualitative judgements can then be made based on the quantitative information provided by a mathematical model which makes such projections for the various alternatives being considered. A purely qualitative assessment would require the analyst to make judgements regarding potential outcomes based on essentially the same *quantitative* information which is fed into the model; i.e., knowledge of catch rates, bycatch rates, and constraints such as TAC ceilings or PSC caps for the various industry sectors. However, those types of assessments would not enable discrete projections, but only ranges which would provide little or no differentiation among the alternatives.

Although some of the data limitations noted earlier cannot be overcome at this time, we do have very good information on many of the variables noted above. For that reason, a model has been developed which calculates projected outcomes of each alternative, for a variety of issues identified by the industry and the Council as critical to the decision making process. These include projections, overall and for each sector, of total cod catch, cod catch in both target and non-target fisheries, discards of cod in both target and non-target fisheries, bycatch of prohibited species, and gross revenues from the fisheries. If the alternatives were limited to only a gear allocation between fixed and trawl gear, such calculations would be greatly simplified, and may not be all that necessary (in other words, a purely qualitative assessment would probably provide reliable results). However, the further suballocations of the trawl apportionment between catcher vessels and catcher/processors add another, complicating layer to such an assessment. This is due, for example, to differential bycatch and discard rates between these two sectors, and to the differential amounts each takes as target vs non-targets. These nuances preclude qualitative judgements without some supporting quantitative calculations.

Because of the various concerns expressed with regard to the original LP model, that model has been scrapped and is not relevant to the present analysis. A new model has been developed and is detailed in the subsequent discussions. This model differs from the original in several key areas, including the following:

1. The present model no longer uses gross revenue as the "maximand" - it *calculates* gross revenues for each alternative but is not *driven* by gross revenues.

2. The new model also incorporates a set ratio of CV catch rates to CP catch rates within the trawl sector, which further reduces its reliance on gross revenue and makes its operation consistent with actual fisheries observances.

3. Sensitivity analysis is offered which illustrates the importance, and variability of results, of differential halibut bycatch rates. The model still relies on bycatch rates - potential variations in those rates will affect outcomes, but such differences are a function of the fishery, not of the model.

4. Total cod catches in other groundfish fisheries (other than midwater pollock) are fixed, which provides an estimate of bycatch needs of cod by these fisheries, therefore enabling reasonable estimates of cod remaining for target fisheries.

5. Model runs are developed which do recognize the limitations on harvesting capacity of the pot gear sector (other gear types are limited only by TAC or PSC constraints). These model runs were developed to ascertain the potential maximum PSC catches for illustrative purposes. Other model runs still show "excess" cod accruing to the pot sector. The ability of that sector to take that extra fish is the subject of a separate discussion.

6. Essentially, this model is a deterministic model - it is a convenient tool for calculating a variety of necessary mathematical equations, utilizing a necessary minimum of assumptions regarding the prosecution of the fisheries.

The use of this model allows the analysts to quantify that information which is usefully quantifiable, and which is necessary for making reasonable judgements regarding the merits of the various alternatives. Additionally, the model produces some important counter intuitive findings which would otherwise have been overlooked, but upon closer examination do make sense.

4.2 The New Model

The new model assumes constant catches in the bottom pollock and flatfish fisheries, and therefore, unvarying bycatch of Pacific cod. With some additional simplifying assumptions discussed below, catches of the target Pacific cod fisheries can be calculated under each alternative. The model uses a system of simultaneous equations and constraints in the form of inequalities to project outcomes of the various alternative allocations for a given set of assumptions. Fishery specific assumptions are fully developed in the next section. This will be followed by a discussion of more general assumptions imbedded in the model. Finally, we specify the model and outline its use in projecting outcomes.

4.2.1 Fishery Specific Assumptions

This section develops and specifies fishery specific assumptions used in the model to project target fishery catches under each of the alternatives.

Target Fisheries Included in Model

The model includes only trawl and fixed gear Pacific cod fisheries and those target fisheries which have significant Pacific cod bycatch. Historical catches presented in Chapter 3, show that only the pollock and flatfish fisheries in the BSAI have significant bycatch of Pacific cod. Therefore, all other fisheries are excluded from further consideration. Eleven target fisheries are included (Table 4.1).

Table 4.1 Fisheries Included in the Model

Pacific Cod Fisheries	1) Trawl CV	2) Trawl CP	3) Longline	4) Pot
Pollock Fisheries	5) Inshore bottom	6) Offshore bottom	7) Inshore midwater	8) Offshore midwater
Flatfish Trawl Fisheries	9) Yellowfin sole	10) Rock sole	11) Other flatfish/Flathead sole	

TACs and Halibut PSC Cap

The model uses TACs and Halibut PSC mortality caps as set for 1996, as standard assumptions, but also is run using TACs adjusted by CDQs which reduce non-pollock TACs and halibut PSC caps by 7.5% (Table 4.2).

Table 4.2 Assumed TACs and Halibut PSC Caps for Each Year in the Model

	Total Allowable Catch		Halibut PSC Mortality Cap	
Fishery	TAC	TAC w/ CDQs	PSC Caps	PSC Caps w/ CDQs
Pacific Cod: All Gears	270,000	249,750	Not Applicable	
Non-Jig Apportionment at 98%	264,600	244,755	Not Applicable	
- Fixed Gear Apportionment	To be determined		Not Applicable	
Longline Apportionment	Not Applicable		800	740
Pot Apportionment	Not Applicable		Unconstrained	
Trawl Apportionment	To be determined		1,685	1,559
Catcher Vessel Apportionment	To be determined		To be determined	
Catcher Processor Apportionment	To be determined		To be determined	
Pollock (TAC less current CDQ Allocation)	1,100,750	1,100,750	Not Applicable	
Inshore Pollock	385,263	385,263	Not Applicable	
Offshore Pollock	715,488	715,488	Not Applicable	
All Bottom Pollock Targets (jointly with Atka mackerel and other groundfish)	Not Applicable		430	398
All Midwater Pollock Targets	Not Applicable		Unconstrained	
Yellowfin Sole	200,000	185,000	820	759
Rock Sole	70,000	64,750	730	675
Other Flatfish & Flathead Sole	65,000	60,125		

Jig Catches of Pacific Cod Are Unaffected

Because 2% is set aside for jig vessels under all alternatives, the jig fishery is left out of the model. Table 4.3 shows the jig catch allowed under the 1996 TAC and with CDQs removed. The jig fleet has no halibut PSC cap.

Table 4.3 Jig Apportionments

	Total Allowable Catch	
Fishery	TAC	TAC w/CDQs
Pacific Cod: All Gears	270,000	249,750
Jig Gear Apportionment at 2%	5,400	4,995

Each Gear Group Has the Catch Capacity to Harvest Its Full Apportionment

The model assumes that each gear group has the latent harvesting capacity to catch whatever amount is apportioned to it. This assumption is specifically included because the allocation alternatives could increase the apportionments to levels previously unattained by any given sector. This is particularly true of the pot gear group where harvests have not exceeded 20,000 mt in the past. It appears, however, that the pot catch in 1996 will exceed 20,000 mt, and that additional pot vessels may enter the Pacific cod fishery due to the downturn in crab stocks. The ramifications of this assumption will be discussed in Chapter 5.

Inseason Reallocation of Pacific Cod

The model assumes that NMFS will reallocate Pacific cod once a gear group takes its halibut bycatch mortality cap. Thus, if the trawl fishery reaches its PSC before catching its allotted amount of Pacific cod, NMFS will reallocate unused Pacific cod to the fixed gear sector, after accounting for the cod necessary as bycatch for remaining trawl fisheries, i.e., yellowfin sole, pollock, etc. Within the fixed gear sector, longliners likely will reach their halibut PSC cap, in which case they would be shut down. However, given that the bycatch of halibut by the pot gear group does not accrue to any halibut PSC cap, fixed gear as a whole will never be shut down because of halibut bycatch. Therefore, any reallocation that might occur will always favor the fixed gear sector. In no case, under current regulations, will there be cause to reallocate Pacific cod from the fixed gear sector to the trawl gear sector. NMFS may change regulations in the future to allow reallocation of Pacific cod to a given sector if it appears that the other sector will not harvest their apportionment due to the lack of harvest capacity. That possibility has not been added into the model, in fact, the previous assumption precludes its necessity.

Bycatch of Pacific Cod in Other Trawl Target Fisheries

The model assumes that the trawl bycatch of Pacific cod in all non-Pacific cod fisheries (with the exception of bycatch of Pacific cod in the midwater pollock fisheries) is fixed at a predetermined level. This primary assumption is based on four secondary assumptions:

1) NMFS will continue to close target fisheries with TAC remaining to allow for bycatch in other target fisheries. For the trawl sector, this means that the P. cod target fisheries will be closed prior to the attainment of the total trawl apportionment to allow for the considerable bycatch of P. cod in the yellowfin sole and pollock target fisheries.

2) The yellowfin sole, rock sole, and other flatfish fisheries will achieve their halibut PSC caps (see Table 4.2 above). Further, bycatch mortality rates of halibut and bycatch and discard rates of Pacific cod in each of these fisheries will be the same as in 1995.

3) The ratio of bottom pollock target fisheries to the total pollock catch, in both inshore and offshore sectors, will be the same as in 1995. Further, halibut bycatch mortality rates, and rates of bycatch and discards of Pacific cod in each of the bottom pollock fisheries will be the same as in 1995.

4) Other groundfish trawl targets not discussed above do not take significant bycatches of Pacific cod and are left out of the model. In other words, we assume these fisheries will have no impact on the catch of Pacific cod.

Given the assumptions above, the model assumes constant, under all alternatives, the target catches, cod bycatch, cod discards, and halibut mortalities in the five fisheries shown in Table 4.4. As shown, 12,876 mt of Pacific cod will be taken by trawl CV in the five non-target fisheries. Trawl CPs are assumed to catch 32,069 mt in the same fisheries. These catches, plus the non-target catch of Pacific cod in the midwater pollock fisheries, will reduce the amount of target Pacific cod available to trawlers.

Table 4.4 also shows the bycatch of pollock in the yellowfin sole, rock sole, and other flatfish fisheries. The bycatch of pollock in these fisheries is an important parameter in the model because it helps determine how much pollock will be available in the midwater pollock target fisheries. Since the midwater pollock fishery also catches significant amounts of Pacific cod, the amount of pollock in the midwater target fisheries helps determine how much trawl Pacific cod may be taken. The bycatch of Pacific cod in the pollock midwater fisheries is discussed in the following section. To simulate NMFS management, the model will deduct these bycatch amounts first, before allowing target catches by the trawl sectors to occur.

Table 4.4 Assumed Catches of Non-Pacific Cod Target Fisheries Based on 1995

Target Fishery	Projected Target Catch All Trawls	Projected PCOD Bycatch & Discards Trawl CV	Trawl CP	Projected Pollock Catch & Bycatch Inshore	Offshore	Projected Trawl Halibut Bycatch Mortality
Inshore Bottom Pollock						
Target Catch (mt)	46,044			46,044		
Bycatch (mt)		8,857	4			137
Bycatch Rate		19.24%	0.01%			2.97
P. cod Discards (mt)		1,867	2			
P. cod Discard Rate		4.05%	0.00%			
Offshore Bottom Pollock						
Target Catch (mt)	90,106				90,106	
Bycatch (mt)		731	7,354			229
Bycatch Rate		0.81%	8.16%			2.54
P. cod Discards (mt)		570	5,906			
P. cod Discard Rate		0.63%	6.55%			
Rock sole						
Target Catch (mt)	26,179					
Bycatch (mt)		400	7,823	840	5,916	588
Bycatch Rate		1.53%	29.88%	3.21%	22.60%	22.47
P. cod Discards (mt)		174	4,333			
P. cod Discard Rate		0.66%	16.55%			
Yellowfin sole						
Target Catch (mt)	138,573					
Bycatch (mt)		2,887	15,722	2,661	33,424	820
Bycatch Rate		2.08%	11.35%	0.02%	0.24%	5.92
P. cod Discards (mt)		628	7,543			
P. cod Discard Rate		0.45%	5.44%			
Other Flatfish						
Target Catch (mt)	5,236					
Bycatch (mt)		-	1,166	72	1,914	142
Bycatch Rate		-	22.26%	1.38%	36.55%	27.07
P. cod Discards (mt)		0	604			
P. cod Discard Rate		0.00%	11.54%			
TOTAL		12,876	32,069	49,617	131,360	1,916

Notes:

1) Cod bycatch & discard rates represent the catch of P. cod per ton of the target fishery and are assumed to equal 1995 rates. This information is from the 1995 blend data set.
2) Halibut bycatch mortality rates are set at 1995 rates and show KG of mortality per ton of target fishery catch.
3) For the three flatfish fisheries target catch was assumed to be limited by halibut bycatch and therefore the total halibut mortality in those fisheries equals the 1996 PSC cap set by the Council.
4) Total Pollock Bottom trawl catches were set using the ratio of bottom pollock targets to the all pollock catches in 1995.
5) The ratio of inshore and offshore bottom pollock target catches were set equal to their ratio in 1995, i.e., 0.511 to 1.
6) Each target fishery above has a set level of bycatch of each of the other target species. These bycatch levels are set based on 1995 rates which we have not shown here.

Proportional Catches of Trawl CV and Trawl CP in the Pacific Cod Target Fisheries

The model assumes that the ratio of target Pacific cod catch by trawl catcher vessels to that of trawl catcher processors will be constant up to the point where one is constrained by its Pacific cod allocation. In 1995, the ratio of Trawl CP target catches to Trawl CV target catches through April 22 was 0.9663 to 1.000. After April 22, trawl target catches were limited because of the trawl halibut PSC mortality cap. Figures 3.3 and 3.4 in Chapter 3 confirm this assumption. The model will assume that for every 1,000 tons of catch made by the trawl catcher vessels in the Pacific cod target fishery there will be 966.3 tons of target Pacific cod catch by catcher processors. Once either group reaches its apportionment, then the catch of the other will not be limited by this ratio.

The Maximum Target Catch of Pacific Cod by Trawlers Is Limited by Non-target Bycatch of Pacific Cod

Table 4.4 showed the amounts of Pacific cod which will be assumed to be caught in the five non-target trawl fisheries the model holds as constant. Combining these catches with the Alternatives under consideration, we can determine the amount of Pacific cod remaining for target fishing in the trawl sector. This is done in Table 4.5 below. The first set of columns specifies the alternative under consideration, the trawl/fixed split and the catcher processor/catcher vessel split. The second set of columns calculates the amount of total trawl catch (target and non-target) each alternative would allow. The third set of columns (taken from Table 4.4) lists the predetermined amounts of bycatch of Pacific cod which is assumed to occur in the flatfish and bottom pollock target fisheries. The bycatch of Pacific cod in the midwater pollock target fisheries is also considerable and will be calculated within the model, rather than assumed. The final set of columns subtracts the predetermined non-target catch of Pacific cod from the trawl apportionments under each alternative (with minor rounding errors). This is the maximum potential trawl catch allowed for catcher vessels and catcher processors.

Table 4.5 Pacific Cod Catch Remaining for Target Fishing in the Trawl Sector After Accounting for Predetermined Bycatch of Pacific Cod in Non-target Fisheries

Alternative	Apportionment TRW/FIX (CP/CV)	Maximum Pacific Cod Catch Under Each Alternative		Predetermined Non-Target Pacific Cod Catches		Remaining Potential Target P. Cod Catch	
		Trawl CV	Trawl CP	Trawl CV	Trawl CP	Trawl CV	Trawl CP
Alternative 1A	No Split	264,400		12,876	32,069	219,457	
Alternative 2A	54/44 (none)	145,800		12,876	32,069	100,857	
Alternative 2B	54/44 (60/40)	58,320	87,480	12,876	32,069	45,444	55,413
Alternative 2C	54/44 (40/60)	87,480	58,320	12,876	32,069	74,604	26,253
Alternative 2D	54/44 (55/45)	65,610	80,190	12,876	32,069	52,734	48,123
Alternative 3A	44/54 (none)	118,800		12,876	32,067	73,857	
Alternative 3B	44/54 (60/40)	47,520	71,280	12,876	32,067	34,644	39,213
Alternative 3C	44/54 (40/60)	71,280	47,520	12,876	32,067	58,404	15,453
Alternative 3D	44/54 (55/45)	53,460	65,340	12,876	32,067	40,584	33,273
Alternative 4A	59/39 (none)	159,300		12,876	32,067	114,357	
Alternative 4B	59/39 (60/40)	63,720	95,580	12,876	32,069	50,844	63,513
Alternative 4C	59/39 (40/60)	95,580	63,720	12,876	32,069	82,704	31,653
Alternative 4D	59/39 (55/45)	71,685	87,615	12,876	32,069	58,809	55,548
Alternative 5A	39/59(none)	105,300		12,876	32,069	60,357	
Alternative 5B	39/59(60/40)	42,120	63,180	12,876	32,069	29,244	31,113
Alternative 5C	39/59(40/60)	63,180	42,120	12,876	32,069	50,304	10,053
Alternative 5D	39/59(55/45)	47,385	57,915	12,876	32,069	34,509	25,848
Alternative 6A	49/49(none)	132,300		12,876	32,069	87,357	
Alternative 6B	49/49(60/40)	52,920	79,380	12,876	32,069	40,044	47,313
Alternative 6C	49/49(40/60)	79,380	52,920	12,876	32,069	66,504	20,853
Alternative 6D	49/49(55/45)	59,535	72,765	12,876	32,069	46,659	40,698

Notes:

1) Since the midwater pollock fisheries target total have yet to be determined, the non-target bycatch of cod will increase, and therefore, the actual target catches will be lower.

2) Under Alternative 1A there is no allocation specified for fixed gear. Technically therefore, the theoretical maximum potential trawl catch and target catch are 264,400 mt and 219,457 mt respectively. Obviously other factors will limit that catch, e.g., the trawl PSC cap for halibut and competing gear groups. Also they represent a 2% reduction from the TAC (270,000 mt) because of the jig gear allocation.

Halibut Bycatch Mortality in the Pacific Cod Fisheries

The model assumes that the 1995 halibut bycatch mortality rates will apply to future fisheries. In using the term "halibut bycatch mortality rate," we mean the observed bycatch of halibut as occurred in 1995 multiplied by the 1995 mortality rate (as specified in regulations) for each gear group, divided by the total catch of P. cod by that gear group. Table 4.6 shows the 1995 halibut bycatch mortality rates for each of the Pacific cod fisheries as well as the PSC cap. The table also shows the maximum amount of Pacific cod each group could potentially take given their bycatch mortality rate and PSC cap.

Table 4.6 Assumed Halibut Bycatch Mortality Rates and Potential Pacific Cod Catches

Pacific Cod Gear Group	Halibut Bycatch Mortality Rate Kg/MT	Halibut Bycatch Mortality PSC Cap MT	Potential Catch of Pacific cod
Longline	8.5005	800	94,112
Pot	0.5429	Unconstrained	
Trawl Catcher Vessels	25.2707	1,685	66,678
Trawl Catcher Processors	19.1192		88,131

Notes:
1) Bycatch mortality rates are based on 1995 observed bycatch and the 1995 mortality rates as specified in regulations.
1) Potential catches of P. cod are calculated by dividing the PSC cap by the rate (adjusted to MT), i.e., the potential catch of P. cod by the longline fleet, given the bycatch mortality rate and PSC cap is $800 \div 8.5005 \times 1000 = 94,112$ MT.
2) The potential catches by the separate trawl groups assume that the other group's P. cod catch is zero. The potential catch of the trawl sector as a whole will fall within this range.

Potential Catches of Pollock and Bycatch of Pacific Cod in the Midwater Pollock Fisheries

Target Catches in the pollock midwater trawl fisheries for both the inshore and offshore sectors are allowed to vary in the model. However, the maximum amount of midwater pollock which may be taken is already determined given the TACs, inshore/offshore apportionments, and the assumptions in the previous section. From Table 4.4, we see that 131,360 mt of offshore pollock will be taken in the bottom pollock and flatfish fisheries. Using the offshore apportionment (715,488 mt) of pollock from Table 4.2, and subtracting the 131,360 mt, we can conclude that the maximum amount of pollock which can be taken in the offshore midwater fishery is 584,128 mt. Similarly, the inshore midwater pollock fishery can potentially take 335,645 mt in the midwater pollock fishery.

The midwater pollock fisheries take significant amounts of Pacific cod as bycatch. The bycatch rates of Pacific cod per ton of midwater pollock target catch are shown in Table 4.7. Given the maximum amount of mid- water pollock fishing under the assumption already discussed, we can estimate the maximum potential amount of Pacific cod bycatch in the pollock fisheries.

Table 4.7 Bycatch of Pacific Cod in Midwater Pollock in Fisheries and Bycatch of Pollock in P. Cod Fisheries

Midwater Pollock Target Fisheries	Maximum Potential Catch	Pacific Cod Bycatch Rates		Maximum Bycatch of Pacific Cod	
		Trawl CV	Trawl CP	Trawl CV	Trawl CP
Inshore	584,128	1.18%	NA	6,893	NA
Offshore	335,645	0.23%	0.64%	772	2,148

Notes:
1) All rates are based on the 1995 fisheries, and show bycatch as a percent of the catch of the target species.
2) Catcher processors in the inshore sector did not participate in midwater pollock fisheries, therefore, bycatch of P. cod was zero.

Potential Bycatches of Pollock in the Pacific Cod Target Fisheries

The amount of target fishing for Pacific cod depends not only on the alternative allocations, but also on the amount of midwater pollock target fishing, given that bycatch of Pacific cod in other target fisheries is held constant by assumption. The bycatch rates of pollock per ton of Pacific cod target catch for each Pacific cod gear group are shown in Table 4.8.

Table 4.8 Bycatch of Pollock in the Pacific Cod Target Fisheries

Pacific Cod Target Fisheries	Pollock Bycatch	
	Inshore	Offshore
Longline	0.17%	2.80%
Pot	0.07%	0.00%
Trawl Catcher Vessel	28.87%	4.60%
Trawl Catcher Processor	3.24%	28.80%

All rates are based on the 1995 fisheries, and show bycatch as a percent of the catch of the target species.

Potential Catches of Pacific Cod by Pot Gear

As shown in Table 4.6, the maximum potential Pacific cod catches of three of the four gear groups in question are limited by their halibut bycatch. Only the pot gear group is unlimited. Catch by pot gear has not exceeded 20,000 mt in the past. Even though the pot fishery will increase, the model assumes that the catch of pot gear will not impede the harvesting capacity of the other three sectors. This assumption appears at first to be somewhat arbitrary, however, given the longline and trawl halibut bycatch rates and PSC caps, the assumption that NMFS will reallocate un-harvested Pacific cod to the fixed gear sector, and relatively low levels of participation by pot vessels; it does not appear to be far out of line. Further, by making this assumption, we are able to determine the pot catch under each alternative, by setting it equal to the unharvested Pacific cod which remains after the longline and trawl fisheries take their maximum allowable catches under the PSC cap or P. cod apportionments.

Longline Pacific Cod Catch Assumptions

Given the full set of assumptions made above, we now have enough information to determine the catch of the longline gear group under any of the alternatives under consideration as well as the minimum amounts available to the pot gear group. Table 4.9 shows the fixed and trawl gear apportionments under each of the six alternatives ignoring for the moment the sub-options which could divide the trawl apportionment between trawl catcher vessels and trawl catcher processors. The maximum longline catch as determined by the halibut bycatch mortality rate is less than the total fixed gear apportionment in every alternative. With the assumption that pot catches will in no case impede the harvesting by other gear groups, we can assume that the longline sector is limited by its halibut PSC and thus catches 94,112 mt under each alternative.

Table 4.9 Longline Catch Assumptions Under Each Alternative.

Alternative # and Trawl/Fixed Gear Split	Fixed Gear Apportionment	**Longline Maximum**	Trawl Apportionment	Minimum Available to Pot Gear
Alternative 1 (none)	No Apportionment	**94,112**	No Apportionment	Undetermined
Alternative 2 (54/44)	118,800	**94,112**	145,800	24,688
Alternative 3 (44/54)	145,800	**94,112**	118,800	51,688
Alternative 4 (59/39)	105,300	**94,112**	159,300	11,188
Alternative 5 (39/59)	159,300	**94,112**	105,300	65,188
Alternative 6 (49/49)	132,300	**94,112**	132,300	38,188

Notes:
1) This table is designed to show the minimum catches available to the pot gear group under each of the alternatives.
2) Maximum longline catch is determined by their halibut PSC mortality cap, and represents the final projected outcome for that group under each of the alternatives.
3) Minimum Available to Pot Gear is determined by subtracting the longline maximum from the fixed gear apportionment. These figures represent minimums because they do not account for potential reallocation of cod to the fixed gear sector if the trawl sector reaches its halibut cap with apportionment remaining.

4.2.2 Model Specification

The assumptions made up to this point collectively limit the number of unknown target catch totals in the model. Of the 11 target fisheries included in the model, six (inshore and offshore bottom pollock target fisheries, the three flatfish target fisheries, and the longline Pacific cod fishery) are held constant by assumption, the last being limited by halibut PSC. Further, as noted above, the Pacific cod Pot target fisheries will be assumed to be equal to the unharvested Pacific cod remaining after the other target fishery catches of Pacific cod are determined. The four remaining fisheries with as yet undetermined catch levels are the trawl catcher vessel and catcher processor target fisheries for Pacific cod, and the inshore and offshore midwater pollock fisheries. These four target catches, and the assumption that any fixed gear allocation (plus any inseason reallocations) beyond the longline maximum, will go to pot gear, are included in a system of simultaneous equations and inequalities. The system of equations is defined in Tables 4.10 and 4.11.

The variables described in the tables include both quantities and rates. Variables which designate quantities are assigned upper case letters; variables designating bycatch rates are given lower case letters. For convenience we have designated Trawl CP as **F** (for factory trawler), and Trawl CV as **H** (for harvester trawler).

The system appears fairly complex, but basically consists of a set of five equations with five unknowns which must meet specific constraints, such as the PSC halibut mortality cap. The system can be expressed in non-mathematical terms as follows. (Letters are bolded for cross reference to Tables 4.10 and 4.11.)

1. Calculate the **R**emaining Cod available (multipy cod TAC by the non-jig proportion, then subtract the sum of the longline cod target catch, and cod bycatch taken in the yellowfin, rock sole, other flounder and the inshore and offshore bottom pollock target fisheries).

2. Calculate **R**emaining **I**nshore and **O**ffshore pollock (pollock TAC minus the sum of bottom pollock fisheries and pollock bycatch in the flatfish fisheries).

3. Solve five simultaneous equations (steps 4-8 below) to find Additional catch amounts of Pacific cod for the factory trawl (**AFC**), harvester trawl (**AHC**), and Pot vessels, and additional pollock catch for inshore (**AI**) and offshore (**AO**) pollock fisheries.

("Additional catch" means catch in addition to the bycatch of Pacific cod and pollock already accounted in the bottom pollock and flatfish fisheries. The additional catches are subject to the constraints of the Remaining Cod available of Pacific cod for factories (RFC) and harvesters (RHC), the Remaining pollock available for Inshore (RI) and Offshore (RO) sector , as well as bycatch caps of halibut for trawl Pacific cod (MC).)

These remaining amounts for each fishery are calculated in the same manner as for the remaining overall cod. Further:

4. Pot target catch of Pacific cod equals the Remaining Cod minus the sum of the Factory target catch, Harvester target catch and the bycatch of Pacific cod by harvesters and factory trawlers in the Inshore and Offshore pollock target fisheries.

5. Additional Harvester trawl Catch equals the Pacific cod target Harvester catch, plus harvester trawl bycatch of Pacific cod in the Inshore and Offshore midwater pollock target fisheries;

6. Additional Factory trawl Catch equals the Pacific cod target Factory catch, plus factory trawl bycatch of Pacific cod in the Inshore and Offshore midwater pollock target fisheries;

7. Additional Inshore pollock catch equals Inshore midwater target catch of pollock, plus the bycatch of pollock accruing to the inshore sector from Harvester, Factory and Pot target catches of Pacific cod;

8. Additional Offshore pollock catch equals Offshore midwater target catch of pollock, plus the bycatch of pollock accruing to the offshore sector from Harvester, Factory and Pot target catches of P. cod;

Ten model constraints are shown in Table 4.11. Note that the final constraint is that the ratio of target catches of Pacific cod by Factory trawlers to Harvesters will be set the same as the 1995 ratio, i.e., 0.9663 as discussed on page 85, when the specific alternatives allow it. This constraint means that whenever possible, the target catches will be proportional. This last constraint also means that under some alternatives the system needs to be solved through an iterative process whereby F is initially set equal to r × F up to the point where a constraint is met. If F is constrained then H can increase until the system is solved; if H is constrained then F can increase until the system is solved.

Table 4.10 System of Equations: Variable Definition of Known or Assumed Quantities (based on example using Alternative 2B). Bolded numbers and rows are assumed constant for all alternatives.

Known quantities and rates	Variable Name	Formulae	*Quantity*	Unit	Ref. Table
Overall Cod TAC	**TC**		**270,000**	**mt**	4.2
Non-Jig Apportionment	**NJP**		**98**	**%**	4.2
Cod apportionment for trawls	CP		54.00	%	4.5
Cod apportionment for trawl Harvesters	CHP		21.60	%	4.5
Cod apportionment for trawl Factories	CFP		32.40	%	4.5
Total Non-Jig Cod Cap	NJC	NJC = TC × NJP	264,600	mt	4.5
Trawl Cod Cap	TCC	TCC = NJP × CP	145,800	mt	4.5
Trawl Harvester Cod Cap	THC	THC = TCC × CHP	58,320	mt	4.5
Trawl Factory Cod Cap	TFC	TFC = TCC × CFP	87,480	mt	4.5
Inshore pollock TAC	**TI**		**385,263**	**mt**	4.2
Offshore pollock TAC	**TO**		**715,488**	**mt**	4.2
Longline target catch of cod	**L**		**94,112**	**mt**	4.9
Non-target catch of cod by Harvesters	**NH**		**12,876**	**mt**	4.5
Non-target catch of cod by Factories	**NF**		**32,069**	**mt**	4.5
Non-midwater catch of Inshore pollock	**NI**		**49,782**	**mt**	4.4[1]
Non-midwater catch of Offshore pollock	**NO**		**134,002**	mt	4.4[1]
Remaining Cod	RC	RC = NJC - L - NH - NF	125,545	mt	Calc
Remaining Trawl cod	RT	RT = TCC - NH - NF	100,857	mt	Calc
Remaining Harvester Cod	RH	RH = RT - THC	45,444	mt	Calc
Remaining Factory Cod	RF	RF = RT - TFC	55,413	mt	Calc
Remaining Inshore Pollock	RI	RI = TI - NI	335,480	mt	Calc
Remaining Offshore Pollock	RO	RO = TO - NO	581,486	mt	Calc
Inshore pollock bycatch rate in Cod by H.	**ih**		**28.870**	**%**	4.8
Inshore pollock bycatch rate in Cod by F.	**if**		**3.241**	**%**	4.8
Inshore pollock bycatch rate in Cod by P.	**ip**		**0.073**	**%**	4.8
Offshore pollock bycatch rate in Cod by H.	**oh**		**4.600**	**%**	4.8
Offshore pollock bycatch rate in Cod by F.	**of**		**28.801**	**%**	4.8
Offshore pollock bycatch rate in Cod by P.	**op**		**0.004**	**%**	4.8
Cod bycatch rate by harvesters in mw I. plck.	**hi**		**1.180**	**%**	4.7
Cod bycatch rate by harvesters in mw O. plck.	**ho**		**0.226**	**%**	4.7
Cod bycatch rate by factories in mw I. plck.	**fi**		**0.000**	**%**	4.7
Cod bycatch rate by factories in mw O. plck.	**fo**		**0.642**	**%**	4.7
Halibut Mortality cap for Cod trawls	**MC**		**1,685,000**	**kg**	4.6
Halibut Mortality cap for cod Harvesters	**MH**		**1,685,000**	**kg**	4.6
Halibut Mortality cap for cod Factories	**MF**		**1,685,000**	**kg**	4.6
Halibut Bycatch mortality rate for cod Harvesters	**bh**		**25.0000**	**kg/mt**	4.6
Halibut Bycatch mortality rate for cod Factories	**bh**		**19.1192**	**kg/mt**	4.6
Ratio of Cod targets (as of 4/22/95):F/H	**r**		**0.9663**		p. 85

[1]These catches are the total catches for pollock in Table 4.4, increased by the bycatch of pollock by Pacific cod longliners, most which is assigned by NMFS to the offshore category.

Table 4.11 System of Equations: Unknowns and Formulae

Unknown quantities	Variable Name	Formula
Inshore pollock midwater catch	I	Solve
Offshore pollock midwater catch	O	Solve
cod target catch by Harvesters	H	Solve
cod target catch by Factories	F	Solve
cod target catch by Pots	P	$= RC - (F + H + ho \times O + hi \times I + fo \times O + fi \times I)$
Additional Harvester Cod Catch	AHC	$= H + ho \times O + hi \times I$
Additional Factory Cod Catch	AFC	$= F + fo \times O + fi \times I$
Additional Inshore Pollock Catch	AI	$= I + ih \times H + ih \times F + ip \times P$
Additional Offshore Pollock Catch	AO	$= O + oh \times H + of \times F + op \times P$
Additional Trawl Cod Catch	ATC	$= AHC + AFC$
Additional Cod Catch	AC	$= ATC + P$
Remaining Factory Trawl Cod Constraint	RF	$\geq AFC$
Remaining Harvester Cod Constraint	RH	$\geq AHC$
Remaining Trawl Cod Constraint	RT	$\geq ATC$
Remaining Cod Constraint	RC	$\geq AC$
Inshore Pollock Constraint	RI	$\geq AI$
Offshore Pollock Constraint	RO	$\geq AO$
Trawl Halibut Mortality Constraint	MC	$\geq H \times bh + F \times bf$
Harvester Halibut Mortality Constraint	MH	$\geq H \times h$
Factory Halibut Mortality Constraint	MF	$\geq F \times bh$
Factory to Harvester Ratio Constraint	F	$\leq r \times H$, unless H is constrained by the allocation alternative to be less than F/r, in which case $H \leq (1 \div r) \times F$.

4.2.3 General Assumptions

The assumptions, model, and system of equations developed up to this point collectively allow unique solutions for each alternative. The assumptions presented so far have been very specific to the fisheries impacted by the Pacific cod allocation. In this section, we will specify some general assumptions which underlie many of the specific assertions already made. There are several key assumptions of all linear models which should be discussed. These assumptions are largely simplifications of real-world situations which allow models of this nature to develop unique solutions.

Decision Variable Appropriateness: The development and use of this model explicitly assume that the five target fisheries included are properly specified, and indeed are the only fisheries that will be impacted by the alternatives under consideration. They also imply that we have correctly specified the six other target fisheries which have significant bycatch of cod. Additionally, we assume that any of the five target fisheries can be prosecuted at any level within the constraint set.

Constraint Appropriateness: In using this model, we assume that we have correctly and fully specified the constraints on the decision variables, that any solution that is within the constraints set is admissible as a solution, and that there exist no admissible solutions which fall outside the constraint set. Additionally, we assume that the constraints are homogenous; for example, within the constraint on Catcher Vessel Pacific cod, the catch of Pacific cod in the pollock bottom fishery by a catcher vessel counts the same as the catch of Pacific cod by a catcher vessel in the yellowfin sole fishery and the catch of Pacific cod in the target fishery. Finally, we assume that the constraints are inviolate, i.e., even an amount one pound over a TAC or PSC constraint is unacceptable.

In making the assumption that the constraints we have included in the model are appropriate and complete, we imply that no other constraints exist which would limit the catch of a given target fishery. Thus we assume by its omission as a constraint, that no target fishery is limited by the number of vessels or by their catch capacity to harvest the full amount possible the TAC. Given that in 1995 the highest catch by pot boats of Pacific cod in any week was just over 1,600 mt as shown in Chapter 3, this assumption may be questionable. However, given the recent downturn in the crab stocks, and with them the prospects of shorter seasons lower profits in the crab fisheries, it is likely that there will be increased effort in Pacific cod by the pot fleet in 1996 and beyond.

Proportionality: All variables included in the model exhibit proportionality, i.e., all functions involving variables are linear, and are independent of the level of the activity. An example of proportionality is found in the assignment of halibut and non-target groundfish bycatch in the target fisheries. Each ton of catch of the target fishery results in a fixed additional amount of bycatch of groundfish and of halibut, whether it is the first ton or the last ton harvested.

Divisibility: This model allows fractional values of all activity variables and constraints to occur. For example, the model is allowed to find a solution in which 41,113.746 tons of trawl CV target catch is taken. There is no requirement that integers be used.

Certainty: This model asserts that all parameters in the model are known constants and are non-stochastic. In other words, we do not allow for variations in bycatch rates, within a given model run. We will relax this assumption later in order to show the sensitivity of the projected outcomes to specific parameters.

Simultaneous Decisions: The model simultaneously solves a single set of equations as defined above. This does not entirely reflect the decision making process of the fishing industry. Under the fisheries, as currently managed, each fishing and processing firm is faced with many decisions within a given year. The fish processing firm must ask itself on a regular basis whether it can make the most profit by purchasing one species or another from among those currently available. Because of the "open access" management of the fishery, it must choose to buy the fish which would produce the most at that particular time rather than delaying purchase until later when they might be worth more. Any delay in purchasing may preclude later use because another firm may use the available quota. Similarly the fish harvester will make periodic decisions determining its participation in various fisheries throughout the year, based on prices available from the processors. Thus, a more accurate model of the fishery under open access would solve for many periods throughout the year. Such models have been developed in theory by Arnarson, and by Berman and Hartley. The latter was considered for use in this analysis, but was rejected because of its reliance on periodic CPUE, cost, and net revenue data, which are currently unavailable.

Clearly, the assumptions listed above are simplifications of the real-world. We know that most, if not all, of these assumptions are violated in actuality. For example, we know that bycatch rates vary over the years. Nonetheless, we go forward with the model as developed in order to demonstrate some of the possible ramifications of the alternatives facing the Council. We will then re-examine the assumptions made in predicting these results, and discuss how relaxation of the assumptions may impact the findings.

4.3 Additional Fishery Parameters Used in the Analysis

The model, which is now fully specified, will yield projections of the Pacific cod target catches and halibut bycatch mortality by the longline, pot, trawl catcher vessel, and trawl catcher processor fleets. It will also produce estimates of the catches of Pacific cod in other trawl target fisheries. The Council, however, has expressed a wide array of concerns in its problem statement, and in discussions at Council meetings. With the assumption of linearity, and the findings of Chapter 3, we can use the model to project discards of Pacific cod in cod target fisheries and in other trawl target fisheries. We can also predict crab bycatch, processed products, and gross revenue and opportunity costs in the four cod target fisheries. Table 4.12 summarizes the parameters, already discussed in Chapter 3, which enable these additional projections.

Table 4.12 Summary of Discard, Bycatch, and Revenue Information in the 1995 Pacific Cod Target Fishery

Topic	Longline	Pot	Trawl CV	Trawl CP	Source
Discard rate of groundfish in cod target fishery	3.77%	1.31%	8.91%	13.39%	Table 3.5
Halibut mortality rate in cod target (kg/ton)	8.5	0.5	25.7	19.1	Table 3.7
C. bairdi bycatch rate in cod target (crab/mt)	0.26	3.37	2.57	5.67	Table 3.8
C. opilio bycatch rate in cod target (crab/mt)	0.80	8.20	0.51	1.01	Table 3.9
Red king crab bycatch rate in cod target (crab/mt)	0.00	0.16	0.01	0.09	Table 3.10
Metric tons of processed product per mt of target cod	0.46	0.49	0.29	0.26	Table 3.13[a]
Gross revenue from cod per mt of target cod	$ 847.49	$ 833.24	$ 853.60	$ 748.25	Table 3.18[a]
Gross revenue from all species per mt of target cod	$ 851.19	$ 833.24	$ 879.46	$ 974.84	Table 3.17[a]
Reduced halibut gross revenue per mt of target cod	$ 24.65	$ 1.54	$ 106.22	$ 80.37	Table 3.22[a]
Reduced crab gross revenue per mt of target cod	$ 2.42	$ 32.73	$ 17.89	$ 41.61	Table 3.23[a]
Reduced groundfish gross revenue per mt of target cod	$ 18.77	$ 0.66	$ 485.19	$ 580.53	Table 3.24[a]
Reduced gross revenue per mt of target cod (All species)	$ 46.09	$ 34.93	$ 612.79	$ 706.57	Table 3.25[a]

[a]These rates were calculated based on the information reported in the table cited and Table 3.2.

The source field identifies the table in Chapter 3 where the information was initially reported. Rates that were calculated are based on the table listed in the source field and Table 3.2. The calculation was performed by dividing the information reported in the source table by that in Table 3.2 The calculated information was not explicitly reported in Chapter 3.

4.4 Model Runs

Ten sets of model runs were made for each of the 21 alternatives in order to show the impacts of various options and assumptions. The results of these runs are shown in Chapter 5. The first model run uses the assumptions and parameters as specified above with TACs set at 1996 levels and with no split of the trawl halibut mortality cap. Runs 2-5 show the sensitivity of the model to certain key parameters and assumptions within the model, i.e., internal changes. Runs 6-10 examine the impacts of external or systemic changes in the management of the cod fisheries, including a split of the trawl PSC cap between catcher vessels and catcher processors, the implementation of CDQs, and a reduction in Pacific cod bycatch in non-cod target fisheries resulting from the possible implementation of the Improved Retention/Improved Utilization (IRIU) amendment. More details of each model run are shown in Table 4.13 below.

Table 4.13 Model Runs Employed In the Analysis

Run Number	Feature Management Assumptions
Run 1	This model run employs all of the assumptions described in the preceding section and should be viewed as the default run, or "Standard" against which other model runs will be compared.
Runs Showing the Sensitivity of Key Parameters	
Run 2	A key assumption of the model is the proportion of trawl catcher processor target catch to the target catch of catcher vessels in unconstrained situations. In this model run, the ratio is changed from 0.9663 to 1.0629, a 10% increase. This will have the effect of increasing catcher processor catches under most alternatives.
Run 3	This run decreases the CP:CV ratio by 10% to 0.8697, creating greater catcher vessel catches under most alternatives.
Run 4	Halibut bycatch rates are also a key parameter in the model. This run employs the halibut bycatch mortality rates experienced in 1994 in the Pacific cod target fisheries. Since these bycatch rates were higher than those in 1995 for each gear group, a greater amount of catch will be projected for the pot gear group under each alternative.
Run Showing the Impact of Systemic Changes To The Management Regime	
Run 5	Trawl Halibut PSC caps in the Pacific cod fishery are set equal to the Pacific cod splits within the trawl sector, i.e., in 'B' Alternatives 40% of the halibut PSC cap will be allocated to catcher vessels, and in 'C' Alternative 60% will be allocated to catcher vessels. This was not done in Run #1.
Run 6	This run is identical to Run #1, i.e., with in-season reallocations and no split of trawl halibut PSCs, except that all TACs and PSCs show the impacts of the 7.5% allocation to CDQs anticipated in 1998. (There is no additional CDQ reduction of the Pollock TACs.)
Run 7	The Council has expressed an interest in changing the PSC Halibut Mortality caps in the FMP in a separate action. This run therefore eliminates the halibut bycatch constraints for the Pacific cod fisheries in order to provide an indication of the amounts of halibut PSC needed by each gear group in order to fully prosecute their cod apportionments. In order to solve the system of equations, pot catches are assumed to equal 25,000 mt under each alternative, with longline catches varying to fill the fixed gear catch apportionment. Under this run there will be no inseason reallocation of Pacific cod.
Run 8	This run is identical to Run # 7 except that Pot catches are set at 35,000 mt.
Run 9	The Council is considering the "Improved Retention/Improved Utilization Amendment" which is designed to reduce groundfish discards in the groundfish fisheries. If this amendment is implemented, it is likely that there will be significant decreases in the bycatch of Pacific cod in the pollock and flatfish fisheries. This run demonstrates the impacts of IRIU on the projected outcomes, by reducing the bycatch of Pacific cod by 10% in each of the seven non-Pacific cod target fisheries included in the model.
Run 10	This run is identical to Run #9 except the Pacific cod bycatch is reduced by 25% .

5.0 REGULATORY IMPACT REVIEW: ECONOMIC AND SOCIOECONOMIC IMPACTS OF THE ALTERNATIVES

5.1 Introduction

This section provides information about the economic and socioeconomic impacts of the alternatives including identification of the individuals or groups that may be affected by the action, the nature of these impacts, quantification of the economic impacts if possible, and discussion of the trade-offs between qualitative and quantitative benefits and costs.

The requirements for all regulatory actions specified in E.O. 12866 are summarized in the following statement from the order:

> In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.

This section also addresses the requirements of both E.O. 12866 and the Regulatory Flexibility Act to provide adequate information to determine whether an action is "significant" under E.O. 12866 or will result in "significant" impacts on small entities under the RFA.

E.O. 12866 requires that the Office of Management and Budget review proposed regulatory programs that are considered significant. A significant regulatory action is one that is likely to :

(1) Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or state, local, or tribal governments or communities;

(2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

(3) Materially alter the budgetary impact of entitlement, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or

(4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

A regulatory program is "economically significant" if it is likely to result in the effects described above. The RIR is designed to provide information to determine whether the proposed regulation is likely to be "economically significant." Regulatory Flexibility Act implications are discussed in Chapter 6 - "Summary and Conclusions."

5.1.1 Review of the Alternatives

The Council has asked that five different apportionments between fixed gear and trawl gear be analyzed, as well as the no action alternative which would not specify a split between gears. Within each of the five apportionments, four ways (no split, 40/60, 60/40, 45/55[1]) to divide the trawl catch between catcher processors and catcher vessels are specified. This results in the 21 alternatives (#1-6d) listed on Table 5.1. The simulation model described in the previous chapter was applied to each alternative. Additionally, the Council has asked that the alternatives be studied with and without a corresponding split of the trawl Pacific cod halibut PSC mortality split, and to examine the effect of the 7.5% reduction in groundfish TACs associated with CDQs which are anticipated to be implemented with the License Limitation Program in 1998.

Table 5.1 Alternative Allocations of Pacific Cod in the BSAI

Alternative	**Trawl**		**Fixed**	**Jig**
	Catcher Vessels	**Catcher Processors**		
1	No Action - Current allocation will expire at the end of 1996.			
2a (Current)	54%		44%	2%
2b (40/60)	21.6%	32.4%	44%	2%
2c (60/40)	32.4%	21.6%	44%	2%
2d (45/55)	24.3%	29.7%	44%	2%
3a	44%		54%	2%
3b (40/60)	17.6%	26.4%	54%	2%
3c (60/40)	26.4%	17.6%	54%	2%
3d (45/55)	19.8%	24.2%	54%	2%
4a	59%		39%	2%
4b (40/60)	23.6%	35.4%	39%	2%
4c (60/40)	35.4%	23.6%	39%	2%
4d (45/55)	26.6%	32.5%	39%	2%
5a	39%		59%	2%
5b (40/60)	15.6%	23.4%	59%	2%
5c (60/40)	23.4%	15.6%	59%	2%
5d (45/55)	17.6%	21.5%	59%	2%
6a (Defacto)	49%		49%	2%
6b (40/60)	19.6%	29.4%	49%	2%
6c (60/40)	29.4%	19.6%	49%	2%
6d (45/55)	22.1%	26.9%	49%	2%
NOTE: The "d" sub-option split (45/55) for each alternative represents the 3-year average of Trawl CP and Trawl CV.				

Because of the large number of alternatives and the many important factors in relating the various outcomes and impacts, we will provide results for all of the alternatives under each of the ten model runs as discussed at the end of Chapter 4.

5.1.2 Chapter Organization

The remainder of this chapter is divided into three major sections: (1) the first section - "Summary Results" - is an overall summary of the findings of the analysis - this is broken down by the model runs employed, the first being the "Base Case," which evaluates the alternatives in the context of the existing regulations. This is

[1]This split represents the three-year average ratio, from 1993-1995, of trawl CP to trawl CV catches.

followed by summary findings from each of the additional model runs (2 through 10) described in Chapter 4. This section also contains an explicit discussion of the specific issues contained in the Council's Problem Statement; (2) The second major part of this chapter is a detailed examination of the "Base Case" model run, in which we more fully describe the projected impacts, how and why these impacts occur, and provide summary tables which provide detailed information for each of the alternatives; (3) the third major section of this chapter is a more detailed examination of the additional model runs which can be compared to the "Base Case" - in this section, we concentrate primarily on changes which occur relative to the "Base Case."

5.2 Summary Results

This section of the document attempts to summarize the major findings from Chapter 5 of the analysis. Model Runs #1 contains the most relevant basic findings. Other model runs are provided to show the effects of sensitivity analyses or the effects of various sets of assumptions such as CDQ allocations, splitting the trawl halibut PSC apportionment between catcher vessels and catcher/processors, and the Improved Retention and Utilization initiative.

5.2.1 Model Run #1 - Assumes Reallocation of Unused Pacific Cod Quota But No Split of the Trawl PSC Cap

This model run most closely depicts the impacts of each alternative given the other existing regulations for the fisheries, and should be considered the 'Base Case' reference point. It reallocates remaining Pacific cod to groups which were not constrained by their halibut mortality caps, but does not split the PSC cap between CV and CP trawl sectors. Other model runs, incorporating a variety of assumptions, can be compared to the results of this model run.

* Because pot vessels do not have a cap on PSC halibut mortality, fixed gear overall will not be constrained by existing halibut PSC caps.

* Within the fixed gear group, the longline target fishery is constrained by their halibut PSC caps under every Alternative at 94,112 mt as estimated by the model. Therefore, the alternatives will have little impact on the longline fleet, unless some change in the halibut PSC caps are made.

* Trawl gears are constrained by PSC caps in any alternative which allocates 49% or greater to that sector, but are constrained by the Pacific cod apportionment in alternatives which allocate less the 49%. Because they are constrained by halibut under the current program (Alternative 2), and by any alternative which increases the trawl apportionment, the trawl sector would not realize gains in Pacific cod catch under any of the alternatives under consideration, unless changes are made to the PSC caps.

* The primary beneficiary of an increase in the fixed gear allocation will be pot vessels - this is because longline gear is constrained by the current PSC cap.

* Pacific cod catches in other trawl groundfish target fisheries are stable at around 53,000 mt under each alternative. This represents between 40% and 50% of the total trawl catch under any of the alternatives. Under current regulations Pacific cod in catches in other trawl groundfish fisheries will be largely unimpacted by the apportionments.

* Trawl catcher processor catches of Pacific cod in other groundfish fisheries are likely to be about 35,000 mt under each alternative. Pacific cod catches in other groundfish fisheries by trawl catcher vessels are approximately 18,000 mt. Neither of the fixed gears have significant bycatch of Pacific cod in other groundfish fisheries.

* Discards are estimated to decrease with increases in allocations to the fixed gear sector, assuming current management regulations, though no major differences occur across alternatives. Approximately 75% of all Pacific cod discards occur in trawl fisheries for other targets other than Pacific cod. These discards will be largely unaffected by the allocation.

* Total halibut bycatch mortality from the cod fisheries decreases in allocations favoring fixed gear. Within the trawl sector, halibut mortality is reduced in allocations favoring catcher processors.

* Crab bycatch generally increases under alternatives which allocate a higher percentage to fixed gear. This is because cod trawl target fisheries have generally lower crab bycatch rates than pot gear fisheries for cod (other trawl groundfish targets take the vast majority of crab bycatch). This finding does not take into account differential mortality rates associated with each gear type.

* Total product from the cod fisheries is greatest under Alternative 7, where fixed gear receives the highest allocation percentage. This is due to higher utilization rates (production of whole and H&G product as opposed to fillets, for example).

* The total amount of cod going to domestic markets will likely remain unchanged, assuming current halibut PSC caps. This is because any change in the apportionment appear to affect only trawl and pot gear, which produce similar products for the same markets.

* Gross revenue per ton of target catch is greatest for trawl catcher processors. However, because much of their catch of Pacific cod occurs in other groundfish fisheries, overall gross revenue impacts of the alternatives are relatively small. The difference between the alternative with highest gross revenue estimate and that with lowest is $4.6 million dollars, approximately 2.5% of overall gross revenues in the Pacific cod target fisheries of all gears.

* Gross revenue estimates assume that the pot fleet will be able to harvest the Pacific cod made available to it by the apportionments. If the pot fleet is unable to catch their share, and the other sectors are constrained by either halibut or by the Pacific cod apportionment, then gross revenue will fall from the projected amounts by $833 for each ton "left on the table." If for example 1,000 mt of Pacific cod are left unharvested, then overall gross revenues will be $833,000 less than projected. If 5,500 mt are left unharvested then overall gross revenues will fall by $4.6 million which was the total range seen in the alternatives, under the assumption that all Pacific cod would be caught.

* Gross revenue measures ignore costs of production and do not necessarily reflect the greatest net return to the Nation. Reliable cost information is unavailable, but as discussed in Chapter 3 would tend to indicate that net revenue is higher in trawl fisheries than in pot fisheries. Since pot fisheries are the primary beneficiary of a reallocation to fixed gears it would appear that net revenue decreases would be likely, under this scenario.

* Opportunity costs as represented by reduced gross revenue amounts generally decrease with increases in the fixed gear allocation. This finding is heavily influenced by the reduced gross revenue impacts which would be felt by the groundfish fisheries themselves, rather than in impacts on the halibut fishery, or on the crab fisheries. There is a direct (albeit partial) tradeoff between revenues in the Pacific cod trawl target fisheries and revenues in the pollock fisheries. In alternatives which increase revenues for the trawl Pacific cod fisheries, revenues are reduced (i.e., reduced gross revenues are higher) in the pollock fisheries.

General Assessment of the Alternatives Under Model Run #1:

Alternatives 1, 2, and 4 and Sub Options:

* Under these alternatives, which keep the apportionment at the current levels or increase the apportionment to the trawl sector, the trawl fleet is constrained by their catch of halibut rather than by the Pacific cod apportionment. Therefore, little or no change from the current situation can be expected, for either sector. Under the 'C' sub-options of these alternatives target catches are expected to shift from the Trawl CP to the Trawl CV sector. Because trawl catcher vessels appear to have a higher halibut PSC mortality rate, overall trawl catches decrease under the 'C' options, which allocate 40% to Trawl Catcher Processors and 60% to Trawl Catcher Vessels.

Alternative 3 and Sub-Options:

* Under Alternative 3 which reverses the current apportionment allocating 44% to the trawl sector and 54% to the fixed gears, the pot fleet is expected to have over 51,000 mt available to it, assuming the longline fleet will be constrained by their halibut PSC catch. This is an increase of 33,000 mt from their 1995 catch.

* Under 3A (no CP/CV split), the ratio of catch between the CP and CV groups is projected to be the same as under the current allocation. Overall trawl target catches decrease by 10,673 mt, and halibut PSC mortality drop with it to 1,447 mt, 238 mt less than the current trawl halibut PSC mortality cap. Under options B and D more Trawl CP target catches increase and halibut PSC mortality drops to a low of 1426 mt under option 3B. Under option 3C Trawl CV target catches increase, and halibut PSC mortality is projected to be 1,573 mt.

Alternative 5 and Sub Options:

* Under all options of Alternative 5 which allocates 59% of the Pacific cod to fixed gears, projected catches by the pot fleet are over 65,000 mt. This exceeds their 1995 catch by approximately 46,000 mt. Since the longline fleet is constrained by their halibut PSC mortality cap, capacity in the pot fleet will have to increase in order to harvest the entire Pacific cod TAC, if it stays at current levels.

* Target fishing for Pacific cod by catcher processors is estimated to fall to very low levels (6,000 mt) under Alternative 5C. This Alternative allocates 39% of the Pacific cod to the trawl sector, with 60% of that going to catcher vessels. Under this alternative, target catches of the trawl catcher vessels are projected to be higher than under the current apportionment. Under other Sub-Options target catches are much more evenly distributed between the Trawl CV and Trawl CP groups.

Alternative 6 and Sub-Options:

* Under Alternative 6, which is a 49/49 split between trawl and fixed gear, the pot fleet is projected to have between 39,896 mt (under 6B) and 45,936 mt (under 6C) available to it. This is an increase of over 20,000 mt from their 1995 catch.

* Under Alternative 6, the total trawl target catch (an average of 48% under the four options) is just below the level which can be taken by their cod apportionment. The trawl target catch is still constrained by their overall trawl halibut PSC mortality cap, but with a small decrease in their bycatch rates, they would instead be constrained by the cod apportionment. Total trawl catches are highest under option 6B, 48.4% of the TAC, and lowest under option 6C at 46.1% of the TAC.

5.2.2 Model Run #2 and #3 - Sensitivity Analysis Which Changes (± 10%)the Ratio of CV to CP Catch Rates

* Increasing the ratio of trawl CP to CV target catch increases the target catch going to trawl catcher processor under each alternative. With increased CP target catch, more trawl Pacific cod is caught per ton of halibut, and therefore, the overall trawl total catch will tend to increase. Decreasing this ratio will result in an opposite directional effect.

5.2.3 Model Run #4 - Sensitivity Analysis Which Uses 1994 (as opposed to 1995) Halibut Bycatch Rates

This model run simply uses the 1994 halibut bycatch mortality rates for each fishery, as opposed to the 1995 rates used in the "Base Case." Because PSC caps are an important constraint on the fisheries (other than pot gear), the results under each alternative are significantly influenced by halibut bycatch mortality rates. In this case, because the mortality rate for longline gear was 50% higher than in 1995, the resulting catch of cod by this sector is reduced by about 50%. Additional catch is accrued to the pot gear sector. Trawl mortality rates were higher also, but only slightly so. If the reverse occurs (halibut bycatch mortality rates decrease for longline and/or trawl gear), then the amount of cod catch available for the pot gear sector would be decreased.

5.2.4 Model Run #5 - Assumes a Pro-rata Apportionment of the Trawl Halibut PSC Cap Between Catcher Vessels (CV) and Catcher Processors (CP)

* The findings under this scenario are similar to the "Base Case," with the following notable exceptions:

* Splitting the trawl PSC cap favors catcher processors (CP) under the current percentage split, its reciprocal, or a 49/49 split - this sector gains cod harvest from the CV sector which reaches its PSC cap relatively sooner.

* A split PSC cap is neutral under alternatives which significantly increase the fixed gear allocation, because TAC will be the constraining factor anyway.

* Splitting the PSC cap proportional to the cod quota reduces overall halibut mortality, relative to having a common cap for the two trawl sectors. This results because under the current apportionment the catcher vessels take 51% of the trawl target catch but account for 58% of the total trawl halibut PSC mortality in the Pacific cod fisheries. If the catcher vessels were to catch 60% of the target cod they would end up with 68% of the halibut mortality. Therefore if they receive only 60% of the halibut, they will not be able to catch 60% of the cod, and the total halibut mortality will decrease, but only if the catcher processors have low enough halibut bycatch rates to first use their cod allocation.

* These results are primarily due to two factors: (1) the catcher vessels have a higher percentage of their cod catch in cod target fisheries, and (2) the catcher vessels have a higher bycatch rate of halibut, in cod targets, than catcher/processors.

5.2.5 Model Run #6 - Assumes a 7.5% TAC Reduction for CDQs

* This model run was made with the assumption of 7.5% of the TACs, including cod, being set aside as CDQs. Essentially, this reduction in TAC, because it is accompanied by a 7.5% reduction in the halibut PSC caps for each fishery, does not alter the basic outcomes other than to proportionally reduce the catch and gross revenues for the longline and trawl sectors. Pot gear, unconstrained by PSC caps, would continue to harvest any of the 'excess' quota (above 49%) allocated to fixed gear.

5.2.6 Model Runs #7 and #8 - Release the Halibut PSC Constraints for Longline and Trawl Gear and Sets the Pot Gear Catch at a Maximum of 25,000 mt and 35,000 mt Respectively

* The primary purpose of these model runs is to examine what would be required, in terms of halibut PSC allowances, by each sector under the full range of allocation alternatives.

* Because longline gear no longer has a cap in this model run, pot gear catch was arbitrarily constrained at 25,000 mt in order to make the model work (i.e., tell us how much halibut might be needed by the other sectors to prosecute their quota allocations). This is a 33% increase over the 1995 catch by pot gear.

* In order to catch the full cod quota under the <u>current</u> allocation, an additional 376 mt of halibut mortality would be required. Of the total amount needed (2,861 mt) to fully take the cod TAC, 797 mt would be for the longline sector (just below their actual cap of 800 mt) with 2,050 mt by trawl gear (365 mt over their actual cap of 1,685 mt) and pot gear would account for 14 mt. If the trawl allocation is split 60% to the catcher vessel sector, the total increase would be only 516 mt (with the trawl CV sector accounting for 1,759 mt).

* Under a reciprocal of the current split (allocating 54% to fixed gear), and assuming a 25,000 mt catch by pot vessels, the longline sector would need a total of 1,027 mt of PSC, 227 mt over their existing cap. The trawl sector would be constrained by the cod quota in this case and would take 1,447 mt, 238 mt <u>short</u> of their existing cap, for a net "savings" of 11 mt.

* Under a 49/49 split, the longline sector would need 912 mt of total halibut PSC, and the trawl sector (assuming no sub-split) would need a total of 1,749 mt of PSC to cover cod catch in directed (target) cod fisheries. This is, as in Alternative 2, above the existing caps.

* Under the most extreme allocation alternative which would reduce overall PSC mortality (Alternative 5 which allocates 59% to fixed gear), the total potential halibut "savings" would be 197 mt, which is the total savings from the trawl sector minus the additional halibut needed for the longline sector.

* A final model run was performed which raises the pot gear sector's cod catch to 35,000 mt, which is double their 1995 catch. In this case, the total PSC needed by the trawl and longline sectors decreases. The lowest amount of potential halibut bycatch in this case is 2,222 mt (again from Alternative 5), for an overall potential "savings" of 282 mt.

* Potential "savings" of halibut from the trawl sector can be reapportioned to other trawl groundfish fisheries during the annual specifications process (thereby negating the "savings"), or allowed to be reapportioned to the directed halibut fisheries, or 'banked' to enhance future halibut biomass (the latter two options are at the discretion of the IPHC). A change in the overall caps for longline or trawl fisheries would require a separate FMP/regulatory amendment.

5.2.7 Model Runs #9 and #10 - Evaluates Interaction With IR/IU Program and Assumes a 10% Decrease in the Catch of Cod in Other Groundfish Fisheries (25% reduction assumed in #10)

* This model run was made to examine potential interactions with the Council's proposed Improved Retention and Utilization (IR/IU) program. Obvious impacts are that discards would be reduced to zero (other than regulatory discards). Less obvious impacts are derived by making an assumption regarding the avoidance of cod bycatch in other groundfish target fisheries. Two scenarios are developed: (1) assumes that bycatch of cod in other fisheries will decrease by 10%, and (2) assumes that bycatch of cod in other fisheries will decrease by 25%.

* The primary impact is to make more cod available to all target fisheries, of which gains accrue primarily to the trawl fisheries since fixed gear fisheries take nearly all of their cod in targets anyway.

* Under the assumption of a 25% decrease in cod caught in other fisheries, Alternative 3A (which is a flip of the current percentage splits) shows an increase in the target catch of cod for both the CV and CP trawl sectors (about 5,000 mt each), so that their total target catch is equal to the target catch under the current allocation percentage; i.e., the percentage allocations could be reversed and the target catch of cod by trawlers would remain unchanged relative to Alternative 2. [This comparison is assuming the IR/IU program is in place - the total target catch would be lower than Alternative 2 without IR/IU in place, so would represent a decrease in catch for trawlers in at least 1997.]

5.2.8 Overall Findings

* Given the current halibut bycatch rates in the trawl fishery, the current allocation of Pacific cod (Alternative 2: 54% to trawls and 44% to fixed gear) could not be harvested without an inseason reallocation from the trawl sector to the fixed gear sector of at least 12,000 mt.

* Under a 49%/49% allocation between fixed and trawl gear (Alternative 6), both fixed and trawl Pacific cod catch could be accommodated within the existing halibut PSC caps without inseason reallocation.

* Due to bycatch constraints on both longline and trawl gear, the primary beneficiary of any increase in the fixed gear allocation above 49% will be pot gear. To the extent pot gear is unable to take the additional allocation, there will be foregone harvest of Pacific cod.

* If an increase is made to the trawl gear sector, then foregone harvest of Pacific cod would be expected as they are constrained by halibut bycatch, unless some halibut is reapportioned from other target trawl fisheries in the annual specifications process. They are currently constrained at about 49% of the TAC. If it were re-apportioned in the fall to fixed gear, pot gear may or may not be able to take that 'excess' fish, depending on the size of the unused quota and the amount of pot gear effort exerted.

* Overall halibut mortality and overall cod discards tend to decrease under Alternatives favoring fixed gear.

* Within the trawl fleet, the CV trawl sector has higher halibut bycatch mortality rates, while the CP sector has higher cod discard rates.

* Reduction in the trawl gear allocation will tend to be at the expense of the trawl cod target fisheries, since bycatch needs in other fisheries will still be accommodated. Since the CV sector targets cod at a relatively higher rate, they will be most impacted, barring sub-allocations between the two trawl sectors.

* Based on available information for this analysis, differences between the alternatives, in terms of total gross revenues, will not be significant. Primary impacts will be distributional; i.e., the different allocations will create benefits for the pot sector at the expense of the trawl sector. The trawl sector is unable to benefit from increases in the trawl apportionment due to the halibut mortality cap.

* All findings in the document should be made, bearing in mind the assumptions and caveats of the analysis. In particular, we remind the readers the 1995 bycatch rates are an important determinant of the results. These rates have varied widely over the years included in the analysis, and are expected to continue to vary. Finally, we remind the reader that because gross revenues do not incorporate costs of production, these numbers should not be used as predictors of overall benefits to the Nation.

5.3 Specific Issues in the Council's Problem Statement

Although much of the preceding summary touched on specific items in the Council's Problem Statement, an additional summary is provided in this section which explicitly refers to issues raised in that Problem Statement - the Problem Statement is shown again below for reference:

> *The Bering Sea/Aleutian Islands Pacific cod fishery continues to manifest many of the problems that led the NPFMC to adopt Amendment 24 in 1993. These problems include compressed fishing seasons, periods of high bycatch, waste of resource, and new entrants competing for the resource due to crossovers allowed under the NPFMC's Moratorium Program. Since the apportionment of BSAI cod TAC between fixed gear, jig, and trawl gear was implemented on January 1, 1994, when Amendment 24 went into effect, the trawl, jig, and fixed gear components have harvested the TAC with demonstrably differing levels of PSC mortality, discards, and bycatch of non-target species. Management measures are needed to ensure that the cod TAC is harvested in a manner which reduces discards in the target fisheries, reduces PSC mortality, reduces non-target bycatch of cod and other groundfish species, takes into account the social and economic aspects of variable allocations and addresses impacts of the fishery on habitat. In addition, the amendment will continue to promote stability in the fishery as the NPFMC continues on the path towards comprehensive rationalization.*

The following specific issues are identified and discussed below:

Compressed Fishing Seasons

Fishing seasons for each industry sector involved were discussed in some detail in Chapter 3. None of the alternatives being considered will directly address the issue of compressed fishing seasons overall, though there are implications for season length, in the form of trade-offs between the industry sectors involved. For example, a growth in participation in the cod fisheries by pot vessels, which is evident currently and could expand due to downturns in the crab fisheries, has the potential to further compress fishing seasons for the fixed gear fisheries overall. This would occur under allocation alternatives which retain the existing percentages or those very close to the existing percentages. An increase in the allocation to fixed gear has the potential to mitigate this trend, though it would be at the expense of the trawl sector, whose seasons would be further compressed by a change in the allocation percentages favoring fixed gear. The reciprocal is also true, though any further compression of trawl fishing seasons could be mitigated to some extent by those alternatives which tend to increase the relative amount of cod taken in target fisheries, as opposed to being taken as bycatch in other groundfish fisheries.

Periods of High Bycatch

Halibut bycatch in general will greatly affect both the longline trawl sectors' ability to take their overall TAC, as well as the length of the seasons. Specific periods of high bycatch may still be unavoidable, though trimester allocations of the longline fishery may help avoid periods of higher bycatch, though these options exist regardless of the percentage allocations between gear types. Trawl fisheries for cod typically occur in the spring of the year and are completed, due to attainment of either the TAC or the PSC cap, by the end of April. This is largely a function of the derby nature of the fishery and will be unaffected by any of the allocation alternatives, other than to slightly shorten, or lengthen, the period of fishing activity.

Halibut bycatch in the cod target fisheries tends to be reduced overall in allocation alternatives which favor fixed gear. These savings occur because trawl fisheries become constrained by their smaller cod quota allocation (at more extreme allocation percentages)and never achieve the PSC caps *currently* allocated to the cod fishery. Though the overall BSAI trawl PSC cap is fixed in regulation, the cod portion of that cap is set during the annual specifications process, and could be apportioned to other trawl fisheries, resulting in little or nor overall halibut savings. If not reapportioned to other fisheries, then a potential savings of halibut occurs which can either be

* The primary impact is to make more cod available to all target fisheries, of which gains accrue primarily to the trawl fisheries since fixed gear fisheries take nearly all of their cod in targets anyway.

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Waste of Resource (Discards)

The majority of discards are from trawl fisheries, particularly catcher/processor vessels, and primarily because relatively more of their cod catch occurs in groundfish fisheries where cod is not the target (discards are generally higher in non-target fisheries). Overall discards are not expected to change significantly under any of the alternatives, though alternatives which allocate a greater percentage to fixed gear result in the fewest discards, particularly of discards in target fisheries. If an Improved Retention and Utilization (IR/IU) program is implemented (which includes BSAI cod fisheries), the total discards, other than regulatory, will be eliminated for all fisheries, and there will be no difference among any of the alternatives in terms of discards. More of the fish will be taken in target fisheries, due to avoidance reactions of vessels in other groundfish fisheries.

New Entrants From Moratorium Crossover Provisions (Growth of Pot Gear Sector)

The provisions of the moratorium, coupled with the recent downturn in crab fisheries, will likely increase participation in the cod fisheries, particularly of pot gear vessels. Recent data show a doubling of pot gear catch from 1994 to 1995 (from 8,000 mt to 18,000 mt), and a 50% increase so far in 1996 relative to 1995. For example, 1996 catch by pot gear may be as high as 28,000 mt given current catch rates. Given current (1996) cod quotas, and given the fact that trawl and longline gear are currently constrained by PSC caps, all of the alternatives under consideration would accommodate that level of pot gear catch and more. Under the current allocation percentages, the projected pot catch is 41,051 mt, which assumes current PSC caps for the other gear types, and assumes that the pot gear sector could catch that much cod. As an additional reference point, a reversal of the current split, such that fixed gear is allocated 54% of the quota, would result in 51,688 mt available to pot gear.

Unless pot gear catch exceeds those amounts, all of the alternatives would appear to allow for substantial growth in the pot sector, without impacting the catch by the longline sector. If overall cod quotas decrease in the future, then alternatives which allocate a greater (than current) percentage to fixed gear would be necessary to accomodate the growth of the pot sector, without impacting the longline share. In that case, the reallocation would be at the expense of the trawl sector.

Non-target Bycatch of Cod

Bycatch of cod in other groundfish fisheries occurs primarily in trawl fisheries, and the catcher/processor has a relatively higher percentage of non-target catch than catcher vessels. Fixed gear catch occurs almost entirely in target fisheries. As mentioned above, discards of cod are much higher in non-target fisheries than in target fisheries. Because bycatch needs in other fisheries will still be provided for in the management system, any reduction in quota to the trawl sector will mostly be felt by the target cod fisheries. Total amounts taken in other fisheries will remain largely unaffected. An exception to this occurs under an assumption of IR/IU, where it is likely that bycatch of cod in other fisheries will be reduced, thereby providing additional fish for the directed (target) cod fisheries. Although total non-target cod catch remains largely unaffected across alternatives, there are differences in the distribution of target catch between catcher vessels and catcher processors. For example, sub-alternatives which allocate 60% of the trawl sector's quota to catcher vessels result in a disproportionate distribution of the overall trawl target catch to catcher vessels (the catch of cod in targets by the CP sector is greatly reduced - most of their cod catch occurs in non-targets in these cases).

Habitat Concerns

As is described in Chapter 2 and in other existing literature, there are benthic impacts associated with all gear types, though the lack of research in the North Pacific fisheries preclude any quantitative comparisons of impacts under the alternatives being considered. To the extent that preferential allocations to fixed gear will reduce any trawl gear impacts from directed cod fishing, it is possible that effort would be transferred to other trawl fisheries, resulting in a net change of little or no reduction in overall trawling.

Stability in the Fishery and Comprehensive Rationalization

Judgements regarding stability may be very subjective and depend on the perception of stability and upon assumptions regarding potential future steps in the Comprehensive Rationalization process; further, there are the often countervailing issues of stability *across* industry sectors to be reconciled with stability *within* industry sectors. For example, maintaining the current percentage allocations may promote stability across industry sectors, as well as within industry sectors, except that it may not provide for stability within an increasing pot gear fishery which may depend heavily on the cod resource in the future. If the pot gear sector continues to grow at the current rate, it may be necessary to increase the fixed gear allocation to insure future stability of the longline sector, though that of course will be at the expense of stability to the trawl sector. Stability of the onshore processing sector may be impacted by the allocation alternatives as well, with trade-offs between it and the offshore processing sector. Finally, stability within each of the trawl sectors (CV and CP) can be affected by the sub-allocations being considered.

How the various sectors will be impacted under any allocation alternative can also be affected by future management programs which can affect both the overall cod fisheries and particular segments of the cod fisheries; these potential programs include CDQ allocations, the IR/IU program, and individual Vessel Bycatch Accounting (VBA) programs. From the analysis, it appears that any of the alternatives will provide stability to the longline fishery, in terms of maintaining its current harvest levels. Stability to the trawl sector is a bit more difficult to ascertain, because there are possible differences in the distribution of *target* catch between the CV and CP sectors. Overall, an allocation which reflects the current split (49/49) may provide the most stability across and within industry sectors, though a reciprocal of the current split (54/44 in favor of fixed gear) could provide a similar distribution of target catch, *assuming* an IR/IU program with resulting decreases in the catch of cod in other trawl groundfish fisheries.

5.4 Detailed Examination of "Base Case" Model Run

5.4.1 Model Run #1 - Uses The "Standard" Assumption Set (Base Case)

The first model run shows the impacts of the 21 alternatives under the "standard" set of assumptions, i.e., using 1996 TACs without CDQs, and assuming there is no split of the trawl halibut PSC mortality cap between the CV and CP. This model run will be the "default" model run against which other model runs should be compared. Because this run is assumed to be the standard or "Base Case," we include a complete set of 21 output tables showing the results of the model and the impacts of the alternatives on the fishery.

List of Tables Showing the Impacts of Alternatives Using the Standard Assumption Set: Model Run #1

Table 5.8:	Total Pacific Cod Discards In Non-Pacific Cod Target Fisheries
Table 5.9:	Metric Tons of Halibut Mortality in Pacific Cod Target Fisheries
Table 5.10:	Bycatch of C. Bairdi
Table 5.11:	Bycatch of C. Opilio
Table 5.12:	Bycatch of Red King Crab
Table 5.13:	Gross Revenue From All Species Products in Pacific Cod Target Fisheries
Table 5.14:	Reduced Gross Revenue in the Directed Halibut Fisheries Resulting From Halibut Bycatch Mortality (Opportunity Cost of Halibut Bycatch)
Table 5.15:	Reduced Gross Revenue in the Directed Crab Fisheries Resulting From Crab Bycatch Mortality (Opportunity Cost of Crab Bycatch)
Table 5.16:	Reduced Gross Revenue in the Pollock Fisheries Resulting From Pollock Bycatch in the Pacific Cod Fisheries (Opportunity Cost of Pollock Bycatch)
Table 5.17:	Reduced Gross Revenue in the All Directed Fisheries Resulting From Bycatch (Opportunity Cost of All Bycatch)
Table 5.18:	Summary of Target Catches of Halibut Mortality By Fixed and Trawl Gear
Table 5.19:	Summary of Projected Outcomes Of Alternative Pacific Cod Allocations
Table 5.20:	Ranking of Projected Outcomes Of Alternative Pacific Cod Allocations

These tables are shown on pages 121-139. Similar tables for each of the remaining nine model runs were also created. Because each of those additional runs focuses on changes in a small sub-set of the model assumptions, only tables relevant to the particular issue will be reproduced in this document. The complete set of tables (over 200 pages in all) is available by contacting the Council office.

With the exception of Table 5.5 and summary Tables 5.18 through 5.20, these tables are developed with similar formats. The first two columns list the alternatives by number and show the trawl/fixed gear split as well as the trawl CP/CV split. (The latter is shown in parentheses.) The next four columns show the total quantity of each measure projected to accrue to each of the four gear groups (Longline, Pot, Trawl CV, and Trawl CP). The seventh column adds the four gear groups to produce a total for each measure. The third set of columns shows percentages for each of the groups. In most cases, the percentages are calculated with the gear's total in the numerator and the sum of the four gears in the denominator. In this case, the sum of the percentages will add up to the total percent (usually 100%, but not always.) In some cases, the percentages show the gear group's total as a percent of that gear group's total from a previous table. An example of this is found in Table 5.4 which shows total Pacific cod catch in non-Pacific cod target fisheries. In this table, the percentages show the gear group's non-target Pacific cod as a percent of all Pacific cod caught by that gear group.

The last column ranks each of the alternatives. With one exception, the ranking is made on the Total quantity in the seventh column. If the measure is generally a positive aspect of the fishery (e.g., gross revenue) then the ranking gives a '1' to the alternative(s) with the highest total. If the measure is generally a negative aspect of the fishery (e.g., halibut PSC mortality) then the alternative with the lowest total receives the #1 ranking. In cases of ties, two or more alternatives may receive the same ranking. As an example, look at Table 5.3, showing the total Pacific cod catch in target fisheries. The total Pacific cod catch in target fisheries is highest at 210,902 mt and is ranked #1 under 13 of the 21 alternatives because it's the same; the next highest catch (210,885 mt), therefore, receives a rank of 14.

Total Pacific Cod Catch In All Fisheries

Table 5.2 shows the total Pacific cod catch in all fisheries. This includes the catch in the four Pacific cod target fisheries as well as the catch (bycatch) of Pacific cod in the pollock and flatfish fisheries. The allocation alternatives under consideration divide the catch of Pacific cod among gear groups regardless of the target in which that Pacific cod is caught. Theoretically then, the percentage of total catch of Pacific cod in all fisheries for fixed and trawl gear should equal the apportionments. However, because of the constraining halibut PSC mortality caps, and the assumption of inseason reallocation of Pacific cod, the projected catches for the fixed gears exceed their apportionment in many cases. Under Alternative 2A for example, the fixed gears are projected to catch over 50% of the Pacific cod TAC, whereas their apportionment was only 44%. Over 6% of the Pacific cod was reallocated to fixed gear in-season. This occurs, as will be seen in Table 5.9, because the trawl Pacific cod fisheries are constrained by their halibut PSC mortality cap after catching just less than 48% (under this alternative) of the total Pacific cod. Under Alternative 3A where the trawl apportionment is 44%, the trawl total Pacific cod catch is in fact 44%. Under this alternative, the apportionment constrains the trawl catch rather than the halibut PSC mortality cap.

Further examination of the total trawl catches of Pacific cod in Table 5.2 reveals that under all sub-options of Alternatives 3 and 5, the trawl catches equal the amounts allowed under the alternative apportionments. This is because the trawl groups are constrained in these alternatives by the apportionment and not by their halibut PSC mortality cap. Further, under sub-options B, C, and D, the relative share of each sectors' catch equals the proportion allowed under the alternative. For example, under Alternative 3D, the trawl sector as a whole is allocated 44% of the Pacific cod TAC, with 55% of that going to the trawl catcher processors. Adding the percentages from columns 10 and 11 for this alternative, we see that indeed the trawl sector is projected to receive 44% of the total. Dividing the percent going to the trawl CP group by 44% (24.2% ÷ 44%) reveals that the trawl CP group catches 55% of the trawl total.

Under all sub-options for Alternatives 2, 4, and 6, the trawl catch falls short of its allocated apportionment. This, as stated above, is due to their bycatch of halibut. Under these alternatives, cod is reallocated from the trawl sector to the fixed gear sector. On average under these alternatives, the trawl sector is projected to catch 47.7%. Further, the projected catches under the "A" sub options for Alternative 1, 2, 4, and 6 are identical. None of these alternatives include a separate split of the trawl harvest, and since the trawl fleet is constrained by halibut rather than the apportionments, the projection relies on the assumption of proportional target trawl catches embedded in the model. With further scrutiny, we notice that projected catches under 8 of the 21 alternatives produce identical catch results for the trawl sectors (Alternatives 1A, 2A, 2B, 2D, 4A, 4B, 4D, and 6A). In all of these cases, we can infer that the apportionment is non-binding, and that the results hinge on the bycatch of halibut rather than the allocation of Pacific cod. We can also assume that because of the assumption of linearity, these 8 alternatives will be identical in all 21 tables presented for this model run.

Longline and pot catches in this table represent total Pacific cod catches as well as target catches, because no other fisheries for these gear were included in the model. The longline catch in Table 5.2 is projected to remain constant at 94,112 mt under each alternative. This is because, as discussed in Chapter 4, the longline halibut bycatch mortality rate (assumed to equal their 1995 rate of 8.501 kg/mt of target catch), and their 800 mt halibut PSC mortality cap, combine to constrain that gear under each alternative.

Projected pot harvests increase under every alternative, relative to their 1995 catch. For example, under Alternative 2A, the current allocation, the pot catch is projected to more than double from their 1995 catch. Part of the increase is due to the higher Pacific cod TAC in 1996, which increases the total projected Pacific cod catch by all four gears by nearly 38,000 mt. Another part of the increase results from the reallocation of unharvested Pacific cod from the trawl sector which cannot be taken by the longline sector. It is also important to reiterate that the model assumes that each sector has the capacity to harvest any amount made available to it, unless constrained by their halibut PSC mortality cap. Thus, the model assumes in its projection that the pot vessels will be able to harvest this amount.

While it appears from the early season statistics for 1996 that pot harvest capacity has increased, it is uncertain whether it has increased enough to harvest the 41,051 mt projected under this alternative. It appears, however, that the longline and trawl sectors will both be constrained by their halibut PSC mortality caps. Therefore, either the Pacific cod is harvested by the pot sector, or it may go unharvested resulting in a less than optimum yield in the fisheries.

Table 5.2 clearly demonstrates a principle finding of the analysis: **any reallocation of Pacific cod to fixed gear from trawls is likely to directly benefit only the pot gear group.** Direct benefits to the longline fleet of a reallocation favoring the fixed gear sector would only occur if the longline halibut bycatch mortality rate or the PSC cap changed. The longliners themselves can affect a change in the bycatch rate by fishing cleaner, however, a change in the PSC cap is outside the scope of the alternatives under consideration. The issue of the PSC caps is discussed further in the discussion of Model Runs 7 and 8.

Although it appears that the longliners will not receive a direct benefit from the reapportionment of the Pacific cod TAC, indirect benefits are possible. To demonstrate this, assume that the apportionment remained at 54/44 favoring the trawl sector, and that halibut bycatch rates in the trawl sector drop such that they are able to harvest their entire apportionment (145,800 mt). This would leave 118,800 mt for the fixed gear sector. Further, assume that the pot sector continues to grow, and that in 1996, they harvest 25,000 mt. This would leave 93,800 mt for the longline sector, a slight but perhaps insignificant decrease in their catch. But now assume that the pot sector capacity increased such that they were able to harvest 35,000 mt in 1996. The amount available for longliner catch would drop to 83,800 mt. Under a reapportionment to fixed gear, the longline catch would less likely be impacted by the increasing capacity in the pot sector.

In order to clearly see the impacts of the allocation alternatives on the trawl sector, the trawl Pacific cod catch must be divided between Pacific cod target fisheries and non-Pacific cod target fisheries. Table 5.3 shows the catch of each gear group in Pacific cod target fisheries and Table 5.4 shows Pacific cod catches in other target fisheries where Pacific cod is a significant bycatch species.

Total Pacific Cod Catch in Pacific Cod Target Fisheries

Table 5.3 shows each gear group's catch of Pacific cod in the Pacific cod target fisheries. A quick examination of the ranking column shows that total target catches are greatest when the alternatives favor the trawl sector, however, the range of total target catches is relatively minor (a range of 81 tons). Further, because the bycatch of Pacific cod by fixed gears in other groundfish target fisheries is minimal and was excluded from the model, fixed gear sector target catches do not change from their total Pacific cod catch. Therefore, this section will focus on target catches of Pacific cod in the trawl sector and the difference of the target catches in the sub-option within each alternative.

Many of the findings in this section draw on both the target catches shown in Table 5.3 and on Table 5.9 which focuses on halibut mortality. For convenience, a summary of the information in both Table 5.3 and 5.9 is provided in Table 5.18 which shows total target and halibut bycatch mortality by the combined fixed gear and combined trawl gear sectors. This table also computes a weighted average bycatch mortality rate of each gear sector as a whole. Because of differential bycatch rates between longline and pots and between trawl catcher vessels and catcher processors, these average bycatch rates will vary under each of alternative. These differences will be helpful in explaining some of the results found in Table 5.3.

As seen in Table 5.3, and as noted in the previous section, target catches in Alternatives 1A, 2A, 2B, 2D, 4A, 4B, 4D, and 6A are identical. In these alternatives, the trawl sector is constrained by their halibut PSC cap rather than by the apportionment of Pacific cod. Comparing the Trawl CP target catch to the Trawl CV target catch for each these alternatives, we see that the catch ratio between the two is 0.9663. This is the ratio imposed in the model, and therefore, we can conclude that CP/CV split within the trawl sector is non-binding, and nor is the trawl/fixed gear apportionment. In other words, under these alternatives, we would anticipate that the trawl target Pacific cod fisheries will continue unconstrained until the halibut PSC mortality cap for Pacific cod is attained. At that point, both target fisheries will be closed and the remaining Pacific cod reallocated to fixed gears. In

Table 5.18, we see that for these alternatives, the average halibut bycatch mortality rate for the trawl sector as a whole is 22.2476 kg/mt of target catch.

Target catches under Alternative 6D demonstrate the way the model switches from the trawl target ratio constraint to constraints imposed by the Pacific cod apportionment and the halibut PSC mortality cap. This alternative very nearly exhibits the same ratio of catch among the trawl groups as the alternatives discussed in the previous paragraph. In this case however, the trawl CP fishery is shut down 177 mt earlier. Refer back to Tables 5.2, and note that the total Trawl CP catch represents 26.9% of the TAC which, as seen in Table 5.1, is the percentage of the total Pacific cod TAC allowed the catcher processors under this alternative. The catcher vessels total catch on the other hand is actually less than that allowed indicating that, after the trawl CP target fishery was closed due to the apportionment, the trawl CV target fishery could not continue for long before they were shut down as well, in this case because of the trawl Halibut PSC mortality cap, rather than the apportionment. This can be verified by turning to Table 5.18, showing halibut mortality under the alternatives, and noting that the sum of the trawl halibut PSC mortality under this alternative equals the halibut PSC mortality cap of 1,685 mt. The fact (from Table 5.3) that the trawl CV target catch increases by only 134 mt, 33 mt less than the decrease in the CP catch, demonstrates the impact of the higher halibut PSC mortality rates seen in the trawl catcher vessel Pacific cod target fishery.

The relatively higher halibut PSC mortality rate of the trawl CV gear groups (25.271 kg/target mt compared to 19.119 kg/target mt for the catcher processors) explains why the total trawl target catch is lower under Alternatives 2C, 4C, and 6C (Table 5.18), than for the other sub-options under the same general Alternatives. Under these options the Trawl CV group is slated for 60% of the trawl cod apportionment. When the catcher processors reach their 40% of the trawl apportionment, they are shut down. After they are shut down, the average halibut PSC mortality catch in the trawl target Pacific cod fishery increases to the trawl catcher vessel rate, and each additional ton of target catch accumulates halibut mortality more quickly.

As an example of the impacts of the differential bycatch rates, examine the trawl CV and CP targets catches under Alternative 6B. Here, the total trawl catch, at 48.4% (Table 5.2), is greater than under any other option, as is the target catch of the trawl catcher processors (41,968 mt in Table 5.3). This occurs because the trawl CV target catch is limited by their 40% share of the trawl apportionment. Because the catcher processors have a lower bycatch rate of halibut they are able to prosecute most of the remaining trawl apportionment before being shut down. As seen in Table 5.18, the average trawl halibut mortality in kilograms of halibut per metric ton of target catch for 6B is (21.91) and is less in 6B than under any option except 3B. Therefore, the trawl sector as a whole catches more Pacific cod.

Comparing 6B to Alternative 6C, we see that the trawl CP catch is relatively low in 6C, lower in fact than in all other alternatives with the exception of 3C and 5C. Because a much greater proportion of the trawl catch goes to the catcher vessels, the average halibut bycatch rate for the trawl sector is higher (23.78), therefore, the halibut PSC mortality cap is reached relatively soon.

The differential bycatch rates also explain the somewhat counter-intuitive results of Alternative 4C. Under this scenario, the trawl catcher vessels are allowed to catch up to 60% of the 59% allocated to the trawl sector. They catch less under this scenario than when they are allowed to catch up to 60% of the 49% allocated to the trawl sector under alternative 6C. Under both of these alternatives, the catcher processor's total catch is constrained by the their cod apportionment rather than the overall trawl halibut PSC mortality cap. The trawl target fishery as a whole, however is constrained by their halibut bycatch. Because the proportion of catcher processor's catch is higher under 4C than under 6C, the average halibut bycatch will be lower. This is verified in Table 5.18. Because the average bycatch rate is lower, total trawl target catch is greater in 4C (73,489 mt) than in 6C (70,854 mt). However, the increase in the total target catch in 4C is less than the increase in CP target catch. Therefore, the catcher vessels catch less cod because less halibut mortality was available for them to use.

In general, we can conclude that the total trawl target catch is higher when the proportion of catcher processor target catch is greater than the proportion of catch by catcher vessels.

Total Pacific Cod Catch in Non-Pacific Cod Target Fisheries

The catches in the pollock bottom fisheries and in the flatfish fisheries were assumed to be fixed at the same level under each alternative. From Table 4.4, we saw that the total Pacific cod catch by trawl CP in these fisheries was 32,069 mt, with an additional 12,876 mt of Pacific cod bycatch taken by trawl catcher vessels. These bycatch totals were treated as constants in the model. Additional bycatches of Pacific cod results from Pacific cod catches in the midwater pollock fisheries. In Table 5.4, we see that the additional bycatch of Pacific cod, in the midwater pollock fishery, increases the bycatch of Pacific cod in the non-target fisheries by catcher vessels to approximately 18,000 mt under each alternative with very little variation. The catcher processor bycatch exhibits a similar lack of variation, with the total bycatch of Pacific cod ranging only 63 tons between 35,713 mt and 35,776 mt.

Comparing non-target catches to target catches of the Trawl CP and Trawl CV gear groups, it is apparent that the catcher processors catch of non-target cod is a much greater proportion of their total trawl catch than for catcher vessels. This has some interesting ramifications given that non-target catches are impacted very little by the apportionments. Under Alternative 5A for example, the non-target catch of catcher processors is 58.5% (from Table 5.4). Under 5B which allocates 60% of the trawl catch to catcher processors, the non-target catch drops to 56.6%. This is because Trawl CP catches increase slightly under this alternative. Under 5C however, non-target catch jumps to 84.9% of the CP total. Because the catcher vessels target catch is a greater proportion of their total they do not experience the same extremes of variation under the same three alternatives. In general, we can conclude that catcher processor target catches show more variability under the options, than Trawl CV, because of their relatively greater amount of non-target Pacific cod catch.

More important, however, as is reinforced by the information in Table 5.4, is that the non-target Pacific cod bycatch does not appear to vary much between alternatives, and it is a significantly greater share of catcher processor total catch of Pacific cod than of the trawl catcher vessels. When we examined the target catches above, we noted that trawl catcher vessels also had a higher bycatch rate of halibut. The combination of higher halibut bycatch rates and a greater proportion of catch in target fisheries means that when the trawl catcher vessels receive a higher share of the trawl Pacific cod apportionment, the total trawl catch is likely to decrease, even when comparing alternatives with the same overall trawl allocation.

Impacts on the Pollock Midwater Fishery

The lack of variation in the non-target catches is a reflection of bycatch rates of Pacific cod in the midwater pollock fishery. The impacts on the pollock midwater fishery catches are shown in Table 5.5. In the inshore pollock fishery, the bycatch rate of Pacific cod is 1.18%. In other words, 11.8 mt of Pacific cod bycatch accrue for every 1,000 mt in the inshore midwater pollock fishery. In the offshore fishery, the bycatch rate of Pacific cod is roughly half that of the inshore pollock fishery. The Pacific cod bycatch range in the Trawl CP fishery represents approximately 10,000 mt of pollock in the offshore midwater pollock fishery (compare 5C and 6B in Table 5.5). The difference in cod bycatch between those same two alternatives is 85 mt. While the impact of ± 85 mt of Pacific cod is relatively minor, the impact of ±10,000 mt in the pollock fishery is relatively higher.

With this information we can conclude that there is a potentially important tradeoff between catches in the trawl Pacific cod target fisheries and the midwater pollock fisheries.

1) With increasing trawl target catches of Pacific cod, the midwater pollock catches decrease.
2) With decreasing trawl target catches of Pacific cod, the midwater pollock catches increase.
3) When trawl catcher vessel Pacific cod target catches increase, the inshore midwater pollock target catches decreases.

4) When trawl catcher processor Pacific cod target catches increase, the offshore pollock target fishery decreases.

These tradeoffs can potentially compensate the trawl sector as a whole if there is a reapportionment of Pacific cod to fixed gear which effects a decrease in Pacific cod target catches by trawlers (i.e., as found with Alternatives 3 or 5). However it is unlikely that the trawlers, which would be negatively impacted by a reduced Pacific cod allocation, will be the same trawlers that will receive the benefit from increased pollock catches.

<u>Discards of Pacific Cod</u>

Discards of Pacific cod have been highlighted as a primary concern of the Council. Three tables focus on this issue, all showing discards of Pacific cod. Table 5.6 shows Pacific cod in all fisheries, Table 5.7 looks at just the Pacific cod target fisheries, and finally Table 5.8 shows the discards in non-Pacific cod target fisheries.

Using the ranking column on Table 5.6, we see that the smallest amount of discards occurs with the four options under Alternative 5, which allocates 59% of the Pacific cod to the fixed gear. In general, discards are higher with apportionments that allocate more to the trawl sector. However, the range between the alternative with highest discard total (6B), and that with the lowest discard total (5C) is 3,468 mt, less than 10% of the total under any of the options.

Within each main alternative, we can see that discards are lower in the sub-options which give more of the Pacific cod to the trawl catcher vessel fleet. The bycatch percentage in Table 5.6 leads to the same conclusion since the discard percentages shown indicate that fixed gear overall has a lower rate of discards, and that within the trawl sector, discards are lower by catcher vessels than by catcher processors

The percentages as shown in Table 5.6 calculate the amount of Pacific cod discards by each fishery as a percent of the total catch by gear (from Table 5.2) of all Pacific cod. In other words, the discard percent is the discard of the longliners divided by the total catch of the longliners. From the table we see that the discard <u>rate</u> of either gear in the fixed gear fleet does not change under the alternatives. This is a function of the assumptions of linearity, and the fact that fixed gear fisheries for targets other than Pacific cod do not have significant discards of Pacific cod and have not been included in the projections. We also see that total discards by longliners do not change with the alternatives. This is a function of their constant level of catch. Overall discard rates in the trawl sectors vary under each alternative because of the differing proportion of target catches and non-targets catches under each alternative. While it is tempting to make additional conclusions using this table, we believe that in order to really understand the discard issue as it applies to Pacific cod, we need to examine discards in the target and non-target fisheries separately.

Table 5.8 shows the projected discards of Pacific cod in the non-Pacific cod target fisheries. As noted above, fixed gear discards in other fisheries are zero under these projections. Overall Pacific cod discards in the non-Pacific cod fisheries are relatively stable. The percent columns on the other hand show much more variability.

The percentage columns in this table differ from those in the previous table. Here, we divide Pacific cod discards in non-Pacific cod fisheries by the discards of Pacific cod in the all fisheries. Thus, we can see that discards by catcher vessels in other target fisheries account for the majority of their total Pacific cod discards, even though the catcher vessel's non-Pacific cod target catches are minor compared to their Pacific cod target catches. The same holds for the catcher processors whose non-Pacific cod discards account for at least 79% of all discards by the catcher processors.

The lowest discard (i.e., ranked #1) of Pacific cod in non-Pacific cod fisheries occurs under Alternative 6B, which also has one of the lowest average bycatch rates of halibut, and one of the highest target catch totals for the trawl sector. Overall discards in non-Pacific cod fisheries will tend to increase with lower target catches of Pacific cod by catcher processors, and will tend to decrease when catcher processor target catches of Pacific cod increase.

This is again a function of the tradeoff between the Pacific cod target fisheries and the pollock midwater target fisheries. All of the variability in the non-Pacific cod target discard of Pacific cod comes from the midwater pollock fishery. (The other target fisheries were held constant by assumption in the model.) When that fishery increases, due to changes in the apportionments, non-Pacific cod target discards of Pacific cod increase and Pacific cod trawl target catches decrease.

Moving now to the Pacific cod discards in the Pacific cod target fisheries as shown in Table 5.7, we can see that, relative to discards in other target fisheries, discards in the Pacific cod target fisheries are smaller. Total Pacific cod discards in target fisheries range between 9,211 mt. under Alternative 5C to 12,750 mt under Alternative 6B. Pacific cod discards in other target fisheries were highest under Alternative 5C at 28,338 mt and lowest under 6C at 28,268 mt. Discards in the target fisheries account for approximately ¼ of all Pacific cod discards. In general, discards in the target fisheries are lower when the apportionments to trawlers (in particular to catcher processors) are lower.

In summary, discards of Pacific cod are more prevalent in other target fisheries than in the Pacific cod fisheries. Because of the way the fisheries are managed, the apportionments primarily affect the target fisheries rather than the fisheries in which Pacific cod is a bycatch species. Therefore, the reapportionment alternatives have relatively little impact on the discards of Pacific cod overall. Further, under its Improved Retention and Improved Utilization initiative, the Council is considering a requirement that all Pacific cod be retained in all fisheries, thus, eliminating the discard problem entirely. Some of the potential impacts of the IR/IU program are considered later in this chapter using separate model runs.

Halibut Bycatch Mortality

Throughout this document, the importance of halibut mortality caps on an industry sector's ability to harvest their allocation of the Pacific cod TAC has been discussed. The halibut mortality rates for 1992-95 were reported in Table 3.7 of Chapter 3. The rates across years were quite variable. Because of the variability in halibut bycatch mortality, run number four of this analysis will use the 1994 rates for comparison purposes. We have also reported that both the trawl and longline sectors reached their halibut mortality caps in 1995. Pot vessels are not constrained by halibut PSC caps, so they are free to continue fishing any Pacific cod TAC available to the fixed gear sector, even if the longliners have reached their cap.

Table 5.9 lists the 1995 halibut mortality reported by NMFS, and the projected halibut mortality resulting from each of the Council's proposed allocation alternatives. As we know, 1995 halibut mortality was originally reported in Chapter 3. Those numbers are repeated on the first row of this table in order to provide a point of reference. Longline vessels used 799 mt of halibut mortality in 1995. Pot vessels, who are not constrained by halibut mortality caps, accounted for 10 mt. Trawl vessels had a total of 1,341 mt of halibut mortality. Catcher vessels had 788 mt and catcher processors 553 mt.

A summary table of halibut bycatch mortality is reported in Table 5.18. This table shows the total projected halibut bycatch mortality and the average kilograms of halibut mortality per metric ton of cod target catches in the Pacific cod target fishery under each of the Council's alternatives. The table also ranks the alternatives from low to high in terms of the amount of halibut bycatch they are projected to generate.

Under each of the 21 alternatives analyzed in this document, longline vessels are projected to incur 800 mt of halibut mortality. Given the wide variations in cod they are allocated under the various alternatives, this may seem counter intuitive at first. However, with the constant assumed rate of halibut mortality used in the model (8.501 kg/mt of target cod), and the in-season reallocation of cod that occurs when the trawl fleet reaches their cap, this result is reasonable. So under each of the alternatives, the longline fishery is expected to reach their halibut mortality cap.

The model assumed that pot vessels would incur 0.543 kg of halibut mortality per mt of cod target catch. This rate results in the pot fleet causing between 22 and 35 mt of halibut mortality, depending on the allocation alternative. Halibut mortality in the pot fishery is projected to be 22 mt under Alternatives 1 (no split), 2 (54/44), 4 (59/39), and 6 (49/49), except when the trawl sector cod apportionment is divided with 60% going to catcher vessels (these are the "C" alternatives). In those cases, the pot fleet's halibut mortality increases to 24 mt (Alternatives 2 and 4), or 25 mt in Alternative 6C. The "C" options had higher pot halibut mortality because more of the TAC is reallocated in-season from the trawl sector to fixed gear. More cod is reallocated to fixed gear because trawl catcher vessels were allocated 60% of the trawl TAC, and they have higher halibut mortality rates than the catcher processors. Therefore, the trawl portion of the halibut cap is reached with less cod harvested by the trawl sector.

Trawl catcher vessels incur more halibut mortality under each of the alternatives than the trawl catcher processor fleet. This is due to their assumed halibut mortality rate of 25.271 kg/mt versus the trawl catcher processor's rate of 19.119 kg/mt, and the fact that the projected trawl catcher vessel's catch is never enough higher than the catcher processors' to make up the difference in mortality rates.

Trawl catcher vessels had their lowest halibut mortality (609 mt) under alternative 5B. This alternative would allocate 39% of the TAC to trawl gear, and catcher vessels would then be issued 40% of the trawl total of cod. Trawl catcher vessels would have the most halibut mortality under Alternative 6C. That alternative allocates 49% of the TAC to trawl gear, and catcher vessels receive 60% of the trawl total. In general, trawl catcher vessels have the most halibut mortality when they are allocated 60% of the trawl sector TAC (i.e., the "C" alternatives).

Trawl catcher processors had the least halibut mortality under Alternative 5C (121 mt), and the most under Alternative 6B (802 mt). Trawl catcher processors tended to have more halibut mortality when there was no split of the trawl allocation between catcher vessels and catcher processors, or when there was a split of the trawl allocation and catcher processors were granted 60% of the trawl total.

Halibut mortality in all Pacific cod target fisheries was smallest under the options that granted trawl gear only 39% of the cod TAC. The 39% and 44% TAC allocations to trawl gear were small enough to allow their entire portion of the TAC to be harvested before the halibut mortality cap was reached. These allocations resulted in the least total halibut mortality, particularly when the CP sector was granted 60% of the trawl apportionment and CVs 40%. Halibut mortality under each of the other alternatives was fairly consistent.

Under the current apportionment, and under any allocation where the ratio of the CP target catch to the CV target catch is 0.9663 (Alternatives 1A, 2A, 2B, 2D, 4A, 4B, 4D, 5A, and 6A), trawl catcher vessels have 51% of the target catch, but have 58% of the halibut mortality. In options where the catcher vessels receive 60 % of the total trawl catch, the ratio of target catches increases to well above 60% since the catcher vessel catches of Pacific cod in non-target fisheries is less. For example, under Alternative 3C as shown below, the Trawl CV target catch is 82% of the trawl total target catch of Pacific cod, but their halibut mortality is 86% of the total trawl halibut mortality.

Comparison of Trawl Target Pacific cod Catches and Halibut Mortality Under 'B' and 'C' Options

Alternative	Split TRW/FIXED (CP/CV)	Target Catch CV	Target Catch CP	Halibut Catch CV	Halibut Catch CP	Catcher Processors Target %	Catcher Processors Halibut %
Alternative 2B	54/44 (60/40)	38,518	37,221	973	712	49%	42%
Alternative 3B	44/54 (60/40)	29,509	35,553	746	680	55%	48%
Alternative 4B	59/39 (60/40)	38,518	37,221	973	712	49%	42%
Alternative 5B	39/59 (60/40)	24,082	27,437	609	525	53%	46%
Alternative 6B	49/49 (60/40)	34,926	41,968	883	802	55%	48%

Alternative	Split TRW/FIXED (CP/CV)	Target Catch CV	Target Catch CP	Halibut Catch CV	Halibut Catch CP	Catcher Vessels Target %	Catcher Vessels Halibut %
Alternative 2C	54/44 (40/60)	44,604	22,568	1,254	431	66%	74%
Alternative 3C	44/54 (40/60)	53,328	11,756	1,348	225	82%	86%
Alternative 4C	59/39 (40/60)	45,510	27,979	1,150	535	62%	68%
Alternative 5C	39/59 (40/60)	45,194	6,344	1,142	121	88%	90%
Alternative 6C	49/49 (40/60)	53,698	17,156	1,357	328	76%	0.81

C. bairdi Bycatch

Projected bycatch of *C. bairdi* crab in the Pacific cod target fisheries is reported in Table 5.10. These bycatch amounts were based on the rates reported for the 1995 fisheries. These rates were 0.2616 crab/mt of target cod in the longline fishery, 3.3681 crab/mt in the pot fishery, 2.5209 crab/mt in the trawl catcher vessel fishery, and 5.6718 crab/mt in the trawl catcher processor cod fishery. The rates are multiplied by the projected total catch of Pacific cod under each alternative to estimate the total *C. bairdi* crab bycatch by sector. Like halibut, crab bycatch rates also tend to be fairly variable across years (Table 3.8). Had 1994 rates been used, the reported bycatch would be lower for each sector except longline.

Because the projected catch of cod in the longline fishery is constant under each of the alternatives, the *C. bairdi* bycatch is also constant at 24,622 crab. Pot vessels are expected to at least double their *C. bairdi* bycatch under each of the alternatives when compared to 1995. This is a result of projected increases in the pot fleet's harvest of cod. The pot fleet is expected to incur the highest bycatch under the alternatives that grant 59% of the cod TAC to fixed gear vessels, and the lowest bycatch when fixed gear receives 39% of the cod TAC.

Trawl catcher vessels have the highest bycatch levels under Alternatives 6C (135,367) and 3C (134,434). This is about twice their 1995 bycatch level. Which means their catch also about doubled, because bycatch amounts were based on the 1995 average rates. Trawl catcher vessels had their lowest bycatch (60,708) under Alternative 5B.

Total *C. bairdi* bycatch in cod target fisheries is estimated to be smallest under Alternative 5C (394,092), and largest in 6B (485,072). Because longline bycatch is the same for all alternatives, these differences are a result of changes in catch between the pot, trawl catcher vessel, and trawl catcher processor fleets. These estimates are bycatch only and ignore potential mortality rates associated with each gear type. We have no definitive information regarding mortality rates by fixed gear.

C. opilio Bycatch

Table 5.11 reports the estimated *C. opilio* bycatch by alternative. These bycatch amounts are calculated by multiplying the total projected catch of cod in the target fishery by the 1995 *C. opilio* bycatch rate. The *C. opilio* bycatch rates for 1992-95 are reported in Table 3.9 of Chapter 3. These rates were found to be highly variable across years. Had 1993 rates been used, the resulting bycatch rates would only be 7% of those reported here for pot gear, so estimates herein (based on 1995 rates)should be viewed with that in mind. In 1995, the reported rates were 0.8031 crab per metric ton of longline cod target catch, 8.1979 crab per metric ton for pot vessels, 0.5041 crab per metric ton for trawl catcher vessels, and 1.0097 crab per metric ton for trawl catcher processors.

Longline bycatch of *C. opilio* in the cod target fishery is 75,584 crabs under each alternative. Pot vessel projected bycatch ranges from 327,063 under Alternative 6B, to 534,408 under Alternatives 5A, 5B, 5C, or 5D.

Trawl bycatch of *C. opilio* crab is lower overall than that reported for longline or pot vessels. Trawl catcher vessels had the least bycatch (12,138 animals) under Alternative 5B, and the most (27,067 animals) under Alternative 6C. Trawl catcher processors are projected to have the least bycatch (6,405 animals) under Alternative 5C, and the most under Alternative 6B (42,373 animals).

Total *C. opilio* crab bycatch tends to be largest, by significant amounts, under alternatives that result in pot gear having the most catch. However, it should be noted that this would not necessarily be true had bycatch rates from another year such as 1993 been used in the model. These estimates also do not address the issue of mortality of crab caught as bycatch in cod pot fisheries - we have no definitive information on those mortality rates.

Red King Crab Bycatch

Bycatch rates for 1995 were used to project total red king crab bycatch under each alternative. The 1995 rates were 0.0022 crab per metric ton of longline cod target catch, 0.1592 crab per metric ton of pot cod target catch, 0.0131 crab per metric ton of trawl catcher vessel cod target catch, and 0.0894 crab per metric ton of trawl catcher processor cod target catch. These rates indicate that if you allocate all the cod to longline gear you will minimize the red king crab bycatch, and if you allocate all the cod to pot gear you will maximize your red king crab bycatch. The rates for 1992-95 are reported in Table 3.10 of Chapter 3. These rates varied across years, and again ignore potential mortality rates associated with fixed gear.

Table 5.12 reports that the longline bycatch of red king crab was 203 animals under each alternative. Pot bycatch ranged from a low of 6,353 animals under Alternative 6B to a high of 10,380 animals under Alternatives 5A through 5D. Trawl catcher vessels bycaught between 315 and 702 animals depending on the allocation. Those levels are less than the pot sector and slightly higher than the longliners. Trawl catcher processors bycaught between 567 (Alternative 5C) and 3,751 (Alternative 6B) animals.

Total red king crab bycatch in the pot fishery is projected to be smallest (9,752 animals) under Alternative 6C. This is the 49/49 split with trawl catcher vessels receiving 60% of the trawl total. The most red king crab bycatch (13,350 animals) would occur under Alternative 5B (39% going to trawl vessels with catcher processors being allocated 60% of the trawl total).

Product Produced From Pacific Cod Retained in the Pacific Cod Target Fisheries

Although we do not produce a table showing estimates of products produced from target catch, they can be estimated, based on the projected target catch of Pacific cod by sector under each of the alternatives, and the average 1995 utilization rates. These rates were calculated by dividing total product (as shown in Chapter 3 from information on production in the weekly processor reports) by total catch from the blend data. The utilization rates of Pacific cod alone are 47.7% for longline, 49.0% for pot, 43.2% for trawl catcher vessels, and 35.6% for trawl catcher processors in the target fisheries. Each of the gear groups while fishing for Pacific cod, catch some amount of bycatch of other species, and to varying degrees process these species into products. The utilization rates for all species caught in the Pacific cod target fisheries show the total amount of product produced from these fisheries. These utilization rates are 47.9%, 49.0%, 44.6%, and 43.5% for the longline, pot trawl CV and trawl CP groups respectively.

As discussed in Chapter 3, much of the product produced by the pot sector and by the trawl sector find their way to the same markets. Since the tradeoff in the alternatives occurs between the pot sector and the trawl sector, it is not anticipated that the amount of products destined to the U.S. will change. The product markets for the longline sector are somewhat different, but since the catch of the longline fleet is not directly impacted by the alternatives, the relative importance of the markets for their products are diminished within the scope of this analysis.

Utilization rates and total production amounts do not account for the type of product produced. Catcher processors tend to have a higher proportion of fillet production than longliners, for example, and therefore, although they produce less total product, the value of the product may be higher.

Gross Revenues From the Pacific Cod Target Fisheries

Gross revenues are a measure of the value of the fisheries. Gross revenue, by itself however, is viewed as an inadequate measure of the net benefit associated with the fishery, although it is often construed as such. Net revenue on the other hand is a more reasonable measure of net benefits. Net revenue, from an economic perspective must include not only the gross revenue of an activity or an alternative, but must also include the harvest and production cost and other opportunity costs. Chapter 3 contained a section that briefly discussed the variable costs contained in the original Pacific cod analysis. This discussion was primarily qualitative and does not provide enough information to quantify net revenues for all industry sectors. It does mention however that in general, harvest costs in the trawl sector appear to be less than those in the pot sector, but comparable to cost in the longline sector. Since the reliable quantitative cost numbers are unavailable, there is not enough information available to make net revenue comparisons across industry sectors. Therefore, this analysis will provide estimates of gross revenues and some proxies for some of the opportunity costs.

Gross revenues in the Pacific cod target fisheries are calculated by multiplying the projected catch from each sector by the gross revenue per metric ton of Pacific cod catch in the cod target fishery. A description of how per ton gross revenues were calculated was provided in Section 3.10 of Chapter 3. The average gross revenue per metric ton of Pacific cod catch was reported in Table 4.12, as well as at the bottom of Table 5.13. These values are \$851.19 for longline, \$833.24 for pot, \$879.46 for trawl catcher vessels, and \$974.84 for trawl catcher processors.

Projections of gross revenues using these per ton values and the projected target catches from Table 5.3 are shown in Table 5.13. Using the ranking column at the right, we can see that the highest overall gross revenue from the Pacific cod target fisheries is generated under Alternative 6B and is projected to be \$184.98 million per year. The lowest gross revenue (\$180.36 million) is generated under Alternative 5C. The range from the highest to the lowest is \$4.62 million. In general, revenues will be higher in alternatives in which the trawl catcher processors catch is higher, and lower when the Pot and Trawl CV catches are higher. The lack of variability in the gross revenue estimates is perhaps surprising given the large difference in per ton gross revenues between the Trawl CP and Pot groups. This can be explain by recalling that much of the Trawl CP catch of Pacific cod comes in the groundfish fisheries other than the Pacific cod fishery. Also many of the tradeoffs in target catches as well as revenue occur between the two trawl groups rather than between the trawl and fixed gears. This is demonstrated by comparing Alternatives 6B and 6C, both of which allocate 49% of the Pacific cod to the trawl groups. Gross revenue under 6C is the ranked 17th among the 21 alternatives while 6B is ranked #1. Under 6C target catches and therefore gross revenues increase for both the trawl CV sector and the pot sector, while gross revenues decrease for the catcher processor. The net effect is that the changes tend to cancel each other out.

Throughout the analysis we have assumed that the catch made available to the pot group by the allocations will be harvested. The ramifications of that assumption are perhaps most easily described here in the discussion of gross revenues. Because we have assumed that all Pacific cod will be harvested, the overall gross revenue impacts are limited. If however the pot sector is not able to harvest the amount available to them then gross revenue for the fishery as a whole will fall. For each ton of Pacific cod that is not harvested, gross revenues from the Pacific cod target fisheries will fall by $833.24, assuming that the trawl and longline groups are constrained either by their halibut PSC mortality cap or by the apportionment. Thus a 1,000 mt shortfall in the harvest of the Pacific cod will result in $0.83 million decrease in gross revenues. Thus the ability of the pot sector to harvest the amount available to it can have dramatic impact on gross revenue. This is demonstrated below by showing the reduction in overall gross revenue under varying assumptions of harvest shortfalls. Assume for example that Alternative 3A was chosen by the Council as it preferred alternative, but that the pot sector was only able to harvest 36,188 mt. rather than the 51,888 this alternative makes available to them The 15,000 mt harvest shortfall would reduce the gross revenues in the Pacific cod fisheries by $12.5 million, down to $179.95. Overall the potential for a significant reduction in gross revenue is more a function of harvest shortfall, then the reapportionment *per se*.

Gross Revenue Reductions Under Various Harvest Shortfalls.

Harvest Shortfall in Metric Tons	5,000	10,000	15,000	20,000	35,000	40,000
Gross Revenue Reduction ($ millions)	$ 4.17	$ 8.33	$ 12.50	$ 16.66	$ 29.16	$ 33.33

Reduced Gross Revenue to the Directed Halibut Fishery

As mentioned above, opportunity costs are one portion of the "net benefits" equation. Because we do not have reliable harvesting and processing cost information for the directed halibut fishery we are unable to estimate the opportunity costs imposed on the halibut fishery through bycatch mortality of halibut in the Pacific cod fisheries. We are, however, able to estimate the revenue impacts on the directed halibut fishery. The amount of revenue forgone by the directed halibut fishery because of halibut bycatch in cod fisheries is reported in Table 5.14. Reduced gross revenues in the 1992-95 halibut fisheries were discussed in Section 3.12.1 of Chapter 3. The description of how reduced gross revenues were calculated in Chapter 3 still holds. It is important to remember that reduced gross revenues were calculated at the ex-processor level.

In this analysis, gross revenues in the halibut fishery are reduced proportionally for each ton of halibut bycatch mortality within a target fishery. This is because bycatch rates within the fishery were assumed to equal those reported in 1995. Also, gross revenue is reduced the same amount for each ton of halibut bycatch mortality in a target fishery. The reduced estimates of gross revenue per KG of halibut mortality for each gear group are shown in the note on the bottom of Table 5.14. Reduced gross revenue per KG of mortality from trawl bycatch is greater than that for the fixed gears, because of differences in the relative ages of the halibut killed. Fixed gear tends to kill older halibut, and therefore the ramifications for the halibut fishery are more immediate, but less pervasive.

Because halibut PSC mortality is greater with increasing trawl catches, and because each ton of trawl mortality imposes of higher cost on the halibut fishery, the reduction in the revenues in the halibut fishery will be greatest when the total trawl halibut PSC mortality cap is taken. Looking at Table 5.14 we see that under 12 of the 21 alternatives, the overall reduction in revenues for the directed halibut fishery is maximized at $9.47 million dollars. Thus when overall gross revenue is highest (Table 5.13), the reduction of revenue in the halibut fishery is also highest. To some extent then, changes in gross revenue in the Pacific cod fisheries will be offset by the changes in the "reduced gross revenues" in the halibut fishery.

Reading down the Pacific cod longline fishery column of Table 5.14, we see that the reduced gross revenue in the directed halibut fishery is always $2.32 million. This is because the longline fishery's catch of Pacific cod was estimated to be the same under each of the alternatives studied, the constant mortality rate per ton of target catch that was used, and the constant value per ton assigned to the halibut bycatch mortality.

The Pacific cod pot fleet's halibut bycatch mortality was estimated to reduce the revenues generated in the directed halibut fishery by $0.06 to $0.10 million depending on the alternative. Alternatives 5A-D had the greatest impact on the halibut fleet due to halibut bycatch in the pot cod fishery. However, these four alternatives had the least impact on the halibut fishery overall. This is because the pot cod fishery reduces the gross revenue in the halibut fishery, per ton of target catch, less than longliners or trawlers. The reader should note that based on the pot fleet's past catch history, it is unlikely they could currently harvest that amount of cod. The amount of cod they could take is unknown. So, because each alternative modeled predicts that pot cod vessels could increase their total catch over their 1995 amount, their ability to increase their catch will determine their overall impact on the halibut fishery.

Pacific cod trawl catcher vessels were estimated to reduce gross revenues in the directed halibut fishery by $2.56 to $5.70 million per year. The level of catch that corresponds to a $2.56 million reduction is 24,082 mt. This was the predicted outcome under Alternative 5B. Recall that this alternative would initially allocate 39% of the BSAI cod TAC to trawl gear, and then subdivide the trawl portion of the TAC 40% for catcher vessels and 60% for catcher processors. The small predicted catch by the catcher vessels in this case is caused by the initial allocation and the catcher processors having a lower halibut mortality rate per ton of cod catch in 1995 than the catcher vessels. Trawl catcher vessels would reduce the halibut fishery's gross revenue the most under Alternative 6C (i.e., have the most catch). This alternative allocates 49% of the TAC to trawl gear, and then subdivides the trawl TAC 60% for catcher vessels and 40% for catcher processors.

Trawl catcher processors in the Pacific cod fishery would have the smallest impact on the halibut fishery under Alternative 5C. This is because they would have the least catch in the directed fishery for cod. Alternative 6B would cause the trawl catcher processor fleet to reduce halibut gross revenues by $3.37 million.

Reduced Gross Revenue in the Directed Crab Fisheries

The bycatch of crab in the groundfish fisheries reduces the gross revenue accruing to the directed crab fisheries. As discussed in Chapter 3, reduced gross revenues are estimated based on the 1995 bycatch rates of crab in the directed fishery, the processed value of that crab, and the number of crab caught as a result of the target catch of Pacific cod by each gear.

As discussed earlier the Pacific cod target fishery takes significant bycatches of three major crab species, *C. Bairdi*, *C. Opilio*, and Red King Crab. Separate estimates of reduced gross revenue were made for each of these species. With the information available, we were unable to make differential estimates based on the gear. A primary caveat is that our estimates assume 100% mortality crab taken as bycatch. Therefore our estimates of reduced gross revenue in the crab fisheries should be used with caution. The estimates of reduced gross revenue per animal are shown in the note at the bottom of Table 5.15. Each Red King Crab taken as bycatch was assumed to reduce gross revenues in the crab fishery by $24.00; each Bairdi crab taken as bycatch imposes a cost of $6.83 on the crab fisheries, while each opilio crab results in a $0.72 reduction.

As seen in Table 5.15 it is difficult to find a trend in the reduction of revenues from the bycatch of crab in the Pacific cod fisheries. This is a function of the differing bycatch rates in each gear and differing dollar amounts assigned to each crab species. The total amount of reduced gross revenue ranges between $3.93, and $3.36 million dollars. Overall the changes in revenue to the crab fishery resulting from crab bycatch due to a change in the apportionment do not appear to be significant.

Reduced Gross Revenue in Pollock Fisheries

As was discussed in the development of the model and in the section dealing with the mid-water pollock fishery, bycatch of groundfish in the Pacific cod target fisheries can be expected to negatively impact revenues in the mid-water pollock fishery. As shown in Table 5.5, total catches in the mid-water pollock fishery changed by as much as 8,000 tons in the inshore sector and 10,000 tons in the offshore sector as a result of changes in the apportionment of Pacific cod under the different alternatives.[2] Reduced gross revenue estimates in the pollock fishery were made by taking the total target catch of each gear group, multiplied by the bycatch rates of inshore and offshore pollock by each of the different gear groups and the gross revenue of inshore and offshore midwater pollock fishery. These projections are shown in Table 5.16.

Pollock revenue is reduced the least under Alternative 5B ($9.45 million), with all of the sub-options of the alternative very closely clustered around $9.5 million, and the most under Alternative 6B ($13.41 million). Overall there is a swing of approximately $ 4 million from the low to the high. Recall the projected Gross Revenue in the Pacific cod fishery was highest under Alternative 6B and lowest under 5C, and that the difference between the two was $4.6 million. This suggests that the revenue differences in the Pacific cod target fishery resulting from the apportionment are very nearly offset by differences in the pollock fishery.

Reduced Gross Revenue in All Fisheries

Table 5.17 sums the reduced gross revenues in the halibut, crab, and pollock fisheries which occur because of bycatch in the Pacific cod target fishery. Alternative 5C results in the smallest reduction in the gross revenues in these other fisheries, while Alternative 6B causes the greatest reduction. Overall, the total reduced gross revenues range $6.2 million from lowest to highest. This more than offsets the range of gross revenues which result in the Pacific cod target fisheries. Therefore, we can conclude that the changes in gross revenue which are caused directly by the reapportionment of Pacific cod are negligible. This conclusion is made with the assumption the entire Pacific cod TAC would be harvested under any of the alternative apportionments.

Overall gross revenue changes then can be expected to occur only to the extent that the pot sector is unable to harvest the share of Pacific cod made available to them. As reported earlier, each ton of Pacific cod left unharvested is expected to result in reduction of $833.24 in the projected gross revenue.

Summary of Projected Outcomes of Alternative Pacific Cod Allocations

Table 5.19 provides a summary of the results from the "base case" presented above. The table is divided into six sections. The first section reports the projected total catch of Pacific cod caught in all fisheries. The second section lists the Pacific cod catch in cod target fisheries. Discards of Pacific cod are provided in the third section. Both discards in the cod target and non-target fisheries are presented. The metric tons of halibut mortality are listed in the fourth section, by alternative allocation. Crab bycatch in the Pacific cod target fishery and projected gross revenues from Pacific cod target fisheries are in the fifth and sixth sections. This table is provided for easy reference of the material which has already been discussed in detail earlier. Therefore, we will not readdress the results listed in the table again here.

Table 5.20 ranks the projections listed in Table 5.19. The rankings were discussed earlier in this chapter. A rank of 1 is the "best." This means the alternative had the lowest bycatch, highest catch, least halibut mortality, and so on, would be ranked #1. If alternatives have the same result they are given the same rank. So, a rank of 1 is given to each alterative for total catch by longline vessels.

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[2]There is of course bycatch of other groundfish species in each of the gear groups. In general, target fisheries for these other species were not constrained by their TAC, and therefore, the bycatch in the cod fisheries would have no impact on the other target fishery revenues.

Table 5.2 - **MODEL RUN #1**

Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

Total Pacific Cod Catch In All Fisheries

	Split	Metric Tons					Percent of Pacific Cod Catch in All Fisheries					Rank of
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Total
1995 Fishery	54/44 (none)	93,955	18,716	50,183	63,817	226,671	41.3%	8.2%	22.1%	28.1%	99.7%	High = 1
Alternative 1A	No Split	94,112	41,051	56,495	72,942	264,601	34.9%	15.2%	20.9%	27.0%	98.0%	1
Alternative 2A	54/44 (none)	94,112	41,051	56,495	72,942	264,601	34.9%	15.2%	20.9%	27.0%	98.0%	1
Alternative 2B	54/44 (60/40)	94,112	41,051	56,495	72,942	264,601	34.9%	15.2%	20.9%	27.0%	98.0%	1
Alternative 2C	54/44 (40/60)	94,112	44,618	67,558	58,312	264,601	34.9%	16.5%	25.0%	21.6%	98.0%	1
Alternative 2D	54/44 (55/45)	94,112	41,051	56,495	72,942	264,601	34.9%	15.2%	20.9%	27.0%	98.0%	1
Alternative 3A	44/54 (none)	94,112	51,688	51,092	67,708	264,601	34.9%	19.1%	18.9%	25.1%	98.0%	1
Alternative 3B	44/54 (60/40)	94,112	51,688	47,520	71,280	264,601	34.9%	19.1%	17.6%	26.4%	98.0%	1
Alternative 3C	44/54 (40/60)	94,112	51,688	71,280	47,520	264,601	34.9%	19.1%	26.4%	17.6%	98.0%	1
Alternative 3D	44/54 (55/45)	94,112	51,688	53,460	65,340	264,601	34.9%	19.1%	19.8%	24.2%	98.0%	1
Alternative 4A	59/39 (none)	94,112	41,051	56,495	72,942	264,601	34.9%	15.2%	20.9%	27.0%	98.0%	1
Alternative 4B	59/39 (60/40)	94,112	41,051	56,495	72,942	264,601	34.9%	15.2%	20.9%	27.0%	98.0%	1
Alternative 4C	59/39 (40/60)	94,112	43,301	63,472	63,715	264,601	34.9%	16.0%	23.5%	23.6%	98.0%	1
Alternative 4D	59/39 (55/45)	94,112	41,051	56,495	72,942	264,601	34.9%	15.2%	20.9%	27.0%	98.0%	1
Alternative 5A	39/59 (none)	94,112	65,188	44,234	61,066	264,601	34.9%	24.1%	16.4%	22.6%	98.0%	1
Alternative 5B	39/59 (60/40)	94,112	65,188	42,120	63,180	264,601	34.9%	24.1%	15.6%	23.4%	98.0%	1
Alternative 5C	39/59 (40/60)	94,112	65,188	63,180	42,120	264,601	34.9%	24.1%	23.4%	15.6%	98.0%	1
Alternative 5D	39/59 (55/45)	94,112	65,188	47,385	57,915	264,601	34.9%	24.1%	17.5%	21.4%	98.0%	1
Alternative 6A	49/49 (none)	94,112	41,051	56,495	72,942	264,601	34.9%	15.2%	20.9%	27.0%	98.0%	1
Alternative 6B	49/49 (60/40)	94,112	39,896	52,912	77,681	264,601	34.9%	14.8%	19.6%	28.8%	98.0%	1
Alternative 6C	49/49 (40/60)	94,112	45,936	71,643	52,909	264,601	34.9%	17.0%	26.5%	19.6%	98.0%	1
Alternative 6D	49/49 (55/45)	94,112	41,094	56,629	72,765	264,601	34.9%	15.2%	21.0%	26.9%	98.0%	1

Percentages shown add the projected jig catch total to total catch to the denominator. This allows the percentage to correspond to those in the alternatives.

The Rank of each alternative is based on the Total Catch. In this case the total catch is the same for each alternative and therefore all alternatives are ranked equally.

Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

Total Pacific Cod Catch in Pacific Cod Target Fisheries

	Split	Metric Tons					Percent of Total Pacific Cod Target Catch					Rank of
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Total
1995 Fishery	54/44 (none)	93,955	18,716	31,169	28,912	172,751	54.4%	10.8%	18.0%	16.7%	100.0%	High = 1
Alternative 1A	No Split	94,112	41,051	38,518	37,221	210,902	44.6%	19.5%	18.3%	17.6%	100.0%	1
Alternative 2A	54/44 (none)	94,112	41,051	38,518	37,221	210,902	44.6%	19.5%	18.3%	17.6%	100.0%	1
Alternative 2B	54/44 (60/40)	94,112	41,051	38,518	37,221	210,902	44.6%	19.5%	18.3%	17.6%	100.0%	1
Alternative 2C	54/44 (40/60)	94,112	44,618	49,604	22,568	210,902	44.6%	21.2%	23.5%	10.7%	100.0%	1
Alternative 2D	54/44 (55/45)	94,112	41,051	38,518	37,221	210,902	44.6%	19.5%	18.3%	17.6%	100.0%	1
Alternative 3A	44/54 (none)	94,112	51,688	33,090	31,976	210,866	44.6%	24.5%	15.7%	15.2%	100.0%	16
Alternative 3B	44/54 (60/40)	94,112	51,688	29,509	35,553	210,863	44.6%	24.5%	14.0%	16.9%	100.0%	17
Alternative 3C	44/54 (40/60)	94,112	51,688	53,328	11,756	210,885	44.6%	24.5%	25.3%	5.6%	100.0%	14
Alternative 3D	44/54 (55/45)	94,112	51,688	35,464	29,604	210,868	44.6%	24.5%	16.8%	14.0%	100.0%	15
Alternative 4A	59/39 (none)	94,112	41,051	38,518	37,221	210,902	44.6%	19.5%	18.3%	17.6%	100.0%	1
Alternative 4B	59/39 (60/40)	94,112	41,051	38,518	37,221	210,902	44.6%	19.5%	18.3%	17.6%	100.0%	1
Alternative 4C	59/39 (40/60)	94,112	43,301	45,510	27,979	210,902	44.6%	20.5%	21.6%	13.3%	100.0%	1
Alternative 4D	59/39 (55/45)	94,112	41,051	38,518	37,221	210,902	44.6%	19.5%	18.3%	17.6%	100.0%	1
Alternative 5A	39/59 (none)	94,112	65,188	26,201	25,319	210,821	44.6%	30.9%	12.4%	12.0%	100.0%	20
Alternative 5B	39/59 (60/40)	94,112	65,188	24,082	27,437	210,819	44.6%	30.9%	11.4%	13.0%	100.0%	21
Alternative 5C	39/59 (40/60)	94,112	65,188	45,194	6,344	210,838	44.6%	30.9%	21.4%	3.0%	100.0%	18
Alternative 5D	39/59 (55/45)	94,112	65,188	29,360	22,164	210,824	44.6%	30.9%	13.9%	10.5%	100.0%	19
Alternative 6A	49/49 (none)	94,112	41,051	38,518	37,221	210,902	44.6%	19.5%	18.3%	17.6%	100.0%	1
Alternative 6B	49/49 (60/40)	94,112	39,896	34,926	41,968	210,902	44.6%	18.9%	16.6%	19.9%	100.0%	1
Alternative 6C	49/49 (40/60)	94,112	45,936	53,698	17,156	210,902	44.6%	21.8%	25.5%	8.1%	100.0%	1
Alternative 6D	49/49 (55/45)	94,112	41,094	38,652	37,044	210,902	44.6%	19.5%	18.3%	17.6%	100.0%	1

Table 5.4 - **MODEL RUN #1**

Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

Total Pacific Cod Catch in Non-Pacific Cod Target Fisheries												
	Split	Metric Tons					Non-Target P. Cod as Percent of Gear Groups Total P. Cod					Rank of
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Total
1995 Fishery	54/44 (none)	1	-	19,014	34,905	53,920	0.0%	0.0%	37.9%	54.7%	23.8%	Low = 1
Alternative 1A	No Split	1	-	17,978	35,721	53,699	0.0%	0.0%	31.8%	49.0%	20.3%	1
Alternative 2A	54/44 (none)	1	-	17,978	35,721	53,699	0.0%	0.0%	31.8%	49.0%	20.3%	1
Alternative 2B	54/44 (60/40)	1	-	17,978	35,721	53,699	0.0%	0.0%	31.8%	49.0%	20.3%	1
Alternative 2C	54/44 (40/60)	1	-	17,954	35,745	53,699	0.0%	0.0%	26.6%	61.3%	20.3%	1
Alternative 2D	54/44 (55/45)	1	-	17,978	35,721	53,699	0.0%	0.0%	31.8%	49.0%	20.3%	1
Alternative 3A	44/54 (none)	1	-	18,002	35,732	53,735	0.0%	0.0%	35.2%	52.8%	20.3%	16
Alternative 3B	44/54 (60/40)	1	-	18,011	35,727	53,738	0.0%	0.0%	37.9%	50.1%	20.3%	17
Alternative 3C	44/54 (40/60)	1	-	17,952	35,764	53,716	0.0%	0.0%	25.2%	75.3%	20.3%	14
Alternative 3D	44/54 (55/45)	1	-	17,996	35,736	53,732	0.0%	0.0%	33.7%	54.7%	20.3%	15
Alternative 4A	59/39 (none)	1	-	17,978	35,721	53,699	0.0%	0.0%	31.8%	49.0%	20.3%	1
Alternative 4B	59/39 (60/40)	1	-	17,978	35,721	53,699	0.0%	0.0%	31.8%	49.0%	20.3%	1
Alternative 4C	59/39 (40/60)	1	-	17,963	35,736	53,699	0.0%	0.0%	28.3%	56.1%	20.3%	1
Alternative 4D	59/39 (55/45)	1	-	17,978	35,721	53,699	0.0%	0.0%	31.8%	49.0%	20.3%	1
Alternative 5A	39/59 (none)	1	-	18,033	35,746	53,780	0.0%	0.0%	40.8%	58.5%	20.3%	20
Alternative 5B	39/59 (60/40)	1	-	18,038	35,743	53,782	0.0%	0.0%	42.8%	56.6%	20.3%	21
Alternative 5C	39/59 (40/60)	1	-	17,986	35,776	53,762	0.0%	0.0%	28.5%	84.9%	20.3%	18
Alternative 5D	39/59 (55/45)	1	-	18,025	35,751	53,777	0.0%	0.0%	38.0%	61.7%	20.3%	19
Alternative 6A	49/49 (none)	1	-	17,978	35,721	53,699	0.0%	0.0%	31.8%	49.0%	20.3%	1
Alternative 6B	49/49 (60/40)	1	-	17,985	35,713	53,699	0.0%	0.0%	34.0%	46.0%	20.3%	1
Alternative 6C	49/49 (40/60)	1	-	17,945	35,753	53,699	0.0%	0.0%	25.0%	67.6%	20.3%	1
Alternative 6D	49/49 (55/45)	1	-	17,977	35,721	53,699	0.0%	0.0%	31.7%	49.1%	20.3%	1

Total catch (and bycatch of cod) of all non-target fisheries were held constant with the exception of inshore and offshore midwater pollock fisheries. All variation is due to changes in the amount of midwater pollock fishing. Target catches of bottom pollock, yellowfin, rock sole and other flounder are shown below:

Target Catches of Non-Pacific cod Fisheries	inshore bottom pollock	offshore bottom pollock	yellowfin sole	rock sole	other flatfish
Target catch	46,044	90,106	138,573	26,179	5,236
Pacific cod bycatch	8,862	8,085	18,608	8,223	1,166

Table 5.5 - **MODEL RUN #1**

Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

Midwater Pollock Target Fisheries: Total Catch, Pacific Cod Bycatch, and Discards of Pacific Cod

	Split	Inshore Mid-water Pollock Fishery			Offshore Mid-water Pollock Fishery			Total Midwater Plck. Bycatch and Discards of Cod				Rank of
			Pacific Cod			Pacific Cod		Bycatch	% of all Cod	Discards	% of all Cod	P.Cod
	TRW/FIX (CP/CV)	Pollock	Bycatch	Discards	Pollock	Bycatch	Discards	Total	Bycatch	Total	Discards	Bycatch
1995 Fishery	54/44 (none)	368,658	4,351	1,654	663,648	5,763	5,322	10,114	19%	6,975	18%	Low = 1
Alternative 1A	No Split	323,123	3,814	1,449	568,992	4,941	4,563	8,755	16%	6,012	15%	2
Alternative 2A	54/44 (none)	323,123	3,814	1,449	568,992	4,941	4,563	8,755	16%	6,012	15%	2
Alternative 2B	54/44 (60/40)	323,123	3,814	1,449	568,992	4,941	4,563	8,755	16%	6,012	15%	2
Alternative 2C	54/44 (40/60)	320,395	3,781	1,437	572,703	4,973	4,592	8,754	16%	6,029	15%	16
Alternative 2D	54/44 (55/45)	323,123	3,814	1,449	568,992	4,941	4,563	8,755	16%	6,012	15%	2
Alternative 3A	44/54 (none)	324,853	3,834	1,457	570,752	4,957	4,577	8,791	16%	6,034	15%	12
Alternative 3B	44/54 (60/40)	325,770	3,845	1,461	569,887	4,949	4,570	8,794	16%	6,031	15%	11
Alternative 3C	44/54 (40/60)	319,665	3,773	1,434	575,645	4,999	4,616	8,772	16%	6,050	16%	20
Alternative 3D	44/54 (55/45)	324,244	3,827	1,454	571,326	4,962	4,581	8,789	16%	6,036	15%	13
Alternative 4A	59/39 (none)	323,123	3,814	1,449	568,992	4,941	4,563	8,755	16%	6,012	15%	2
Alternative 4B	59/39 (60/40)	323,123	3,814	1,449	568,992	4,941	4,563	8,755	16%	6,012	15%	2
Alternative 4C	59/39 (40/60)	321,403	3,793	1,442	571,332	4,962	4,581	8,755	16%	6,023	15%	13
Alternative 4D	59/39 (55/45)	323,123	3,814	1,449	568,992	4,941	4,563	8,755	16%	6,012	15%	2
Alternative 5A	39/59 (none)	327,047	3,860	1,467	572,986	4,976	4,595	8,836	16%	6,062	16%	17
Alternative 5B	39/59 (60/40)	327,590	3,866	1,469	572,473	4,971	4,591	8,837	16%	6,060	16%	15
Alternative 5C	39/59 (40/60)	322,179	3,803	1,445	577,577	5,016	4,631	8,819	16%	6,077	16%	21
Alternative 5D	39/59 (55/45)	326,238	3,850	1,463	573,749	4,983	4,601	8,833	16%	6,064	16%	18
Alternative 6A	49/49 (none)	323,123	3,814	1,449	568,992	4,941	4,563	8,755	16%	6,012	15%	2
Alternative 6B	49/49 (60/40)	324,007	3,824	1,453	567,790	4,931	4,553	8,755	16%	6,006	15%	1
Alternative 6C	49/49 (40/60)	319,388	3,770	1,433	574,073	4,985	4,603	8,755	16%	6,036	15%	19
Alternative 6D	49/49 (55/45)	323,090	3,813	1,449	569,037	4,942	4,563	8,755	16%	6,012	15%	10

1995 cod bycatch & discard rates for the midwater pollock fisheries, as shown to the right, were used: Bycatch % of target: I = 1.18%, O = 0.50%; Discards % of bycatch, I = 38.0%, O = 92.3%.

Table 5.6 - **MODEL RUN #1**

Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

Total Pacific Cod Discards in All Fisheries

	Split	Metric Tons					Percent of All Pacific Cod Catch					Rank of
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Total
1995 Fishery	54/44 (none)	3,546	245	9,069	26,132	38,992	3.8%	1.3%	18.1%	40.9%	17.2%	Low = 1
Alternative 1A	No Split	3,552	538	9,238	27,389	40,717	3.8%	1.3%	16.4%	37.5%	15.4%	13
Alternative 2A	54/44 (none)	3,552	538	9,238	27,389	40,717	3.8%	1.3%	16.4%	37.5%	15.4%	13
Alternative 2B	54/44 (60/40)	3,552	538	9,238	27,389	40,717	3.8%	1.3%	16.4%	37.5%	15.4%	13
Alternative 2C	54/44 (40/60)	3,552	585	10,204	25,450	39,790	3.8%	1.3%	15.1%	43.6%	15.0%	9
Alternative 2D	54/44 (55/45)	3,552	538	9,238	27,389	40,717	3.8%	1.3%	16.4%	37.5%	15.4%	13
Alternative 3A	44/54 (none)	3,552	678	8,774	26,698	39,701	3.8%	1.3%	17.2%	39.4%	15.0%	8
Alternative 3B	44/54 (60/40)	3,552	678	8,463	27,171	39,864	3.8%	1.3%	17.8%	38.1%	15.1%	10
Alternative 3C	44/54 (40/60)	3,552	678	10,533	24,019	38,782	3.8%	1.3%	14.8%	50.5%	14.7%	5
Alternative 3D	44/54 (55/45)	3,552	678	8,980	26,383	39,594	3.8%	1.3%	16.8%	40.4%	15.0%	7
Alternative 4A	59/39 (none)	3,552	538	9,238	27,389	40,717	3.8%	1.3%	16.4%	37.5%	15.4%	13
Alternative 4B	59/39 (60/40)	3,552	538	9,238	27,389	40,717	3.8%	1.3%	16.4%	37.5%	15.4%	13
Alternative 4C	59/39 (40/60)	3,552	568	9,847	26,166	40,133	3.8%	1.3%	15.5%	41.1%	15.2%	11
Alternative 4D	59/39 (55/45)	3,552	538	9,238	27,389	40,717	3.8%	1.3%	16.4%	37.5%	15.4%	13
Alternative 5A	39/59 (none)	3,552	855	8,186	25,820	38,412	3.8%	1.3%	18.5%	42.3%	14.5%	3
Alternative 5B	39/59 (60/40)	3,552	855	8,002	26,100	38,508	3.8%	1.3%	19.0%	41.3%	14.6%	4
Alternative 5C	39/59 (40/60)	3,552	855	9,836	23,306	37,549	3.8%	1.3%	15.6%	55.3%	14.2%	1
Alternative 5D	39/59 (55/45)	3,552	855	8,460	25,402	38,269	3.8%	1.3%	17.9%	43.9%	14.5%	2
Alternative 6A	49/49 (none)	3,552	538	9,238	27,389	40,717	3.8%	1.3%	16.4%	37.5%	15.4%	13
Alternative 6B	49/49 (60/40)	3,552	523	8,925	28,018	41,017	3.8%	1.3%	16.9%	36.1%	15.5%	21
Alternative 6C	49/49 (40/60)	3,552	602	10,561	24,733	39,448	3.8%	1.3%	14.7%	46.7%	14.9%	6
Alternative 6D	49/49 (55/45)	3,552	539	9,249	27,366	40,706	3.8%	1.3%	16.3%	37.6%	15.4%	12

Table 5.7 - **MODEL RUN #1**

Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

Total Pacific Cod Discards in Pacific Cod Target Fisheries

	Split	Metric Tons					Group's Discards as a % of All Cod Discards in Cod Fisheries					Rank of
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Total
1995 Fishery	54/44 (none)	3,546	245	2,728	3,870	10,389	34.1%	2.4%	26.3%	37.3%	100.0%	Low = 1
Alternative 1A	No Split	3,552	538	3,371	4,982	12,444	28.5%	4.3%	27.1%	40.0%	100.0%	13
Alternative 2A	54/44 (none)	3,552	538	3,371	4,982	12,444	28.5%	4.3%	27.1%	40.0%	100.0%	13
Alternative 2B	54/44 (60/40)	3,552	538	3,371	4,982	12,444	28.5%	4.3%	27.1%	40.0%	100.0%	13
Alternative 2C	54/44 (40/60)	3,552	585	4,341	3,021	11,499	30.9%	5.1%	37.8%	26.3%	100.0%	9
Alternative 2D	54/44 (55/45)	3,552	538	3,371	4,982	12,444	28.5%	4.3%	27.1%	40.0%	100.0%	13
Alternative 3A	44/54 (none)	3,552	678	2,896	4,280	11,406	31.1%	5.9%	25.4%	37.5%	100.0%	8
Alternative 3B	44/54 (60/40)	3,552	678	2,583	4,759	11,572	30.7%	5.9%	22.3%	41.1%	100.0%	10
Alternative 3C	44/54 (40/60)	3,552	678	4,667	1,574	10,471	33.9%	6.5%	44.6%	15.0%	100.0%	5
Alternative 3D	44/54 (55/45)	3,552	678	3,104	3,963	11,296	31.4%	6.0%	27.5%	35.1%	100.0%	7
Alternative 4A	59/39 (none)	3,552	538	3,371	4,982	12,444	28.5%	4.3%	27.1%	40.0%	100.0%	13
Alternative 4B	59/39 (60/40)	3,552	538	3,371	4,982	12,444	28.5%	4.3%	27.1%	40.0%	100.0%	13
Alternative 4C	59/39 (40/60)	3,552	568	3,983	3,745	11,848	30.0%	4.8%	33.6%	31.6%	100.0%	11
Alternative 4D	59/39 (55/45)	3,552	538	3,371	4,982	12,444	28.5%	4.3%	27.1%	40.0%	100.0%	13
Alternative 5A	39/59 (none)	3,552	855	2,293	3,389	10,089	35.2%	8.5%	22.7%	33.6%	100.0%	3
Alternative 5B	39/59 (60/40)	3,552	855	2,108	3,673	10,187	34.9%	8.4%	20.7%	36.1%	100.0%	4
Alternative 5C	39/59 (40/60)	3,552	855	3,955	849	9,211	38.6%	9.3%	42.9%	9.2%	100.0%	1
Alternative 5D	39/59 (55/45)	3,552	855	2,570	2,967	9,943	35.7%	8.6%	25.8%	29.8%	100.0%	2
Alternative 6A	49/49 (none)	3,552	538	3,371	4,982	12,444	28.5%	4.3%	27.1%	40.0%	100.0%	13
Alternative 6B	49/49 (60/40)	3,552	523	3,057	5,618	12,750	27.9%	4.1%	24.0%	44.1%	100.0%	21
Alternative 6C	49/49 (40/60)	3,552	602	4,700	2,297	11,150	31.9%	5.4%	42.1%	20.6%	100.0%	6
Alternative 6D	49/49 (55/45)	3,552	539	3,383	4,959	12,432	28.6%	4.3%	27.2%	39.9%	100.0%	12
1995 discard rates per target ton, as shown to the right, are used for each alternative:							3.77%	1.31%	8.75%	13.39%		

Table 5.8 - **MODEL RUN #1**

Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

Total Pacific Cod Discards in Non-Pacific Cod Target Fisheries													
	Split	Metric Tons					Non-Target P. Cod Discards as a % of All P.Cod Discards					Rank of
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Total
1995 Fishery	54/44 (none)	-	-	6,341	22,262	28,603	-	-	69.9%	85.2%	73.4%	Low = 1
Alternative 1A	No Split	-	-	5,867	22,407	28,273	-	-	63.5%	81.8%	69.4%	2
Alternative 2A	54/44 (none)	-	-	5,867	22,407	28,273	-	-	63.5%	81.8%	69.4%	2
Alternative 2B	54/44 (60/40)	-	-	5,867	22,407	28,273	-	-	63.5%	81.8%	69.4%	2
Alternative 2C	54/44 (40/60)	-	-	5,862	22,429	28,291	-	-	57.5%	88.1%	71.1%	12
Alternative 2D	54/44 (55/45)	-	-	5,867	22,407	28,273	-	-	63.5%	81.8%	69.4%	2
Alternative 3A	44/54 (none)	-	-	5,878	22,417	28,295	-	-	67.0%	84.0%	71.3%	14
Alternative 3B	44/54 (60/40)	-	-	5,880	22,412	28,293	-	-	69.5%	82.5%	71.0%	13
Alternative 3C	44/54 (40/60)	-	-	5,866	22,446	28,311	-	-	55.7%	93.4%	73.0%	17
Alternative 3D	44/54 (55/45)	-	-	5,877	22,421	28,297	-	-	65.4%	85.0%	71.5%	15
Alternative 4A	59/39 (none)	-	-	5,867	22,407	28,273	-	-	63.5%	81.8%	69.4%	2
Alternative 4B	59/39 (60/40)	-	-	5,867	22,407	28,273	-	-	63.5%	81.8%	69.4%	2
Alternative 4C	59/39 (40/60)	-	-	5,864	22,421	28,285	-	-	59.6%	85.7%	70.5%	11
Alternative 4D	59/39 (55/45)	-	-	5,867	22,407	28,273	-	-	63.5%	81.8%	69.4%	2
Alternative 5A	39/59 (none)	-	-	5,893	22,430	28,323	-	-	72.0%	86.9%	73.7%	19
Alternative 5B	39/59 (60/40)	-	-	5,894	22,427	28,321		-	73.7%	85.9%	73.5%	18
Alternative 5C	39/59 (40/60)	-	-	5,881	22,457	28,338	-	-	59.8%	96.4%	75.5%	21
Alternative 5D	39/59 (55/45)	-	-	5,891	22,435	28,326	-	-	69.6%	88.3%	74.0%	20
Alternative 6A	49/49 (none)	-	-	5,867	22,407	28,273	-	-	63.5%	81.8%	69.4%	2
Alternative 6B	49/49 (60/40)	-	-	5,868	22,400	28,268	-	-	65.7%	79.9%	68.9%	1
Alternative 6C	49/49 (40/60)	-	-	5,861	22,437	28,297	-	-	55.5%	90.7%	71.7%	15
Alternative 6D	49/49 (55/45)	-	-	5,866	22,407	28,274	-	-	63.4%	81.9%	69.5%	10

1995 cod discard rates for non-P. cod target fisheries, as shown below as a % of cod bycatch, were used:

	Bottom Pollock		Mid-water Pollock				
Pacific Cod Discards in Non-Target Fisheries	Inshore	Offshore	Inshore	Offshore	yellowfin sole	rock sole	other flatfish
As a Percent of Pacific Cod Bycatch	19.71%	74.85%	38.00%	92.34%	50.95%	53.43%	50.55%

Table 5.9 - **MODEL RUN #1**

Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

Metric Tons of Halibut Mortality in Pacific Cod Target Fisheries

	Split	Metric Tons					Percent of Halibut Mortality in all Pacific Cod Target Fisheries					Rank of
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Total
1995 Fishery	54/44 (none)	799	10	788	553	2,149	37.2%	0.5%	36.7%	25.7%	100.0%	Low = 1
Alternative 1A	No Split	800	22	973	712	2,507	31.9%	0.9%	38.8%	28.4%	100.0%	9
Alternative 2A	54/44 (none)	800	22	973	712	2,507	31.9%	0.9%	38.8%	28.4%	100.0%	9
Alternative 2B	54/44 (60/40)	800	22	973	712	2,507	31.9%	0.9%	38.8%	28.4%	100.0%	9
Alternative 2C	54/44 (40/60)	800	24	1,254	431	2,509	31.9%	1.0%	50.0%	17.2%	100.0%	19
Alternative 2D	54/44 (55/45)	800	22	973	712	2,507	31.9%	0.9%	38.8%	28.4%	100.0%	9
Alternative 3A	44/54 (none)	800	28	836	611	2,276	35.1%	1.2%	36.7%	26.9%	100.0%	6
Alternative 3B	44/54 (60/40)	800	28	746	680	2,254	35.5%	1.2%	33.1%	30.2%	100.0%	5
Alternative 3C	44/54 (40/60)	800	28	1,348	225	2,400	33.3%	1.2%	56.2%	9.4%	100.0%	8
Alternative 3D	44/54 (55/45)	800	28	896	566	2,290	34.9%	1.2%	39.1%	24.7%	100.0%	7
Alternative 4A	59/39 (none)	800	22	973	712	2,507	31.9%	0.9%	38.8%	28.4%	100.0%	9
Alternative 4B	59/39 (60/40)	800	22	973	712	2,507	31.9%	0.9%	38.8%	28.4%	100.0%	9
Alternative 4C	59/39 (40/60)	800	24	1,150	535	2,509	31.9%	0.9%	45.8%	21.3%	100.0%	19
Alternative 4D	59/39 (55/45)	800	22	973	712	2,507	31.9%	0.9%	38.8%	28.4%	100.0%	9
Alternative 5A	39/59 (none)	800	35	662	484	1,982	40.4%	1.8%	33.4%	24.4%	100.0%	2
Alternative 5B	39/59 (60/40)	800	35	609	525	1,969	40.6%	1.8%	30.9%	26.6%	100.0%	1
Alternative 5C	39/59 (40/60)	800	35	1,142	121	2,099	38.1%	1.7%	54.4%	5.8%	100.0%	4
Alternative 5D	39/59 (55/45)	800	35	742	424	2,001	40.0%	1.8%	37.1%	21.2%	100.0%	3
Alternative 6A	49/49 (none)	800	22	973	712	2,507	31.9%	0.9%	38.8%	28.4%	100.0%	9
Alternative 6B	49/49 (60/40)	800	22	883	802	2,507	31.9%	0.9%	35.2%	32.0%	100.0%	9
Alternative 6C	49/49 (40/60)	800	25	1,357	328	2,510	31.9%	1.0%	54.1%	13.1%	100.0%	21
Alternative 6D	49/49 (55/45)	800	22	977	708	2,507	31.9%	0.9%	39.0%	28.3%	100.0%	9
1995 halibut bycatch mortality rates, as shown to the right in kg/mt, are used for each alternative:							8.501	0.543	25.271	19.119		

Table 5.10 - **MODEL RUN #1**

Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

Bycatch of C. Bairdi in Pacific Cod Target Fisheries

	Split	Number of Animals					C. Bairdi as a Percent of All C. Bairdi in Pacific Cod Fisheries					Rank of
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Total
1995 Fishery	54/44 (none)	24,581	63,037	78,573	163,983	330,174	7.4%	19.1%	23.8%	49.7%	100.0%	Low = 1
Alternative 1A	No Split	24,622	138,263	97,099	211,109	471,094	5.2%	29.3%	20.6%	44.8%	100.0%	12
Alternative 2A	54/44 (none)	24,622	138,263	97,099	211,109	471,094	5.2%	29.3%	20.6%	44.8%	100.0%	12
Alternative 2B	54/44 (60/40)	24,622	138,263	97,099	211,109	471,094	5.2%	29.3%	20.6%	44.8%	100.0%	12
Alternative 2C	54/44 (40/60)	24,622	150,277	125,046	127,999	427,944	5.8%	35.1%	29.2%	29.9%	100.0%	4
Alternative 2D	54/44 (55/45)	24,622	138,263	97,099	211,109	471,094	5.2%	29.3%	20.6%	44.8%	100.0%	12
Alternative 3A	44/54 (none)	24,622	174,089	83,416	181,361	463,489	5.3%	37.6%	18.0%	39.1%	100.0%	10
Alternative 3B	44/54 (60/40)	24,622	174,089	74,389	201,652	474,753	5.2%	36.7%	15.7%	42.5%	100.0%	20
Alternative 3C	44/54 (40/60)	24,622	174,089	134,434	66,680	399,826	6.2%	43.5%	33.6%	16.7%	100.0%	2
Alternative 3D	44/54 (55/45)	24,622	174,089	89,401	167,909	456,021	5.4%	38.2%	19.6%	36.8%	100.0%	8
Alternative 4A	59/39 (none)	24,622	138,263	97,099	211,109	471,094	5.2%	29.3%	20.6%	44.8%	100.0%	12
Alternative 4B	59/39 (60/40)	24,622	138,263	97,099	211,109	471,094	5.2%	29.3%	20.6%	44.8%	100.0%	12
Alternative 4C	59/39 (40/60)	24,622	145,840	114,725	158,693	443,880	5.5%	32.9%	25.8%	35.8%	100.0%	5
Alternative 4D	59/39 (55/45)	24,622	138,263	97,099	211,109	471,094	5.2%	29.3%	20.6%	44.8%	100.0%	12
Alternative 5A	39/59 (none)	24,622	219,558	66,051	143,606	453,837	5.4%	48.4%	14.6%	31.6%	100.0%	7
Alternative 5B	39/59 (60/40)	24,622	219,558	60,708	155,616	460,504	5.3%	47.7%	13.2%	33.8%	100.0%	9
Alternative 5C	39/59 (40/60)	24,622	219,558	113,929	35,982	394,092	6.2%	55.7%	28.9%	9.1%	100.0%	1
Alternative 5D	39/59 (55/45)	24,622	219,558	74,013	125,708	443,901	5.5%	49.5%	16.7%	28.3%	100.0%	6
Alternative 6A	49/49 (none)	24,622	138,263	97,099	211,109	471,094	5.2%	29.3%	20.6%	44.8%	100.0%	12
Alternative 6B	49/49 (60/40)	24,622	134,372	88,045	238,032	485,072	5.1%	27.7%	18.2%	49.1%	100.0%	21
Alternative 6C	49/49 (40/60)	24,622	154,714	135,367	97,305	412,009	6.0%	37.6%	32.9%	23.6%	100.0%	3
Alternative 6D	49/49 (55/45)	24,622	138,409	97,436	210,105	470,572	5.2%	29.4%	20.7%	44.6%	100.0%	11
1995 C. Bairdi bycatch rates, as shown to the right in #/target mt, are used for each alternative:							0.2616	3.3681	2.5209	5.6718		

Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

Bycatch of C. Opilio in Pacific Cod Target Fisheries

	Split	Number of Animals					C. Opilio as a Percent of All C. Opilio in Pacific Cod Fisheries					Rank of
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Total
1995 Fishery	54/44 (none)	75,458	153,434	15,711	29,192	273,794	27.6%	56.0%	5.7%	10.7%	100.0%	Low = 1
Alternative 1A	No Split	75,584	336,536	19,415	37,581	469,115	16.1%	71.7%	4.1%	8.0%	100.0%	2
Alternative 2A	54/44 (none)	75,584	336,536	19,415	37,581	469,115	16.1%	71.7%	4.1%	8.0%	100.0%	2
Alternative 2B	54/44 (60/40)	75,584	336,536	19,415	37,581	469,115	16.1%	71.7%	4.1%	8.0%	100.0%	2
Alternative 2C	54/44 (40/60)	75,584	365,777	25,003	22,786	489,150	15.5%	74.8%	5.1%	4.7%	100.0%	12
Alternative 2D	54/44 (55/45)	75,584	336,536	19,415	37,581	469,115	16.1%	71.7%	4.1%	8.0%	100.0%	2
Alternative 3A	44/54 (none)	75,584	423,736	16,679	32,285	548,284	13.8%	77.3%	3.0%	5.9%	100.0%	16
Alternative 3B	44/54 (60/40)	75,584	423,736	14,874	35,897	550,091	13.7%	77.0%	2.7%	6.5%	100.0%	17
Alternative 3C	44/54 (40/60)	75,584	423,736	26,880	11,870	538,070	14.0%	78.8%	5.0%	2.2%	100.0%	14
Alternative 3D	44/54 (55/45)	75,584	423,736	17,876	29,890	547,086	13.8%	77.5%	3.3%	5.5%	100.0%	15
Alternative 4A	59/39 (none)	75,584	336,536	19,415	37,581	469,115	16.1%	71.7%	4.1%	8.0%	100.0%	2
Alternative 4B	59/39 (60/40)	75,584	336,536	19,415	37,581	469,115	16.1%	71.7%	4.1%	8.0%	100.0%	2
Alternative 4C	59/39 (40/60)	75,584	354,978	22,939	28,250	481,751	15.7%	73.7%	4.8%	5.9%	100.0%	11
Alternative 4D	59/39 (55/45)	75,584	336,536	19,415	37,581	469,115	16.1%	71.7%	4.1%	8.0%	100.0%	2
Alternative 5A	39/59 (none)	75,584	534,408	13,207	25,564	648,763	11.7%	82.4%	2.0%	3.9%	100.0%	20
Alternative 5B	39/59 (60/40)	75,584	534,408	12,138	27,702	649,832	11.6%	82.2%	1.9%	4.3%	100.0%	21
Alternative 5C	39/59 (40/60)	75,584	534,408	22,780	6,405	639,178	11.8%	83.6%	3.6%	1.0%	100.0%	18
Alternative 5D	39/59 (55/45)	75,584	534,408	14,799	22,378	647,169	11.7%	82.6%	2.3%	3.5%	100.0%	19
Alternative 6A	49/49 (none)	75,584	336,536	19,415	37,581	469,115	16.1%	71.7%	4.1%	8.0%	100.0%	2
Alternative 6B	49/49 (60/40)	75,584	327,063	17,605	42,373	462,625	16.3%	70.7%	3.8%	9.2%	100.0%	1
Alternative 6C	49/49 (40/60)	75,584	376,577	27,067	17,322	496,549	15.2%	75.8%	5.5%	3.5%	100.0%	13
Alternative 6D	49/49 (55/45)	75,584	336,889	19,482	37,402	469,357	16.1%	71.8%	4.2%	8.0%	100.0%	10
1995 C. Opilio bycatch rates, as shown to the right in #/target mt, are used for each alternative:							0.8031	8.1979	0.5041	1.0097		

Table 5.12 - **MODEL RUN #1**

Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

Bycatch of Red King Crab in Pacific Cod Target Fisheries

	Split	Number of Animals					Red King Cr. as a Percent of All Red King Cr. in P. Cod Fisheries					Rank of
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Total
1995 Fishery	54/44 (none)	202	2,980	407	2,584	6,174	3.3%	48.3%	6.6%	41.9%	100.0%	Low = 1
Alternative 1A	No Split	203	6,537	503	3,327	10,570	1.9%	61.8%	4.8%	31.5%	100.0%	6
Alternative 2A	54/44 (none)	203	6,537	503	3,327	10,570	1.9%	61.8%	4.8%	31.5%	100.0%	6
Alternative 2B	54/44 (60/40)	203	6,537	503	3,327	10,570	1.9%	61.8%	4.8%	31.5%	100.0%	6
Alternative 2C	54/44 (40/60)	203	7,105	648	2,017	9,973	2.0%	71.2%	6.5%	20.2%	100.0%	2
Alternative 2D	54/44 (55/45)	203	6,537	503	3,327	10,570	1.9%	61.8%	4.8%	31.5%	100.0%	6
Alternative 3A	44/54 (none)	203	8,230	432	2,858	11,724	1.7%	70.2%	3.7%	24.4%	100.0%	16
Alternative 3B	44/54 (60/40)	203	8,230	386	3,178	11,997	1.7%	68.6%	3.2%	26.5%	100.0%	18
Alternative 3C	44/54 (40/60)	203	8,230	697	1,051	10,181	2.0%	80.8%	6.8%	10.3%	100.0%	3
Alternative 3D	44/54 (55/45)	203	8,230	463	2,646	11,543	1.8%	71.3%	4.0%	22.9%	100.0%	15
Alternative 4A	59/39 (none)	203	6,537	503	3,327	10,570	1.9%	61.8%	4.8%	31.5%	100.0%	6
Alternative 4B	59/39 (60/40)	203	6,537	503	3,327	10,570	1.9%	61.8%	4.8%	31.5%	100.0%	6
Alternative 4C	59/39 (40/60)	203	6,895	595	2,501	10,193	2.0%	67.6%	5.8%	24.5%	100.0%	4
Alternative 4D	59/39 (55/45)	203	6,537	503	3,327	10,570	1.9%	61.8%	4.8%	31.5%	100.0%	6
Alternative 5A	39/59 (none)	203	10,380	342	2,263	13,188	1.5%	78.7%	2.6%	17.2%	100.0%	20
Alternative 5B	39/59 (60/40)	203	10,380	315	2,453	13,350	1.5%	77.8%	2.4%	18.4%	100.0%	21
Alternative 5C	39/59 (40/60)	203	10,380	591	567	11,740	1.7%	88.4%	5.0%	4.8%	100.0%	17
Alternative 5D	39/59 (55/45)	203	10,380	384	1,981	12,948	1.6%	80.2%	3.0%	15.3%	100.0%	19
Alternative 6A	49/49 (none)	203	6,537	503	3,327	10,570	1.9%	61.8%	4.8%	31.5%	100.0%	6
Alternative 6B	49/49 (60/40)	203	6,353	456	3,751	10,763	1.9%	59.0%	4.2%	34.9%	100.0%	14
Alternative 6C	49/49 (40/60)	203	7,314	702	1,534	9,752	2.1%	75.0%	7.2%	15.7%	100.0%	1
Alternative 6D	49/49 (55/45)	203	6,544	505	3,311	10,563	1.9%	61.9%	4.8%	31.3%	100.0%	5
1995 red king cr. bycatch rates, as shown to the right in #/target mt, are used for each alternative:							0.0022	0.1592	0.0131	0.0894		

Table 5.13 - **MODEL RUN #1**

Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

Gross Revenue From All Species Products in Millions of Dollars In Pacific Cod Target Fisheries												
	Split	Millions of Dollars					Groups Percent of Total Gross Revenue in Pacific Cod Fisheries					Rank of
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Total
1995 Fishery	54/44 (none)	$ 79.97	$ 15.60	$ 27.41	$ 28.18	$ 151.16	52.9%	10.3%	18.1%	18.6%	100.0%	High = 1
Alternative 1A	No Split	$ 80.11	$ 34.21	$ 33.87	$ 36.28	$ 184.47	43.4%	18.5%	18.4%	19.7%	100.0%	2
Alternative 2A	54/44 (none)	$ 80.11	$ 34.21	$ 33.87	$ 36.28	$ 184.47	43.4%	18.5%	18.4%	19.7%	100.0%	2
Alternative 2B	54/44 (60/40)	$ 80.11	$ 34.21	$ 33.87	$ 36.28	$ 184.47	43.4%	18.5%	18.4%	19.7%	100.0%	2
Alternative 2C	54/44 (40/60)	$ 80.11	$ 37.18	$ 43.62	$ 22.00	$ 182.91	43.8%	20.3%	23.9%	12.0%	100.0%	15
Alternative 2D	54/44 (55/45)	$ 80.11	$ 34.21	$ 33.87	$ 36.28	$ 184.47	43.4%	18.5%	18.4%	19.7%	100.0%	2
Alternative 3A	44/54 (none)	$ 80.11	$ 43.07	$ 29.10	$ 31.17	$ 183.45	43.7%	23.5%	15.9%	17.0%	100.0%	13
Alternative 3B	44/54 (60/40)	$ 80.11	$ 43.07	$ 25.95	$ 34.66	$ 183.79	43.6%	23.4%	14.1%	18.9%	100.0%	11
Alternative 3C	44/54 (40/60)	$ 80.11	$ 43.07	$ 46.90	$ 11.46	$ 181.54	44.1%	23.7%	25.8%	6.3%	100.0%	20
Alternative 3D	44/54 (55/45)	$ 80.11	$ 43.07	$ 31.19	$ 28.86	$ 183.22	43.7%	23.5%	17.0%	15.8%	100.0%	14
Alternative 4A	59/39 (none)	$ 80.11	$ 34.21	$ 33.87	$ 36.28	$ 184.47	43.4%	18.5%	18.4%	19.7%	100.0%	2
Alternative 4B	59/39 (60/40)	$ 80.11	$ 34.21	$ 33.87	$ 36.28	$ 184.47	43.4%	18.5%	18.4%	19.7%	100.0%	2
Alternative 4C	59/39 (40/60)	$ 80.11	$ 36.08	$ 40.02	$ 27.28	$ 183.49	43.7%	19.7%	21.8%	14.9%	100.0%	12
Alternative 4D	59/39 (55/45)	$ 80.11	$ 34.21	$ 33.87	$ 36.28	$ 184.47	43.4%	18.5%	18.4%	19.7%	100.0%	2
Alternative 5A	39/59 (none)	$ 80.11	$ 54.32	$ 23.04	$ 24.68	$ 182.15	44.0%	29.8%	12.7%	13.6%	100.0%	18
Alternative 5B	39/59 (60/40)	$ 80.11	$ 54.32	$ 21.18	$ 26.75	$ 182.35	43.9%	29.8%	11.6%	14.7%	100.0%	16
Alternative 5C	39/59 (40/60)	$ 80.11	$ 54.32	$ 39.75	$ 6.18	$ 180.36	44.4%	30.1%	22.0%	3.4%	100.0%	21
Alternative 5D	39/59 (55/45)	$ 80.11	$ 54.32	$ 25.82	$ 21.61	$ 181.85	44.1%	29.9%	14.2%	11.9%	100.0%	19
Alternative 6A	49/49 (none)	$ 80.11	$ 34.21	$ 33.87	$ 36.28	$ 184.47	43.4%	18.5%	18.4%	19.7%	100.0%	2
Alternative 6B	49/49 (60/40)	$ 80.11	$ 33.24	$ 30.72	$ 40.91	$ 184.98	43.3%	18.0%	16.6%	22.1%	100.0%	1
Alternative 6C	49/49 (40/60)	$ 80.11	$ 38.28	$ 47.23	$ 16.72	$ 182.33	43.9%	21.0%	25.9%	9.2%	100.0%	17
Alternative 6D	49/49 (55/45)	$ 80.11	$ 34.24	$ 33.99	$ 36.11	$ 184.45	43.4%	18.6%	18.4%	19.6%	100.0%	10
1995 gross revenue per ton of P. cod catch, as shown to the right, are used for each alternative							$ 851.19	$ 833.24	$ 879.46	$ 974.84		
These estimates do not include revenue from Pacific cod produced in non-Pacific cod Fisheries.												

Table 5.14 - MODEL RUN #1

Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

Reduced Gross Revenue in the Directed Halibut Fishery Resulting From Halibut Bycatch Mortality (Opportunity Cost of Halibut Bycatch)

	Split	Millions of Dollars					Groups Percentage Contribution to Gross Revenue Reduction					Rank of
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Total
1995 Fishery	54/44 (none)	$ 2.32	$ 0.03	$ 3.31	$ 2.32	$ 7.98	29.0%	0.4%	41.5%	29.1%	100.0%	Low = 1
Alternative 1A	No Split	$ 2.32	$ 0.06	$ 4.09	$ 2.99	$ 9.47	24.5%	0.7%	43.2%	31.6%	100.0%	10
Alternative 2A	54/44 (none)	$ 2.32	$ 0.06	$ 4.09	$ 2.99	$ 9.47	24.5%	0.7%	43.2%	31.6%	100.0%	10
Alternative 2B	54/44 (60/40)	$ 2.32	$ 0.06	$ 4.09	$ 2.99	$ 9.47	24.5%	0.7%	43.2%	31.6%	100.0%	10
Alternative 2C	54/44 (40/60)	$ 2.32	$ 0.07	$ 5.27	$ 1.81	$ 9.47	24.5%	0.7%	55.6%	19.2%	100.0%	10
Alternative 2D	54/44 (55/45)	$ 2.32	$ 0.06	$ 4.09	$ 2.99	$ 9.47	24.5%	0.7%	43.2%	31.6%	100.0%	10
Alternative 3A	44/54 (none)	$ 2.32	$ 0.08	$ 3.51	$ 2.57	$ 8.48	27.4%	0.9%	41.5%	30.3%	100.0%	6
Alternative 3B	44/54 (60/40)	$ 2.32	$ 0.08	$ 3.13	$ 2.86	$ 8.39	27.7%	0.9%	37.4%	34.1%	100.0%	5
Alternative 3C	44/54 (40/60)	$ 2.32	$ 0.08	$ 5.66	$ 0.94	$ 9.01	25.8%	0.9%	62.9%	10.5%	100.0%	8
Alternative 3D	44/54 (55/45)	$ 2.32	$ 0.08	$ 3.77	$ 2.38	$ 8.55	27.1%	0.9%	44.1%	27.8%	100.0%	7
Alternative 4A	59/39 (none)	$ 2.32	$ 0.06	$ 4.09	$ 2.99	$ 9.47	24.5%	0.7%	43.2%	31.6%	100.0%	10
Alternative 4B	59/39 (60/40)	$ 2.32	$ 0.06	$ 4.09	$ 2.99	$ 9.47	24.5%	0.7%	43.2%	31.6%	100.0%	10
Alternative 4C	59/39 (40/60)	$ 2.32	$ 0.07	$ 4.83	$ 2.25	$ 9.47	24.5%	0.7%	51.0%	23.7%	100.0%	10
Alternative 4D	59/39 (55/45)	$ 2.32	$ 0.06	$ 4.09	$ 2.99	$ 9.47	24.5%	0.7%	43.2%	31.6%	100.0%	10
Alternative 5A	39/59 (none)	$ 2.32	$ 0.10	$ 2.78	$ 2.03	$ 7.24	32.0%	1.4%	38.4%	28.1%	100.0%	2
Alternative 5B	39/59 (60/40)	$ 2.32	$ 0.10	$ 2.56	$ 2.21	$ 7.18	32.3%	1.4%	35.6%	30.7%	100.0%	1
Alternative 5C	39/59 (40/60)	$ 2.32	$ 0.10	$ 4.80	$ 0.51	$ 7.73	30.0%	1.3%	62.1%	6.6%	100.0%	4
Alternative 5D	39/59 (55/45)	$ 2.32	$ 0.10	$ 3.12	$ 1.78	$ 7.32	31.7%	1.4%	42.6%	24.3%	100.0%	3
Alternative 6A	49/49 (none)	$ 2.32	$ 0.06	$ 4.09	$ 2.99	$ 9.47	24.5%	0.7%	43.2%	31.6%	100.0%	10
Alternative 6B	49/49 (60/40)	$ 2.32	$ 0.06	$ 3.71	$ 3.37	$ 9.46	24.5%	0.6%	39.2%	35.7%	100.0%	9
Alternative 6C	49/49 (40/60)	$ 2.32	$ 0.07	$ 5.70	$ 1.38	$ 9.47	24.5%	0.7%	60.2%	14.6%	100.0%	10
Alternative 6D	49/49 (55/45)	$ 2.32	$ 0.06	$ 4.11	$ 2.98	$ 9.47	24.5%	0.7%	43.4%	31.4%	100.0%	10
Estimates of yield loss and revenue per kg halibut mortality from 1995, as shown to the right, are used:							$ 2.00	$ 2.83	$ 4.20	$ 4.20		

Table 5.15 - **MODEL RUN #1**

Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

Reduced Gross Revenue in the Directed Crab Fisheries Resulting From Crab Bycatch Mortality (Opportunity Cost of Crab Bycatch)

	Split	*Millions of Dollars*					Groups Percentage Contribution to Gross Revenue Reduction					Rank of
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Total
1995 Fishery	54/44 (none)	$ 0.23	$ 0.61	$ 0.56	$ 1.20	$ 2.60	8.7%	23.6%	21.5%	46.3%	100.0%	Low = 1
Alternative 1A	No Split	$ 0.23	$ 1.34	$ 0.69	$ 1.55	$ 3.81	6.0%	35.3%	18.1%	40.7%	100.0%	7
Alternative 2A	54/44 (none)	$ 0.23	$ 1.34	$ 0.69	$ 1.55	$ 3.81	6.0%	35.3%	18.1%	40.7%	100.0%	7
Alternative 2B	54/44 (60/40)	$ 0.23	$ 1.34	$ 0.69	$ 1.55	$ 3.81	6.0%	35.3%	18.1%	40.7%	100.0%	7
Alternative 2C	54/44 (40/60)	$ 0.23	$ 1.46	$ 0.89	$ 0.94	$ 3.51	6.5%	41.6%	25.3%	26.8%	100.0%	4
Alternative 2D	54/44 (55/45)	$ 0.23	$ 1.34	$ 0.69	$ 1.55	$ 3.81	6.0%	35.3%	18.1%	40.7%	100.0%	7
Alternative 3A	44/54 (none)	$ 0.23	$ 1.69	$ 0.59	$ 1.33	$ 3.84	5.9%	44.1%	15.4%	34.6%	100.0%	17
Alternative 3B	44/54 (60/40)	$ 0.23	$ 1.69	$ 0.53	$ 1.48	$ 3.93	5.8%	43.0%	13.4%	37.6%	100.0%	20
Alternative 3C	44/54 (40/60)	$ 0.23	$ 1.69	$ 0.95	$ 0.49	$ 3.36	6.8%	50.3%	28.4%	14.6%	100.0%	1
Alternative 3D	44/54 (55/45)	$ 0.23	$ 1.69	$ 0.63	$ 1.23	$ 3.79	6.0%	44.6%	16.7%	32.5%	100.0%	6
Alternative 4A	59/39 (none)	$ 0.23	$ 1.34	$ 0.69	$ 1.55	$ 3.81	6.0%	35.3%	18.1%	40.7%	100.0%	7
Alternative 4B	59/39 (60/40)	$ 0.23	$ 1.34	$ 0.69	$ 1.55	$ 3.81	6.0%	35.3%	18.1%	40.7%	100.0%	7
Alternative 4C	59/39 (40/60)	$ 0.23	$ 1.42	$ 0.81	$ 1.16	$ 3.62	6.3%	39.1%	22.5%	32.2%	100.0%	5
Alternative 4D	59/39 (55/45)	$ 0.23	$ 1.34	$ 0.69	$ 1.55	$ 3.81	6.0%	35.3%	18.1%	40.7%	100.0%	7
Alternative 5A	39/59 (none)	$ 0.23	$ 2.13	$ 0.47	$ 1.05	$ 3.88	5.9%	55.0%	12.1%	27.2%	100.0%	18
Alternative 5B	39/59 (60/40)	$ 0.23	$ 2.13	$ 0.43	$ 1.14	$ 3.93	5.8%	54.3%	11.0%	29.1%	100.0%	20
Alternative 5C	39/59 (40/60)	$ 0.23	$ 2.13	$ 0.81	$ 0.26	$ 3.43	6.6%	62.2%	23.6%	7.7%	100.0%	3
Alternative 5D	39/59 (55/45)	$ 0.23	$ 2.13	$ 0.53	$ 0.92	$ 3.81	6.0%	56.0%	13.8%	24.2%	100.0%	7
Alternative 6A	49/49 (none)	$ 0.23	$ 1.34	$ 0.69	$ 1.55	$ 3.81	6.0%	35.3%	18.1%	40.7%	100.0%	7
Alternative 6B	49/49 (60/40)	$ 0.23	$ 1.31	$ 0.62	$ 1.75	$ 3.90	5.8%	33.5%	16.0%	44.8%	100.0%	19
Alternative 6C	49/49 (40/60)	$ 0.23	$ 1.50	$ 0.96	$ 0.71	$ 3.41	6.7%	44.1%	28.2%	20.9%	100.0%	2
Alternative 6D	49/49 (55/45)	$ 0.23	$ 1.34	$ 0.69	$ 1.54	$ 3.81	6.0%	35.3%	18.2%	40.5%	100.0%	7

The following estimates of reduced revenue for each bycatch animal were used for each alternative: RKC $ 24.00 , Bairdi $ 6.83 , Opilio $ 0.72

Table 5.16 - **MODEL RUN #1**

Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

Reduced Gross Revenue in the Pollock Fisheries Resulting From Pollock Bycatch in the P. Cod Fisheries (Opportunity Cost of Pollock Bycatch)												Rank of Total
	Split	Millions of Dollars					Groups Percentage Contribution to Gross Revenue Reduction					Total
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Low = 1
Alternative 1A	No Split	$ 1.35	$ 0.02	$ 6.12	$ 5.75	$ 13.24	10.2%	0.1%	46.3%	43.5%	100.0%	12
Alternative 2A	54/44 (none)	$ 1.35	$ 0.02	$ 6.12	$ 5.75	$ 13.24	10.2%	0.1%	46.3%	43.5%	100.0%	12
Alternative 2B	54/44 (60/40)	$ 1.35	$ 0.02	$ 6.12	$ 5.75	$ 13.24	10.2%	0.1%	46.3%	43.5%	100.0%	12
Alternative 2C	54/44 (40/60)	$ 1.35	$ 0.02	$ 7.89	$ 3.49	$ 12.74	10.6%	0.1%	61.9%	27.4%	100.0%	10
Alternative 2D	54/44 (55/45)	$ 1.35	$ 0.02	$ 6.12	$ 5.75	$ 13.24	10.2%	0.1%	46.3%	43.5%	100.0%	12
Alternative 3A	44/54 (none)	$ 1.35	$ 0.02	$ 5.26	$ 4.94	$ 11.58	11.7%	0.2%	45.4%	42.7%	100.0%	6
Alternative 3B	44/54 (60/40)	$ 1.35	$ 0.02	$ 4.69	$ 5.50	$ 11.56	11.7%	0.2%	40.6%	47.5%	100.0%	5
Alternative 3C	44/54 (40/60)	$ 1.35	$ 0.02	$ 8.48	$ 1.82	$ 11.67	11.6%	0.2%	72.7%	15.6%	100.0%	8
Alternative 3D	44/54 (55/45)	$ 1.35	$ 0.02	$ 5.64	$ 4.58	$ 11.59	11.7%	0.2%	48.7%	39.5%	100.0%	7
Alternative 4A	59/39 (none)	$ 1.35	$ 0.02	$ 6.12	$ 5.75	$ 13.24	10.2%	0.1%	46.3%	43.5%	100.0%	12
Alternative 4B	59/39 (60/40)	$ 1.35	$ 0.02	$ 6.12	$ 5.75	$ 13.24	10.2%	0.1%	46.3%	43.5%	100.0%	12
Alternative 4C	59/39 (40/60)	$ 1.35	$ 0.02	$ 7.24	$ 4.32	$ 12.93	10.5%	0.1%	56.0%	33.4%	100.0%	11
Alternative 4D	59/39 (55/45)	$ 1.35	$ 0.02	$ 6.12	$ 5.75	$ 13.24	10.2%	0.1%	46.3%	43.5%	100.0%	12
Alternative 5A	39/59 (none)	$ 1.35	$ 0.02	$ 4.17	$ 3.91	$ 9.46	14.3%	0.3%	44.0%	41.4%	100.0%	2
Alternative 5B	39/59 (60/40)	$ 1.35	$ 0.02	$ 3.83	$ 4.24	$ 9.45	14.3%	0.3%	40.5%	44.9%	100.0%	1
Alternative 5C	39/59 (40/60)	$ 1.35	$ 0.02	$ 7.19	$ 0.98	$ 9.54	14.2%	0.2%	75.3%	10.3%	100.0%	4
Alternative 5D	39/59 (55/45)	$ 1.35	$ 0.02	$ 4.67	$ 3.43	$ 9.47	14.3%	0.3%	49.3%	36.2%	100.0%	3
Alternative 6A	49/49 (none)	$ 1.35	$ 0.02	$ 6.12	$ 5.75	$ 13.24	10.2%	0.1%	46.3%	43.5%	100.0%	12
Alternative 6B	49/49 (60/40)	$ 1.35	$ 0.01	$ 5.55	$ 6.49	$ 13.41	10.1%	0.1%	41.4%	48.4%	100.0%	21
Alternative 6C	49/49 (40/60)	$ 1.35	$ 0.02	$ 8.54	$ 2.65	$ 12.56	10.8%	0.1%	68.0%	21.1%	100.0%	9
Alternative 6D	49/49 (55/45)	$ 1.35	$ 0.02	$ 6.15	$ 5.73	$ 13.24	10.2%	0.1%	46.4%	43.2%	100.0%	12

The following estimates of reduced pollock revenue per bycatch ton were used for each alternative: INSHORE: $ 473.73; OFFSHORE: $ 483.37.

The yellowfin, rock sole, and other flatfish fisheries were closed due to halibut bycatch. Therefore the bycatch of these species in cod fisheries does not create an opportunity cost.

Table 5.17 - **MODEL RUN #1**

Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

	Reduced Gross Revenue in All Directed Fisheries Resulting From Bycatch											Rank of
	Split	Millions of Dollars					*Groups Percentage Contribution to Gross Revenue Reduction*					*Total*
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Low = 1
Alternative 1A	No Split	$ 3.90	$ 1.42	$ 10.91	$ 10.29	$ 26.52	14.7%	5.4%	41.1%	38.8%	100.0%	13
Alternative 2A	54/44 (none)	$ 3.90	$ 1.42	$ 10.91	$ 10.29	$ 26.52	14.7%	5.4%	41.1%	38.8%	100.0%	13
Alternative 2B	54/44 (60/40)	$ 3.90	$ 1.42	$ 10.91	$ 10.29	$ 26.52	14.7%	5.4%	41.1%	38.8%	100.0%	13
Alternative 2C	54/44 (40/60)	$ 3.90	$ 1.55	$ 14.04	$ 6.24	$ 25.73	15.2%	6.0%	54.6%	24.3%	100.0%	10
Alternative 2D	54/44 (55/45)	$ 3.90	$ 1.42	$ 10.91	$ 10.29	$ 26.52	14.7%	5.4%	41.1%	38.8%	100.0%	13
Alternative 3A	44/54 (none)	$ 3.90	$ 1.79	$ 9.37	$ 8.84	$ 23.90	16.3%	7.5%	39.2%	37.0%	100.0%	6
Alternative 3B	44/54 (60/40)	$ 3.90	$ 1.79	$ 8.35	$ 9.83	$ 23.88	16.3%	7.5%	35.0%	41.2%	100.0%	5
Alternative 3C	44/54 (40/60)	$ 3.90	$ 1.79	$ 15.10	$ 3.25	$ 24.04	16.2%	7.4%	62.8%	13.5%	100.0%	8
Alternative 3D	44/54 (55/45)	$ 3.90	$ 1.79	$ 10.04	$ 8.19	$ 23.92	16.3%	7.5%	42.0%	34.2%	100.0%	7
Alternative 4A	59/39 (none)	$ 3.90	$ 1.42	$ 10.91	$ 10.29	$ 26.52	14.7%	5.4%	41.1%	38.8%	100.0%	13
Alternative 4B	59/39 (60/40)	$ 3.90	$ 1.42	$ 10.91	$ 10.29	$ 26.52	14.7%	5.4%	41.1%	38.8%	100.0%	13
Alternative 4C	59/39 (40/60)	$ 3.90	$ 1.50	$ 12.88	$ 7.74	$ 26.02	15.0%	5.8%	49.5%	29.7%	100.0%	11
Alternative 4D	59/39 (55/45)	$ 3.90	$ 1.42	$ 10.91	$ 10.29	$ 26.52	14.7%	5.4%	41.1%	38.8%	100.0%	13
Alternative 5A	39/59 (none)	$ 3.90	$ 2.26	$ 7.42	$ 7.00	$ 20.58	19.0%	11.0%	36.0%	34.0%	100.0%	2
Alternative 5B	39/59 (60/40)	$ 3.90	$ 2.26	$ 6.82	$ 7.59	$ 20.56	19.0%	11.0%	33.2%	36.9%	100.0%	1
Alternative 5C	39/59 (40/60)	$ 3.90	$ 2.26	$ 12.80	$ 1.75	$ 20.71	18.8%	10.9%	61.8%	8.5%	100.0%	4
Alternative 5D	39/59 (55/45)	$ 3.90	$ 2.26	$ 8.31	$ 6.13	$ 20.60	18.9%	11.0%	40.4%	29.8%	100.0%	3
Alternative 6A	49/49 (none)	$ 3.90	$ 1.42	$ 10.91	$ 10.29	$ 26.52	14.7%	5.4%	41.1%	38.8%	100.0%	13
Alternative 6B	49/49 (60/40)	$ 3.90	$ 1.38	$ 9.89	$ 11.61	$ 26.78	14.6%	5.2%	36.9%	43.3%	100.0%	21
Alternative 6C	49/49 (40/60)	$ 3.90	$ 1.59	$ 15.20	$ 4.74	$ 25.44	15.3%	6.3%	59.8%	18.6%	100.0%	9
Alternative 6D	49/49 (55/45)	$ 3.90	$ 1.42	$ 10.94	$ 10.24	$ 26.51	14.7%	5.4%	41.3%	38.6%	100.0%	12

1995 estimates of halibut yield loss and revenue, as shown to the right, are used in each alternative: $ 2.00 $ 2.83 $ 4.20 $ 4.20

The following estimates of reduced revenue for each bycatch animal were used for each alternative: RKC $ 24.00 , Bairdi $ 6.83 , Opilio $ 0.72

The following estimates of reduced pollock revenue per bycatch ton were used for each alternative: INSHORE: $ 473.73; OFFSHORE:$ 483.37.

The yellowfin, rock sole, and other flatfish fisheries were closed due to halibut bycatch. Therefore the bycatch of these species in cod fisheries does not create an opportunity cost.

Table 5.18 - MODEL RUN #1

Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

Summary of Target Catches and Halibut Mortality By Fixed and Trawl Gears

		Fixed Gear Target Catch and Bycatch				Trawl Target Catch and Bycatch (MT)				Total Target Catch and Bycatch (MT)			
	Split TRW/FIX (CP/CV)	P. Cod Target (MT)	Halibut Bycatch (MT)	Bycatch Rate (Kg/MT)	Rank of Bycatch Rate	P. Cod Target (MT)	Halibut Bycatch (MT)	Halibut Bycatch (KG/MT)	Rank of Bycatch Rate	P. Cod Target (MT)	Halibut Bycatch (MT)	Halibut Bycatch (KG/MT)	Rank of Bycatch Rate
1995 Fishery	54/44 (none)	112,671	809	7.1786	Low = 1	60,081	1,340	22.3105	Low = 1	172,751	2,149	12.4413	Low = 1
Alternative 1A	No Split	135,163	822	6.0836	13	75,739	1,685	22.2476	4	210,902	2,507	11.8884	10
Alternative 2A	54/44 (none)	135,163	822	6.0836	13	75,739	1,685	22.2476	4	210,902	2,507	11.8884	10
Alternative 2B	54/44 (60/40)	135,163	822	6.0836	13	75,739	1,685	22.2476	4	210,902	2,507	11.8884	10
Alternative 2C	54/44 (40/60)	138,730	824	5.9412	10	72,172	1,685	23.3472	18	210,902	2,509	11.8976	20
Alternative 2D	54/44 (55/45)	135,163	822	6.0836	13	75,739	1,685	22.2476	4	210,902	2,507	11.8884	10
Alternative 3A	44/54 (none)	145,800	828	5.6794	5	65,066	1,448	22.2476	4	210,866	2,276	10.7918	6
Alternative 3B	44/54 (60/40)	145,800	828	5.6794	5	65,063	1,425	21.9092	1	210,863	2,254	10.6872	5
Alternative 3C	44/54 (40/60)	145,800	828	5.6794	5	65,085	1,572	24.1595	20	210,885	2,400	11.3829	8
Alternative 3D	44/54 (55/45)	145,800	828	5.6794	5	65,068	1,462	22.4719	15	210,868	2,290	10.8611	7
Alternative 4A	59/39 (none)	135,163	822	6.0836	13	75,739	1,685	22.2476	4	210,902	2,507	11.8884	10
Alternative 4B	59/39 (60/40)	135,163	822	6.0836	13	75,739	1,685	22.2476	4	210,902	2,507	11.8884	10
Alternative 4C	59/39 (40/60)	137,413	824	5.9929	11	73,489	1,685	22.9286	17	210,902	2,509	11.8942	19
Alternative 4D	59/39 (55/45)	135,163	822	6.0836	13	75,739	1,685	22.2476	4	210,902	2,507	11.8884	10
Alternative 5A	39/59 (none)	159,300	835	5.2441	1	51,521	1,146	22.2476	4	210,821	1,982	9.3995	2
Alternative 5B	39/59 (60/40)	159,300	835	5.2441	1	51,519	1,133	21.9946	3	210,819	1,969	9.3375	1
Alternative 5C	39/59 (40/60)	159,300	835	5.2441	1	51,538	1,263	24.5135	21	210,838	2,099	9.9544	4
Alternative 5D	39/59 (55/45)	159,300	835	5.2441	1	51,524	1,166	22.6245	16	210,824	2,001	9.4918	3
Alternative 6A	49/49 (none)	135,163	822	6.0836	13	75,739	1,685	22.2476	4	210,902	2,507	11.8884	10
Alternative 6B	49/49 (60/40)	134,008	822	6.1314	21	76,894	1,685	21.9133	2	210,902	2,507	11.8854	9
Alternative 6C	49/49 (40/60)	140,047	825	5.8904	9	70,854	1,685	23.7812	19	210,902	2,510	11.9010	21
Alternative 6D	49/49 (55/45)	135,206	822	6.0819	12	75,695	1,685	22.2603	14	210,902	2,507	11.8885	18

Table 5.19 - **MODEL RUN #1**

Summary of Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Cod, and No Split of the Trawl Halibut Cap

Alternative Cod Allocations		Total Pacific Cod Catch In All Fisheries				Total Pacific Cod Catch In Target Fisheries				Pacific Cod Discards				Halibut	Crab Bycatch Number of Animals (Rounded to nearest 100)			Target Fishery Revenue
										Metric Tons		% of Cod MT						
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Longline	Pot	Trawl CV	Trawl CP	All	Target	All	Target	Mortality	Bairdi	Oplio	Red King	($ millions)
1995	54/44 (none)	93,955	18,716	50,183	63,817	93,955	18,716	31,169	28,912	38,992	10,389	17.2%	6.0%	2,149	330,200	273,800	6,200	$ 151.16
Alt. 1A	No Split	94,112	41,051	56,495	72,942	94,112	41,051	38,518	37,221	40,717	12,444	15.4%	5.9%	2,507	471,100	469,100	10,600	$ 184.47
Alt. 2A	54/44 (none)	94,112	41,051	56,495	72,942	94,112	41,051	38,518	37,221	40,717	12,444	15.4%	5.9%	2,507	471,100	469,100	10,600	$ 184.47
Alt. 2B	54/44 (60/40)	94,112	41,051	56,495	72,942	94,112	41,051	38,518	37,221	40,717	12,444	15.4%	5.9%	2,507	471,100	469,100	10,600	$ 184.47
Alt. 2C	54/44 (40/60)	94,112	44,618	67,558	58,312	94,112	44,618	49,604	22,568	39,790	11,499	15.0%	5.5%	2,509	427,900	489,200	10,000	$ 182.91
Alt. 2D	54/44 (55/45)	94,112	41,051	56,495	72,942	94,112	41,051	38,518	37,221	40,717	12,444	15.4%	5.9%	2,507	471,100	469,100	10,600	$ 184.47
Alt. 3A	44/54 (none)	94,112	51,688	51,092	67,708	94,112	51,688	33,090	31,976	39,701	11,406	15.0%	5.4%	2,276	463,500	548,300	11,700	$ 183.45
Alt. 3B	44/54 (60/40)	94,112	51,688	47,520	71,280	94,112	51,688	29,509	35,553	39,864	11,572	15.1%	5.5%	2,254	474,800	550,100	12,000	$ 183.79
Alt. 3C	44/54 (40/60)	94,112	51,688	71,280	47,520	94,112	51,688	53,328	11,756	38,782	10,471	14.7%	5.0%	2,400	399,800	538,100	10,200	$ 181.54
Alt. 3D	44/54 (55/45)	94,112	51,688	53,460	65,340	94,112	51,688	35,464	29,604	39,594	11,296	15.0%	5.4%	2,290	456,000	547,100	11,500	$ 183.22
Alt. 4A	59/39 (none)	94,112	41,051	56,495	72,942	94,112	41,051	38,518	37,221	40,717	12,444	15.4%	5.9%	2,507	471,100	469,100	10,600	$ 184.47
Alt. 4B	59/39 (60/40)	94,112	41,051	56,495	72,942	94,112	41,051	38,518	37,221	40,717	12,444	15.4%	5.9%	2,507	471,100	469,100	10,600	$ 184.47
Alt. 4C	59/39 (40/60)	94,112	43,301	63,472	63,715	94,112	43,301	45,510	27,979	40,133	11,848	15.2%	5.6%	2,509	443,900	481,800	10,200	$ 183.49
Alt. 4D	59/39 (55/45)	94,112	41,051	56,495	72,942	94,112	41,051	38,518	37,221	40,717	12,444	15.4%	5.9%	2,507	471,100	469,100	10,600	$ 184.47
Alt. 5A	39/59 (none)	94,112	65,188	44,234	61,066	94,112	65,188	26,201	25,319	38,412	10,089	14.5%	4.8%	1,982	453,800	648,800	13,200	$ 182.15
Alt. 5B	39/59 (60/40)	94,112	65,188	42,120	63,180	94,112	65,188	24,082	27,437	38,508	10,187	14.6%	4.8%	1,969	460,500	649,800	13,400	$ 182.35
Alt. 5C	39/59 (40/60)	94,112	65,188	63,180	42,120	94,112	65,188	45,194	6,344	37,549	9,211	14.2%	4.4%	2,099	394,100	639,200	11,700	$ 180.36
Alt. 5D	39/59 (55/45)	94,112	65,188	47,385	57,915	94,112	65,188	29,360	22,164	38,269	9,943	14.5%	4.7%	2,001	443,900	647,200	12,900	$ 181.85
Alt. 6A	49/49 (none)	94,112	41,051	56,495	72,942	94,112	41,051	38,518	37,221	40,717	12,444	15.4%	5.9%	2,507	471,100	469,100	10,600	$ 184.47
Alt. 6B	49/49 (60/40)	94,112	39,896	52,912	77,681	94,112	39,896	34,926	41,968	41,017	12,750	15.5%	6.0%	2,507	485,100	462,600	10,800	$ 184.98
Alt. 6C	49/49 (40/60)	94,112	45,936	71,643	52,909	94,112	45,936	53,698	17,156	39,448	11,150	14.9%	5.3%	2,510	412,000	496,500	9,800	$ 182.33
Alt. 6D	49/49 (55/45)	94,112	41,094	56,629	72,765	94,112	41,094	38,652	37,044	40,706	12,432	15.4%	5.9%	2,507	470,600	469,400	10,600	$ 184.45

*"All Discards" % is amount of P. cod discards all fisheries (target and non-target) over the total catch of P. cod in all fisheries, i.e., 38,992 / 226,671 = 17.2%. (93,555 + 18,716 + 50,183 + 63,817 = 226,671)

*"Target Discards" % is the amount of P. cod discards target fisheries over the total catch of P. cod in target fisheries, i.e., 10,389 / 172,751 = 6.0%. (93,555 + 18,716 + 31,169 + 28,912 = 172,751)

Table 5.20 - **MODEL RUN #1**

Ranking of Projected Outcomes of Alternative Pacific Cod Allocations

Assumes Inseason Reallocation of Cod, and No Split of the Trawl Halibut Cap

Alternative Cod Allocations		Total Pacific Cod Catch In All Fisheries				Total Pacific Cod Catch In Target Fisheries				Pacific Cod Discards				Halibut	Crab Bycatch Number of Animals (Rounded to nearest 100)			Target Fishery Revenue
										Metric Tons		% of Cod MT						
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Longline	Pot	Trawl CV	Trawl CP	All	Target	All	Target	Mortality	Bairdi	Opilio	Red King	($ millions)
	Ranking Method	High=1	High=1	High=1	High=1	High=1	High=1	High=1	High=1	Low=1	Low=1	Low=1	Low=1	Low=1	Low=1	Low=1	Low=1	High=1
Alt. 1A	No Split	1	13	7	2	1	13	7	2	13	13	12	12	9	12	2	5	2
Alt. 2A	54/44 (none)	1	13	7	2	1	13	7	2	13	13	12	12	9	12	2	5	2
Alt. 2B	54/44 (60/40)	1	13	7	2	1	13	7	2	13	13	12	12	9	12	2	5	2
Alt. 2C	54/44 (40/60)	1	10	3	17	1	10	3	17	9	9	7	9	19	4	12	2	15
Alt. 2D	54/44 (55/45)	1	13	7	2	1	13	7	2	13	13	12	12	9	12	2	5	2
Alt. 3A	44/54 (none)	1	5	17	12	1	5	17	12	8	8	7	7	6	10	16	16	13
Alt. 3B	44/54 (60/40)	1	5	18	11	1	5	18	11	10	10	10	9	5	20	17	18	11
Alt. 3C	44/54 (40/60)	1	5	2	20	1	5	2	20	5	5	5	5	8	2	14	3	20
Alt. 3D	44/54 (55/45)	1	5	15	13	1	5	15	13	7	7	7	7	7	8	15	15	14
Alt. 4A	59/39 (none)	1	13	7	2	1	13	7	2	13	13	12	12	9	12	2	5	2
Alt. 4B	59/39 (60/40)	1	13	7	[illegible]	1	13	7	2	13	13	12	12	9	12	2	5	2
Alt. 4C	59/39 (40/60)	1	11	4	[illegible]	1	11	4	14	11	11	11	11	19	5	11	3	12
Alt. 4D	59/39 (55/45)	1	13	7	[illegible]	1	13	7	2	13	13	12	12	9	12	2	5	2
Alt. 5A	39/59 (none)	1	1	20	[illegible]	1	1	20	16	3	3	2	3	2	7	20	20	18
Alt. 5B	39/59 (60/40)	1	1	21	15	1	1	21	15	4	4	4	3	1	9	21	21	16
Alt. 5C	39/59 (40/60)	1	1	5	21	1	1	5	21	1	1	1	1	4	1	18	16	21
Alt. 5D	39/59 (55/45)	1	1	19	18	1	1	19	18	2	2	2	2	3	5	19	19	19
Alt. 6A	49/49 (none)	1	13	7	2	1	13	7	2	13	13	12	12	9	12	2	5	2
Alt. 6B	49/49 (60/40)	1	21	16	1	1	21	16	1	21	21	21	21	9	21	1	14	1
Alt. 6C	49/49 (40/60)	1	9	1	19	1	9	1	19	6	6	6	6	21	3	13	1	17
Alt. 6D	49/49 (55/45)	1	12	6	10	1	12	6	10	12	12	12	12	9	11	10	5	10

5.4.2 Model Runs #2 and 3 - Testing the Sensitivity of the Base Case Model to Changes in the Trawl CP:CV Ratio

A key assumption in the model is that the ratio of target catches by catcher processors to target catches by catcher vessels is constant until such time as one or the other is constrained by their apportionment of cod or by their halibut PSC cap. This ratio was assumed to equal 0.9663 in the "Base Case," model run # 1. Because this is such a key determinant of catches by the trawl sector, we made two model runs in which we change this ratio. In Model Run #2, we increase the ratio by 10% to 1.0629 which increases the target catches of the Trawl CP relative to Trawl CV. In Model Run #3, we decrease the ratio by 10% to 0.8697.

Tables 5.21 - 5.22 summarize the results of these model runs. It is fairly easy to draw conclusions from these tables by comparing them to the Table 5.19 which shows the results of the Base Case model run. Look first at the results of the eight alternatives which produced identical results under the base case. (Alternatives 1A, 2A, 2B, 2D, 4A, 4B, 4D, and 6A.) As would be expected, under each of these model runs these same alternatives again produce results identical to each other. With the ratio increased, Trawl CP target catches obviously increase as do overall trawl target catches. With the rate decreased, Trawl CV catches increase, but trawl catches overall decrease.

The finding above may be somewhat counter intuitive, however, it is readily explained by noting again that the trawl catcher vessels have a higher halibut mortality rate than trawl catcher processors. Under these alternatives, the trawl sector is constrained by their halibut PSC mortality cap, and therefore, the higher average bycatch mortality rate results in less Pacific cod caught for the same amount of halibut. This also explains why decreasing this ratio increases the projected target catches of the pot sector relative to the base case, and why overall, the halibut mortality decreases.

5.4.3 Model Run #4 - Sensitivity of the Model to Halibut Bycatch Rates - Using the 1994 Data

The model, as developed, relies on halibut bycatch rates to help calculate catches of cod, in both target and non-target fisheries, and to curtail catch when a sector reaches its halibut mortality cap. This is an important determinant in the model and variations in the rates employed can significantly affect the projections. As an example of the sensitivity of the projections developed in the "Base Case," which used 1995 halibut bycatch data, an additional projection was made with an alternate set of halibut bycatch rates - those from the 1994 fisheries.

The rates used are the rate of bycatch multiplied by the assumed mortality rate. Therefore, there are two factors which can change the rate for a given sector in a given year: (1) the rate of actual bycatch in a fishery, and (2) the assumed mortality associated with that catch. The data from the 1994 fishery are expressed as kg of halibut per mt of Pacific cod taken in the cod target fisheries, and uses the assumed mortality rates from <u>that year</u>. The biggest change when compared to the 1995 data occurs for the longline fishery. They had a higher assumed mortality rate in that year which impacts the overall kg/mt rate; they also had a slightly higher actual bycatch rate in that year. Combined, this results in nearly a 50% increase in bycatch when compared to 1995 data. Their overall rate for 1994 is 12.06 kg/mt, compared to a rate of 8.5 kg/mt from the 1995 data.

The other sectors' rates were relatively unchanged from 1995 to 1994, though all were slightly higher in 1994: pot gear's rate was 0.569 kg/mt in 1994 compared to 0.543 kg/mt in 1995; trawl CV rate was 27.858 kg/mt in 1994 compared to 25.271 kg/mt in 1995; trawl CP rate was 20.804 kg/mt in 1994 compared to 19.119 kg/mt in 1995.

The impacts of these different halibut bycatch mortality rates are fairly straightforward and readily seen in the summary tables. Table 5.19 is the "Base Case" scenario using 1995 rates, while Table 5.23 is the corresponding summary table using the 1994 rates. Longline catch of cod decreases almost proportionally to the increase in halibut bycatch mortality rates (from 94,112 mt down to 66,578 mt), while catch for the two trawl categories also decreases proportionally when they are constrained by halibut mortality, with their decrease felt in the trawl target fisheries (to which the PSC gets assigned). Pot gear, as in previous projections, accrues all of the "extra" cod which is given up by the other sectors. This is a consistent finding across all alternatives.

Ta. .21 - MODEL RUN #2

Summary of Projected Outcomes of Alternative Pacific Cod Allocations With Increased Trawl CP Catch Per Week

Assumes a 10% increase in the CP/CV Ratio, Inseason Reallocation of Cod, and No Split of the Trawl Halibut Cap

Alternative Cod Allocations	TRW/FIX (CP/CV)	Total Pacific Cod Catch In All Fisheries: Longline	Pot	Trawl CV	Trawl CP	Total Pacific Cod Catch In Target Fisheries: Longline	Pot	Trawl CV	Trawl CP	Pacific Cod Discards, Metric Tons: All	Target	Pacific Cod Discards, % of Cod MT: All	Target	Halibut Mortality	Crab Bycatch Number of Animals (Rounded to nearest 100): Bairdi	Opilio	Red King	Target Fishery Revenue ($ millions)
1995	54/44 (none)	93,955	18,716	50,183	63,817	93,955	18,716	31,169	28,912	38,992	10,389	17.2%	6.0%	2,149	330,200	273,800	6,200	$ 151.16
Alt. 1A	No Split	94,112	40,549	54,938	75,001	94,112	40,549	36,957	39,284	40,848	12,577	15.4%	6.0%	2,507	477,200	466,300	10,700	$ 184.69
Alt. 2A	54/44 (none)	94,112	40,549	54,938	75,001	94,112	40,549	36,957	39,284	40,848	12,577	15.4%	6.0%	2,507	477,200	466,300	10,700	$ 184.69
Alt. 2B	54/44 (60/40)	94,112	40,549	54,938	75,001	94,112	40,549	36,957	39,284	40,848	12,577	15.4%	6.0%	2,507	477,200	466,300	10,700	$ 184.69
Alt. 2C	54/44 (40/60)	94,112	44,618	67,558	58,312	94,112	44,618	49,604	22,567	39,790	11,499	15.0%	5.5%	2,509	427,900	489,200	10,000	$ 182.91
Alt. 2D	54/44 (55/45)	94,112	40,549	54,938	75,001	94,112	40,549	36,957	39,284	40,848	12,577	15.4%	6.0%	2,507	477,200	466,300	10,700	$ 184.69
Alt. 3A	44/54 (none)	94,112	51,688	49,545	69,255	94,112	51,688	31,539	33,525	39,772	11,478	15.0%	5.4%	2,266	468,400	549,100	11,800	$ 183.59
Alt. 3B	44/54 (60/40)	94,112	51,688	47,520	71,280	94,112	51,688	29,509	35,553	39,864	11,572	15.1%	5.5%	2,254	474,800	550,100	12,000	$ 183.79
Alt. 3C	44/54 (40/60)	94,112	51,688	71,280	47,520	94,112	51,688	53,328	11,756	38,782	10,471	14.7%	5.0%	2,400	399,800	538,100	10,200	$ 181.54
Alt. 3D	44/54 (55/45)	94,112	51,688	53,460	65,340	94,112	51,688	35,464	29,604	39,594	11,296	15.0%	5.4%	2,290	456,000	547,100	11,500	$ 183.22
Alt. 4A	59/39 (none)	94,112	40,549	54,938	75,001	94,112	40,549	36,957	39,284	40,848	12,577	15.4%	6.0%	2,507	477,200	466,300	10,700	$ 184.69
Alt. 4B	59/39 (60/40)	94,112	40,549	54,938	75,001	94,112	40,549	36,957	39,284	40,848	12,577	15.4%	6.0%	2,507	477,200	466,300	10,700	$ 184.69
Alt. 4C	59/39 (40/60)	94,112	43,301	63,473	63,714	94,112	43,301	45,510	27,979	40,132	11,848	15.2%	5.6%	2,509	443,900	481,800	10,200	$ 183.49
Alt. 4D	59/39 (55/45)	94,112	40,549	54,938	75,001	94,112	40,549	36,957	39,284	40,848	12,577	15.4%	6.0%	2,507	477,200	466,300	10,700	$ 184.69
Alt. 5A	39/59 (none)	94,112	65,188	43,009	62,291	94,112	65,188	24,974	26,546	38,468	10,146	14.5%	4.8%	1,974	457,700	649,400	13,300	$ 182.27
Alt. 5B	39/59 (60/40)	94,112	65,188	42,120	63,180	94,112	65,188	24,082	27,437	38,508	10,187	14.6%	4.8%	1,969	460,500	649,800	13,400	$ 182.35
Alt. 5C	39/59 (40/60)	94,112	65,188	63,180	42,120	94,112	65,188	45,194	6,344	37,549	9,211	14.2%	4.4%	2,099	394,100	639,200	11,700	$ 180.36
Alt. 5D	39/59 (55/45)	94,112	65,188	47,385	57,915	94,112	65,188	29,360	22,164	38,269	9,943	14.5%	4.7%	2,001	443,900	647,200	12,900	$ 181.85
Alt. 6A	49/49 (none)	94,112	40,549	54,938	75,001	94,112	40,549	36,957	39,284	40,848	12,577	15.4%	6.0%	2,507	477,200	466,300	10,700	$ 184.69
Alt. 6B	49/49 (60/40)	94,112	39,897	52,915	77,676	94,112	39,897	34,930	41,963	41,017	12,749	15.5%	6.0%	2,507	485,100	462,600	10,800	$ 184.98
Alt. 6C	49/49 (40/60)	94,112	45,936	71,644	52,909	94,112	45,936	53,699	17,155	39,448	11,150	14.9%	5.3%	2,510	412,000	496,600	9,800	$ 182.33
Alt. 6D	49/49 (55/45)	94,112	41,095	56,630	72,764	94,112	41,095	38,652	37,043	40,706	12,432	15.4%	5.9%	2,507	470,600	469,400	10,600	$ 184.45

*"All Discards" % is amount of P. cod discards all fisheries (target and non-target) over the total catch of P. cod in all fisheries, i.e., 38,992 / 226,671 = 17.2%. (93,555 + 18,716 + 50,183 + 63,817 = 226,671)

*"Target Discards" % is the amount of P. cod discards target fisheries over the total catch of P. cod in target fisheries, i.e., 10,389 / 172,751 = 6.0%. (93,555 + 18,716 + 31,169 + 28,912 = 172,751)

Table 5.22 - **MODEL RUN #3**

Summary of Projected Outcomes of Alternative Pacific Cod Allocations With Increased Trawl CV Catch Per Week

Assumes a 10% Decrease in the CP/CV Ratio, Inseason Reallocation of Cod, and No Split of the Trawl Halibut Cap

Alternative Cod Allocations		Total Pacific Cod Catch In All Fisheries				Total Pacific Cod Catch In Target Fisheries				Pacific Cod Discards					Crab Bycatch Number of Animals (Rounded to nearest 100)			Target Fishery Revenue
										Metric Tons		% of Cod MT		Halibut				
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Longline	Pot	Trawl CV	Trawl CP	All	Target	All	Target	Mortality	Bairdi	Opilio	Red King	($ millions)
1995	54/44 (none)	93,955	18,716	50,183	63,817	93,955	18,716	31,169	28,912	38,992	10,389	17.2%	6.0%	2,149	330,200	273,800	6,200	$ 151.16
Alt. 1A	No Split	94,112	41,598	58,190	70,700	94,112	41,598	40,216	34,976	40,575	12,299	15.3%	5.8%	2,508	464,500	472,200	10,500	$ 184.23
Alt. 2A	54/44 (none)	94,112	41,598	58,190	70,700	94,112	41,598	40,216	34,976	40,575	12,299	15.3%	5.8%	2,508	464,500	472,200	10,500	$ 184.23
Alt. 2B	54/44 (60/40)	94,112	41,598	58,190	70,700	94,112	41,598	40,216	34,976	40,575	12,299	15.3%	5.8%	2,508	464,500	472,200	10,500	$ 184.23
Alt. 2C	54/44 (40/60)	94,112	44,618	67,557	58,313	94,112	44,618	49,603	22,568	39,790	11,499	15.0%	5.5%	2,509	427,900	489,100	10,000	$ 182.91
Alt. 2D	54/44 (55/45)	94,112	41,598	58,190	70,700	94,112	41,598	40,216	34,976	40,575	12,299	15.3%	5.8%	2,508	464,500	472,200	10,500	$ 184.23
Alt. 3A	44/54 (none)	94,112	51,688	52,799	66,001	94,112	51,688	34,801	30,266	39,624	11,327	15.0%	5.4%	2,286	458,100	547,400	11,600	$ 183.29
Alt. 3B	44/54 (60/40)	94,112	51,688	47,520	71,280	94,112	51,688	29,509	35,553	39,864	11,572	15.1%	5.5%	2,254	474,800	550,100	12,000	$ 183.79
Alt. 3C	44/54 (40/60)	94,112	51,688	71,280	47,520	94,112	51,688	53,328	11,756	38,782	10,471	14.7%	5.0%	2,400	399,800	538,100	10,200	$ 181.54
Alt. 3D	44/54 (55/45)	94,112	51,688	53,460	65,340	94,112	51,688	35,464	29,604	39,593	11,296	15.0%	5.4%	2,290	456,000	547,100	11,500	$ 183.22
Alt. 4A	59/39 (none)	94,112	41,598	58,190	70,700	94,112	41,598	40,216	34,976	40,575	12,299	15.3%	5.8%	2,508	464,500	472,200	10,500	$ 184.23
Alt. 4B	59/39 (60/40)	94,112	41,598	58,190	70,700	94,112	41,598	40,216	34,976	40,575	12,299	15.3%	5.8%	2,508	464,500	472,200	10,500	$ 184.23
Alt. 4C	59/39 (40/60)	94,112	43,301	63,471	63,716	94,112	43,301	45,509	27,980	40,133	11,848	15.2%	5.6%	2,509	443,900	481,700	10,200	$ 183.49
Alt. 4D	59/39 (55/45)	94,112	41,598	58,190	70,700	94,112	41,598	40,216	34,976	40,575	12,299	15.3%	5.8%	2,508	464,500	472,200	10,500	$ 184.23
Alt. 5A	39/59 (none)	94,112	65,188	45,586	59,714	94,112	65,188	27,556	23,966	38,351	10,026	14.5%	4.8%	1,990	449,600	648,100	13,100	$ 182.02
Alt. 5B	39/59 (60/40)	94,112	65,188	42,120	63,180	94,112	65,188	24,082	27,437	38,508	10,187	14.6%	4.8%	1,969	460,500	649,800	13,400	$ 182.35
Alt. 5C	39/59 (40/60)	94,112	65,188	63,180	42,120	94,112	65,188	45,194	6,344	37,549	9,211	14.2%	4.4%	2,099	394,100	639,200	11,700	$ 180.36
Alt. 5D	39/59 (55/45)	94,112	65,188	47,385	57,915	94,112	65,188	29,360	22,164	38,269	9,943	14.5%	4.7%	2,001	443,900	647,200	12,900	$ 181.85
Alt. 6A	49/49 (none)	94,112	41,598	58,190	70,700	94,112	41,598	40,216	34,976	40,575	12,299	15.3%	5.8%	2,508	464,500	472,200	10,500	$ 184.23
Alt. 6B	49/49 (60/40)	94,112	39,895	52,908	77,685	94,112	39,895	34,923	41,972	41,018	12,750	15.5%	6.0%	2,507	485,100	462,600	10,800	$ 184.98
Alt. 6C	49/49 (40/60)	94,112	45,935	71,643	52,910	94,112	45,935	53,698	17,157	39,448	11,150	14.9%	5.3%	2,510	412,000	496,500	9,800	$ 182.33
Alt. 6D	49/49 (55/45)	94,112	41,598	58,190	70,700	94,112	41,598	40,216	34,976	40,575	12,299	15.3%	5.8%	2,508	464,500	472,200	10,500	$ 184.23

*"All Discards" % is amount of P. cod discards all fisheries (target and non-target) over the total catch of P. cod in all fisheries, i.e., 38,992 / 226,671 = 17.2%. (93,555 + 18,716 + 50,183 + 63,817 = 226,671)

*"Target Discards" % is the amount of P. cod discards target fisheries over the total catch of P. cod in target fisheries, i.e., 10,389 / 172,751 = 6.0%. (93,555 + 18,716 + 31,169 + 28,912 = 172,751)

T. 5.23 - MODEL RUN #4

Summary of Projected Outcomes of Alternative Pacific Cod Allocations Using 1994 Halibut Bycatch Rates For Cod Fisheries

Assumes Inseason Reallocation of Cod, and No Split of the Trawl Halibut Cap

Alternative	Cod Allocations TRW/FIX (CP/CV)	Total Pacific Cod Catch In All Fisheries: Longline	Pot	Trawl CV	Trawl CP	Total Pacific Cod Catch In Target Fisheries: Longline	Pot	Trawl CV	Trawl CP	Pacific Cod Discards, Metric Tons: All	Target	% of Cod MT: All	Target	Halibut Mortality	Crab Bycatch Number of Animals (Rounded to nearest 100): Bairdi	Opilio	Red King	Target Fishery Revenue ($ millions)
1995	54/44 (none)	93,955	18,716	50,183	63,817	93,955	18,716	31,169	28,912	38,992	10,389	20.0%	10.0%	2,149	330,200	273,800	6,200	$ 151.16
Alt. 1A	No Split	66,578	75,220	53,125	69,677	66,578	75,220	35,132	33,949	39,405	11,118	10.0%	10.0%	2,528	551,900	722,100	15,600	$ 183.34
Alt. 2A	54/44 (none)	66,578	75,220	53,125	69,677	66,578	75,220	35,132	33,949	39,405	11,118	10.0%	10.0%	2,528	551,900	722,100	15,600	$ 183.34
Alt. 2B	54/44 (60/40)	66,578	75,220	53,125	69,677	66,578	75,220	35,132	33,949	39,405	11,118	10.0%	10.0%	2,528	551,900	722,100	15,600	$ 183.34
Alt. 2C	54/44 (40/60)	66,578	78,102	61,606	58,314	66,578	78,102	43,632	22,568	38,677	10,377	10.0%	0.0%	2,529	518,500	738,500	15,200	$ 182.12
Alt. 2D	54/44 (55/45)	66,578	75,220	53,125	69,677	66,578	75,220	35,132	33,949	39,405	11,118	10.0%	10.0%	2,528	551,900	722,100	15,600	$ 183.34
Alt. 3A	44/54 (none)	66,578	79,222	51,092	67,708	66,578	79,222	33,090	31,976	39,023	10,728	10.0%	10.0%	2,432	549,000	751,900	16,000	$ 182.95
Alt. 3B	44/54 (60/40)	66,578	79,222	47,520	71,280	66,578	79,222	29,509	35,553	39,186	10,894	10.0%	10.0%	2,407	560,300	753,700	16,300	$ 183.29
Alt. 3C	44/54 (40/60)	66,578	80,842	69,672	47,508	66,578	80,842	51,714	11,744	37,985	9,671	10.0%	0.0%	2,531	486,700	754,100	14,700	$ 180.96
Alt. 3D	44/54 (55/45)	66,578	79,222	53,460	65,340	66,578	79,222	35,464	29,604	38,915	10,618	10.0%	10.0%	2,449	541,600	750,700	15,900	$ 182.73
Alt. 4A	59/39 (none)	66,578	75,220	53,125	69,677	66,578	75,220	35,132	33,949	39,405	11,118	10.0%	10.0%	2,528	551,900	722,100	15,600	$ 183.34
Alt. 4B	59/39 (60/40)	66,578	75,220	53,125	69,677	66,578	75,220	35,132	33,949	39,405	11,118	10.0%	10.0%	2,528	551,900	722,100	15,600	$ 183.34
Alt. 4C	59/39 (40/60)	66,578	76,732	57,574	[illegible]	66,578	76,732	39,591	27,979	39,024	10,729	10.0%	10.0%	2,529	534,400	730,700	15,400	$ 182.70
Alt. 4D	59/39 (55/45)	66,578	75,220	53,125	69,677	66,578	75,220	35,132	33,949	39,405	11,118	10.0%	10.0%	2,528	551,900	722,100	15,600	$ 183.34
Alt. 5A	39/59 (none)	66,578	92,722	44,234	61,066	66,578	92,722	26,202	25,319	37,734	9,411	10.0%	0.0%	2,109	539,400	852,400	17,500	$ 181.66
Alt. 5B	39/59 (60/40)	66,578	92,722	42,120	63,180	66,578	92,722	24,082	27,437	37,830	9,509	10.0%	0.0%	2,094	546,000	853,400	17,700	$ 181.86
Alt. 5C	39/59 (40/60)	66,578	92,722	63,180	42,120	66,578	92,722	45,194	6,344	36,871	8,533	10.0%	0.0%	2,244	479,600	842,800	16,100	$ 179.86
Alt. 5D	39/59 (55/45)	66,578	92,722	47,385	57,915	66,578	92,722	29,360	22,164	37,591	9,265	10.0%	0.0%	2,132	529,400	850,800	17,300	$ 181.36
Alt. 6A	49/49 (none)	66,578	75,220	53,125	69,677	66,578	75,220	35,132	33,949	39,405	11,118	10.0%	10.0%	2,528	551,900	722,100	15,600	$ 183.34
Alt. 6B	49/49 (60/40)	66,578	75,150	52,920	69,952	66,578	75,150	34,927	34,225	39,423	11,136	10.0%	10.0%	2,528	552,700	721,700	15,600	$ 183.37
Alt. 6C	49/49 (40/60)	66,578	79,472	65,639	52,911	66,578	79,472	47,673	17,156	38,331	10,024	10.0%	0.0%	2,530	502,600	746,300	15,000	$ 181.54
Alt. 6D	49/49 (55/45)	66,578	75,220	53,125	69,677	66,578	75,220	35,132	33,949	39,405	11,118	10.0%	10.0%	2,528	551,900	722,100	15,600	$ 183.34

*"All Discards" % is amount of P. cod discards all fisheries (target and non-target) over the total catch of P. cod in all fisheries, i.e., 38,992 / 226,671 = 17.2%. (93,555 + 18,716 + 50,183 + 63,817 = 226,671)

*"Target Discards" % is the amount of P. cod discards target fisheries over the total catch of P. cod in target fisheries, i.e., 10,389 / 172,751 = 6.0%. (93,555 + 18,716 + 31,169 + 28,912 = 172,751)

Alternative bycatch rates could be employed, though 1995 is likely the best information upon which to base any judgements of the alternatives. We simply do not know how halibut bycatch may change in future years, or what methods may be developed to reduce the mortalities associated with halibut bycatch. This model run was developed to simply illustrate the directional tendencies associated with potential changes in those rates.

5.4.4 Model Run #5 - Impacts Assuming a Pro-rata Apportionment of Trawl PSC Between CV and CP

In addition to the alternatives which allocate the overall Pacific cod TAC between gear types, the Council has identified three explicit alternatives for apportioning the trawl sector allocation between catcher vessels (CV) and catcher processors (CP). The Council identified a 60/40 split, a 40/60 split, and the three-year historical average which comes out to 55/45 (CP/CV). These sub-alternatives have been included in each of the model examinations included in this analysis, though all of those examinations assumed a common trawl halibut PSC cap for both CP and CV (as is the current situation). This section employs a model run which also apportions the trawl halibut PSC cap between the two trawl sectors, in the same proportion as the Pacific cod split. If one of the trawl sectors attains its PSC cap in this case, and the other trawl sector still has PSC remaining, then the unused cod from the first sector gets reapportioned to the other. If that sector then hits its PSC cap, then any remaining cod is reapportioned to the fixed gear sector.

The impacts of making this PSC split are not necessarily intuitive; i.e., catches by the two trawl sectors are not affected proportionally, due primarily to: (1) differences in the halibut mortality rates between CV and CP (recall from Chapter 3 that the mortality rates of halibut are higher for the CV sector in cod fisheries), and (2) the differences in the relative amounts of cod which are taken in cod target fisheries (recall that the CV sector catches relatively more of its cod in cod targets). As with the 'Base Case', the catch of cod in other fisheries remains virtually constant for both sectors. Table 5.24 is the basic summary table for this model run (with the PSC split) and shows the catch of cod in targets, as well as the overall catch of cod in all fisheries. Again, overall differences between each alternative are due almost entirely to differences in the target catch.

For example, let us examine Alternative 2, and its suboptions A, B, C, and D. Under Alternative 2A, which does not split the cod quota or the PSC cap, the target catch is about the same for both sectors (38,518 mt vs 37,221 mt). When CP are allocated 60% of the PSC, in addition to 60% of the cod (Alternative 2B), their target cod catch jumps to 52,879 mt while the CV catch drops to 26,671 mt. Conversely, when CV are allocated 60% of the cod quota and the PSC (Alternative 2C), their share of the cod rises back up to only 40,007 mt, just slightly more than what is was without any PSC split, while the CP sector's catch drops slightly to 35,253 mt. Finally, under Alternative 2D which splits the PSC 55/45 (CP/CV), the CV sector is estimated to take 30,005 mt of cod while the CP sector is estimated to take 48,472 mt of cod. The changes in these suboptions, relative to option A which does not split the cap, are not proportional.

A comparison to the 'Base Case' (which does split the cod quota but not the PSC) will shed further light on this issue (Table 5.19). In that case, again looking at Alternative 2, option D does not result in any change in the relative catch between the two sectors (compared to 2A), while adding the PSC split imparts a fairly dramatic change as described in the preceding paragraph. In the 'Base Case' only option C, which allocates 60% of the PSC cap to the CV sector, imparts a change in the relative catch between the two sectors.

A further example would be to look at Alternative 6D, which is a 49/49 split between trawl and fixed gear with a 55/45 split between CP and CV for both cod and the PSC cap. In the 'Base Case', the target cod catch was nearly equal for these two sectors (CV was 38,652 mt and CP was 37,044 mt). In the case where PSC is also split at 55/45 (CP/CV), the catch for the CP sector rises to 48,472 mt, while the CV catch drops to 30,005 mt.

As was noted above, these perhaps unexpected results are due largelyto the higher bycatch mortality associated with CV. Someof the total target catch projections for CV and CP appear out of sync with the percentage allocations; a different way of explaining this is to consider that, under the current apportionment, the CV sector takes 51% of the trawl target catch, but accounts for 58% of the halibut PSC mortality. If the CV sector were to catch 60% of the cod target, they would account for 68% of the halibut mortality. Splitting the PSC cap proportional to the cod split, between trawl sectors, also results in a lower total halibut PSC mortality under any of the alternatives. In general, the PSC split favors the CV sector only in alternatives which allocate a greater percentage of the cod quota to trawl gear than the current allocation (Alternative 4 and its suboptions), and is fairly neutral in extreme allocations favoring the fixed gear. The PSC split favors the CP sector under the current regime, its reciprocal, or the 49/49 split.

5.4.5 Model Run #6 - Impacts Assuming a 7.5% CDQ Set Aside

The "Base Case" model runs were made using the total 1996 TACs for Pacific cod; the potential implementation of the all-species CDQ program would reduce the TAC available to the remaining industry sector by 7.5%. The "Base Case" summary table (Table 5.19) is needed for comparison. Table 5.25 summarizes the model run where TACs are reduced to reflect the CDQ set aside; halibut PSC caps are also reduced proportionally, consistent with the Council's stated intent for the groundfish CDQ program. Because CDQs for the pollock fishery are already in place and included in the model, there was no reduction in the pollock TACs, nor did we reduce the bottom pollock halibut mortality cap.

A reduction in the amount of Pacific cod available to the "open access" fishery will obviously impact the catch of the fixed and trawl gear sectors, in both target and non-target fisheries, as well as subsequent gross revenues attributable to that catch and PSC bycatch attributed to that catch. However, because the CDQ program will also allocate 7.5% of the halibut PSC caps to the CDQ fisheries, the impacts are directly proportional to the impacts described in the previous model run, with a few minor exceptions. In other words, each gear sector is still constrained by the PSC caps, but at a lower level of TAC harvest than before. The distributional impacts associated with various TAC apportionments being considered are the same as under previous projections - catch and gross revenues are proportionally reduced, or increased, for each sector. Some of the less obvious impacts, which may not be exactly proportional, are discussed below.

For example, under this scenario the target catch of cod by the longline fishery is reduced by 7.5%, from 94,112 mt to 87,054 mt, (under the current allocation - Alternative 2A). Under the same alternative, the target catch of cod is also reduced by 7.5% for both the CV and CP trawl categories. However, pot gear harvest is disproportionally reduced by about 12%, from 41,051 mt to 35,994 mt when compared to the "Base Case." In this case, pot gear still harvests all of the "excess" cod once the longline fleet is shut down by PSC constraints, though the total amount of "excess" is less, and varies under the various allocation splits. The pot sector in the model bears a disproportionate share of the 'burden' of the reduced TAC, because while trawl target catch is reduced by 7.5%, the catch of cod in other groundfish targets is not reduced by 7.5%. Table 5.4 shows the "Base Case" summary of cod catch in non-cod targets, while Table 5.26 shows the corresponding information for the CDQ model run. Longline and pot gear are unaffected since all of their cod is taken in cod targets, while the trawl CV sector exhibits only a 1.2 % reduction (again under Alternative 2A for illustration) and the CP sector shows a 5% reduction in the amount of cod taken in non-targets.

The reason that the CV sector has less of a reduction, is because they take less cod as bycatch relative to the CP sector. It is also because most of the bycatch they do take is in the pollock fishery, for which the model did not impose an *additional* 7.5% TAC reduction - it was already taken out in the "Base Case" because that program is already in effect. The point to be made is that a TAC reduction, whether because of CDQ allocations or because of biomass reductions, will disproportionately affect the target cod fisheries in general, and the pot gear projected harvest in particular. This is consistent with earlier findings which showed that a reduction in the trawl sector's overall percentage allocation would be disproportionately borne by trawlers who target cod, because bycatch needs in other fisheries would still need to be accounted for.

Gross revenues are also proportionally reduced for each sector, reflecting the overall lower catches with a 7.5% TAC reduction. In essence, because the PSC caps are also reduced by 7.5%, all sectors except pot gear are equally, and proportionally, affected by the CDQ set asides, and each sector can expect a reduction in its total cod catch.

Table 5.24 - **MODEL RUN #5**

Summary of Projected Outcomes of Alternative Pacific Cod Allocations With the Trawl Halibut PSC Cap Split between CV and CP

Assumes Inseason Reallocation of Cod

Alternative	Cod Allocations	Total Pacific Cod Catch In All Fisheries				Total Pacific Cod Catch In Target Fisheries				Pacific Cod Discards				Halibut	Crab Bycatch Number of Animals (Rounded to nearest 100)			Target Fishery Revenue
										Metric Tons		% of Cod MT						
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Longline	Pot	Trawl CV	Trawl CP	All	Target	All	Target	Mortality	Bairdi	Opilio	Red King	($ millions)
1995	54/44 (none)	93,955	18,716	50,183	63,817	93,955	18,716	31,169	28,912	38,992	10,389	17.2%	6.0%	2,149	330,200	273,800	6,200	$ 151.16
Alt. 1A	No Split	94,112	41,051	56,495	72,942	94,112	41,051	38,518	37,221	40,717	12,444	15.4%	5.9%	2,507	471,100	469,100	10,600	$ 184.47
Alt. 2A	54/44 (none)	94,112	41,051	56,495	72,942	94,112	41,051	38,518	37,221	40,717	12,444	15.4%	5.9%	2,507	471,100	469,100	10,600	$ 184.47
Alt. 2B	54/44 (60/40)	94,112	37,240	44,674	88,574	94,112	37,240	26,671	52,879	41,708	13,453	15.8%	6.4%	2,505	517,200	447,700	11,200	$ 186.14
Alt. 2C	54/44 (40/60)	94,112	41,530	57,981	70,977	94,112	41,530	40,007	35,253	40,593	12,317	15.3%	5.8%	2,508	465,300	471,800	10,500	$ 184.26
Alt. 2D	54/44 (55/45)	94,112	38,312	48,001	84,175	94,112	38,312	30,005	48,472	41,429	13,169	15.7%	6.2%	2,506	504,200	453,700	11,000	$ 185.67
Alt. 3A	44/54 (none)	94,112	51,688	51,092	67,708	94,112	51,688	33,090	31,976	39,701	11,406	15.0%	5.4%	2,276	463,500	548,300	11,700	$ 183.45
Alt. 3B	44/54 (60/40)	94,112	51,688	44,689	74,111	94,112	51,688	26,671	38,389	39,993	11,703	15.1%	5.6%	2,236	483,700	551,500	12,200	$ 184.05
Alt. 3C	44/54 (40/60)	94,112	51,688	57,992	60,808	94,112	51,688	40,007	25,066	39,387	11,086	14.9%	5.3%	2,318	441,700	544,800	11,200	$ 182.79
Alt. 3D	44/54 (55/45)	94,112	51,688	48,015	70,785	94,112	51,688	30,005	35,058	39,842	11,549	15.1%	5.5%	2,257	473,200	549,800	12,000	$ 183.74
Alt. 4A	59/39 (none)	94,112	41,051	56,495	72,942	94,112	41,051	38,518	37,221	40,717	12,444	15.4%	5.9%	2,507	471,100	469,100	10,600	$ 184.47
Alt. 4B	59/39 (60/40)	94,112	37,240	44,674	88,574	94,112	37,240	26,671	52,879	41,708	13,453	15.8%	6.4%	2,505	517,200	447,700	11,200	$ 186.14
Alt. 4C	59/39 (40/60)	94,112	41,530	57,981	70,977	94,112	41,530	40,007	35,253	40,593	12,317	15.3%	5.8%	2,508	465,300	471,800	10,500	$ 184.26
Alt. 4D	59/39 (55/45)	94,112	38,312	48,001	84,175	94,112	38,312	30,005	48,472	41,429	13,169	15.7%	6.2%	2,506	504,200	453,700	11,000	$ 185.67
Alt. 5A	39/59 (none)	94,112	65,188	44,234	61,066	94,112	65,188	26,201	25,319	38,412	10,089	14.5%	4.8%	1,982	453,800	648,800	13,200	$ 182.15
Alt. 5B	39/59 (60/40)	94,112	65,188	42,120	63,180	94,112	65,188	24,082	27,437	38,508	10,187	14.6%	4.8%	1,969	460,500	649,800	13,400	$ 182.35
Alt. 5C	39/59 (40/60)	94,112	65,188	58,005	47,295	94,112	65,188	40,007	11,527	37,785	9,451	14.3%	4.5%	2,067	410,400	641,800	12,100	$ 180.85
Alt. 5D	39/59 (55/45)	94,112	65,188	47,385	57,915	94,112	65,188	29,360	22,164	38,269	9,943	14.5%	4.7%	2,001	443,900	647,200	12,900	$ 181.85
Alt. 6A	49/49 (none)	94,112	41,051	56,495	72,942	94,112	41,051	38,518	37,221	40,717	12,444	15.4%	5.9%	2,507	471,100	469,100	10,600	$ 184.47
Alt. 6B	49/49 (60/40)	94,112	38,188	44,675	87,625	94,112	38,188	26,671	51,928	41,595	13,338	15.7%	6.3%	2,488	515,000	454,500	11,300	$ 186.00
Alt. 6C	49/49 (40/60)	94,112	41,530	57,981	70,977	94,112	41,530	40,007	35,253	40,593	12,317	15.3%	5.8%	2,508	465,300	471,800	10,500	$ 184.26
Alt. 6D	49/49 (55/45)	94,112	38,312	48,001	84,175	94,112	38,312	30,005	48,472	41,429	13,169	15.7%	6.2%	2,506	504,200	453,700	11,000	$ 185.67

*"All Discards" % is amount of P. cod discards all fisheries (target and non-target) over the total catch of P. cod in all fisheries, i.e., 38,992 / 226,671 = 17.2%. (93,555 + 18,716 + 50,183 + 63,817 = 226,671)

*"Target Discards" % is the amount of P. cod discards target fisheries over the total catch of P. cod in target fisheries, i.e., 10,389 / 172,751 = 6.0%. (93,555 + 18,716 + 31,169 + 28,912 = 172,751)

Ta. .25 - MODEL RUN #6

Summary of Projected Outcomes of Alternative Pacific Cod Allocations With TACs Reduced By CDQs

Assumes Inseason Reallocation of Cod, and No Split of the Trawl Halibut Cap

Alternative Cod Allocations	TRW/FIX (CP/CV)	Total Pacific Cod Catch In All Fisheries: Longline	Pot	Trawl CV	Trawl CP	Total Pacific Cod Catch In Target Fisheries: Longline	Pot	Trawl CV	Trawl CP	Pacific Cod Discards: Metric Tons: All	Target	% of Cod MT: All	Target	Halibut Mortality	Crab Bycatch Number of Animals (Rounded to nearest 100): Bairdi	Opilio	Red King	Target Fishery Revenue ($ millions)
1995	54/44 (none)	93,955	18,716	50,183	63,817	93,955	18,716	31,169	28,912	38,992	10,389	17.2%	6.0%	2,149	330,200	273,800	6,200	$ 151.16
Alt. 1A	No Split	87,054	35,994	53,384	68,324	87,054	35,994	35,629	34,429	38,712	11,484	15.8%	5.9%	2,318	429,100	417,700	9,500	$ 168.99
Alt. 2A	54/44 (none)	87,054	35,994	53,384	68,324	87,054	35,994	35,629	34,429	38,712	11,484	15.8%	5.9%	2,318	429,100	417,700	9,500	$ 168.99
Alt. 2B	54/44 (60/40)	87,054	35,994	53,384	68,324	87,054	35,994	35,629	34,429	38,712	11,484	15.8%	5.9%	2,318	429,100	417,700	9,500	$ 168.99
Alt. 2C	54/44 (40/60)	87,054	39,501	64,262	53,938	87,054	39,501	46,530	20,020	37,801	10,556	15.4%	5.5%	2,320	386,700	437,400	8,900	$ 167.45
Alt. 2D	54/44 (55/45)	87,054	35,994	53,384	68,324	87,054	35,994	35,629	34,429	38,712	11,484	15.8%	5.9%	2,318	429,100	417,700	9,500	$ 168.99
Alt. 3A	44/54 (none)	87,054	47,811	47,381	62,509	87,054	47,811	29,599	28,602	37,584	10,332	15.4%	5.4%	2,061	420,600	505,700	10,700	$ 167.85
Alt. 3B	44/54 (60/40)	87,054	47,811	43,956	65,934	87,054	47,811	26,166	32,032	37,740	10,490	15.4%	5.4%	2,040	431,400	507,400	11,000	$ 168.18
Alt. 3C	44/54 (40/60)	87,054	47,811	65,934	43,956	87,054	47,811	48,198	10,020	36,739	9,472	15.0%	4.9%	2,176	362,100	496,300	9,300	$ 166.09
Alt. 3D	44/54 (55/45)	87,054	47,811	49,450	60,440	87,054	47,811	31,674	26,529	37,490	10,236	15.3%	5.3%	2,074	414,100	504,600	10,600	$ 167.65
Alt. 4A	59/39 (none)	87,054	35,994	53,384	68,324	87,054	35,994	35,629	34,429	38,712	11,484	15.8%	5.9%	2,318	429,100	417,700	9,500	$ 168.99
Alt. 4B	59/39 (60/40)	87,054	35,994	53,384	68,324	87,054	35,994	35,629	34,429	38,712	11,484	15.8%	5.9%	2,318	429,100	417,700	9,500	$ 168.99
Alt. 4C	59/39 (40/60)	87,054	38,283	60,483	58,936	87,054	38,283	42,743	25,026	38,118	10,878	15.6%	5.6%	2,319	401,400	430,600	9,100	$ 167.99
Alt. 4D	59/39 (55/45)	87,054	35,994	53,384	68,324	87,054	35,994	35,629	34,429	38,712	11,484	15.8%	5.9%	2,318	429,100	417,700	9,500	$ 168.99
Alt. 5A	39/59 (none)	87,054	60,299	41,037	56,365	87,054	60,299	23,227	22,445	36,391	9,113	14.9%	4.7%	1,789	411,700	598,600	12,100	$ 166.65
Alt. 5B	39/59 (60/40)	87,054	60,299	38,961	58,441	87,054	60,299	21,145	24,524	36,486	9,210	14.9%	4.8%	1,776	418,300	599,700	12,300	$ 166.85
Alt. 5C	39/59 (40/60)	87,054	60,299	58,441	38,961	87,054	60,299	40,674	5,013	35,599	8,307	14.5%	4.3%	1,896	356,800	589,800	10,800	$ 165.00
Alt. 5D	39/59 (55/45)	87,054	60,299	43,831	53,571	87,054	60,299	26,027	19,646	36,264	8,984	14.8%	4.7%	1,806	402,900	597,200	11,900	$ 166.38
Alt. 6A	49/49 (none)	87,054	35,994	53,384	68,324	87,054	35,994	35,629	34,429	38,712	11,484	15.8%	5.9%	2,318	429,100	417,700	9,500	$ 168.99
Alt. 6B	49/49 (60/40)	87,054	35,324	48,951	73,426	87,054	35,324	31,186	39,540	38,994	11,771	15.9%	6.1%	2,303	444,600	415,100	9,800	$ 169.50
Alt. 6C	49/49 (40/60)	87,054	40,720	68,041	48,941	87,054	40,720	50,318	15,014	37,484	10,233	15.3%	5.3%	2,321	371,900	444,300	8,700	$ 166.92
Alt. 6D	49/49 (55/45)	87,054	36,242	54,153	67,307	87,054	36,242	36,399	33,411	38,648	11,419	15.8%	5.9%	2,318	426,100	419,100	9,400	$ 168.88

*"All Discards" % is amount of P. cod discards all fisheries (target and non-target) over the total catch of P. cod in all fisheries, i.e., 38,992 / 226,671 = 17.2%. (93,555 + 18,716 + 50,183 + 63,817 = 226,671)

*"Target Discards" % is the amount of P. cod discards target fisheries over the total catch of P. cod in target fisheries, i.e., 10,389 / 172,751 = 6.0%. (93,555 + 18,716 + 31,169 + 28,912 = 172,751)

Table 5.26 - **MODEL RUN #6**

Projected Outcomes of Alternative Pacific Cod Allocations With TACs Reduced By CDQs:

Assumes Inseason Reallocation of Pacific Cod, and No Split of the Halibut Cap

Total Pacific Cod Catch in Non-Pacific Cod Target Fisheries

	Split	Metric Tons					Non-Target P. Cod as Percent of Gear Groups Total P. Cod					Rank of
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Total
1995 Fishery	54/44 (none)	1	-	19,014	34,905	53,920	0.0%	0.0%	37.9%	54.7%	23.8%	Low = 1
Alternative 1A	No Split	1	-	17,755	33,895	51,650	0.0%	0.0%	33.3%	49.6%	21.1%	1
Alternative 2A	54/44 (none)	1	-	17,755	33,895	51,650	0.0%	0.0%	33.3%	49.6%	21.1%	1
Alternative 2B	54/44 (60/40)	1	-	17,755	33,895	51,650	0.0%	0.0%	33.3%	49.6%	21.1%	1
Alternative 2C	54/44 (40/60)	1	-	17,731	33,918	51,650	0.0%	0.0%	27.6%	62.9%	21.1%	1
Alternative 2D	54/44 (55/45)	1	-	17,755	33,895	51,650	0.0%	0.0%	33.3%	49.6%	21.1%	1
Alternative 3A	44/54 (none)	1	-	17,782	33,907	51,690	0.0%	0.0%	37.5%	54.2%	21.1%	16
Alternative 3B	44/54 (60/40)	1	-	17,790	33,902	51,693	0.0%	0.0%	40.5%	51.4%	21.1%	17
Alternative 3C	44/54 (40/60)	1	-	17,736	33,936	51,673	0.0%	0.0%	26.9%	77.2%	21.1%	14
Alternative 3D	44/54 (55/45)	1	-	17,777	33,911	51,688	0.0%	0.0%	35.9%	56.1%	21.1%	15
Alternative 4A	59/39 (none)	1	-	17,755	33,895	51,650	0.0%	0.0%	33.3%	49.6%	21.1%	1
Alternative 4B	59/39 (60/40)	1	-	17,755	33,895	51,650	0.0%	0.0%	33.3%	49.6%	21.1%	1
Alternative 4C	59/39 (40/60)	1	-	17,740	33,910	51,650	0.0%	0.0%	29.3%	57.5%	21.1%	1
Alternative 4D	59/39 (55/45)	1	-	17,755	33,895	51,650	0.0%	0.0%	33.3%	49.6%	21.1%	1
Alternative 5A	39/59 (none)	1	-	17,811	33,921	51,732	0.0%	0.0%	43.4%	60.2%	21.1%	20
Alternative 5B	39/59 (60/40)	1	-	17,816	33,917	51,734	0.0%	0.0%	45.7%	58.0%	21.1%	21
Alternative 5C	39/59 (40/60)	1	-	17,767	33,948	51,716	0.0%	0.0%	30.4%	87.1%	21.1%	18
Alternative 5D	39/59 (55/45)	1	-	17,804	33,925	51,729	0.0%	0.0%	40.6%	63.3%	21.1%	19
Alternative 6A	49/49 (none)	1	-	17,755	33,895	51,650	0.0%	0.0%	33.3%	49.6%	21.1%	1
Alternative 6B	49/49 (60/40)	1	-	17,765	33,887	51,652	0.0%	0.0%	36.3%	46.2%	21.1%	13
Alternative 6C	49/49 (40/60)	1	-	17,723	33,926	51,650	0.0%	0.0%	26.0%	69.3%	21.1%	1
Alternative 6D	49/49 (55/45)	1	-	17,753	33,896	51,650	0.0%	0.0%	32.8%	50.4%	21.1%	1

Total catch (and bycatch of cod) of all non-target fisheries were held constant with the exception of inshore and offshore midwater pollock fisheries. All variation is due to changes in the amount of midwater pollock fishing. Target catches of bottom pollock, yellowfin, rock sole and other flounder are shown below:

Target Catches of Non-Pacific cod Fisheries	inshore bottom pollock	offshore bottom pollock	yellowfin sole	rock sole	other flatfish
Target catch	46,044	90,106	128,180	24,215	4,843
Pacific cod bycatch	8,862	8,085	17,213	7,606	1,078

5.4.6 Model Runs #7 & 8 - Alternative Dispensation of Potential Halibut PSC Savings

Currently, the halibut PSC caps for both longline and trawl gear are set in the BSAI FMP and in regulations, and could be changed by FMP/regulatory amendment. Such a change is beyond the scope of this analysis, but could be pursued separately. Some of the alternatives under consideration in this amendment package have the potential to result in a reduction of overall halibut PSC mortality, depending on the Pacific cod allocation chosen. Possible dispensation of "saved" halibut is discussed in this section.

Current Levels of Apportionment and Projections

For longline gear (pot gear is exempt from the PSC caps), the total amount of halibut PSC available in 1996 is 900 mt, of which the vast majority (800 mt) is apportioned to the Pacific cod target fisheries. This is further apportioned by trimester throughout the season as follows:

January 1 to April 30	475 mt
May 1 to August 31	40 mt
September 1 to Dec 31	285 mt

Though only 2,980 mt of Pacific cod is allocated to the last trimester, any unused PSC is carried over, such that the PSC allocation effects a loading of an additional amount of cod into the fall season. Although currently allocated 44% of the cod quota, fixed gear overall (including pot gear) is taking about 49% of the quota due to reapportionment from the trawl sector when that sector reaches its PSC cap. At that point, some additional cod is taken by longline gear, though they become constrained by halibut bycatch as well at about 94,000 mt of cod catch. In 1995 longline gear had 799 mt of mortality (exceeding the 725 mt cap in place for 1995), while pot gear accounted for only 10 mt of mortality.

As is shown in Table 5.9, longline gear would still account for 800 mt of halibut mortality under any allocation alternative, including allocation of 59% of the quota to trawl gear. This is because trawl gear will hit their cap and cod will be reallocated back to fixed gear, and the longline sector will catch the same amount of fish, and kill the same amount of halibut, under any alternative. So, no "savings" of halibut mortality appear possible from the longline sector. Under current regulations, the longline cap could be increased to a maximum of 900 mt, which would allow for some increase in their take of Pacific cod.

For trawl gear, the halibut PSC mortality cap for the Pacific cod fishery is a subset of the overall trawl cap in the FMP of 3,775 mt. The amount apportioned to the cod fisheries is subject to change every year during the annual specifications setting process, and was increased from the 1995 level of 1,550 mt to 1,685 mt for 1996. In 1995, the 1,550 mt apportionment was constraining and resulted in a redistribution of cod TAC to fixed gear, although trawl gear was closed prematurely due to a miscalculation of halibut mortality. With an increase in the overall TAC for Pacific cod in 1996, this amount would likely be constraining. Whether the 1,685 mt will be constraining is yet to be seen, though projections indicate that it will be. However, in alternatives which allocate 44% or less of the cod TAC to trawl gear, the TAC is the constraining factor (Alternatives 3 and 5). Under Alternative 5, which allocates 59% of the TAC to fixed gear, overall halibut mortality is projected to decrease to 1,969 mt, which is a 180 mt "savings" from the trawl catcher vessel sector which was reduced from 788 mt to 609 mt of halibut mortality. A slight increase in halibut mortality attributable to the pot gear sector occurs, due to the assumption that they catch any Pacific cod left over from the other sectors. All other alternatives result in more overall halibut PSC mortality than in 1995.

Assumptions About the Catch of Cod By Pot Gear

One of the scenarios described in Chapter 4 was an assumed relaxation of the halibut PSC caps for all sectors - this was done to show how much halibut would be required, by each gear type, to take the overall Pacific cod TAC. In this case, it was necessary to make an assumption regarding the possible catch of Pacific cod by the pot gear sector which has no halibut PSC cap. The first scenario assumed that pot gear would be able to take 25,000 mt of cod, or about a 33% increase over their 1995 catch. This is fairly consistent with the catch rates exhibited in the first five months of 1996. As would be expected, all of the alternatives under consideration would result in a higher level of PSC mortality than occurred in 1995. Under this scenario, pot gear halibut mortality is fixed at 14 mt, while halibut mortality from longline and trawl gear fluctuates up and down respectively, depending on the allocation of cod (Table 5.27).

For example, under Alternative 2A (the current split), total PSC mortality required to take the cod TAC is 2,861 mt. Of this amount, 2,050 mt would be required by trawl gear (1,184 mt for CV and 866 for CP) while longline gear PSC mortality is projected at 797 mt, right at their actual cap of 800 mt. Alternative 6 depicts the 49/49 split, which is what actually occurred in 1995; with an increase in the cod TAC for 1996, the longline sector would need 912 mt of halibut mortality to realize that 49% cod share, while the trawl sector would need 1,749 mt. This indicates that both sectors will be constrained by halibut bycatch in 1996.

At the extreme end of potential allocations is the 59/39 (and 39/59) split - if 59% of the cod quota is allocated to fixed gear (Alternative 5A), that sector would need a total of 1,142 mt of halibut PSC, an increase of 342 mt over their 1995 allocation, and an increase of 242 mt over the maximum allowed in the FMP and in regulation. Conversely, this particular allocation would result in a decrease of the trawl sector's halibut PSC to 1,146 mt, down by 539 mt. The net 'savings' of halibut is therefore 197 mt (539 minus 342) relative to 1995. If a further subdivision of the trawl gear cod apportionment is made 60/40 in favor of CPs, then a small additional amount of halibut mortality could be saved (Alternative 5B).

A final scenario was developed to illustrate an additional level of cod harvest by pot vessels, this time up to 35,000 mt, or a doubling of their 1995 catch. Under this scenario, the total PSC needed by longline and trawl sectors, to harvest their respective allocations, drops by a proportional amount. As shown in Table 5.28, Alternative 5B, the lowest total of halibut mortality required would be 2,222 mt, with 1,057 mt required by longline gear and 1,146 mt required by trawl gear (CV and CP combined). The potential "savings," calculated as in the previous example, is 282 mt in this example. In order to realize this savings, the PSC caps for both trawl and longline sectors would have to be adjusted - possible methods for this adjustment are discussed below.

Reapportionment to Other Trawl Fisheries

For the trawl sector overall, the setting of each target fishery's PSC share is a trade-off between the various trawl target fisheries. If halibut are saved due to an increased allocation to fixed gear, the specifications setting process allows the Council to redistribute that halibut to other trawl fisheries to allow for their fuller prosecution. Halibut PSC is typically a constraining factor in all BSAI trawl fisheries. If this is done, then the halibut "saved" by decreasing the cod allocation to trawl gear are simply transferred to another trawl fishery for a net effect of zero. To date, the Council has always distributed the full trawl halibut PSC cap during their annual specifications process, with the intra-fisheries distributions based largely on consensus recommendation from the affected trawl industry.

Reapportionment to the Longline Fishery

An alternative, in the event an increased allocation to the fixed gear sector is chosen, would be to reduce the trawl sector cap, either implicitly or explicitly, and increase the fixed gear cap. A reduction in the trawl cap would not necessarily require an FMP/regulatory amendment, but would simply mean that the Council does not fully allocate the cap in its specifications setting process, thereby leaving PSC "on the table." Alternatively, the cap in the FMP and regulations could be explicitly amended downward to reflect the reduction in the amount of PSC needed for the cod trawl fisheries. A reciprocal amendment could be implemented to increase the PSC cap in the FMP/regulations for the longline fishery, which would then be earmarked for longline cod, if the Council expects the longline fishery to increase its catch of Pacific cod (alternatively, the longline cap would not be reduced if the intent is for pot gear to capture the extra cod allocated to fixed gear).

Ta .27 - MODEL RUN #7

Projected Outcomes of Alternative Pacific Cod Allocations Without Halibut PSC Caps for Pacific Cod Fisheries:

Assumes Pot Catch of 25,000 MT of Pacific cod Under Each Alternative

Metric Tons of Halibut Mortality in Pacific Cod Target Fisheries												
	Split	Metric Tons					Percent of Halibut Mortality in all Pacific Cod Target Fisheries					Rank:
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Low to
1995 Fishery	54/44 (none)	799	10	788	553	2,149	37.2%	0.5%	36.7%	25.7%	100.0%	High
Alternative 1A	No Split	831	14	1,133	828	2,806	29.6%	0.5%	40.4%	29.5%	100.0%	12
Alternative 2A	54/44 (none)	797	14	1,184	866	2,861	27.9%	0.5%	41.4%	30.3%	100.0%	15
Alternative 2B	54/44 (60/40)	797	14	1,020	990	2,821	28.3%	0.5%	36.2%	35.1%	100.0%	14
Alternative 2C	54/44 (40/60)	797	14	1,759	432	3,001	26.6%	0.5%	58.6%	14.4%	100.0%	18
Alternative 2D	54/44 (55/45)	797	14	1,205	851	2,866	27.8%	0.5%	42.0%	29.7%	100.0%	16
Alternative 3A	44/54 (none)	1,027	14	836	611	2,488	41.3%	0.5%	33.6%	24.6%	100.0%	6
Alternative 3B	44/54 (60/40)	1,027	14	746	680	2,466	41.6%	0.6%	30.2%	27.6%	100.0%	5
Alternative 3C	44/54 (40/60)	1,027	14	1,348	225	2,613	39.3%	0.5%	51.6%	8.6%	100.0%	8
Alternative 3D	44/54 (55/45)	1,027	14	896	566	2,503	41.0%	0.5%	35.8%	22.6%	100.0%	7
Alternative 4A	59/39 (none)	683	14	1,358	993	3,048	22.4%	0.4%	44.6%	32.6%	100.0%	19
Alternative 4B	59/39 (60/40)	683	14	1,157	1,145	2,999	22.8%	0.5%	38.6%	38.2%	100.0%	17
Alternative 4C	59/39 (40/60)	683	14	1,964	535	3,196	21.4%	0.4%	61.5%	16.7%	100.0%	21
Alternative 4D	59/39 (55/45)	683	14	1,359	993	3,048	22.4%	0.4%	44.6%	32.6%	100.0%	19
Alternative 5A	39/59 (none)	1,142	14	662	484	2,302	49.6%	0.6%	28.8%	21.0%	100.0%	2
Alternative 5B	39/59 (60/40)	1,142	14	609	525	2,289	49.9%	0.6%	26.6%	22.9%	100.0%	1
Alternative 5C	39/59 (40/60)	1,142	14	1,142	121	2,419	47.2%	0.6%	47.2%	5.0%	100.0%	4
Alternative 5D	39/59 (55/45)	1,142	14	742	424	2,321	49.2%	0.6%	32.0%	18.3%	100.0%	3
Alternative 6A	49/49 (none)	912	14	1,010	739	2,675	34.1%	0.5%	37.8%	27.6%	100.0%	10
Alternative 6B	49/49 (60/40)	912	14	883	835	2,644	34.5%	0.5%	33.4%	31.6%	100.0%	9
Alternative 6C	49/49 (40/60)	912	14	1,553	328	2,807	32.5%	0.5%	55.3%	11.7%	100.0%	13
Alternative 6D	49/49 (55/45)	912	14	1,050	708	2,684	34.0%	0.5%	39.1%	26.4%	100.0%	11
1995 halibut bycatch mortality rates, as shown to the right in kg/mt, are used for each alternative:							8.501	0.543	25.271	19.119		

Table 5.28 - **MODEL RUN #8**

Projected Outcomes of Alternative Pacific Cod Allocations Without Halibut PSC Caps for Pacific Cod Fisheries:

Assumes Pot Catch of 35,000 MT of Pacific cod Under Each Alternative

Metric Tons of Halibut Mortality in Pacific Cod Target Fisheries												
	Split	Metric Tons					Percent of Halibut Mortality in all Pacific Cod Target Fisheries					Rank of
	TRW/FIX (CP/CV)	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total	Total
1995 Fishery	54/44 (none)	799	10	788	553	2,149	37.2%	0.5%	36.7%	25.7%	100.0%	Low = 1
Alternative 1A	No Split	786	19	1,072	784	2,661	29.6%	0.7%	40.3%	29.4%	100.0%	12
Alternative 2A	54/44 (none)	712	19	1,184	866	2,782	25.6%	0.7%	42.6%	31.1%	100.0%	15
Alternative 2B	54/44 (60/40)	712	19	1,020	990	2,741	26.0%	0.7%	37.2%	36.1%	100.0%	14
Alternative 2C	54/44 (40/60)	712	19	1,759	432	2,922	24.4%	0.7%	60.2%	14.8%	100.0%	18
Alternative 2D	54/44 (55/45)	712	19	1,205	850	2,787	25.6%	0.7%	43.2%	30.5%	100.0%	16
Alternative 3A	44/54 (none)	942	19	836	611	2,409	39.1%	0.8%	34.7%	25.4%	100.0%	6
Alternative 3B	44/54 (60/40)	942	19	746	680	2,386	39.5%	0.8%	31.3%	28.5%	100.0%	5
Alternative 3C	44/54 (40/60)	942	19	1,348	225	2,533	37.2%	0.8%	53.2%	8.9%	100.0%	8
Alternative 3D	44/54 (55/45)	942	19	896	566	2,423	38.9%	0.8%	37.0%	23.4%	100.0%	7
Alternative 4A	59/39 (none)	598	19	1,358	993	2,968	20.1%	0.6%	45.8%	33.5%	100.0%	19
Alternative 4B	59/39 (60/40)	598	19	1,157	1,145	2,919	20.5%	0.7%	39.6%	39.2%	100.0%	17
Alternative 4C	59/39 (40/60)	598	19	1,964	535	3,116	19.2%	0.6%	63.0%	17.2%	100.0%	21
Alternative 4D	59/39 (55/45)	598	19	1,359	993	2,968	20.1%	0.6%	45.8%	33.4%	100.0%	19
Alternative 5A	39/59 (none)	1,057	19	662	484	2,222	47.6%	0.9%	29.8%	21.8%	100.0%	2
Alternative 5B	39/59 (60/40)	1,057	19	609	525	2,209	47.8%	0.9%	27.6%	23.8%	100.0%	1
Alternative 5C	39/59 (40/60)	1,057	19	1,142	121	2,339	45.2%	0.8%	48.8%	5.2%	100.0%	4
Alternative 5D	39/59 (55/45)	1,057	19	742	424	2,241	47.1%	0.8%	33.1%	18.9%	100.0%	3
Alternative 6A	49/49 (none)	827	19	1,010	739	2,595	31.9%	0.7%	38.9%	28.5%	100.0%	10
Alternative 6B	49/49 (60/40)	827	19	883	835	2,564	32.3%	0.7%	34.4%	32.6%	100.0%	9
Alternative 6C	49/49 (40/60)	827	19	1,553	328	2,728	30.3%	0.7%	56.9%	12.0%	100.0%	13
Alternative 6D	49/49 (55/45)	827	19	1,050	708	2,605	31.8%	0.7%	40.3%	27.2%	100.0%	11
1995 halibut bycatch mortality rates, as shown to the right in kg/mt, are used for each alternative:							8.501	0.543	25.271	19.119		

In either case, a separate plan/regulatory amendment would need to be initiated to change the PSC caps for either the trawl sector, the longline sector, or both. Depending on the alternative chosen, this may or may not be seen as a necessity by the Council. Recall that only the more extreme allocation alternatives would require such an adjustment - it may be that mid-range alternatives would allow for the Council's goals and objectives without changing the PSC caps. If an amendment is initiated to change the caps, it is unlikely that such a change would be in place until 1998. If analyses are initiated by the Council this summer, or this fall in the groundfish amendment cycle, the analyses could be completed by the end of 1996 or early 1997, for Council action in early to mid 1997. The time required for Secretarial review and approval would make 1998 the target implementation year for such an amendment.

Reapportionment to the Directed Halibut Fishery or "Banking"

If halibut PSC mortality is reduced as a result of the cod allocation (or as a result of any other management actions by the Council), and such reduction is not redistributed by the Council to either other trawl fisheries or to longline fisheries, the savings will be at the disposal of the International Pacific Halibut Commission (IPHC). The IPHC takes into account estimated bycatch needs, subsistence needs, and the sport fishery take prior to setting the directed hook and line quota for the commercial fishery. Reductions in any of the aforementioned areas are typically redistributed to the commercial fishery quota. The IPHC could choose to not make a reapportionment to the directed fishery of any halibut PSC savings, but instead "bank" the halibut in order to bolster future halibut biomass. This would be a decision of the IPHC, but may be influenced by recommendations from the Council.

5.4.7 Model Runs #9 & 10 - Interaction with Improved Retention and Utilization

The Council is currently developing an Improved Retention/Utilization (IR/IU) initiative for the North Pacific in order to reduce the discard and waste of groundfish. One of the four species included in this program is Pacific cod. The IR/IU program is being analyzed as part of a separate amendment package, so a detailed examination is beyond the scope of this analysis. However, because that program will likely be implemented in 1998, and because the discard of cod has been raised as an issue in the context of gear allocations, there is considerable interest in how that program may interact with the Pacific cod allocation alternatives being considered in this analysis.

In order to examine some of the implications of IR/IU, two additional model runs were developed - the basic difference in these model runs, relative to the previous model runs, is that an assumption is made regarding the trawl fleet's behavior in response to a mandatory retention requirement, particularly the 'avoidance' response in terms of groundfish fisheries which do not target on cod. The fixed gear fisheries are assumed to not change, simply because all, or nearly all, of their cod is taken in cod target fisheries. Recall that much of the discard of cod is occurring in other groundfish trawl target fisheries; a full retention/utilization requirement will likely cause vessels in these fisheries to avoid catching cod in the first place. Therefore, the two model runs make the following assumptions: (1) that catch of cod in non-target fisheries decreases by 10%, and (2) that the catch of cod in non-target fisheries decreases by 25%.

The primary result of this change is to make more cod available to all of the cod target fisheries. Discards of cod are, of course, eliminated for all fisheries. The original summary table of cod catch in target fisheries (Table 5.19), from the core model run is needed for purposes of comparisons to the new model run. Table 5.29 shows the summary results of the model run which assumes a 10% reduction in cod catch by other groundfish target fisheries (again, this is the summary of cod catch in target fisheries). Total cod catch in targets increases from 210,902 mt to 216,272 mt for all alternatives. For purposes of further illustration, we will examine the IR/IU impacts under Alternative 2A, the current split, and under Alternative 3A, the reciprocal. Looking at Alternative 2A, we see that longline and trawl catch stays the same due to the halibut PSC constraint, while pot gear realizes the entire 5,000 mt increase.

Under Alternative 3A, which flips the percentage allocations to 44% for trawl and 54% for fixed gear, both longline and pot gear remain the same across both scenarios (across both tables), while the trawl gear sectors, both CV and CP, experience gains due to the increased amount of cod available to target fisheries. Keep in mind these are gains relative to not having an IR/IU mandate; their catch is still below that experienced under the status quo percentage split.

Table 5.29 - **MODEL RUN #9**

Summary of Projected Outcomes of Alternative Pacific Cod Allocations With 10% Cod Bycatch Reduction Under IRIU

Assumes Inseason Reallocation of Pacific Cod, and No Split of Trawl Halibut Cap

Alternative	Cod Allocations TRW/FIX (CP/CV)	Total Pacific Cod Catch In All Fisheries: Longline	Pot	Trawl CV	Trawl CP	Total Pacific Cod Catch In Target Fisheries: Longline	Pot	Trawl CV	Trawl CP	Pacific Cod Discards, Metric Tons: All	Target	% of Cod MT: All	Target	Halibut Mortality	Crab Bycatch Number of Animals (Rounded to nearest 100): Bairdi	Opilio	Red King	Target Fishery Revenue ($ millions)
1995	54/44 (none)	93,955	18,716	50,183	63,817	93,955	18,716	31,169	28,912	38,992	10,389	17.2%	6.0%	2,149	330,200	273,800	6,200	$ 151.16
Alt. 1A	No Split	94,112	46,421	54,697	69,370	94,112	46,421	38,518	37,221	-	-	-	-	2,510	489,200	513,100	11,400	$ 188.95
Alt. 2A	54/44 (none)	94,112	46,421	54,697	69,370	94,112	46,421	38,518	37,221	-	-	-	-	2,510	489,200	513,100	11,400	$ 188.95
Alt. 2B	54/44 (60/40)	94,112	46,421	54,697	69,370	94,112	46,421	38,518	37,221	-	-	-	-	2,510	489,200	513,100	11,400	$ 188.95
Alt. 2C	54/44 (40/60)	94,112	49,116	63,057	58,315	94,112	49,116	46,894	26,150	-	-	-	-	2,512	456,600	528,300	11,000	$ 187.77
Alt. 2D	54/44 (55/45)	94,112	46,421	54,697	69,370	94,112	46,421	38,518	37,221	-	-	-	-	2,510	489,200	513,100	11,400	$ 188.95
Alt. 3A	44/54 (none)	94,112	51,688	52,022	66,778	94,112	51,688	35,831	34,625	-	-	-	-	2,396	485,400	552,300	12,000	$ 188.44
Alt. 3B	44/54 (60/40)	94,112	51,688	47,520	71,280	94,112	51,688	31,319	39,133	-	-	-	-	2,368	499,600	554,600	12,300	$ 188.87
Alt. 3C	44/54 (40/60)	94,112	51,750	71,228	47,510	94,112	51,750	55,081	15,329	-	-	-	-	2,513	424,700	543,100	10,500	$ 186.61
Alt. 3D	44/54 (55/45)	94,112	51,688	53,460	65,340	94,112	51,688	37,273	33,184	-	-	-	-	2,404	480,900	551,600	11,900	$ 188.30
Alt. 4A	59/39 (none)	94,112	46,421	54,697	69,370	94,112	46,421	38,518	37,221	-	-	-	-	2,510	489,200	513,100	11,400	$ 188.95
Alt. 4B	59/39 (60/40)	94,112	46,421	54,697	69,370	94,112	46,421	38,518	37,221	-	-	-	-	2,510	489,200	513,100	11,400	$ 188.95
Alt. 4C	59/39 (40/60)	94,112	47,799	58,972	63,717	94,112	47,799	42,800	31,560	-	-	-	-	2,511	472,500	520,900	11,200	$ 188.34
Alt. 4D	59/39 (55/45)	94,112	46,421	54,697	69,370	94,112	46,421	38,518	37,221	-	-	-	-	2,510	489,200	513,100	11,400	$ 188.95
Alt. 5A	39/59 (none)	94,112	65,188	45,163	60,137	94,112	65,188	28,945	27,970	-	-	-	-	2,102	475,800	652,800	13,500	$ 187.15
Alt. 5B	39/59 (60/40)	94,112	65,188	42,120	63,180	94,112	65,188	25,895	31,018	-	-	-	-	2,083	485,400	654,400	13,700	$ 187.43
Alt. 5C	39/59 (40/60)	94,112	65,188	63,180	42,120	94,112	65,188	47,002	9,928	-	-	-	-	2,213	419,000	643,700	12,100	$ 185.44
Alt. 5D	39/59 (55/45)	94,112	65,188	47,385	57,915	94,112	65,188	31,172	25,745	-	-	-	-	2,115	468,800	651,700	13,300	$ 186.94
Alt. 6A	49/49 (none)	94,112	46,421	54,697	69,370	94,112	46,421	38,518	37,221	-	-	-	-	2,510	489,200	513,100	11,400	$ 188.95
Alt. 6B	49/49 (60/40)	94,112	45,847	52,916	71,725	94,112	45,847	36,733	39,580	-	-	-	-	2,510	496,100	509,900	11,500	$ 189.20
Alt. 6C	49/49 (40/60)	94,112	50,433	67,143	52,912	94,112	50,433	50,987	20,739	-	-	-	-	2,512	440,600	535,700	10,800	$ 187.19
Alt. 6D	49/49 (55/45)	94,112	46,421	54,697	69,370	94,112	46,421	38,518	37,221	-	-	-	-	2,510	489,200	513,100	11,400	$ 188.95

*"All Discards" % is amount of P. cod discards all fisheries (target and non-target) over the total catch of P. cod in all fisheries, i.e., 38,992 / 226,671 = 17.2%. (93,555 + 18,716 + 50,183 + 63,817 = 226,671)

*"Target Discards" % is the amount of P. cod discards target fisheries over the total catch of P. cod in target fisheries, i.e., 10,389 / 172,751 = 6.0%. (93,555 + 18,716 + 31,169 + 28,912 = 172,751)

Table 5.30 contains the same sets of information, for each of the alternatives, but is based on an assumption of a 25% reduction in the catch of cod in other groundfish targets. For Alternative 2A, the total catch by longline and trawl gear is the same as in the "base" case, while catch by pot gear soars from 41,051 mt to 54,476 mt (again, this model assumes that pot gear could take that amount of fish). For Alternative 3A, the results are more interesting, and show that, while the catch of cod in target fisheries remains unchanged for the longline sector, and increase by about 3,000 mt for pot gear, the catch by the trawl sectors increases substantially (by about 5,000 mt for CV and about 5,000 mt for CP). In fact, the catch of cod in cod targets for both CV and CP is equal to the catch under Alternative 2A, the current allocation percentage. In essence, this indicates that the percentage allocations could be reversed from the current split, and each trawl sector's directed cod catch would remain unchanged.

This finding of course is based on the assumption that IR/IU will be implemented, and that catch of cod in other targets will be reduced by 25% as a result. It also assumes the current halibut PSC caps for trawl gear would remain in place. Keep in mind that, as relatively more cod is taken in targets, the halibut bycatch associated with that catch is counted against the PSC cap for that fishery. If those caps are reduced, as has been suggested might be possible if the trawl percentage is reduced, then this finding would no longer hold true; PSC would become constraining at a lower level of catch, and a reversal of the percentage splits would result in a reduction of the catch by trawlers in cod targets. This general finding would hold true even if TACs for the "open access" fishery are reduced, either by biomass reductions or by CDQ set asides; for example, if we assume a 7.5% reduction for the CDQ program, catches by the two trawl sectors would no longer be at the levels described above. However, if we also assumed a 7.5% reduction *in the "Base Case,"* then the numbers would once again be comparable.

The alternatives discussed above are presented as examples of the potential interactions between this amendment and the IR/IU amendment. The tables presented in this section also allow the reviewer to examine the potential impacts for the various additional alternatives under consideration.

5.5 TAC Considerations

The preceding analysis was based on the 1996 levels of Pacific cod TAC. It is possible that the TAC for cod could increase, or decrease in the future, and would affect the findings included in this analysis. Model Run # 5 did look at a 7.5% reduction in TACs for the CDQ program, and these results are somewhat indicative of what would occur under the scenario of a decrease in the overall TAC; however, in that case we also assumed a proportional decrease in the halibut PSC caps, so it is not entirely indicative of the potential impacts. A more relevant assumption would be to look at a TAC decrease while maintaining the existing PSC caps. Chapter 2 contained projections of Pacific cod biomasss and Acceptable Biological Catch (ABC) over the next four years, through 1999. These projections indicate a potential 20% decrease between 1996 and 1999, at roughly 5% each year. If these projections hold true, the overall TAC in 1999 could be down in the area of 220,000 mt (compared to 270,000 in 1996).

In the situation where cod TACs decrease, but PSC caps are maintained, longline catch share would not be expected to change, unless pot gear expanded (dramatically) to the point where they actually cut into the longline share. The trawl apportionments would be expected to decrease proportionally to the TAC reduction; under the estimates above, the TACs would become the constraining factor for that sector by 1999, as opposed to the PSC caps, under some of the alternatives being considered (those would generally be the alternatives which allocate 49% or less to the trawl sector). In summary, the potential TAC reductions projected through 1999 are likely to impact the pot gear sector and the trawl gear sector, but not the longline sector. The impacts to the pot gear sector would occur relative to their ability to take a given amount of cod TAC - at the current catch rates it would only impact them under alternatives which allocate 54% or less to the fixed gear sector.

Table 5.30 - **MODEL RUN #10**

Summary of Projected Outcomes of Alternative Pacific Cod Allocations With 25% Cod Bycatch Reduction Under IRIU

Assumes Inseason Reallocation of Pacific Cod, and No Split of Trawl Halibut Cap

Alternative Cod Allocations	TRW/FIX (CP/CV)	Total Pacific Cod Catch In All Fisheries: Longline	Pot	Trawl CV	Trawl CP	Total Pacific Cod Catch In Target Fisheries: Longline	Pot	Trawl CV	Trawl CP	Pacific Cod Discards, Metric Tons: All	Target	Pacific Cod Discards, % of Cod MT: All	Target	Halibut Mortality	Crab Bycatch Number of Animals (Rounded to nearest 100): Bairdi	Opilio	Red King	Target Fishery Revenue ($ millions)
1995	54/44 (none)	93,955	18,716	50,183	63,817	93,955	18,716	31,169	28,912	38,992	10,389	17.2%	6.0%	2,149	330,200	273,800	6,200	$ 151.16
Alt. 1A	No Split	94,112	54,476	52,001	64,011	94,112	54,476	38,518	37,221	-	-	-	-	2,515	516,300	579,200	12,700	$ 195.66
Alt. 2A	54/44 (none)	94,112	54,476	52,001	64,011	94,112	54,476	38,518	37,221	-	-	-	-	2,515	516,300	579,200	12,700	$ 195.66
Alt. 2B	54/44 (60/40)	94,112	54,476	52,001	64,011	94,112	54,476	38,518	37,221	-	-	-	-	2,515	516,300	579,200	12,700	$ 195.66
Alt. 2C	54/44 (40/60)	94,112	55,864	56,307	58,318	94,112	55,864	42,831	31,520	-	-	-	-	2,515	499,500	587,000	12,500	$ 195.05
Alt. 2D	54/44 (55/45)	94,112	54,476	52,001	64,011	94,112	54,476	38,518	37,221	-	-	-	-	2,515	516,300	579,200	12,700	$ 195.66
Alt. 3A	44/54 (none)	94,112	54,476	52,001	64,011	94,112	54,476	38,518	37,221	-	-	-	-	2,515	516,300	579,200	12,700	$ 195.66
Alt. 3B	44/54 (60/40)	94,112	53,029	47,512	69,947	94,112	53,029	34,022	43.163	-	-	-	-	2,514	533,800	571,000	13,000	$ 196.29
Alt. 3C	44/54 (40/60)	94,112	58,497	64,478	47,513	94,112	58,497	51,015	20,703	-	-	-	-	2,517	467,700	601,800	12,000	$ 193.90
Alt. 3D	44/54 (55/45)	94,112	54,476	52,001	64,011	94,112	54,476	38,518	37,221	-	-	-	-	2,515	516,300	579,200	12,700	$ 195.66
Alt. 4A	59/39 (none)	94,112	54,476	52,001	64,011	94,112	54,476	38,518	37,221	-	-	-	-	2,515	516,300	579,200	12,700	$ 195.66
Alt. 4B	59/39 (60/40)	94,112	54,476	52,001	64,011	94,112	54,476	38,518	37,221	-	-	-	-	2,515	516,300	579,200	12,700	$ 195.66
Alt. 4C	59/39 (40/60)	94,112	54,547	52,221	63,720	94,112	54,547	38,739	36,929	-	-	-	-	2,515	515,400	579,600	12,700	$ 195.63
Alt. 4D	59/39 (55/45)	94,112	54,476	52,001	64,011	94,112	54,476	38,518	37,221	-	-	-	-	2,515	516,300	579,200	12,700	$ 195.66
Alt. 5A	39/59 (none)	94,112	65,188	46,558	58,742	94,112	65,188	33,056	31,943	-	-	-	-	2,281	508,700	658,900	13,900	$ 194.64
Alt. 5B	39/59 (60/40)	94,112	65,188	42,120	63,180	94,112	65,188	28,610	36,386	-	-	-	-	2,254	522,700	661,200	14,200	$ 195.06
Alt. 5C	39/59 (40/60)	94,112	65,188	63,180	42,120	94,112	65,188	49,709	15,301	-	-	-	-	2,384	456,300	650,500	12,600	$ 193.06
Alt. 5D	39/59 (55/45)	94,112	65,188	47,385	57,915	94,112	65,188	33,885	31,115	-	-	-	-	2,287	506,100	658,500	13,800	$ 194.56
Alt. 6A	49/49 (none)	94,112	54,476	52,001	64,011	94,112	54,476	38,518	37,221	-	-	-	-	2,515	516,300	579,200	12,700	$ 195.66
Alt. 6B	49/49 (60/40)	94,112	54,476	52,001	64,011	94,112	54,476	38,518	37,221	-	-	-	-	2,515	516,300	579,200	12,700	$ 195.66
Alt. 6C	49/49 (40/60)	94,112	57,180	60,392	52,916	94,112	57,180	46,923	26,111	-	-	-	-	2,516	483,600	594,400	12,300	$ 194.47
Alt. 6D	49/49 (55/45)	94,112	54,476	52,001	64,011	94,112	54,476	38,518	37,221	-	-	-	-	2,515	516,300	579,200	12,700	$ 195.66

*"All Discards" % is amount of P. cod discards all fisheries (target and non-target) over the total catch of P. cod in all fisheries, i.e., 38,992 / 226,671 = 17.2%. (93,555 + 18,716 + 50,183 + 63,817 = 226,671)

*"Target Discards" % is the amount of P. cod discards target fisheries over the total catch of P. cod in target fisheries, i.e., 10,389 / 172,751 = 6.0%. (93,555 + 18,716 + 31,169 + 28,912 = 172,751)

6.0 OTHER ISSUES AND OTHER APPLICABLE LAWS

This chapter contains some limited information regarding regional distributional impacts, and addresses the requirements of other applicable laws not addressed in the preceding analyses.

6.1 Community and Regional Impacts

Community and regional impacts may be predicted using the results of the model runs relative to tables in this section. A limited discussion of state and regional (via vessel classes) impacts is provided below:

State Impacts

The catch of Pacific cod by the vessel owner's state of residence was provided in Table 3.29 of Chapter 3. That table reported the catch of Pacific cod in cod target fisheries for the years 1992-95. Catch distribution among states, in 1995, will provide a baseline for dividing catch under each of the Council's allocation alternatives. Total catch for each sector of the industry is then broken out by state using the 1995 rates.

Table 6.1 lists the catch by state and vessel sector for each of the Council's allocation alternatives. Also included in this table is the actual reported catch in 1995. The numbers reported in this section, for 1995, and those reported in Chapter 3 are the same. Each of the allocation alternatives are based on the 1995 rates. So, since longline vessel owners who live in Alaska caught 19.94% of the cod in cod targets during 1995, each of the alternatives in this table will give that same percentage of the cod longline total to Alaska.

Vessel owners from Washington harvest a majority of the Pacific cod in each sector. Under each of the Council's alternatives, the model predicts longline vessels will harvest the same amount of cod in the target fishery. Because the projected harvest accruing to each state is based on the same rate, the catch by state for longliners is the same under each of the alternatives. Longliners from Alaska are projected to catch 18,761 mt under each of the alternatives. Washington longliners would catch 73,563 mt, and longliners from other states would harvest the remaining 1,788 mt in the cod target fishery. This would seem to suggest that the Washington freezer longliner fleet will not feel much of an impact no matter which allocation alternative is selected by the Council.

Trawl catcher vessels from Alaska reported the lowest catch of cod in the cod target fishery. Alaskan trawl catcher vessels are projected to catch only about 6% of that sectors total. Both Washington (62%) and the other state category (mainly Oregon in this case) are projected to catch significantly more cod than Alaska.

The trawl catcher processor sector is primarily from Washington. About 86% of the sector's total is projected to be harvested by vessels whose owner is from there. Alaskan trawl catcher processors are predicted to harvest only slightly more of the remaining cod for this sector that the other states.

Vessel Classes

Vessels that harvest cod were aggregated into classes. Each class is comprised of vessels with similar characteristics. A complete list of the vessel classes and their definitions are presented in Chapter 3 (page 30). Projected catch for each of the Council's alternatives is broken out by the vessel classes. Catch during 1995 was used to calculate the percentage of each vessel classes total catch compared to the total for all classes. This percentage was then applied to the projected total catch under each of the alternatives. The results are presented in Table 6.2.

Table 6.1 Total Pacific cod catch in the target fishery by vessel owner's state of residence (based on percent of state's catch in 1995)

Alternative		Alaska					Washington					Other States				
		Longline	Pot	Trawl CV	Trawl CP	AK Total	Longline	Pot	Trawl CV	Trawl CP	WA Total	Longline	Pot	Trawl CV	Trawl CP	Other Total
1995	54/44 (none)	18,730	4,753	1,834	2,368	27,685	73,440	9,664	19,349	24,797	127,249	1,785	4,299	9,986	1,748	17,818
Alt. 1A	No Split	18,761	10,425	2,266	3,048	34,501	73,563	21,196	23,911	31,923	150,593	1,788	9,430	12,340	2,250	25,808
Alt. 2A	54/44 (none)	18,761	10,425	2,266	3,048	34,501	73,563	21,196	23,911	31,923	150,593	1,788	9,430	12,340	2,250	25,808
Alt. 2B	54/44 (60/40)	18,761	10,425	2,266	3,048	34,501	73,563	21,196	23,911	31,923	150,593	1,788	9,430	12,340	2,250	25,808
Alt. 2C	54/44 (40/60)	18,761	11,331	2,919	1,848	34,859	73,563	23,038	30,793	19,356	146,749	1,788	10,249	15,892	1,364	29,293
Alt. 2D	54/44 (55/45)	18,761	10,425	2,266	3,048	34,501	73,563	21,196	23,911	31,923	150,593	1,788	9,430	12,340	2,250	25,808
Alt. 3A	44/54 (none)	18,761	13,127	1,947	2,619	36,454	73,563	26,688	20,542	27,424	148,217	1,788	11,873	10,601	1,933	26,195
Alt. 3B	44/54 (60/40)	18,761	13,127	1,736	2,912	36,536	73,563	26,688	18,319	30,492	149,062	1,788	11,873	9,454	2,149	25,264
Alt. 3C	44/54 (40/60)	18,761	13,127	3,138	963	35,989	73,563	26,688	33,105	10,083	143,439	1,788	11,873	17,085	711	31,457
Alt. 3D	44/54 (55/45)	18,761	13,127	2,087	2,424	36,399	73,563	26,688	22,016	25,390	147,656	1,788	11,873	11,362	1,790	26,812
Alt. 4A	59/39 (none)	18,761	10,425	2,266	3,048	34,501	73,563	21,196	23,911	31,923	150,593	1,788	9,430	12,340	2,250	25,808
Alt. 4B	59/39 (60/40)	18,761	10,425	2,266	3,048	34,501	73,563	21,196	23,911	31,923	150,593	1,788	9,430	12,340	2,250	25,808
Alt. 4C	59/39 (40/60)	18,761	10,997	2,678	2,291	34,727	73,563	22,358	28,252	23,996	148,169	1,788	9,947	14,580	1,691	28,006
Alt. 4D	59/39 (55/45)	18,761	10,425	2,266	3,048	34,501	73,563	21,196	23,911	31,923	150,593	1,788	9,430	12,340	2,250	25,808
Alt. 5A	39/59 (none)	18,761	16,555	1,542	2,073	38,932	73,563	33,659	16,265	21,715	145,202	1,788	14,974	8,394	1,531	26,687
Alt. 5B	39/59 (60/40)	18,761	16,555	1,417	2,247	38,980	73,563	33,659	14,950	23,532	145,703	1,788	14,974	7,715	1,659	26,136
Alt. 5C	39/59 (40/60)	18,761	16,555	2,659	520	38,495	73,563	33,659	28,056	5,441	140,718	1,788	14,974	14,479	383	31,625
Alt. 5D	39/59 (55/45)	18,761	16,555	1,727	1,815	38,859	73,563	33,659	18,226	19,009	144,457	1,788	14,974	9,406	1,340	27,508
Alt. 6A	49/49 (none)	18,761	10,425	2,266	3,048	34,501	73,563	21,196	23,911	31,923	150,593	1,788	9,430	12,340	2,250	25,808
Alt. 6B	49/49 (60/40)	18,761	10,132	2,055	3,437	34,385	73,563	20,600	21,682	35,994	151,838	1,788	9,164	11,189	2,537	24,679
Alt. 6C	49/49 (40/60)	18,761	11,666	3,160	1,405	34,992	73,563	23,718	33,335	14,714	145,330	1,788	10,552	17,204	1,037	30,580
Alt. 6D	49/49 (55/45)	18,761	10,436	2,274	3,034	34,506	73,563	21,218	23,995	31,771	150,546	1,788	9,440	12,383	2,239	25,850

The catch distribution by owner's state of residence in 1995 was used to allocate catch in this table.

Table 6.2 Total Pacific cod catch in the target fishery by vessel class (based on percent of classes' catch in 1995)

Alternative		LH	LP	MSC	PCP	TH1	TH2	TH3	TP1	TP2	TP3	Total
1995	54/44 (none)	32	76,145	9,825	17,571	3,419	19,501	6,249	7,748	10,949	21,311	172,752
Alt. 1A	No Split	40	76,870	13,456	35,234	4,229	24,815	7,971	9,950	13,958	24,379	210,902
Alt. 2A	54/44 (none)	40	76,870	13,456	35,234	4,229	24,815	7,971	9,950	13,958	24,379	210,902
Alt. 2B	54/44 (60/40)	40	76,870	13,456	35,234	4,229	24,815	7,971	9,950	13,958	24,379	210,902
Alt. 2C	54/44 (40/60)	51	76,970	14,246	38,084	5,445	31,628	10,151	6,448	8,835	19,046	210,902
Alt. 2D	54/44 (55/45)	40	76,870	13,456	35,234	4,229	24,815	7,971	9,950	13,958	24,379	210,902
Alt. 3A	44/54 (none)	34	77,151	14,326	43,617	3,637	21,974	7,075	8,548	12,053	22,452	210,866
Alt. 3B	44/54 (60/40)	30	77,149	14,188	43,607	3,244	19,819	6,387	9,389	13,297	23,752	210,862
Alt. 3C	44/54 (40/60)	55	77,160	15,107	43,677	5,854	34,151	10,964	3,794	5,020	15,102	210,884
Alt. 3D	44/54 (55/45)	36	77,152	14,418	43,624	3,897	23,402	7,531	7,990	11,228	21,590	210,868
Alt. 4A	59/39 (none)	40	76,870	13,456	35,234	4,229	24,815	7,971	9,950	13,958	24,379	210,902
Alt. 4B	59/39 (60/40)	40	76,870	13,456	35,234	4,229	24,815	7,971	9,950	13,958	24,379	210,902
Alt. 4C	59/39 (40/60)	47	76,933	13,954	37,032	4,996	29,112	9,346	7,741	10,727	21,015	210,902
Alt. 4D	59/39 (55/45)	40	76,870	13,456	35,234	4,229	24,815	7,971	9,950	13,958	24,379	210,902
Alt. 5A	39/59 (none)	27	77,507	15,430	54,257	2,885	18,368	5,938	6,768	9,635	20,006	210,820
Alt. 5B	39/59 (60/40)	25	77,506	15,349	54,251	2,652	17,093	5,530	7,266	10,371	20,776	210,819
Alt. 5C	39/59 (40/60)	46	77,515	16,163	54,313	4,966	29,796	9,588	2,307	3,035	13,109	210,838
Alt. 5D	39/59 (55/45)	30	77,508	15,552	54,266	3,231	20,269	6,545	6,026	8,537	18,859	210,824
Alt. 6A	49/49 (none)	40	76,870	13,456	35,234	4,229	24,815	7,971	9,950	13,958	24,379	210,902
Alt. 6B	49/49 (60/40)	36	76,838	13,200	34,311	3,835	22,608	7,264	11,084	15,618	26,107	210,902
Alt. 6C	49/49 (40/60)	55	77,007	14,538	39,136	5,894	34,143	10,956	5,154	6,942	17,076	210,902
Alt. 6D	49/49 (55/45)	40	76,871	13,465	35,268	4,244	24,897	7,997	9,907	13,897	24,315	210,902

Vessel classes are defined in Chapter 3 of the document. The catch distribution by vessel class in 1995 was used to allocate catch in this table.

Vessels in the longline class (LH and LP) account for about 77,000 mt under each of the allocation alternatives. This is close to the total projected longline catch. It will not necessarily equal the longline total because vessels in the trawl classes may have also used longline gear during 1995. Vessels that were classified as pot vessels (PCP) are projected to catch from 34,311 to 54,313 mt of cod in the cod target fishery depending on the alternative selected. Alternatives which allocate more cod to fixed gear result in the greatest pot vessel catch.

Vessels that were included in the medium size trawl catcher vessel class (TH2) are projected to harvest the most cod in the trawl harvester classes. The projected catch by TH2 vessels ranges from a low of 17,093 mt under Alternative 5B to a high of 34,151 mt under Alternative 3C. The trawl catcher processors in the H&G class (TP3) are projected to harvest the most cod in the catcher processor class. Their catch ranges from 13,109 mt under Alternative 5C to 26,107 mt in 6B. Fillet processors (TP2) are expected to have about half as much catch as the TP3 vessels. The surimi catcher processors (TP1) are expected to harvest the least cod in the cod target fishery of any trawler processor class.

6.2 NEPA Findings

As described in Chapter 2, none of the alternatives under consideration are likely to significantly affect the quality of the human environment, and the preparation of an EIS for the proposed action is not required.

6.3 Executive Order 12866

None of the alternatives under consideration is expected to result in a 'significant regulatory action' as defined in E.O. 12866. None of the alternatives would result in an impact to the economy of $100 million or more. Gross revenues change under various alternatives, though primarily these are distributional changes attributable to various industry sectors.

6.4 Regulatory Flexibility Act Considerations

The objective of the Regulatory Flexibility Act (RFA) is to require consideration of the capacity of those affected by regulations to bear the direct and indirect costs of regulation. If an action will have a significant impact on a substantial number of small entities, an Initial Regulatory Flexibility Analysis (IRFA) must be prepared to identify the need for the action, alternatives, potential costs and benefits of the action, the distribution of those impacts, and a determination of net benefits.

NMFS has defined all fish-harvesting or hatchery businesses that are independently owned and operated, not dominant in their field of operation, with annual receipts not in excess of $2 million as small businesses. In addition, seafood processors with 500 or fewer employees, wholesale industry members with 100 or fewer employees, not-for-profit enterprises, and government jurisdictions with a population of 50,000 or less are considered small entities. A 'substantial number' of small entities would generally be 20% of the total universe of small entities affected by the regulation. A regulation would have a 'significant impact' on these small entities if it reduced annual gross revenues by more than 5 percent, or resulted in compliance costs that are at least 10 percent higher than compliance costs as a percent of sales for large entities.

If an action is determined to affect a substantial number of small entities, the analysis must include:

(1) A description and estimate of the number of small entities and total number of entities in a particular affected sector, and total number of small entities affected; and

(2) Analysis of economic impacts on small entities, including direct and indirect compliance costs, burden of completing paperwork or record keeping requirements, effect on the competitive position of small

entities, effect on the small entities' cash flow and liquidity, and the ability of small entities to remain in the market.

6.4.1 Economic Impact on Small Entities

The BSAI Pacific cod fisheries are primarily prosecuted by about 40 large trawl catcher/processors, about 20 large freezer/longliners, about 65 medium sized catcher trawl vessels, and less than 200 medium sized pot, longline, and jig vessels. All but the large trawl and longline catcher/processors would likely be considered small entities as defined under the RFA. However, the total number of these vessels currently engaged in the Pacific cod fisheries is less than 400, which is less than 20% of the total groundfish fleet authorized to operate in Council managed fisheries. This number is further reduced, to less than 300, if we only look at those vessels which actually participate in cod target fisheries, as opposed to landing cod as bycatch in other fisheries. Many of the alternatives under consideration have the potential to affect these small entities, some adversely and some beneficially, depending on the allocation chosen.

In terms of significant impact on these entities, the RFA identifies a 5% threshold value - if gross revenues would be reduced by 5% or more the impact would be defined as 'substantial'. In the case of the alternatives under consideration, some of the allocation splits result in a change in the allocations to individual sectors which contain small entities of greater than 5%. However, it must be noted that this change is only for Pacific cod, and therefore must be viewed in the context of how much of overall gross revenues are attributable to cod fisheries vs other groundfish, crab, or salmon fisheries. This will vary significantly across individual operations. It is likely that only the most extreme allocation alternatives under consideration would result in a change of more than 5% in overall gross revenues for any particular operation. Further, to the extent that such a change is possible under the more extreme allocation alternatives, it will likely affect (adversely) less than 20% of the total groundfish fleet. None of the alternatives under consideration will change compliance costs by 5% or more, nor do any of the alternatives result in additional paperwork or reporting requirements.

Though the previous discussion focuses on the lack of negative impacts to the small entities involved, current agency policy also recognizes that potential positive impacts of an action should be considered, and may trigger a finding of significance under the Regulatory Flexibility Act. The Preferred Alternative does establish explicit percentage allocations between gear types, and therefore does hold potential impacts to small entities, relative to the No Action alternative. For example, by establishing the gear allocations, small jig vessels and small pot and longline vessels will have access to cod fishing that otherwise may have been curtailed due to the higher catching power of trawl vessels operating in these fisheries. This results in positive impacts to these vessels' ability to remain competitive and to generate cash flows for their operations. However, offsetting negative impacts may accrue to small trawl vessel operations whose catches of Pacific cod may be constrained relative to the No Action alternative (as discussed above, these are not considered to be significant negative impacts). Additional, but largely unquantifiable, positive impacts of the Council's Preferred Alternative include PSC bycatch reductions, increased amounts of cod available to cod target fisheries, allowances for growth of relatively clean fishing gears (such as pot gear), and overall stability within and across industry sectors.

These positive impacts, though recognized and discussed throughout the document, are more relevant to other applicable laws such as NEPA, Magnuson Act, and E.O. 12866; as such, they are noted herein but are not considered directly relevant to the Regulatory Flexibility Act. In any case, it would be difficult to characterize these positive impacts as significant, in terms of RFA criteria, nor would they be felt by a substantial number of small entities. Similarly, and as previously discussed, no significant negative impacts would accrue to a substantial number of small entities. In summary, this information supports a Finding of No Significant Impact (FONSI) for the proposed action, and an Initial Regulatory Flexibility Analysis is not necessary.

7.0 Preferred Alternative

The Council chose as its preferred alternative an allocation agreed upon by the affected industry groups. Under the agreement 51% of the Pacific cod TAC in the BSAI will be allocated to fixed gears, 47% to trawl gears and 2% to jig gear. The specific provisions of the preferred alternative are shown in the box below.

Pacific Cod Allocations in the Bering Sea and Aleutian Islands

1) TAC Apportionments:
The trawl sector will be allocated 47% of the Bering Sea and Aleutian Islands Pacific cod TAC. The trawl apportionment will be split between catcher vessels and catcher processors 50/50.

The Fixed gear sector will be allocated 51% of the Bering Sea and Aleutian Islands Pacific cod TAC.

The jig gear sector will be allocated 2% of the Bering Sea and Aleutian Islands Pacific cod TAC.

2) Rollovers:
On September 15 of each year, the Regional director shall reallocate 100% of any projected unused amount of the Pacific cod allocated to jig vessels to the fixed gear vessels.

If during a fishing year the Regional Director determines that vessels using trawl gear or hook-and line or pot gear will not be able to harvest the entire amount of Pacific cod allocated to those vessels, then NMFS shall reallocate the projected unused amount of Pacific cod to vessels using the other gear type(s).

3) Halibut PSC Mortality Caps:
The trawl halibut PSC mortality cap for Pacific cod will be no greater than 1,600 mt.

The hook and line gear halibut PSC mortality cap for Pacific cod will be no greater than 900 mt.

4) Review:
The Council will review this agreement at 4 years following the date of implementation.

Imbedded in the Council decision is the implied authority for NMFS to continue to make seasonal allowances of the Pacific cod gear allocations. This authority was established with Amendment 24, and makes it possible for Pacific cod harvests by each gear to be optimized with respect to PSC bycatch, product quality, and markets.

7.1 Decision Background

At the April meeting the Council, at the request of industry, formed a committee consisting of seven industry representatives (longline, pot, trawl, and processor sectors), and tasked them with negotiating an agreement which was acceptable to all parties involved. Dave Hanson, of the Pacific States Marine Fisheries Commission and a non-voting member of the Council, served as the facilitator. The committee members are shown below:

Mothership Trawler	Bob Desautel
Shoreside Trawler	Fred Yeck
Pot Gear	Gordon Blue
Ice Longliner	John Bruce
Freezer Longliner	Thorn Smith
Factory Trawler	Sam Hjelle
Shoreside Processor	John Iani

The Committee met on May 23-24, and agreed upon the allocation of the BSAI Pacific Cod TAC eventually approved by the Council. The trawl sector, in a separate negotiation, agreed to split their apportionment 50/50, between catcher processors and catcher vessels. Other provisions of the agreement would set the maximum amounts of halibut which could be apportioned to the Pacific cod fisheries for trawl sector (1,600 mt) and to the longline gear (900 mt), and stipulate that any unused portion of the jig fishery would be reallocated to the fixed gear sector only. The agreement also asks that the Council review the Pacific cod fisheries after four years following the date of implementation, but the allocation would not sunset if no action were taken by the Council.

7.2 Assessment of the Preferred Alternative

The rest of this chapter will provide a brief assessment of the negotiated agreement on Pacific Cod Allocation in the BSAI. The assessment is based on the analysis of the original alternatives in the draft EA/RIR, and uses the same assumptions and parameters, unless specifically changed by the agreement.

Parameter Changes From the EA/RIR.

Several parameters and assumptions used in the draft EA/RIR are changed in the assessment of the preferred alternative. Primary among these changes are the apportionments to each gear group as well as the trawl CP/CV split. The agreed upon allocation percentages were not explicitly discussed in the analysis, but clearly fall within the scope of the alternatives considered. Alternative 6D in the EA/RIR, which would allocate 49% to both fixed and trawl gears and would split the trawl apportionment 45/55 to CV and CP respectively, is the alternative which best approximates the estimated outcomes of the Pacific cod agreement. Under that Alternative 47.9% is projected to be harvested by trawlers with the remaining 1.1% of their apportionment reallocated to fixed gear because of attainment of the 1,685 mt. trawl halibut PSC mortality cap.

Under the preferred alternative, the maximum amount of halibut mortality which can be allocated to the Trawl Pacific cod fisheries is reduced to 1,600 mt. from the 1996 level of 1,685 mt. The amount of halibut allocated to the trawl Pacific cod fishery is set in the "Specification Setting Process" by the Council in its December meeting. While the FMP sets the total amount of trawl halibut mortality by trawlers at 3,775 mt., the Council may set amounts for specific fisheries. In most instances the Council has followed the recommendations put forward by the trawl sector. Under the provisions of this agreement the trawl sector agrees to recommend that no more than 1,600 mt of halibut mortality be apportioned to the Pacific cod trawl fishery. Therefore, the assessment of the impacts of the preferred alternative will use 1,600 mt as the trawl halibut PSC cap[1].

The preferred alternative also specified a maximum amount of halibut PSC mortality which could be allocated to the longline Pacific cod fishery at 900 mt. Currently the BSAI FMP sets the total amount of halibut PSC mortality for all hook and line fisheries at 900 mt. The Council usually follows the longline sector recommendation to split that amount among the Pacific cod and Greenland turbot fisheries. In 1996, 800 mt. are allocated to the Pacific cod fisheries and 100 mt. are allocated to turbot. If the longline sector were to use all 900 mt. of halibut in the Pacific cod fishery, then, unless there is change in the FMP, no halibut would be available for the turbot fishery, and that fishery would not be prosecuted. This assessment assumes that the longliners will continue to wish to prosecute the turbot fishery, and that only 800 mt. of halibut will be apportioned to the longline Pacific cod fishery. The affects of modifying this assumption will also be discussed.

The preferred alternative would change the regulations regarding the reallocation of unharvested jig catches. Currently, NMFS may reapportion unharvested jig catches to both the fixed and trawl gears proportionately to the Pacific cod allocation. Any reapportionment of the jig allocation would now be directed only to the fixed gear

[1]The preferred alternative does not include any split of the trawl halibut PSC mortality cap between catcher vessels and catcher processors. This was an option under the original alternatives.

sector. In this assessment we assume that the entire jig allocation is taken by the jig fleet, as was done in the EA/RIR. We will however discuss the impacts of a potential reallocation.

All other parameters affecting the projection of catches under the preferred alternative are unchanged from the base model run in the EA/RIR. These assumptions are discussed in detail in Chapters 4 and 5. Specifically, we assume that the TACs from 1996 will apply to each year in the future. We also assume that catch, bycatch, halibut mortality, and discard rates experienced by the various fleets in 1995 will apply. We also use the same product prices as in the EA/RIR.

Projected Outcomes under the Preferred Alternative

The projected outcomes under the preferred alternative are shown in Table 7.1 on the following page. Each row of Table 7.1, shows a different measure of projected outcomes of the Pacific cod fisheries, with the exception of Row 0 which shows the total catch with percentages for the 1995 fishing year. The next three rows (Rows 1-3) show total, target, and non-target catches of Pacific cod by the four gear groups. Rows 4-6 show discards. These are followed by Row 7-10 showing PSC mortality and catches of halibut, *C. bairdi*, *C. Opilio*, and Red King Crab. Rows 11-15show total projected gross revenue and the reduced gross revenue in other target fisheries resulting from bycatch in the Pacific cod fisheries. The first set of four columns show projected amounts for each gear while the second set shows the percentages of the total for that measure.

Looking at the Row 1 in the table we see that model projects that the longline fleet will catch 94,112 mt under the agreement. This is the same outcome projected in the EA/RIR under each alternative for this gear groups. This result occurs because the longline fleet is projected to be constrained by their 800 mt halibut bycatch cap (see row 7). The pot fleet is projected to catch 46,717 mt, which means the fixed gear fleet is projected to catch 52.2% of the total non-jig Pacific cod. This exceeds the fixed gear apportionment and results because the model projects that the trawl fleet will be constrained by their halibut PSC cap (now 1,600 mt) before they can catch their entire apportionment.

Looking at the trawl catches, we see that the catcher processors catch 50% of the overall trawl apportionment (47% × 50% = 23.5%), but the catcher vessels are not able to catch their entire allocated amount. The 3,128 mt. shortfall is reallocated to fixed gear, and is projected to be harvested by the pot fleet. Thus the Trawl CP are constrained by the allocation while the Trawl CV are constrained by the joint halibut PSC cap. This difference is a result of the higher halibut bycatch mortality rates of the trawl catcher vessels (25.271 kg/mt compared to 19.119 kg/mt for trawl CPs), the assumption that non-target catches are basically unaffected by the allocation (see row 3), and that the ratio of targets catches between catcher processors and catcher vessels will be 0.9663 to 1.0, up to the point where one is constrained by the allocation.

Comparing the projected total catch percentages in Row 1 with actual 1995 catch percentage from Row 0, we see that the longline catch <u>as a percent of the TAC</u> is projected to fall. This is because the TAC increased while the longline catch (constrained by the halibut PSC) was nearly unchanged. The amount of Pacific cod available to the pot fleet as a percentage of TAC is more than double the 1995 percentage of the TAC. The projected catch by the trawl catcher vessels as a percent of TAC is expected to increase from 20.1% to 22.3%, while the projected catch by catcher processors is expected to drop from 25.5% to 23.5%.

Row 2 shows the target catches of Pacific cod. As in the EA/RIR target catch for both fixed gear groups equal their total catches of Pacific cod. Target catches by trawler are considerably less than their totals, because of the catches of Pacific cod in other target fisheries as shown in row 3. The allocation of Pacific cod is unlikely to affect, in any large degree, the catches of Pacific cod in other target fisheries. This is due to the way the current regulations define and manage target and directed fishing. Looking at the first three rows we see that the trawl

Table 7.1: Projected Outcomes Under the Preferred Alternative

Assumes Inseason Reallocation of Non-Jig Pacific Cod.

	Metric Tons					Percent of Total				
(Row #) FISHERY MEASURE	Longline	Pot	Trawl CV	Trawl CP	Total	Longline	Pot	Trawl CV	Trawl CP	Total
(0) 1995 Total P. Cod Catch In All Fisheries (Metric Tons)	94,163	18,782	50,208	68,537	231,690	37.7%	7.5%	20.1%	27.4%	92.7%
(1) Total P. Cod Catch In All Fisheries (Metric Tons)	94,112	46,717	60,322	63,450	264,600	34.9%	17.3%	22.3%	23.5%	98.0%
(2) Total P. Cod Catch in P. Cod Target Fisheries (Metric Tons)	94,112	46,717	42,348	27,713	210,889	44.6%	22.2%	20.1%	13.1%	100.0%
(3) Total P. Cod Catch in Non-P. Cod Target Fisheries (Metric Tons)	-	-	17,974	35,737	53,711	0.0%	0.0%	33.5%	66.5%	100.0%
(4) Total P. Cod Discards in All Fisheries (Metric Tons)	3,552	613	9,575	26,132	39,871	8.9%	1.5%	24.0%	65.5%	100.0%
(5) Total P. Cod Discards in P. Cod Target Fisheries (Metric Tons)	3,552	613	3,706	3,710	11,580	30.7%	5.3%	32.0%	32.0%	100.0%
(6) Total P. Cod Discards in Non-P. Cod Fisheries (Metric Tons)	-	-	5,869	22,422	28,290	-	-	20.7%	79.3%	100.0%
(7) Halibut Mortality in P. Cod Target Fisheries (Metric Tons)	800	25	1,070	530	2,425	33.0%	1.0%	44.1%	21.8%	100.0%
(8) Bycatch of C. Bairdi in P. Cod Target Fisheries (Animals)	24,622	157,345	106,754	157,181	445,902	5.5%	35.3%	23.9%	35.3%	100.0%
(9) Bycatch of C. Opilio in P. Cod Target Fisheries (Animals)	75,584	382,979	21,345	27,981	507,889	14.9%	75.4%	4.2%	5.5%	100.0%
(10) Bycatch of Red King Crab in P. Cod Target Fisheries (Animals)	203	7,439	553	2,477	10,672	1.9%	69.7%	5.2%	23.2%	100.0%
(11) Gross Revenue In P. Cod Target Fisheries (Millions)	$ 80.11	$ 38.93	$ 37.24	$ 27.02	$ 183.29	43.7%	21.2%	20.3%	14.7%	100.0%
(12) Reduced Gr. Rev. in the Directed Halibut Fishery (Millions)	$ 2.32	$ 0.07	$ 4.50	$ 2.23	$ 9.12	25.4%	0.8%	49.3%	24.4%	100.0%
(13) Reduced Gr. Rev. in the Directed Crab Fisheries (Millions)	$ 0.23	$ 1.53	$ 0.76	$ 1.15	$ 3.67	6.2%	41.7%	20.6%	31.4%	100.0%
(14) Reduced Gr. Rev. in the Pollock Fisheries (Millions)	$ 1.35	$ 0.02	$ 6.73	$ 4.28	$ 12.39	10.9%	0.1%	54.3%	34.6%	100.0%
(15) Reduced Gr. Rev. in All Directed Fisheries (Millions)	$ 3.90	$ 1.62	$ 11.99	$ 7.66	$ 25.17	15.5%	6.4%	47.6%	30.4%	100.0%

Notes: 1) Assumptions regarding catch, bycatch, and discard rates as well as revenue per ton are the same as used in the EA/RIR/IRFA, and are found in the footnotes of Table 5.2-5.17 on pages 121-136.

2) Row 0 percentages show catch as a percent of the 1995 TAC which was 250,000 mt.

3) Row 1 percentages show projected catch as a percent of the 1996 TAC, which is 270,000 mt.

CP group takes a greater amount of their total Pacific cod as bycatch in the other target fisheries, than they catch in the target fishery. The opposite is true of the trawl CV group.

Rows 4-6 show discards of Pacific cod in total, in Pacific cod target fisheries, and in target fisheries for other species. The greatest amounts of discards of Pacific cod are projected to occur in target fisheries for other species. The discards in non-Pacific cod target fisheries are largely unaffected by the alternatives. (See Table 5.8 in the EA/RIR on page 127 for a comparison.) The lower discard rate of the longliners results in fewer discards than either of the trawl groups even though target catch by the longliners exceeds the combined trawl target catch.

Row 7 shows the projected halibut PSC mortality under the preferred alternative. Overall, 2,425 mt of halibut mortality are projected. This represents a savings of 82 mt over Alternative 6D in the EA/RIR the alternative which most closely resembles the preferred. The savings are due to the 85 mt reduction in the halibut PSC cap for the trawl group. Increased pot catches results in an additional 3mt of halibut mortality. The trawl CVs take 44.1% of the halibut in the Pacific cod fisheries, more than twice the percentage taken by the catcher processors. This is a result not only of their higher bycatch rate but also relative size of the target fishery.

Row 8-10 show the projected bycatch of crab. As noted in the EA/RIR the pot vessels have generally higher bycatch rates of crab any other gear. This is particularly true of C. opilio and red king crab. Reliable information is unavailable regarding the mortality of crab taken as bycatch, and therefore the information in the table may not be a complete indicator of impacts of the preferred alternative on crab stocks.

Row 11 shows the projected gross revenue under the preferred alternative. Gross Revenue per ton of target fishery estimates were calculated in Chapter 3, of the document. As indicated there, gross revenue is only part of the net benefit equation. By itself, gross revenue is potentially misleading as an indicator of impacts. None-the-less, we have included this information as well as estimates of reduced gross revenue (opportunity costs), in order to allow comparisons to other alternatives in the EA/RIR. As noted in earlier chapters, there is little variation in gross revenue projections across the alternatives.

In general it appears that the preferred alternative will allow for expansion of the pot fleet, with only minor impacts on the other sectors of the industry. Overall halibut mortality is reduced, as are Pacific cod discards.

Projected Outcomes Under the Preferred Alternative With Changes in Selected Parameters

The following section show projected outcomes using the preferred alternative as a basis, but with changes in selected parameters. In this section we will briefly discuss changes to the longline halibut cap, and the reallocation of the un-caught jig apportionment. We will also examine the affects of potential changes to the Pacific cod fisheries outside of the allocation. These include implementation of CDQs, changes in the Pacific cod TAC, changes in the trawl harvest vessel bycatch rate, and changes in the bycatch of Pacific cod in other groundfish target fisheries as a result of the Improved Retention / Improved Utilization issue.

Reallocation of the Uncaught Jig Apportionment: In 1995 the jig catch of Pacific cod was approximately 600 mt. This represented just over 0.2% of the 1995 TAC. Under the preferred alternative NMFS will reallocate to the fixed gear sector that part of the jig apportionment which is unlikely to be harvested by the jig gear group. If it is assumed that jig gear will account for 0.5% of the TAC in the future, then we can project that 4,050 mt may be reallocated to fixed gear (given the assumption of a 270,000 mt TAC for Pacific cod). Since the longline gear group is constrained by their 800 mt halibut cap, we project that the entire reallocation would be available for harvest by pots. This would bring the potential pot total up to 50,767 mt.

Increase the Longline Halibut PSC Mortality Cap to 900 MT. No more than 900 mt. of halibut PSC may be apportioned to the longline sector for use in the Pacific cod fishery. If 900 mt were allocated to the longline Pacific cod fishery, and the longline bycatch rate was constant at 1995 levels (8.501 kg/mt.) then the target catch of the longline gear would be projected to increase to 105,876 mt. This would result in a decrease of Pacific cod available for harvest by pot vessels to 34,952 mt., still well above the current catch totals. Additionally, increasing the Pacific cod longline cap to 900 mt of halibut mortality would eliminate the directed fishery for Greenland Turbot with longlines, unless an FMP amendment increasing the overall longline halibut cap were also implemented. Catches by the trawl groups would not be directly impacted.

Implementation of CDQs. The Council's License Limitation Program, if approved by the Secretary of Commerce, includes a CDQ program which would allocate 7.5% of all groundfish and crab TACs, and PSC caps, to communities in Western Alaska. CDQ allocations would not be subject to the gear split under the Pacific cod allocation. It is anticipated that the CDQ program could be implemented by 1998. Allocating 7.5% of the 1996 Pacific cod TAC to the CDQ program would leave 249,750 available for the fixed, trawl, and jig apportionments. The longline halibut cap would be reduced to 740 mt., and the trawl cap reduced to 1,480 mt. Trawl CV catches are projected to equal 57,568 mt, with 39,818 mt. taken in target the target fishery. Trawl catcher processors are projected to catch 24,780 mt. in the Pacific cod target fishery, and 58,961 mt. overall. Longline catches are projected to total 87,054 mt before being constrained by their halibut PSC cap. The pot fleet would have 41,442 mt available to it, prior to any reallocation of the unharvested jig apportionment.

Eliminate the Halibut PSC Cap In Order to Calculate Unconstrained Usage of Halibut. In order to estimate just how much halibut would be needed to prosecute the Pacific cod target fisheries under the preferred alternative, we ran the model without halibut as a constraint on catch. We also make the assumption that pot catch will be 35,000 mt. (A similar run of the model for the original alternatives was discussed on pages 149-153 of the EA/RIR.) In this scenario longline catches of Pacific cod would total 102,700 mt. with 873 mt. of halibut PSC mortality. Trawl catches would be constrained by the apportionment at 63,450 mt for each groups. Halibut PSC mortality by the Trawl CV in the Pacific cod fishery would total 1,150 mt, while the Trawl CP halibut mortality would be 530 mt. From this information we can infer that the trawl CV group would need an additional 80 mt of halibut in order to catch their 50% of the Trawl apportionment, given 1995 bycatch and mortality rates.

A Reduction In The Trawl CV Halibut Bycatch Rate. In the previous section we noted that an additional 80 mt. of halibut mortality would be needed for the trawl CV group to harvest their full apportionment. Trawl CV harvests could also be increased through a reduction in their halibut bycatch. If the Trawl CV group were to reduce their halibut bycatch mortality to 23.53 kg./mt. (a 7% reduction), then they would be able to catch their full apportionment of 63,450 mt. Under this scenario the overall trawl halibut mortality would remain at 1,600 metric tons.

Pacific Cod Bycatch Reduction Under Improved Retention/Improved Utilization (IRIU). Under IRIU it has been assumed that the bycatch of Pacific cod in other trawl target fisheries would be reduced, as vessels would have greater incentives to avoid unwanted species. Such a bycatch reduction will obviously decrease the amount of non-target catches of cod, increasing the amount available to be used in target fisheries. Because the trawl catcher processors have the greatest amount of non-target Pacific cod catch, they would stand to gain relatively more target catch than would the trawl catcher vessels. In other words, bycatch reductions under IRIU would tend to increase overall target catches of Pacific cod, but this increase would all go to the catcher processor fleet at some expense to the trawl catcher vessel fleet. Table 7.2 below show total, target and non-target catches of the two trawl groups under five bycatch reduction scenarios: the base preferred alternative, a 7% reduction, a 14% reduction, a 21% reduction, and a 28% reduction. These reduction numbers were chosen because a 21% reduction in Pacific cod bycatch in other groundfish trawl target fisheries results in the maximum trawl target catch attainable, given the halibut bycatch rates, the 1996 TAC, and the other assumptions of the model.

Table 7.2

Bycatch Reduction Amount	Pacific Cod Catch Under the Preferred Alternative						
	Trawl Catcher Vessels			Trawl Processor Vessels			
	Target	Non-Target	Total	Target	Non-Target	Total	Target Ratio
Base	42,348	17,974	60,322	27,713	35,737	63,450	0.6544
7%	40,422	16,700	57,122	30,258	33,192	63,450	0.7485
14%	38,498	15,425	53,923	32,802	30.648	63,450	0.8520
21%	36,575	14,150	50.724	35,343	28,105	63,448	0.9663
28%	36,575	12,871	49,446	35,343	25.565	60,908	0.9663

The results of an "IRIU Pacific cod bycatcb reduction" may be somewhat counter-intuitive. With a 7% bycatch reduction, CV target catches drop by 1,926 mt, while CP target catches are projected to increase by 2,545 mt. Overall trawl target catches therefore increases by 619 mt. Total Pacific cod catch by the trawl CP group is projected to be constant at 63,450, i.e., 50% of the trawl apportionment. Total catch by the catcher vessels is reduced to 57,122 mt. Thus 3,200 mt. additional Pacific cod will be available to pot vessels. These "counter-intuitive" projection results from the higher relative bycatcb rates of the trawl CV sector and the assumption that until constrained by the groups apportionment of Pacific cod, target catches occur at a CP/CV ratio of 0.9663 to 1. Projections with the assumption that bycatch of Pacific cod decreases by 14% show an increase in the overall trawl target catch of 1,239 mt. Pacific cod available to pots increases by 6,399 from the base scenario. With a 21% bycatch reduction, the target catch ratio of trawl CP to trawl CV reaches 0.9663, and the trawl target catches are projected to hit the halibut PSC cap at the same time as the Trawl CP apportionment is reached. Bycatch reductions beyond 21%, are not projected to further change trawl target catches, and affect only the bycatch of Pacific cod in other trawl target fisheries. Target catches by the trawl fleet under this percentage, with the IRIU assumptions, are not negatively impacted relative to their taret catch under the current (54/44) percentage split.

Changes In the Pacific Cod TAC. The EA/RIR indicates that future Pacific cod ABCs and therefore TACs are projected to decrease through 1999. In light of the possibility that TACs may change we examined the effects of both lower TAC and of higher TACs.

Higher Pacific cod TAC result in greater amount available to the pot fleet but because the longline fleet is constrained by their halibut bycatch, their Pacific cod catch is unlikely to be affected. For the trawl sector, higher TACs result in the same type of impact as a reduction in Pacific cod bycatch discussed above. Because of the assumption that trawl target catches will occur a ratio of 0.9663 mt. of CP target catch for every 1.0000 mt. of trawl CV catch until one group is constrained by the apportionment, increases in the TAC are projected to benefit the catcher processors at some expense to the catcher vessels. This will hold up to the point where target catches equal this ratio. This occurs with a Pacific cod TAC of 302,417 mt. At that level target catches of Pacific cod by the trawl CV group are projected to be 36,575 mt., with trawl CP target projected to be 35,343. These target amounts are the same as projected with a 21% bycatch reduction above. With this TAC, Trawl CVs are projected to catch 18% of the total Pacific cod TAC with the Trawl CPs projected to catch 23.5% of the TAC. Under this scenario the pot fleet would have 76,628 mt available.

According to the EA/RIR, lower TACs in the future are much more likely than higher TACs. As TACs decrease the projected trawl split becomes closer to 50/50. This is because all reductions are assumed to be felt in the target fisheries, rather than in the bycatch of Pacific cod in other groundfish fisheries. At a TAC of 262,420 mt. we project that the trawl CV total catch will be equal to the total catch of the trawl CP group at 61,669 mt. At that level CP target catches drop by 1,786 mt to 25,928 mt., while CV target catches drop by the to 1,789 to 43,698 mt. (The ratio of the decrease is a 0.9663 to 1.0000.) At this TAC, the trawl halibut PSC cap is attained as well as the trawl apportionment. Further TAC reductions will continue to yield a 50/50 trawl split and attainment of the 47% trawl apportionment, and they are also projected to reduce the amount of halibut mortality in the trawl fisheries. i.e., the 1,600 mt. trawl halibut mortality cap will not be attained.

Summary and Conclusions

The negotiated preferred alternative (47/51) would, on paper, reapportion 7% of Pacific cod TAC from the trawl sector to the fixed gear sector. The agreed upon allocation more closely matches what currently occurs in the Pacific cod fisheries (about 49/49) than does the existing apportionment (54/44). Because the allocation takes place at the beginning of the year rather than through in-season reallocation, it is more likely that the full Pacific cod TAC will be taken. In other words, the trawl sector is more likely to take their entire allocation of Pacific cod, possibly eliminating the need to reallocate cod to the fixed gear sector later in the year. A greater assurance that Pacific cod will be available to the pot fleet will likely mean more pot vessels will enter the fishery, thus providing a "safety net" for displaced crab vessels. Any inseason reallocations that would occur (other than from the jig allocation) are projected to come from the trawl catcher vessel apportionment. This is a result of their higher halibut bycatch rates, and greater reliance on Pacific cod as a target. If the TAC is reduced because of smaller ABCs, it is more likely that the trawl catcher vessels will take their entire apportionment.

In arriving at the negotiated agreement, several issues were considered, including halibut PSC impacts, cod discards, growth potential for the pot gear sector, and relative stability across and within the affected industry sectors. The preferred alternative, due to a slight reduction in the trawl allocation coupled with a limit of 1600 mt of halibut PSC, reduces the the total amount of halibut mortality from the cod fisheries, relative to the status quo. Under the assumption of an IR/IU program, discards of cod would obviously be reduced to zero (or nearly so), whether taken in target or non-target fisheries, and whether taken by fixed or trawl gear. The assumption of an IR/IU program, and its attendant incentives, also means that more of the cod would be taken in cod target fisheries, as opposed to being taken as bycatch in other groundfish trawl fisheries. This leads to a secondary, yet significant impact of the Preferred Alternative - the amount of cod taken by the trawl sector in cod target fisheries is not adversely impacted by the reduction in their overall allocation, relative to the amount currently being taken.

This is important in that the negotiated percentages, under this scenario, allow for an increase in the fixed gear allocation, and a growth buffer for the pot gear fleet, without negatively affecting the amount of cod taken in trawl cod target fisheries. Achievement of this compromise maintains a stability within the industry overall, in terms of relative harvest share and absolute tonnage of cod taken by each sector, while allowing for expansion of the pot gear harvest.

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APPENDIX I

INFORMATION OF ALASKA RAW FISH TAXES

A GUIDE TO ALASKA FISHERIES BUSINESS TAX

ALASKA DEPARTMENT OF REVENUE
INCOME & EXCISE AUDIT DIVISION
FISH & EXCISE TAX GROUP
PO BOX 110420
JUNEAU AK 99811-0420
(907) 465-4683

(October 1993)

I. WHAT IS A FISHERIES BUSINESS?

A person, partnership, corporation or joint venture who processes or custom processes a fisheries product or fisheries resource in any way in the State of Alaska for subsequent sale is a fisheries business. A person, partnership, corporation or joint venture who transports an unprocessed fisheries resource *out of the state's taxing jurisdiction* for subsequent sale or processing is also a fisheries business. Persons or businesses who may come under this category include, but are not limited to:

1. Canneries
2. Cold storages
3. Commercial fishermen who process their catch
4. Custom processors
5. Fish buyers, processors or fishermen who transport unprocessed products out of the taxing jurisdiction of the state
6. Freezerships
7. Processing plants
8. Supermarkets and meat markets that buy unprocessed resources directly from fishermen and process them for sale to the public.

II. WHAT IS PROCESSING?

Processing is any activity which modifies the physical condition of a fisheries resource. This activity includes but is not limited to butchering, freezing, salting, cooking, canning, beheading (except for shrimp), dehydrating or smoking. *Not considered processing* is an activity performed by the fishermen licensed under 43.75.017 to preserve the fish, such as gutting, gilling, sliming or icing.

III. WHAT REQUIREMENTS MUST BE MET BEFORE ENGAGING IN A FISHERIES BUSINESS?

There are numerous permits and licenses that may be required. Listed here are only the requirements of the Department of Revenue.

1. If you are buying a fisheries resource from a fisherman or hiring <u>any</u> processing employees, you will need to submit a $10,000 Primary Fish Buyer/Processor for each location you will be buying fish or having processing employees. Refer to the attached information packet on Surety Bonding.

III continued

2. Before engaging or attempting to engage in a fisheries business, a person or company shall first apply for and obtain an Alaska Fisheries Business License for each location of operation. Failure to obtain this license prior to processing may result in an assessment of a civil penalty of $5,000. The application must be accompanied by a $25.00 license fee plus security for the estimated fisheries business taxes.

   To determine the estimated tax you must first indicate the total value of the fisheries resources you expect to process, have custom processed or transport unprocessed out of the state.

3. Once a total value is determined, this must be multiplied by the applicable tax rate which will give you the amount of your estimated fish taxes. This must then be secured by one of the following methods:

   a. Prepay the total estimated tax.
   b. Secure a fisheries business tax bond for twice the estimate.
   c. Obtain a Time Certificate of Deposit (TCD) in the amount of the estimate.
   d. Obtain a Letter of Credit (LOC) for the estimated amount.
   e. Provide proof of real property located in Alaska, owned by the applicant, the lienable value of which is at least three times the estimate. A title search, current within 30 days of the application, and a current property tax assessment notice or appraisal must accompany the application.
   f. If the applicant purchases salmon for export in the round, the amount of security must be $50,000 using one of the methods above.

   NOTE: Non-residents must file a non-resident affidavit form on or before June 2 of each license year. Any application taxes (other than fisheries taxes) which may be due must also be secured at this time.

IV. WHAT ARE THE TAX RATES?

There are different tax rates which are dependent upon the type of processing facility and the type of resources processed. These rates are as follows:

Established Commercial Fisheries	
Floating	5.0%
Salmon cannery/shore based	4.5%
Shore based	3.0%
Developing Commercial Fisheries	
Floating	3.0%
Shore based	1.0%

V. WHAT IS A DEVELOPING COMMERCIAL FISHERY?

The 1979 legislative session allowed for a reduced tax rate to be paid on developing fisheries resources. This reduced tax rate was established to encourage fisheries businesses to purchase or catch and process fisheries resources that were under-utilized in the waters of the State of Alaska.

The Department of Fish and Game establishes the developing commercial fisheries list annually. This list is used by the Department of Revenue to determine tax liability. If a fisheries business claims a fisheries resource on the Alaska Fisheries Business Return as a developing fishery, the tax rate is two percent less in each case.

VI. WHAT IS "VALUE" OR "MARKET VALUE"?

Effective January 1, 1994, AS 43.75.290(11) was repealed and reenacted to read:

> (11) value means (A) the market value of the fisheries resource if the taking of the fisheries resource is done in company owned or company subsidized boats operated by employees of the company or in boats that are operated under lease to or from the company or other arrangement with the company and if the fisheries resource is delivered to the company: in this subparagraph, "company" means a fisheries business, a subsidiary of a fisheries business, or a subsidiary of a parent company of a fisheries business; or (B) for fisheries resources other than those described in (A) of this paragraph, the actual price paid for the fisheries resource by the fisheries business to the fishermen, including indirect consideration and bonus amounts paid for

(11) (B) continued

fuel, supplies, gear, ice, handling, tender fees, or delivery, whether paid at the time of purchase of the fisheries resource or tendered as a deferred or delayed payment;in this subparagraph, "delivery" means (i) transportation of the fisheries resource from the boat or vessel on which the product was taken to a tender; or (ii) if a delivery was not to a tender, transportation of the fisheries resource from the boat or vessel on which the product was taken to a shore based facility in which delivery of the fisheries resource is normally accepted.

VII. WHO IS LIABLE TO REPORT AND PAY ALASKA FISHERIES BUSINESS TAX?

Any person, partnership, corporation or joint venture who obtained an Alaska Fisheries Business License must file the Alaska Fisheries Business Return indicating their activities for the previous calendar year. If you did not obtain a fisheries license but operated as a fisheries business, you still must file the return.

VIII. WHAT INFORMATION IS REQUIRED TO BE REPORTED ON THE ALASKA FISHERIES BUSINESS RETURN?

1. Name of the taxpayer
2. Mailing address
3. Location of operation
4. Fisheries business license number
5. Federal employer number (EIN) or social security number (SSN)
6. Daytime telephone number
7. Year for which tax return is reporting
8. Value of fisheries resources processed during the license year, by category of fisheries business, species and pounds
9. Names of developing commercial fisheries resources processed
10. Name of fisheries business which first actually and physically processed the fisheries resources or which sold or processed the fisheries resources outside the taxing jurisdiction of Alaska
11. Tax Computation

IX. WHEN IS THE ALASKA FISHERIES BUSINESS TAX RETURN AND PAYMENT DUE?

The return and payment are due on or before March 31 of the year following the previous calendar year activities.

X. TRANSPORTING AN UNPROCESSED PRODUCT FROM ALASKA

Alaska Statute 43.75.100 states that the fisheries business which transports an unprocessed fisheries resource out of Alaska's taxing jurisdiction must pay the Fisheries Business Tax. The tax is based on the floating fisheries business rates unless the fisheries business transporting the resource out of the state can substantiate that the resource was processed or sold to a shore based facility out of Alaska's taxing jurisdiction.

XI. WHEN IS PROCESSING OF ROE AND OTHER BY PRODUCTS SEPARATELY TAXABLE FROM THE FISH CARCASS?

If roe and other fish by products are processed by the same fisheries business which purchases the resource in the round and also processes the carcass, the processing of the roe and by products are not separately taxed. If the roe and fish by products are separated from the carcass and transferred or sold separately then the roe and by products are taxed separately. It is the separation of the roe or other by products which creates the separate taxation.

XII. IS A CUSTOM PROCESSOR SUBJECT TO THE FISHERIES BUSINESS TAX?

A custom processor is liable for the tax if he custom processes a fisheries resource for someone who has not been licensed as a fisheries business.

XIII. ARE ADDITIONAL PAYMENTS TO FISHERMEN TAXABLE?

Tax on additional payments (bonus payments) made to fishermen for fisheries resources purchased in the previous year are taxable under AS 43.75.
If your company makes additional payments to fishermen after you have filed your fisheries business return, then you must complete and submit form 04-585, fisheries business tax report of bonus or additional payments. The report and payment of the tax are due no later than the last day of the month following the month the payments were made. If you make additional payments to fishermen before filing your Fisheries Business Return, then you should include those payments as part of the values reported on your return.

XIV. <u>EXTENSION OF TIME TO FILE?</u>

An application for Extension of Time to File must be completed and submitted to the Department by March 16. Since an extension of time to file does not grant an extension of time to pay, the applicant must pay the estimated tax amount with the extension form. A period of 30 to 180 days may be granted for filing.

XV. <u>ARE THERE ANY TAX CREDITS AVAILABLE?</u>

There are two tax credits which can be applied to your tax liability:

1. A.W. "Winn" Brindle Memorial Scholarship: A fisheries business is entitled to a credit of not more than 5 percent of the business tax liability for contributions made during the tax year to the scholarship account. A tax credit may not be for more than 100 percent of the contribution.

2. Education Credit: A taxpayer is allowed a credit for cash contributions accepted for direct instruction, research, and educational support purposes, including library and museum acquisitions.
   Contributions accepted for endowment purposes are also eligible for the credit. The contribution must be given to an accredited, nonprofit, two or four year college or university foundation in Alaska, either public or private. The credit is limited to 50 percent of contributions of not more than $100,000; and 100 percent of the next $100,000 of contributions, not to exceed $150,000.

FY 95 in Retrospect

FY 95 shared taxes and license fees ($24,869,500) increased 22% over the total shared in FY 94 ($20,342,800), primarily due to increased collection of fisheries business taxes and first-year collection of fishery resource landing taxes. Department of Revenue disbursed FY 95 shared taxes and fees to 119 eligible municipalities. Over the past five fiscal years, FY 91 through FY 95, the Department has shared approximately $108 million to local governments.

Significant changes in shared taxes and fees over FY 94 are summarized below.

- ***Fisheries Business Tax*** - Shared fisheries business taxes increased $2,256,000 over FY 94 because of increased fisheries business tax collections which reflect higher harvests and prices paid for salmon during calendar year 1994 (fisheries business taxes for that year were due March 31, 1995). Shared fisheries business taxes for Saint Paul have risen significantly over the past five fiscal years to an all-time high of $2.5 million for FY 95. The increases are a result of Saint Paul's harbor development, completed in 1990, which has lead to three processors locating facilities in that community.

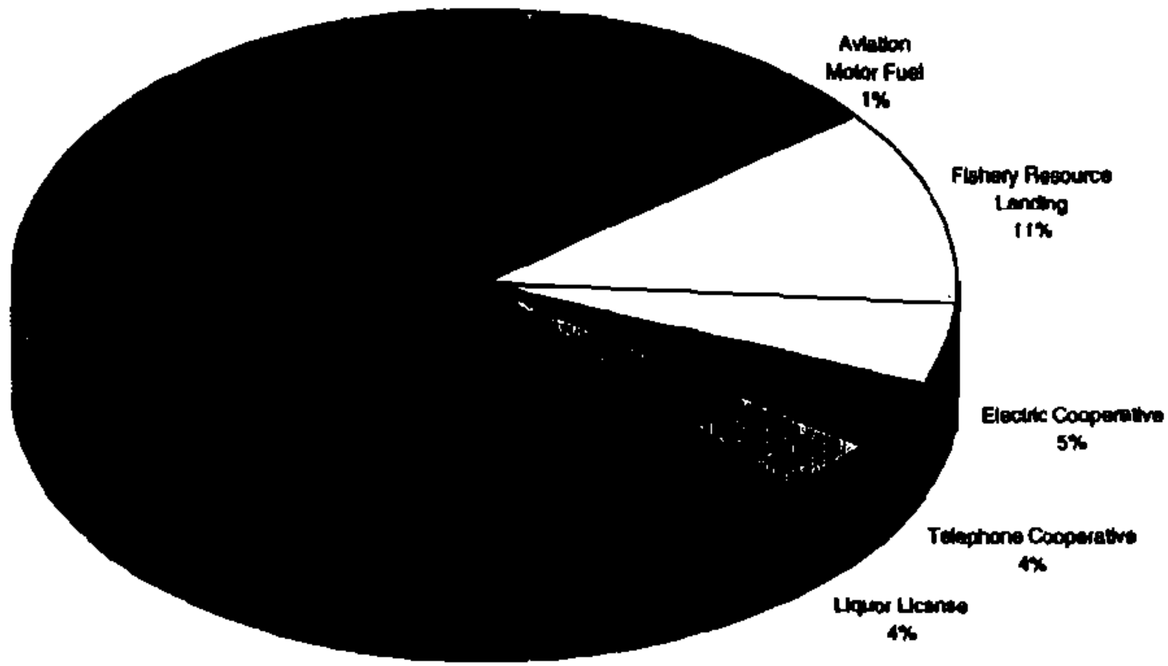
- ***Fishery Resource Landing Tax*** - The fishery resource landing tax took effect January 1, 1994. Calendar year 1994 tax returns were due June 30, 1995. First-year collection of landing taxes resulted in about $2.9 million subject to sharing. Due to pending litigation regarding the constitutionality of the landing tax, it is undetermined at time of publication whether to share with municipalities or escrow taxes until the outcome of litigation. Unalaska (Dutch Harbor) will be the primary benefactor of the shared landing tax program with approximately $2.5 million, or 87% of total shared landing taxes.

- ***Aviation Motor Fuel Tax*** - Shared aviation motor fuel taxes increased over FY 94 because of increased aviation activity, greater compliance toward reporting aviation fuel sales, and amended returns filed by an aviation fuel dealer to reflect a correction in their reporting method. Sitka relinquished ownership of its airport and returned it to the state effective July 1, 1994. The small amount of aviation fuel tax shared to Sitka represents June 1994 fuel sales which were reported in July 1994.

- ***Liquor License Fees*** - Shared liquor license fees stabilized to pre-FY 94 levels. The amount of shared liquor fees had increased for FY 94 because of statutes enacted in 1993 (Ch 63 SLA 93) which authorized biennial renewal of liquor licenses beginning in 1994. In transition to biennial licensing, half of liquor licensees filed a 1994 renewal application for a one-year period while the other half filed for a two-year period. As a result, the Department experienced a one-time increase in collection and sharing of liquor license fees for FY 94.

Amounts shared for the other tax types, ***coin-operated device, electric cooperative and telephone cooperative***, were relatively unchanged from FY 94.

Table 1 - Summary of FY 95 Shared Taxes and Fees



	FY 95		-- Prior Year Comparison -- FY 94		FY 93	
Tax Type	***Share Amount***	***% of Total***	***Share Amount***	***% of Total***	***Share Amount***	***% of Total***
Fisheries Business	$18,600,221	75%	$16,344,252	80%	$20,895,923	87%
Fishery Resource Landing	2,892,601	11%	N/A	N/A	N/A	N/A
Electric Cooperative	1,265,114	5%	1,251,231	6%	1,206,324	5%
Telephone Cooperative	1,021,559	4%	1,249,350	6%	861,372	4%
Liquor License Fees	900,225	4%	1,340,900	7%	884,475	4%
Aviation Motor Fuel	142,794	1%	109,852	1%	116,796	0%
Coin-Operated Device	47,015	0%	47,161	0%	48,289	0%
Total	$24,869,529	100%	$20,342,746	100%	$24,013,179	100%

Fisheries Business Tax
AS 43.75.130

Description
AS 43.75.130 provides that 50% of fisheries business taxes be shared with municipalities where fishery resources were processed. Taxes are shared as follows.

If processing occurred within an incorporated city not located within an organized borough, 50% of the tax collected is shared with the city.

If processing occurred in an incorporated city located within an organized borough, 25% of the tax collected is shared with the city and 25% with the borough.

If processing occurred at a location within an organized borough but not within an incorporated city, 50% of the tax collected is shared with the borough.

For those cities located in an organized borough incorporated after June 16, 1987, the percentage of taxes shared with the city and borough is prorated as follows:

Tax Year	City Share	Borough Share	Total
1	45%	5%	50%
2	40%	10%	50%
3	35%	15%	50%
4	30%	20%	50%
5+	25%	25%	50%

If processing occurred in the unorganized borough, 50% of the tax is shared with municipalities statewide through an allocation program administered by Department of Community and Regional Affairs (DCRA). The amount of FY 95 fisheries business tax subject to allocation by DCRA was $849,798.

Sharing Cycle
The Department disburses shared amounts to cities and boroughs every August based on taxes collected during the preceding fiscal year.

FY 95 Statistics

Tax Shared	$18,600,221
Number of Municipalities	55

Fishery Resource Landing Tax
AS 43.77.060

Description
AS 43.77.060 provides that 50% of fishery resource landing taxes be shared with the municipality where fishery resources were landed. The mechanics for sharing landing taxes are the same as fisheries business taxes, except that the proration applies to boroughs incorporated after January 1, 1994. Note that taxes are shared only on the 3% portion of the 3.3% landing tax rate.

If landings occurred in the unorganized borough, 50% of the tax is shared with municipalities statewide through an allocation program administered by DCRA. The amount of FY 95 fishery resource landing tax subject to allocation by DCRA was $89,195.

Sharing Cycle
Amounts are sharable annually and are based on taxes collected during the preceding fiscal year.

FY 95 Statistics

Tax Sharable	$2,892,601
Number of Municipalities	10

Table 3 - Shared Taxes by Municipality

Municipality	Fisheries Business Tax	Fishery Resource Landing Tax	Other Shared Taxes (Refer to Table 4)	Total
Anchorage	$ 136,889	$ 0	$1,172,157	$1,309,046
Juneau	83,169	0	121,804	204,973
Sitka	733,701	0	22,991	756,692
Total Municipalities	**953,759**	**0**	**1,316,952**	**2,270,711**
Borough				
Aleutians East	1,179,272	3,641	0	1,182,913
Bristol Bay	2,675,428	0	62,789	2,738,217
Denali	0	0	22,817	22,817
Fairbanks North Star	511	0	135,283	135,795
Haines	318,181	0	0	318,181
Kenai Peninsula	738,850	10,315	135,561	884,526
Ketchikan Gateway	362,944	0	0	362,944
Kodiak Island	1,029,408	18,533	11,691	1,059,632
Lake and Peninsula	951,400	0	599	951,999
Matanuska-Susitna	0	0	440,453	440,453
North Slope	0	0	78,718	78,718
Yakutat	201,292	3,268	4,024	208,591
Total Boroughs	**7,457,086**	**35,756**	**891,935**	**8,384,777**
City				
Akhiok	19	0	0	19
Akutan	236,242	0	0	236,242
Alakanuk	0	0	461	461
Alaknagik	0	0	1,875	1,875

Table 3 - Shared Taxes by Municipality

City	*Fisheries Business Tax*	*Fishery Resource Landing Tax*	*Other Shared Taxes (Refer to Table 4)*	*Total*
Ambler	0	0	2,161	**2,161**
Anderson	0	0	7,355	**7,355**
Aniak	5,088	0	0	**5,088**
Anvik	338	0	173	**510**
Atka	15,132	8,511	0	**23,643**
Barrow	0	0	20,126	**20,126**
Bethel	83,737	0	0	**83,737**
Brevig Mission	0	0	215	**215**
Buckland	0	0	1,584	**1,584**
Chevak	0	0	571	**571**
Chignik	95,968	0	0	**95,968**
Clark's Point	175,250	0	626	**175,876**
Cordova	442,733	0	55,558	**498,291**
Craig	30,335	0	10,524	**40,859**
Deering	0	0	902	**902**
Delta Junction	0	0	3,553	**3,553**
Dillingham	261,898	0	42,698	**304,597**
Eek	0	0	240	**240**
Elim	0	0	305	**305**
Emmonak	35,213	0	1,019	**36,232**
Fairbanks	100	0	150,760	**150,860**
False Pass	21,069	0	0	**21,069**
Fort Yukon	0	0	1,500	**1,500**
Galena	2,048	0	1,500	**3,548**
Gambell	0	0	737	**737**
Goodnews Bay	302	0	241	**543**
Grayling	0	0	232	**232**
Haines	637	0	9,173	**9,810**

Table 3 - Shared Taxes by Municipality

City	Fisheries Business Tax	Fishery Resource Landing Tax	Other Shared Taxes (Refer to Table 4)	Total
Holy Cross	0	0	320	320
Homer	91,790	0	49,560	141,351
Hoonah	99,264	0	2,572	101,836
Hooper Bay	1,288	0	900	2,168
Houston	0	0	6,569	6,569
Huslia	0	0	247	247
Kake	73,376	0	1,500	74,876
Kaltag	0	0	277	277
Kasaan	0	0	507	507
Kenai	177,974	0	77,139	255,113
Ketchikan	323,163	0	75,372	398,535
Kiana	0	0	2,646	2,646
King Cove	475,417	0	4,000	479,417
Kivalina	0	0	2,201	2,201
Kobuk	0	0	721	721
Kodiak	644,353	60,164	60,964	765,481
Kotzebue	0	0	41,063	41,063
Koyuk	0	0	341	341
Larsen Bay	51,986	0	0	51,986
Lower Kalskag	0	0	189	189
Manokotak	0	0	2,093	2,093
Marshall	0	0	363	363
McGrath	0	0	4,000	4,000
Mekoryuk	410	0	333	743
Mountain Village	0	0	975	975
Nenana	578	0	5,997	6,575
New Stuyahok	0	0	403	403
Newhalen	0	0	208	208

Table 3 - Shared Taxes by Municipality

City	Fisheries Business Tax	Fishery Resource Landing Tax	Other Shared Taxes (Refer to Table 4)	Total
Nome	0	0	15,136	15,136
Nondalton	0	0	318	318
Noorvik	0	0	3,006	3,006
North Pole	411	0	37,723	38,135
Nulato	0	0	410	410
Nunapitchuk	0	0	349	349
Old Harbor	0	0	332	332
Palmer	0	0	83,922	83,922
Pelican	165,608	0	4,615	170,423
Petersburg	826,209	0	7,900	834,109
Pilot Station	0	0	465	465
Port Lions	0	0	345	345
Quinhagak	0	0	523	523
Ruby	0	0	1,500	1,500
Russian Mission	0	0	245	245
Saint George	287,118	0	0	287,118
Saint Mary's	0	0	760	760
Saint Michael	0	0	392	392
Saint Paul	2,534,079	229,639	4,000	2,767,918
Sand Point	90,021	1,042	4,000	95,063
Savoonga	0	0	553	553
Scammon Bay	0	0	401	401
Selawik	0	0	3,395	3,395
Seldovia	0	0	5,955	5,955
Seward	125,329	45,036	19,292	189,656
Shishmaref	0	0	555	555
Shungnak	0	0	1,809	1,809
Skagway	0	0	7,800	7,800

Table 3 - Shared Taxes by Municipality

City	Fisheries Business Tax	Fishery Resource Landing Tax	Other Shared Taxes (Refer to Table 4)	Total
Soldotna	53	0	38,547	38,600
Stebbins	0	0	473	473
Tanana	0	0	1,500	1,500
Tenakee Springs	0	0	1,225	1,225
Thorne Bay	970	0	1,500	2,470
Togiak	167,157	0	697	168,054
Toksook	0	0	458	458
Tununak	0	0	331	331
Unalakleet	5,084	0	0	5,084
Unalaska	2,193,707	2,512,253	7,368	4,713,328
Upper Kalskag	0	0	185	185
Valdez	267,993	0	107,832	375,825
Wales	0	0	238	238
Wasilla	0	0	125,320	125,320
Whittier	62,368	0	7,232	69,600
Wrangell	77,381	0	13,440	90,821
Total Cities	**10,188,377**	**2,858,845**	**1,167,820**	**14,214,042**
Grand Total	***$18,800,221***	***[illegible]***	***$3,378,702***	***[illegible]***
Number of Communities Shared With	**55**	**10**	**106**	**119**

Table 2 - Summary of FY 95 Shared Taxes by Municipality

Municipality	FY 95	FY 94	Difference
Anchorage	$1,309,046	$1,412,086	($103,040)
Juneau	204,973	158,765	46,208
Sitka	756,692	539,071	217,621
Total Municipalities	**2,270,711**	**2,109,922**	**160,789**
Borough			
Aleutians East	1,182,913	1,834,575	(651,662)
Bristol Bay	2,738,217	2,213,979	524,238
Denali	22,817	22,685	132
Fairbanks North Star	135,795	127,912	7,883
Haines	318,181	255,514	62,667
Kenai Peninsula	884,526	776,723	107,804
Ketchikan Gateway	362,944	319,686	43,258
Kodiak Island	1,059,632	955,387	104,245
Lake and Peninsula	951,999	379,008	572,991
Matanuska-Susitna	440,453	425,433	15,020
North Slope	78,718	277,876	(199,158)
Yakutat	208,581	154,250	54,331
Total Boroughs	**8,384,777**	**7,743,028**	**641,749**
City			
Akhiok	19	0	19
Akutan	236,242	266,578	(30,336)
Alakanuk	481	465	16
Aleknagik	1,875	1,602	273
Ambler	2,161	2,111	50
Anderson	7,355	7,613	(258)
Aniak	5,088	0	5,088
Anvik	510	439	71
Atka	23,643	628	23,015
Barrow	20,126	19,347	779
Bethel	83,737	39,479	44,258
Brevig Mission	215	92	123
Buckland	1,584	1,658	(74)
Chevak	571	563	8
Chignik	95,968	86,988	8,980
Clark's Point	175,876	304,043	(128,167)
Cordova	498,291	326,908	171,383
Craig	40,859	44,088	(3,229)
Deering	902	899	3
Delta Junction	3,553	3,203	350
Dillingham	304,597	205,199	99,398
Eek	240	233	7
Elim	305	292	13
Emmonak	36,232	15,982	20,250

Table 2 - Summary of FY 95 Shared Taxes by Municipality

City	FY 95	FY 94	Difference
Fairbanks	150,860	195,669	(44,809)
False Pass	21,069	96,854	(75,785)
Fort Yukon	1,500	750	750
Galena	3,548	4,922	(1,374)
Gambell	737	699	38
Goodnews Bay	543	573	(30)
Grayling	232	215	17
Haines	9,810	14,805	(4,995)
Holy Cross	320	297	23
Homer	141,351	146,770	(5,419)
Hoonah	101,836	63,247	38,589
Hooper Bay	2,168	825	1,343
Houston	6,569	6,536	33
Huslia	247	224	23
Kake	74,876	34,361	40,515
Kaltag	277	758	(481)
Kasaan	507	0	507
Kenai	255,113	196,605	58,508
Ketchikan	398,535	275,764	122,771
Kiana	2,648	2,341	307
King Cove	479,417	403,581	75,836
Kivalina	2,201	2,347	(146)
Klawock	0	1,505	(1,505)
Kobuk	721	619	102
Kodiak	765,481	640,357	125,124
Kotzebue	41,063	33,744	7,319
Koyuk	341	329	12
Larsen Bay	51,986	61,377	(9,391)
Lower Kalskag	189	174	15
Manokotak	2,093	1,732	361
Marshall	363	365	(2)
McGrath	4,000	7,500	(3,500)
Mekoryuk	743	734	9
Mountain Village	975	851	124
Nenana	6,575	9,499	(2,924)
New Stuyahok	403	357	46
Newhalen	208	218	(10)
Nome	15,136	25,974	(10,838)
Nondalton	318	299	19
Noorvik	3,006	3,113	(107)
North Pole	38,135	40,298	(2,163)
Nulato	410	386	24
Nunapitchuk	349	335	14
Old Harbor	332	332	0

Table 2 - Summary of FY 95 Shared Taxes by Municipality

City	FY 95	FY 94	Difference
Ouzinkie	0	33	(33)
Palmer	83,922	84,637	(715)
Pelican	170,423	138,590	31,833
Petersburg	834,109	761,371	72,738
Pilot Point	0	19,232	(19,232)
Pilot Station	465	456	9
Port Lions	345	353	(8)
Quinhagak	523	437	86
Ruby	1,500	750	750
Russian Mission	245	234	11
Saint George	287,118	360,494	(73,376)
Saint Mary's	760	739	21
Saint Michael	392	357	35
Saint Paul	2,767,918	1,879,680	888,238
Sand Point	95,063	98,149	(3,086)
Savoonga	553	541	12
Scammon Bay	401	398	3
Selawik	3,395	3,145	250
Seldovia	5,955	11,715	(5,760)
Seward	189,656	168,990	20,666
Shageluk	0	124	(124)
Shaktoolik	0	299	(299)
Shishmaref	555	533	22
Shungnak	1,809	1,653	156
Skagway	7,800	10,829	(3,029)
Soldotna	38,600	47,292	(8,692)
Stebbins	473	465	8
Tanana	1,500	750	750
Tenakee Springs	1,225	3,105	(1,880)
Thorne Bay	2,470	750	1,720
Togiak	188,054	96,874	91,180
Toksook	458	447	11
Tununak	331	317	14
Unalakleet	5,084	3,872	1,212
Unalaska	4,713,328	2,635,372	2,077,956
Upper Kalskag	185	187	(2)
Valdez	375,825	236,931	138,894
Wales	238	220	18
Wasilla	125,320	115,784	9,536
Whittier	89,600	73,398	16,202
Wrangell	90,821	91,642	(821)
Total Cities	**14,214,042**	**10,489,796**	**3,724,247**
Grand Total	***$24,869,529***	***$20,342,746***	***$4,526,783***

Table 8 - Fisheries Business Tax

Municipality	[illegible]	[illegible]	[illegible]	[illegible]	FY 91	Total All Years
Anchorage	$ 136,889	$ 85,441	$ 218,848	$ 86,426	$ 150,564	$ 677,986
Juneau	83,169	38,767	35,863	32,457	19,541	209,797
Sitka	733,701	484,705	410,956	440,238	505,543	2,575,143
Total Municipalities	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,462,925
Borough						
Aleutians East	1,179,272	1,834,575	2,424,754	1,792,032	2,392,602	9,623,235
Bristol Bay	2,675,428	2,040,447	3,324,694	1,403,767	1,990,091	11,434,447
Haines	318,161	255,514	228,989	176,613	196,474	1,175,751
Kenai Peninsula	738,650	665,103	1,207,765	512,923	994,575	4,119,015
Ketchikan Gateway	362,944	300,585	311,798	243,441	323,382	1,542,151
Kodiak Island	1,029,408	945,920	1,213,056	1,002,752	1,295,921	5,467,057
Lake and Peninsula	951,400	379,008	544,702	392,141	1,207,093	3,474,344
North Star	511	0	0	5	903	1,419
Northwest Arctic	0	0	0	2	2,695	2,697
Yakutat	201,292	145,750	195,324	170,979	235,273	948,618
Total Boroughs	7,467,086	6,566,902	9,449,064	[illegible]	8,639,007	37,808,734
City						
Akhiok	19	0	0	0	0	19
Akutan	236,242	265,328	733,321	591,128	572,508	2,398,527
Aniak	5,086	0	0	4,345	2,018	11,449
Anvik	338	277	4,056	672	600	6,343
Atka	15,132	628	3,483	651	178,807	198,701
Bethel	83,737	69,479	67,544	64,549	37,573	322,882
Chignik	95,966	66,988	160,248	145,744	245,674	734,621
Clark's Point	175,250	303,370	272,993	120,818	129,477	1,001,907
Cold Bay	0	0	0	703	0	703
Cordova	442,733	264,273	561,157	335,241	529,110	2,132,514
Craig	30,335	32,990	24,270	29,280	39,970	156,844
Dillingham	261,898	159,210	296,659	195,972	280,604	1,194,344

Table 8 - Fisheries Business Tax

City	FY 95	FY 94	FY 93	FY 92	FY 91	Total All Years
Emmonak	35,213	14,982	28,623	35,051	9,303	123,171
Fairbanks	100	0	0	5	47	152
False Pass	21,089	96,854	103,977	12,789	6,719	241,408
Galena	2,048	1,672	3,062	2,554	2,455	11,790
Goodnews Bay	302	347	132	0	17,405	18,186
Haines	637	708	907	2,571	1,302	6,125
Homer	91,790	64,334	109,945	93,158	126,649	505,876
Hoonah	99,284	57,653	63,658	53,377	58,863	333,035
Hooper Bay	1,268	0	0	5,502	0	6,770
Kachemak	0	0	0	27	0	27
Kake	73,376	33,611	2	16,517	0	123,507
Kaltag	0	475	2,226	2,572	1,876	7,152
Kenai	177,974	121,475	338,035	134,286	302,455	1,074,225
Ketchikan	323,163	209,225	308,340	216,403	252,977	1,310,108
King Cove	475,417	399,081	453,043	346,246	456,604	2,130,391
Klawock	0	5	23	0	214	242
Kodiak	644,353	558,915	865,429	613,703	874,193	3,554,593
Kotzebue	0	0	0	2	2,730	2,733
Larsen Bay	51,986	61,377	51,432	55,400	91,283	311,476
Mekoryuk	410	265	0	242	181	1,098
Nenana	578	96	795	1,276	1,086	3,831
Nome	0	0	0	197	0	197
North Pole	411	679	1,235	1,208	484	4,017
Nulato	0	0	0	0	671	671
Old Harbor	0	0	5,812	1,121	3,162	10,095
Ouzinkie	0	33	21	0	0	54
Pelican	165,808	132,518	147,420	163,111	172,183	781,041
Petersburg	826,209	746,865	736,286	599,536	729,582	3,638,479
Pilot Point	0	19,232	58,925	176	0	78,334
Port Heiden	0	0	4,391	0	0	4,391
Saint George	287,118	358,994	278,949	116,409	12,177	1,053,648
Saint Mary's	0	0	0	1,275	7,121	8,395

Table 8 - Fisheries Business Tax

City	[illegible]	[illegible]	[illegible]	[illegible]	FY 91	Total All Years
Saint Paul	2,534,079	1,877,080	715,786	1,140,370	748,353	7,015,668
Sand Point	90,021	93,049	144,061	111,509	87,629	526,289
Seldovia	0	0	0	21	7,281	7,302
Seward	125,329	142,157	187,378	164,983	283,904	903,751
Skagway	0	129	0	0	30	159
Soldotna	53	26	1,011	0	19	1,110
Tenakee Springs	0	680	0	0	6	686
Thorne Bay	970	0	0	0	0	970
Togiak	187,157	96,017	193,067	99,568	99,574	675,383
Toksook	0	15	0	0	13	27
Unalakleet	5,084	2,064	0	9,103	0	16,251
Unalaska	2,193,707	2,614,162	3,525,048	2,531,282	2,067,793	12,931,992
Valdez	267,993	127,678	201,963	249,496	368,659	1,215,786
Whittier	82,368	62,487	66,071	38,068	22,276	271,246
Wrangell	77,381	72,754	60,588	53,102	57,489	321,314
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6,891,067	47,392,011
GRAND TOTAL	**$18,600,221**	**$16,344,252**	**$20,696,023**	**$14,617,513**	**$16,205,762**	**$86,663,670**
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	61	72
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	N/A	$2,362,877

* *The 1990 legislature amended fisheries business statutes by adding a new section, AS 43.75.137, to authorize sharing of 50% of fisheries business tax revenue attributable to processing activities in the unorganized borough (Ch 195 SLA 1990). Department of Community and Regional Affairs (DCRA) is responsible for disbursing to eligible communities the 50% share of revenue collected from the unorganized borough. AS 43.75.137 took effect July 1, 1992.*

Table 9 - Fishery Resource Landing Tax

	FY 95	FY 94 *	FY 93 *	FY 92 *	FY 91 *	Total All Years
Borough						
Aleutians East	$ 3,641	-	-	-	-	$ 3,641
Kenai Peninsula	10,315	-	-	-	-	10,315
Kodiak Island	18,533	-	-	-	-	18,533
Yakutat	3,266	-	-	-	-	3,266
Total Boroughs	**35,756**	-	-	-	-	**35,756**
City						
Atka	8,511	-	-	-	-	8,511
Kodiak	60,164	-	-	-	-	60,164
Saint Paul	229,839	-	-	-	-	229,839
Sand Point	1,042	-	-	-	-	1,042
Seward	45,036	-	-	-	-	45,036
Unalaska	2,512,253	-	-	-	-	2,512,253
Total Cities	**2,856,845**	-	-	-	-	**2,856,845**
GRAND TOTAL	***$2,892,601***	-	-	-	-	***$2,892,601***
Number of Communities Subject to Sharing	10	0	0	0	0	10
Additional Sharing with DCRA **	***$89,195***	**N/A**	**N/A**	**N/A**	**N/A**	***$89,195***

* *Fishery resource landing tax took effect January 1, 1994. Calendar year 1994 landing tax returns were due June 30, 1995.*

** *As part of the fisheries resource landing tax statute enacted by the 1993 legislature, section 43.77.060(d) authorizes sharing 50% of fisheries resource landing tax revenue for landings in the unorganized borough (Ch 67 SLA 1993). DCRA is responsible for disbursing the 50% share of revenue to eligible communities.*

Appendix A - Shared Taxes and Fees Statutes

Aviation Motor Fuel Tax

AS 43.40.010. TAX ON TRANSFERS OR CONSUMPTION OF MOTOR FUEL AND EXPENDITURE OF PROCEEDS. (e) Sixty per cent of the proceeds of the revenue from the taxes on aviation fuel, excluding the amount determined to have been spent by the state in its collection, shall be refunded to a municipality owning and operating or leasing and operating an airport in the proportion that the revenue was collected at the municipal airport. All other proceeds of the taxes on aviation fuel shall be paid into a special aviation fuel tax account in the state general fund. The legislature may appropriate funds from this account for aviation facilities.

Coin-Operated Device Tax

AS 43.35.050. DISTRIBUTION OF TAX. One-half of the proceeds of the gross revenue from the tax under AS 43.35.010 - 43.35.090, excluding distributors' fees, penalties, and the amount determined to have been spent by the state in its collection, shall be refunded to organized boroughs and cities of the first, second, and third classes by action of the legislature in the proportion that the revenue was earned within them, and the balance shall be retained by the state and deposited in the general fund.

Electric Cooperative Tax

AS 10.25.570. REFUND TO LOCAL GOVERNMENTS. The proceeds of the telephone cooperative gross revenue tax and the electric cooperative tax, less the amount expended by the state in their collection, shall be refunded to an organized borough or a city of any class incorporated under state law, in the proportion that the revenue was earned within the city or the borough area outside the city. However, taxes collected on gross revenue earned by a telephone cooperative or on the sale of electricity by an electric cooperative outside a city or organized borough shall be retained by the state and deposited into its general fund.

Fisheries Business Tax

AS 43.75.130. REFUND TO LOCAL GOVERNMENTS. (a) Except as provided in (d) of this section, the commissioner of revenue shall pay

(1) to each unified municipality and to each city located in the unorganized borough, 50 percent of the amount of tax revenue collected in the municipality from taxes levied by this chapter;

(2) to each city located within a borough, 25 percent of the amount of tax revenue collected in the city from taxes levied by this chapter; and

(3) to each borough

(A) 50 percent of the amount of tax revenue collected in the area of the borough outside cities from taxes levied by this chapter; and

(B) 25 percent of the amount of tax revenue collected in cities located within the borough from taxes levied by this chapter.

(b) For purposes of this section, tax revenue collected under AS 43.75.015 from a person entitled to a credit under AS 43.75.032 shall be calculated as if the person's tax had been collected without applying the credit.

(c) *[Repealed, Sec 7 ch 79 SLA 1986]*

(d) Notwithstanding the provisions of (a)(2) and (a)(3)(B) of this section, the commissioner shall pay

(1) to each city that is located in a borough incorporated after June 16, 1987 the following percentages of the tax

Appendix A - Shared Taxes and Fees Statutes

Fisheries Business Tax (Continued)
revenue collected in the city from taxes levied under this chapter:

(A) 45 percent of the taxes collected during the calendar year after the calendar year in which the borough is incorporated;

(B) 40 percent of the taxes collected during the first calendar year after the calendar year in which the borough is incorporated;

(C) 35 percent of the taxes collected during the second calendar year after the calendar year in which the borough is incorporated; and

(D) 30 percent of the taxes collected during the third calendar year after the calendar year in which the borough in incorporated; and

(2) to each borough that is incorporated after June 16, 1987 the following percentages of the tax revenue collected in the cities located within the borough from taxes levied under this chapter:

(A) 5 percent of the taxes collected during the calendar year in which the borough is incorporated;

(B) 10 percent of the taxes collected during the first calendar year after the calendar year in which the borough is incorporated;

(C) 15 percent of the taxes collected during the second calendar year after the calendar year in which the borough is incorporated; and

(D) 20 percent of the taxes collected during the third calendar year after the calendar year in which the borough is incorporated.

(e) Notwithstanding the provisions of (d) of this section, a city may adopt an ordinance to transfer a portion of the funds received under (d)(1) of this section to the borough in which the city is located.

(f) In this section, "tax revenue collected" includes the amount credited against taxes under AS 43.75.018.

AS 43.75.137. ADDITIONAL REFUND. To the extent that appropriations are available for the purpose, and notwithstanding the requirement of AS 37.07.080(e) that approval of the office of management and budget is required, an amount equal to 50 percent of the tax revenue that is collected under this chapter from fisheries businesses and is not subject to division with a municipality under AS 43.75.130 shall be transmitted each fiscal year, without the approval of the office of management and budget, by the department to the Department of Community and Regional Affairs for disbursal to eligible municipalities under AS 29.60.450.

Fishery Resource Landing Tax

AS 43.77.060. REVENUE SHARING. (a) Subject to appropriation by the legislature and except as provided in (b) of this section, the commissioner of revenue shall pay to each

(1) unified municipality and to each city located in the unorganized borough, 50 percent of the amount of tax revenue collected in the municipality from taxes levied under this chapter on the fishery resource landed in the municipality and accounted for under AS 43.77.050(b);

(2) city located within a borough, 25 percent of the amount of tax revenue collected in the city from taxes levied under this chapter on fishery resources landed in the city and accounted for under AS 43.77.050(b); and

(3) borough

(A) 50 percent of the amount of tax revenue collected from taxes levied under this chapter on fishery resources landed in the area of the borough outside cities and

Appendix A - Shared Taxes and Fees Statutes

Fishery Resource Landing Tax (Continued)
accounted for under AS 43.77.050(b); and

(B) 25 percent of the amount of tax revenue collected from taxes levied under this chapter on fishery resources landed in cities located within the borough and accounted for under AS 43.77.050(b).

(b) Notwithstanding the provisions of (a)(2) and (a)(3)(B) of this section, and subject to appropriation by the legislature, the commissioner shall pay to each

(1) city that is located in a borough incorporated after the effective date of this Act *(January 1, 1994)*, the following percentages of the tax revenue collected from taxes levied under this chapter on fishery resources landed in the city and accounted for under AS 43.77.050(b):

(A) 45 percent of the tax revenue collected during the calendar year after the calendar year in which the borough is incorporated;

(B) 40 percent of the tax revenue collected during the first calendar year after the calendar year in which the borough is incorporated;

(C) 35 percent of the tax revenue collected during the second calendar year after the calendar year in which the borough is incorporated; and

(D) 30 percent of the tax revenue collected during the third calendar year after the calendar year in which the borough in incorporated; and

(2) borough that is incorporated after the effective date of this Act *(January 1, 1994)*, the following percentages of the tax revenue collected from taxes levied under this chapter on fishery resources landed in the cities located within the borough and accounted for under AS 43.77.050(b):

(A) five percent of the tax revenue collected during the calendar year in which the borough is incorporated;

(B) 10 percent of the tax revenue collected during the first calendar year after the calendar year in which the borough is incorporated;

(C) 15 percent of the tax revenue collected during the second calendar year after the calendar year in which the borough is incorporated; and

(D) 20 percent of the tax revenue collected during the third calendar year after the calendar year in which the borough is incorporated.

(c) Notwithstanding the provisions of (b) of this section, a city may adopt an ordinance to transfer a portion of the funds received under (b)(1) of this section to the borough in which the city is located.

(d) To the extent that appropriations are available for the purpose, and notwithstanding the requirement of AS 37.07.080(e) that approval of the office of management and budget is required, an amount equal to 50 percent of the tax revenue that is collected under this chapter and is not subject to division with a municipality under (a) -- (c) of this section shall be transmitted each fiscal year, without the approval of the office of management and budget, by the department to the Department of Community and Regional Affairs for disbursal to eligible municipalities under AS 29.60.450.

Telephone Cooperative Tax

AS 10.25.570. REFUND TO LOCAL GOVERNMENTS. The proceeds of the telephone cooperative gross revenue tax and the electric cooperative tax, less the amount expended by the state in their collection, shall be refunded to an organized borough or a city of any class incorporated under state law, in the

This publication was released by the Alaska Department of Revenue and produced in Alaska at a cost of $4.95 per copy. Its purpose is to provide the public with comprehensive information and data regarding shared taxes and fees programs administered by Income and Excise Audit Division.

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