ENVIRONMENTAL ASSESSMENT/REGULATORY IMPACT REVIEW/

INITIAL REGULATORY FLEXIBILITY ANALYSIS

FOR AMENDMENT 16a

TO THE FISHERY MANAGEMENT PLAN FOR

GROUNDFISH OF THE BERING SEA/ALEUTIAN ISLANDS

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1.0 INTRODUCTION

The domestic and joint venture groundfish fisheries in the exclusive economic zone (3-200 miles offshore) of the Bering Sea/Aleutian Islands are managed under the Fishery Management Plan (FMP) for the Groundfish Fishery of the Bering Sea/Aleutian Islands (BSAI). This FMP was developed by the North Pacific Fishery Management Council (Council) under the Magnuson Fishery Conservation and Management Act (Magnuson Act).

The FMP was approved by the Secretary of Commerce and became effective on January 1, 1982 (46 FR 63295, December 31, 1981). This FMP is implemented by Federal regulations appearing at 50 CFR Parts 611, 620, and 675. Sixteen amendments to the BSAI FMP have been approved by the Secretary. An additional amendment (Amendment 6) was adopted by the Council but was disapproved by the Secretary. A portion of Amendment 16 addressing vessel incentives to reduce bycatch rates of prohibited species was disapproved by the Secretary. However, the Council adopted a revised incentive program which was submitted to the Secretary for review and approval in November 1990. Amendments 15 (sablefish effort limitation measures) and 17 (inshore-offshore allocations) are currently being prepared by the Council.

The Council solicits public recommendation for amending the groundfish FMP on an annual basis. Amendment proposals are then reviewed by the Council's BSAI and GOA groundfish FMP Plan Teams (PTs), Plan Amendment Advisory Group (PAAG), Advisory Panel (AP), and Scientific and Statistical Committee (SSC). These advisory bodies make recommendations to the Council on which proposals merit consideration for plan amendment.

Amendment proposals and appropriate alternatives accepted by the Council are then analyzed by the PTs for their efficacy and for their potential biological and socioeconomic impacts. After reviewing this analysis the AP and SSC make recommendations as to whether the amendment alternatives should be rejected or changed in any way, whether and how the analysis should be refined, and whether to release the analysis for general public review and comment. If an amendment proposal and accompanying analysis is released for public review, then the AP, SSC, and the Council will consider subsequent public comments before the Council decides whether to submit the proposals to the Secretary of Commerce for approval and implementation.

1.1 List of Amendment Proposals

This document analyzes two distinct bycatch management topics:

(1) Augment halibut and crab bycatch management measures in the BSAI, and
(2) Implement herring bycatch management measures in the BSAI.

While these are distinct topics, they cannot be treated independently in the analyses because closure of an area due to bycatch of one species will necessarily shift fishing effort to other areas and will have implications for the bycatch of other species. The organization of this document reflects this interrelationship.

These measures supplement the bycatch management measures adopted by the Council in June 1990 and implemented at the start of the 1991 fishing year under Amendment 16 to the BSAI Groundfish FMP. These additional measures were not included in Amendment 16, and are "off-cycle", because there was insufficient time to consider them adequately prior to the Council's adoption of Amendment 16.

1.2 Purpose of the Document

This document provides background information and assessments necessary for the Secretary of Commerce to determine that the FMP amendments are consistent with the Magnuson Act and other applicable law.

1.2.1 Environmental Assessment

One part of the package is the environmental assessment (EA) that is required by NOAA in compliance with the National Environmental Policy Act of 1969 (NEPA). The purpose of the EA is to analyze the impacts of major federal actions on the quality of the human environment. The EA serves as a means of determining if significant environmental impacts could result from a proposed action. If the action is determined not to be significant, the EA and resulting finding of no significant impact (FONSI) would be the final environmental documents required by NEPA. An EIS must be prepared if the proposed action may be reasonably expected: (1) to jeopardize the productive capability of the target resource species or any related stocks that may be affected by the action; (2) to allow substantial damage to the ocean and coastal habitats; (3) to have a substantial adverse impact on public health or safety; (4) to affect adversely an endangered or threatened species or a marine mammal population; or (5) to 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. Following the end of the public review period the Council determined that Amendment 16a to the BSAI FMP will not have significant impacts on the human environment. Therefore, an EIS was not prepared. This EA is prepared to analyze the possible impacts of management measures and their alternatives that are contained in these amendments.

Certain management measures are expected to have some impact on the environment. Such measures are those directed at harvests of stocks and may occur either directly from the actual harvests (e.g. removals of fish from the ecosystem) or indirectly as a result of harvest operations (e.g. effects of bottom trawling on the benthos--animals and plants living on, or in, the bottom substrate). Environmental impacts of management measures may be beneficial when they accomplish their intended effects (e.g. prevention of overharvesting stocks as a result of quota management). Conversely, of course, such impacts may be harmful when management measures do not accomplish their intended effects (e.g. overharvesting may occur if quotas are incorrectly specified). Environmental impacts that may occur as a result of fishery management practices are categorized as changes in predator-prey and competitive relations among species in the ecosystem, physical changes as a direct result of fishing practices, and nutrient changes due to processing and dumping of fish wastes.

1.2.2 Regulatory Impact Review

Another part of the package is the Regulatory Impact Review (RIR) that is required by National Marine Fisheries Service (NMFS) for all regulatory actions or for significant Department of Commerce or NOAA policy changes that are of significant public interest. The RIR: (1) provides a comprehensive review of the level and incidence of impacts associated with a proposed or final regulatory action; (2) 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; and (3) ensures that the regulatory agency systematically and comprehensively considers all available alternatives so that the public welfare can be enhanced in the most efficient and cost effective way.

The RIR also serves as the basis for determining whether any proposed regulations are major under criteria provided in Executive Order 12291 and whether or not proposed regulations will have a significant economic impact on a substantial number of small entities in compliance with the Regulatory Flexibility Act (P.L. 96-354, RFA). The primary purpose of the RFA is to relieve small businesses, small organizations, and small governmental jurisdictions (collectively, "small entities") of burdensome regulatory and recordkeeping requirements. This Act requires that if regulatory and recordkeeping requirements are not burdensome, then the head of an agency must certify that the requirement, if promulgated, will not have a significant effect on a substantial number of small entities.

This RIR analyzes the impacts that Amendment 16a alternatives would have. It also provides a description of and an estimate of the number of vessels (small entities) to which regulations implementing these amendments would apply.

1.3 Catch and Value of Groundfish in the Bering Sea/Aleutian Islands Area

In the BSAI, domestic harvests increased from 1.24 million mt in 1989 to over 1.7 million mt in 1990, an increase of 37 percent (Table 1.1). Domestic (domestic annual processing=DAP) catches of pollock increased by 37 percent, from nearly 1,016,000 mt to nearly 1,390,000 mt. DAP catches of Pacific cod, Pacific ocean perch, Atka mackerel, arrowtooth flounder and yellowfin sole also increased markedly.

1.4 Description of the 1990 Domestic Fishing Fleet Operating in the Bering Sea/Aleutians Islands Area

The NMFS vessel permit database has been examined to determine the current composition of the domestic groundfish fishing fleet. A total of 2,070 vessels were permitted to fish for groundfish in the Bering Sea and Gulf of Alaska in 1990 (Table 1.2). This value is based on the number of 1990 Federal groundfish permits that had been issued to domestic vessels through December 31, 1990.

Fishing operations in which these vessels participate include: harvesting only, harvesting and processing, processing only, and support. The latter type of operation includes transporting fishermen, fuel, groceries, and other supplies to other vessels.

Of the total 2,027 vessels, 88%, or 1,788, are five net tons or larger. Twelve percent, or 239 vessels, are less than five net tons.

Vessels Five Net Tons or Larger

The larger vessels, i.e., those that are 5 net tons or larger, are based in Seattle, Sitka, Kodiak, and Dutch Harbor, and other ports. Most of these larger vessels come from Alaska, based on telephone area codes given with permit applications. The numbers of vessels that come from Alaska is 1,144, the number from the Seattle area is 453, and the number from other areas is 191. These numbers are summarized in Table 1.3 by processing mode.

The total number of catcher vessels (harvesting only) and catcher/processor vessels (harvesting/processing) is 1,574 and 146, respectively (cf. Tables 1.4 and 1.5). Net tonnages of catcher vessels and catcher/processor vessels vary widely. The total net tonnage of the catcher vessels is 70,314 tons, and the total net tonnage of the catcher/processor vessels is 71,496 tons.

Vessels involved in harvesting only (catcher vessels) employ mostly three types of gear: hook-and-line, trawls, or pots. Most of the catcher vessels are hook-and-line vessels and number 1,281 (Table 1.4). They are the smallest vessels fishing groundfish, having average net tonnage capacities equal to 29 tons and average lengths of 48 feet. Pot vessels number 39 and trawl vessels number 247. Their respective average net tonnage capacities are 142 and 111 tons. Their respective average lengths are 100 and 87 feet.

Vessels involved in harvesting and processing (catcher/processor vessels) also employ mostly hook-and-line, trawls, or pots. The number of catcher/processor vessels using hook-and-line gear is 69 (Table 1.5). These vessels are the smallest of the catcher/processor vessels, having average net tonnage capacities equal to 134 tons and average lengths of 85 feet, but are larger than the catcher vessels using hook-and-line gear. Pot vessels number 5 and trawl vessels number 72. Their respective average net tonnage capacities are 426 and 835 tons. Their respective average lengths are 157 and 195 feet. Twenty-two vessels are involved in processing only (motherships). These vessels average 2,464 net tons and lengths of 250 feet.

The number of vessels by length, by gear type, and by operating mode varies. Table 1.6 summarizes these parameters.

Table 1.1 Comparison of 1988, 1989 and 1990 DAP groundfish catches (metric tons) in the Bering Sea/Aleutians Islands management area.

BERING SEA/ALEUTIANS

	1988	1989	1990*	% change 1989-90
ARROWTOOTH FLOUNDER	2735	4964	10189	105
ATKA MACKEREL	2066	18457	23290	26
GREENLAND TURBOT	6713	8948	8904	-
OTHER FLATFISHES	25932	9922	16358	65
OTHER ROCKFISH	544	791	1016	28
OTHER SPECIES	1019	4140	20818	403
PACIFIC COD	86733	126505	166307	31
PACIFIC OCEAN PERCH	2195	6891	22686	229
POLLOCK	533053	1015968	1389938	37
ROCK SOLE	N/A	33582	23324	-(31)
SABLEFISH	6588	4401	4441	1
SQUID	279	329	625	90
YELLOWFIN SOLE	7771	5320	16002	201
TOTAL	675628	1240218	1703898	37

* Through 29 December 1990

Table 1.2 Numbers of groundfish vessels that are less than 5 net tons or 5 net tons and larger that are Federally permitted in 1990 to fish off Alaska.

	Number of Vessels		
Mode	< 5 net tons	>= 5 net tons	
HARVESTING ONLY	108	1574	
HARVESTING/PROCESSING	0	146	
PROCESSING ONLY	0	22	
SUPPORT ONLY	0	39	
OTHER	131	7	
TOTAL VESSELS =	239	1788=	2027

Table 1.3 Numbers of groundfish vessels that are Federally permitted to fish off Alaska in 1990 from the Seattle area, Alaska, and from other areas. All vessels 5 net tons or larger.

Mode	Number Seattle Area	Number Alaska	Number Other Areas
HARVESTING ONLY	313	1083	178
HARVESTING/PROCESSING	91	46	9
PROCESSING ONLY	20	2	0
SUPPORT ONLY	27	9	3
OTHER	2	4	1
TOTAL	453	1144	191

Table 1.4 Numbers and statistics of CATCHER VESSELS by gear type that are Federally permitted to fish off Alaska in 1990 All vessels 5 net tons or larger.

Mode	Number	Avg. Net Tons	Avg. length (ft)
HOOK-AND-LINE	1281	29	48
POTS	39	142	100
TRAWL	247	111	87
OTHER GEAR 1/	7	35	48
TOTAL	1574		

1/ Other gear includes combinations of hook-and-line, pots trawls, jigs, troll gear, and gillnets.

Table 1.5 Numbers and statistics of CATCHER/PROCESSOR and MOTHERSHIP (processing only) VESSELS by gear type that are Federally permitted to fish off Alaska in 1990. All vessels 5 net tons or larger.

Mode	Number	Avg. Net Tons	Avg. length (ft)
HOOK-AND-LINE	69	134	85
POTS	5	426	157
TRAWL	72	835	195
OTHER GEAR 1/	0	0	0
TOTAL	146		
MOTHERSHIPS	22	2464	250

1/ Other gear includes combinations of hook-and-line, pots, trawls, jigs, troll gear, and gillnets.

Table 1.6 Numbers of vessels Federally permitted to fish off Alaska in 1990 by 25-foot length increments, by gear type and by operating mode. Support vessels are excluded. M* = multiple gear.

Length (ft)	Catcher				Catcher/Processor				Mothership
	Trawl	Pot	LL	M*	Trawl	Pot	LL	M*	
<= 24	3	1	39	1	0	0	0	0	0
25 - 49	31	7	895	7	3	0	25	0	0
50 - 74	58	3	361	1	0	0	11	0	0
75 - 99	87	6	61	1	5	0	9	0	0
100-124	49	14	15	0	2	0	4	0	0
125-149	10	2	3	0	8	1	9	0	1
150-174	10	8	3	0	8	4	6	0	5
>= 175	5	0	0	0	46	0	5	0	16
SUBTOTALS	253	41	1377	11	72	5	69	0	22

TOTAL CATCHER & PROCESSOR VESSELS 1850
TOTAL SUPPORT VESSELS 39 TOTAL OTHER MODES 138
TOTAL VESSELS 2027

2.0 OVERVIEW

2.1 The Need for Action and Proposed Management Measures

Because trawl groundfish fisheries use non-selective harvesting techniques, incidental catches (bycatch) including crab, halibut, and herring are taken as a byproduct of the groundfish catch. The level of bycatch varies as a function of a number of factors including time and area, target species, gear, fishing strategies, and oceanographic conditions. A conflict occurs when bycatch is perceived to impact the resources available to another fishery. Bycatch management attempts to balance the effects of various fisheries on each other. This is particularly contentious because fishermen value the use of crab, halibut, or herring very differently, depending on the fishery they pursue.

Amendment 16 was adopted by the Council and approved by the Secretary in June and November of 1990, respectively. It addressed a number of management issues including the bycatch of crab and halibut in the BSAI trawl groundfish fisheries. Specifically, it provides for a bycatch management regime to replace the regime that expired at the end of 1990. A portion of Amendment 16 establishing a vessel incentive program to reduce crab and halibut bycatch rates was disapproved by the Secretary. The Council adopted and submitted for review and approval a revised incentive program in November 1990. Amendment 16a was adopted by the Council in September 1990. If approved by the Secretary, it will provide the Council and Secretary additional tools to control the bycatch of crab and halibut and it will add herring to the trawl groundfish fishery bycatch management regime. These additional measures were not included in Amendment 16 because there was insufficient time to consider them adequately prior to the Council's approval of Amendment 16 in June.

One alternative to the status quo was considered to control the bycatch of crab and halibut. It would:

(1) provide the Regional Director the authority to temporarily close limited areas in-season due to high bycatch rates; and

(2) permit the Regional Director to set a limit on the amount of the pollock TACs that can be taken in the bottom trawl pollock fishery.

Three alternatives to the status quo were considered to control the bycatch of herring in the trawl groundfish fisheries. Each alternative would:

(1) provide a framework for establishing an annual herring PSC limit as a fixed percentage of the estimated herring biomass;

(2) specify time/area closures along the Alaska Peninsula; and

(3) specify a winter time/area closure.

The time/area closures will be triggered when a fishery's apportionment of a PSC limit is reached. PSC limits of 1%, 2%, 4%, and 8% of the estimated eastern Bering Sea herring biomass were considered. The differences between the three alternatives are the sizes of the areas to be closed. The alternatives are more fully described in Section Four.

Initially, Amendment 16a also included the options of establishing crab and halibut prohibited species catch (PSC) limits equal to 50%, 100%, or 150% of the Amendment 12a limits that expired at the end of 1990. However, because the reestablishment of the 12a PSC limits, as recommended by the Council at it June 1990 meeting, was approved by the Secretary as part of Amendment 16, the consideration of PSC limits for crab and halibut was dropped from Amendment 16a.

2.2 Nature and Source of the Problem

Groundfish trawl fisheries result in incidental fishing mortality for crab, halibut, herring and other prohibited species. This use of crab, halibut, and herring is one of several competing uses of these resources. These resources can also be used as current or future target catch in the crab, halibut, or herring fisheries, respectively. These species can also be left in the sea to contribute to other components of the ecosystem, or they can be used as incidental fishing mortality in non-groundfish fisheries.

The analysis of bycatch management in the trawl groundfish fishery focuses on two uses of crab, halibut, and herring. They are the use as bycatch in the trawl groundfish fishery and the use as present or future target catch. The use of these resources as contributors to the rest of the ecosystem is not germane if, out of consideration of the future productivity of the crab, halibut, and herring fisheries, these stocks are maintained at levels that do not adversely affect the ecosystem as a whole. A fourth use, as bycatch in other groundfish and non-groundfish fisheries, is likely more important in determining the appropriate combined total removals by all fisheries than in determining the appropriate distribution of these removals between the two uses considered here.

The optimal levels of bycatch in the trawl groundfish fisheries are those that minimize the cost of bycatch, where that cost has three components: (1) the present and future costs imposed on those who benefit from the crab, halibut, and herring fisheries or the existence of those stocks; (2) the costs imposed on those who benefit from the groundfish fisheries; and (3) management costs associated with regulating bycatch. These three types of costs will be referred to as impact costs, control costs, and agency costs, respectively.

The impact costs are those associated with changes in catch in the crab, halibut, and herring fisheries or changes in stock conditions due to incidental fishing mortality of crab, halibut, and herring in the trawl groundfish fisheries. This mortality will generally be referred to simply as bycatch. The control costs are the costs of actions that the groundfish fleet takes to reduce bycatch. The agency costs are those borne by agencies (e.g., the Council, NMFS, etc.) to select, implement, administer, and enforce the bycatch program.

In the absence of regulatory intervention to control bycatch, bycatches will tend to exceed the optimal levels. The reason for this is that, in making decisions concerning bycatch, a groundfish fisherman considers his bycatch control costs because he bears them but generally ignores the impact costs because they are borne by others. Therefore, a fisherman will not voluntarily take some actions to control bycatch that provide net benefits to the fishery or the nation as a whole because the actions result in net costs to the fisherman. In response to this problem, crab and halibut PSC limits for the trawl groundfish fisheries were established by Amendment 16 and herring PSC limits are included in this amendment package (Amendment 16a).

In 1990, the attainment of the PSC limits adopted by the Council resulted in closures of certain bottom trawl fisheries prior to taking the total allowable catch of their target species. Through 29 December 1990, 92% of the Bering Sea/Aleutian Islands groundfish optimal yield (OY) had been taken. The failure to harvest fully the available resources represents a real cost to certain bottom trawl groundfish fisheries. This cost was only partially offset by increased catch and benefits for the fixed gear groundfish fisheries.

For each PSC limit, the amount of groundfish that can be harvested is determined by the average bycatch rate of the fishery. It has been argued that a PSC limit provides fishermen an incentive to reduce bycatch rates. This argument fails to recognize that, although it is in the best interest of the fleet as a whole to decrease bycatch rates, it is in the best interest of individual operators to ignore bycatch and harvest groundfish rapidly prior to the closure of the fishery. This results in inequities and unnecessarily high bycatch rates. The latter will cause a given PSC limit to impose a much higher cost on the trawl fishery it closes.

The authority to close temporarily areas or fisheries with exceptionally high bycatch rates and to limit the amount of pollock taken in the bottom trawl pollock fishery potentially allows the trawl fishery to collectively make decisions that will reduce bycatch rates and the costs imposed on the trawl fishery by the existing PSC limits.

3.0 DESCRIPTION OF AUGMENTED CRAB AND HALIBUT BYCATCH MANAGEMENT MEASURES

The Council has recommended that the BSAI Groundfish FMP be amended to provide the Regional Director with: (1) inseason authority to close bycatch "hot spots" and (2) authority to establish annually a limit on the amount of the pollock TACs that can be taken in the bottom trawl pollock fishery. This alternative and the status quo are described in this section.

3.1 Alternative 1: Do Nothing (the status quo).

The status quo consists of the bycatch management measures that will be in place if Alternative 2 is not selected. These will include: (1) the prohibition on the retention of crab and halibut bycatch in the groundfish fishery; (2) the trawl groundfish fishery PSC limits and framework for apportioning those limits as specified in Amendment 16; and (3) if approved by the Secretary, the vessel incentive program of revised Amendment 16 as adopted by the Council in November 1990.

3.2 Alternative 2 (Preferred): Augment Amendment 16 bycatch management measures.

The Council adopted both parts of this alternative at its September 1990 meeting. Each part is discussed in a separate subsection.

3.2.1 Part A: Permit the Regional Director to set a limit on the amount of the pollock TACs that may be taken in the directed bottom trawl pollock fishery.

With this part of Alternative 2, the annual process that is used for establishing the pollock TACs is also be used to determine whether to impose a limit on the amount of pollock that can be taken in the bottom trawl pollock fishery and what the limit will be. The information to be used in making these annual decisions include the following:

(1) the PSC limits;

(2) the projected bycatch levels with or without the limit;

(3) the cost of the limit on the bottom trawl and mid-water trawl fisheries; and

(4) other factors that determine the effects of the limit on the attainment of FMP goals and objectives.

3.2.2 Part B: Provide the Regional Director the authority to temporarily close limited areas inseason due to high bycatch rates.

If observer information collected inseason indicates that groundfish operations in an area exhibit relatively high bycatch rates of prohibited species, the Regional Director would have the authority to close that area to the directed fishery that accounts for the high observed bycatch rates for a period of up to sixty days or until either prohibited species distribution or groundfish effort is anticipated to change.

The Regional Director would make the determination that an interim closure is necessary based on: (1) inseason observer reports; (2) estimates of fishing effort in an area; and, (3) historical observer information that provides an index on seasonal distribution patterns of prohibited species and where bycatch "hot spots" have traditionally occurred.

Inseason closures would be based primarily on observer reports on bycatch rates that are submitted on a weekly basis. These reports are currently aggregated by 3-digit statistical area and the existing information and communication systems employed by NMFS do not allow for more refined weekly reports (e.g. latitude/longitude information on daily groundfish effort). Specific haul by haul catch information is not collected from observers until debriefing operations; this information is then verified, keypunched, and entered into the observer database over a 6 - 12 month period.

Given the nature of inseason observer information available to the Regional Director on a weekly basis, most inseason closures would be limited to statistical areas, rather than some smaller portions of a statistical area. Parts of statistical areas could be closed, however, if the Regional Director can make a determination that bycatch rates within a statistical area can be reduced if only a portion of the area is closed on an interim basis.

An inseason closure of all or part of a statistical area would be based upon a determination that such a closure was necessary to prevent:

(a) a continuation of relatively high bycatch rates within all or part of a statistical area;

(b) the take of an excessive share of PSC allowances established for specified fisheries by vessels fishing within all or part of a statistical area;

(c) the closure of a specified fishery due to excessive bycatch rates occurring in target fisheries operating within all or part of a statistical area; and

(d) the premature attainment of established PSC limits and associated loss of opportunity to vessels to harvest the groundfish OY.

The Regional Director would be required to consider any of the following factors when making the above determinations:

(1) the effect on overall fishing effort within all or part of a statistical area;

(2) relative distribution and abundance of stocks of target and bycatch species within all or part of a statistical area;

(3) observed bycatch rates of prohibited species within all or part of a statistical area;

(4) historical bycatch rates observed in target fisheries within all or part of a statistical area;

(5) economic impacts on affected fishing businesses; or

(6) any other factor relevant to the conservation and management of groundfish species for which a TAC has been specified or incidentally caught species which are designated as prohibited species or for which a PSC limit has been specified.

4.0 NEED FOR HERRING BYCATCH MANAGEMENT MEASURES AND DESCRIPTION OF ALTERNATIVES

Herring that spawn along the eastern shore of the Bering Sea migrate to wintering areas near the western edge of the Bering Sea continental shelf, north and west of the Pribilof Islands (Dudnik and Usol'tsev 1964, Rumyantsev and Darda 1970, Wespestad and Barton 1979, Funk 1990). During this annual migration, eastern Bering Sea herring pass through areas in which groundfish vessels are trawling. Herring bycatch exploitation fractions (the percent of the population taken annually by trawlers) have increased from less than 2% in 1983 to 4%-7% in 1989 (Funk et al. 1990). Although herring caught by domestic and joint venture groundfish trawlers are a designated prohibited species and may not be retained, there are currently no limits to the amount of herring that may be incidentally taken.

Some prior restrictions, in the form of increased reporting requirements in certain areas, were in place for the foreign trawl groundfish fishery. A foreign fishery for herring existed in the Bering Sea from the late 1950s until 1980. Following court action initiated by western Alaskan subsistence interests in 1980, offshore fishing for herring in the EEZ was prohibited. At that time, the Council established a special herring reporting zone northwest of the Pribilof Islands encompassing the area between 58° N. and 59°30'N. latitude and 172°W. to 175°W. longitude (Figure 4.1). Although bycatch limits were not implemented, foreign vessels fishing in this zone from September 1 through April 30 were required to report detailed target species catch, herring bycatch, and fishing effort information. Little foreign effort occurred in the area after the reporting regulations were implemented. The increased reporting requirements appear to have been a sufficient disincentive to have discouraged foreign fleets from fishing in this area. These regulations were never applied to domestic vessels.

Following the enactment of the FCMA in 1976, the Council began developing a fishery management plan for herring in the Bering Sea. The Council finally approved an FMP for Bering Sea herring in November, 1983. However, the Secretary of Commerce did not approve the FMP, citing the need for additional data on the origins of herring that would have been caught by high seas trawl fisheries that were allowed under the FMP. The final version of the unimplemented FMP contained four alternative "herring savings areas", varying in size and degree of protection to the herring wintering grounds, which would have been used to control herring bycatch (Figure 4.2). The FMP also contained a herring Allowable Incidental Catch (AIC) set at 0.1% of a user group's Bering Sea/Aleutians groundfish allocation. If the user group's AIC was exceeded, the herring savings area would be closed to trawling by that user group. The FMP would have prohibited retention of herring by foreign vessels, but would have allowed retention for domestic vessels, until the AIC was reached.

At the present time, eastern Bering Sea herring stocks are recognized as being fully utilized in inshore sac roe, food/bait, and traditional subsistence fisheries. These fisheries are managed by the State of Alaska, under harvest policies established by the Alaska Board of Fisheries. These harvest policies established a maximum exploitation fraction of 20% on each distinct spawning stock, and specified that exploitation be reduced when herring stock abundance was low or when commercial fisheries occurred in important herring subsistence fishing areas. Abundance thresholds were also established, below which no commercial harvests were allowed. When the Board of Fisheries reviewed the increases in trawl herring bycatch exploitation fractions at their November 1989 meeting, the maximum allowable herring exploitation fractions under the Board's herring harvest policy were found to be have been exceeded.

Herring stocks are declining in all Bering Sea areas except in Norton Sound. The very strong 1977-78 year classes have been sustaining most eastern Bering Sea herring stocks through the 1980s. These year classes are aged 12 and 13 in 1990 and are rapidly senescing out of the population. Except in Norton Sound, no substantial year classes have recruited to eastern Bering Sea herring stocks since the 1977-78 year classes. Herring biomass was below the threshold for a commercial harvest at Nunivak Island in 1990 and was only very slightly above threshold at Nelson Island. Nelson Island and Nunivak Island herring stocks are projected to be below threshold biomass levels in 1991.

Recent declines in the abundance of Bering Sea herring stocks have prompted additional concern over the impact of trawl incidental harvests, particularly on the smaller discrete stocks of western Alaska. Subsistence utilization of herring is an important part of the culture of the residents of many western Alaskan coastal villages, particularly at Nelson Island (Pete 1989). The importance of herring to the traditional culture and economy of the central Yup'ik Eskimo of the Nelson Island area is further described in the Appendix. The small commercial harvests from these stocks comprise the basis of the cash economies in the coastal villages. Transfer payments from the government are also an important source of income. However, these payments consist primarily of payments in kind rather than cash payments.

Given the declines in eastern Bering Sea herring stocks, the reduced or eliminated inshore herring fisheries, and the concern for maintaining traditional subsistence herring fisheries, measures to control the bycatch of herring in Bering Sea trawl groundfish fisheries may be necessary. At the January 1990 Council meeting, the Council instructed the Plan Team to develop bycatch control measures for Pacific herring. The Council reviewed the first draft of the plan amendment package for herring at its April 1990 meeting and directed the Plan Team to perform additional analyses prior to deciding whether to release the herring plan amendment package for public review. In addition, at its April 1990 meeting, the Council requested an emergency rule for the 1990 fishing season establishing a herring PSC limit of 2.5% of the Bering Sea herring biomass. If this PSC limit were reached, two areas along the Alaska Peninsula would have been closed to both bottom and mid-water trawling for the duration of the herring migration. At the April 1990 meeting, the Council decided to delay consideration of further possible emergency herring bycatch control measures for the fall and winter 1990 herring migration until the June 1990 Council meeting. Although the Council requested emergency action to protect herring in 1990, there were two reasons why no such action was taken by NMFS. The herring stocks appeared to be more abundant than previously projected and the closures resulting from the halibut PSC limits were expected to provide adequate protection for herring for the remainder of 1990.

This analysis attempts to determine the effects of a set of alternative bycatch control measures on the magnitude of the herring bycatch and the catch of groundfish by trawl fisheries. To the extent which economic impacts can be evaluated with the limited economic information available for the groundfish trawl and inshore herring fleets, economic impacts of the alternative actions on groundfish trawl and inshore herring fisheries are also evaluated. The approach used extends the bycatch simulation model described by Smith at al. (1988), which has been used by the Council to evaluate the impacts of alternative bycatch control measures for amendments 12a, 16, and for the crab and halibut portions of this plan amendment.

4.1 The Alternatives

A wide array of possible alternative measures to control herring bycatch in Bering Sea/Aleutian trawl groundfish fisheries were considered. Bycatch controls fall into four basic categories: prohibited species catch (PSC) limits, time/area closures, gear restrictions, and economic incentives. Many combinations of measures from these four categories are possible. A brief review of the four basic categories demonstrates that only certain of these measures are appropriate for controlling herring bycatch in trawl fisheries.

<u>PSC Limits.</u> PSC limits provide a cap on bycatch harvests, above which no fishing is allowed. The amount of the PSC limit can be either unchanging on an annual basis (fixed PSC limit), or can be frameworked to provide for annual changes according to some specified procedure. Bering Sea herring stock abundance is characterized by infrequent periods of very strong recruitment which has resulted in stock fluctuations of an order of magnitude or more over the last decade. Because of these dramatic stock fluctuations, fixed PSC limits could excessively constrain groundfish fisheries during periods of extreme herring abundance, while allowing herring to be over-harvested when herring stocks were low. For this reason, fixed PSC limits alone were not considered as a bycatch control measure.

Frameworked PSC limits based on a percentage of the total groundfish catch were not considered for similar reasons. This type of framework could allow more herring to be taken as bycatch when groundfish TACs were high, but this practice could exacerbate the problems outlined for fixed PSC limits. The herring FMP approved by the Council in 1983 contained frameworked herring PSC limits based only on the magnitude of the groundfish harvest, although earlier drafts of the FMP contained frameworked PSC limits that depended both on total groundfish catch and on herring stock size.

Frameworked PSC limits based on a percentage of eastern Bering Sea herring stock size appear to be a reasonable method of implementing PSC limit bycatch controls. These measures would require an annual determination of the eastern Bering Sea herring stock size, and would annually set the PSC limit as some percentage of the herring stock size. This would allow higher PSC limits when herring were abundant, and would reduce PSC limits when herring were scarce. According to the area swept theory of fishing and assuming that groundfish and herring were randomly distributed, fluctuations in groundfish stock sizes alone would change the catch per unit effort (CPUE) of the groundfish stocks, but would not change the CPUE of herring. While neither groundfish, herring, nor fishing effort are randomly distributed, frameworked PSC limits based on a percentage of herring stock size would still provide more stability to the fishery and protection to herring stocks than either fixed PSC limits or frameworked PSC limits based on percentages of groundfish TACs.

<u>Time/Area Closures.</u> Herring follow well-defined, consistent routes around the Bering Sea continental shelf during their annual migrations. Figure 4.3 depicts the migration routes documented with data available at the time of the drafting of the herring FMP (Wespestad and Barton 1981). Bristol Bay herring stocks were thought to migrate clockwise around Bristol Bay while stocks to the north were thought to move more directly offshore to the wintering grounds after spawning. Recent data derived from 1983-1988 foreign and joint venture herring bycatch records corroborate the earlier finding of a clockwise migration route around Bristol Bay and refine the timing and location of movements of herring along the Alaska Peninsula during the summer months (Figures 4.4 to 4.9; see Funk 1990 for further discussion). During September through March, herring congregate in the area north and west of the Pribilof Islands (Figure 4.10). Recognizing this, the draft herring FMP submitted by the Council to the Secretary for review in 1983 contained four "herring savings areas", varying in size and degree of protection to the herring wintering grounds, which could be used to control herring bycatch (Figure 4.2). Data collected since the draft FMP was prepared in 1983 continue to identify this area as a zone of high herring bycatch during the fall and winter. Time/area closures of other areas along the herring migration route were also considered.

Because herring only occur in restricted portions of the Bering Sea and only during the annual migration, year-long area closures would overly constrain the trawl groundfish fishery and were not considered. The time/area closure options considered involve closures only for the duration of the herring migration and only in those areas directly along the herring migration route. Closure of areas off the main migration route, including closure of the entire Bering Sea, would not appreciably reduce herring bycatch compared to the closure of much smaller areas. Because it is possible for groundfish trawlers to minimize herring bycatch through changes in trawling technique or small shifts in location, time/area closures were only considered in conjunction with PSC limits. A time/area closure that is not triggered by a herring PSC limit could be overly constraining on groundfish trawlers if in fact trawlers were able to reduce their bycatch of herring.

PSC Limit-Time/Area Closure Combinations. Because groundfish fishermen have shown the capability to reduce bycatch rates in certain situations, combinations of PSC limits and time/area closures are likely to be an effective means of controlling herring bycatch. Because individual Bering Sea herring stocks are thought to intermingle extensively during the migration and on the wintering grounds, there is no scientific basis for establishing separate PSC limits by area, if more than one time/area closure is considered. However, there could be pragmatic reasons to apportion PSC limits by area, if more than one area closure is contemplated. Because a rationale for apportioning PSC limits to areas has not yet been identified, this analysis considers only a single Bering Sea-wide PSC limit for herring. A series of timed area closures would be triggered by the attainment of the PSC limit. Only areas along the herring migration route would be closed when the PSC limit was attained and only for the duration that herring are present.

Another possible extension of PSC limit-time/area closures might involve allowing vessels that could demonstrate low herring bycatch rates, or had accrued bycatch credits, to continue fishing once a certain percentage of the PSC limit is reached. This type of incentive system may be difficult to implement, given the variability inherent in herring bycatch rates.

Gear Restrictions. Initial analyses seem to indicate that herring bycatch rates for mid-water trawls are less than for bottom trawls. However the initial analyses are based on joint venture and foreign observer records which do not identify the actual gear used. "Gear" is assigned using a computer algorithm based on the species composition in the catch, and may not accurately reflect the actual gear used. Domestic vessels are becoming increasingly proficient at fishing mid-water trawl gear near the bottom, further blurring the gear type distinction using this method. Because data explicitly testing the effects of different trawls on herring are lacking, consideration of gear restrictions for herring would be premature. The revised definition of pelagic trawls adopted by the Council and the domestic observer data being collected during 1990 may help to clarify distinctions among types of trawls and differences in bycatch rates.

Economic Incentives. While economic incentive options, such as PSC fees, hold potential as a future solution to bycatch problems, establishing a precedent for incentives will require lengthy periods of discussion, preparation, and analysis. Because of the immediate conservation concerns for the herring resource, a solution that can be implemented more rapidly is needed. Economic incentives for herring could be considered as part of a comprehensive bycatch control regime that would include herring and other prohibited species, to be implemented at a later date.

4.1.1 Alternative 1: Do Nothing (the status quo).

Under the status quo, herring are treated as a prohibited species and may not be retained, although there is no limit on the amount of herring that may be captured. Because herring do not survive capture in groundfish trawls, the potential for extensive damage to herring populations exists, particularly where trawling occurs in areas where herring are concentrated along their annual migration routes. The times and locations where trawling occurs, and the subsequent herring bycatch, will be strongly influenced by the PSC restrictions in place for crab and halibut.

4.1.2 Alternative 2: Frameworked PSC Limit which triggers time/area closures along the Alaska Peninsula and a small winter savings area.

This alternative would establish a frameworked PSC limit based on a fixed percentage of the Bering Sea herring stock size. The overall PSC limit would be apportioned to defined target fisheries. The apportionment mechanism is identical to that used for the crab and halibut PSC limits (see Amendment 16). However, while Amendment 16 imposes restrictions only on bottom trawl fisheries, this alternative would specifically include the mid-water pollock fishery in the bycatch management regime. If a PSC apportionment is attained by a target fishery, vessels in that fishery would be prohibited from further trawling in specific areas along the herring migration route, during the times when herring would be present. Under Alternative 2, the two closed areas along the Alaska Peninsula are considered, along with a third area in the central Bering Sea. The areas and closure dates for the Alaska Peninsula summer herring savings areas are similar to those adopted by Council's emergency action at their April 1990 meeting, and are depicted in Figure 4.11. The winter savings area considered in this alternative is identical to the special herring reporting zone established for the foreign fleets (Figure 4.1), and was considered as option B in the 1983 draft herring FMP (Figure 4.2). This winter savings area encompasses only the core of herring wintering ground area. Some additional herring would continue to be caught outside this core area after a herring PSC limit was attained.

A PSC limit of 1% of the eastern Bering Sea herring biomass is evaluated in Section Six for this alternative. Additional PSC limits of 2%, 4%, and 8% were considered in the draft EA/RIR/IRFA that was available to the Council in September. Three PSC limits are evaluated for Alternative 4, the Council's preferred alternative. The eastern Bering Sea herring biomass is defined as the biomass of herring stocks that spawn from Port Moller through Norton Sound. The Alaska Department of Fish and Game publishes an annual herring stock status and forecast document in the fall of each year. Under this alternative, the Council would establish herring PSC limits at the December Council meeting, based on the information provided by ADF&G at that time.

4.1.3 Alternative 3: Frameworked PSC Limit which triggers time/area closures along the Alaska Peninsula and a larger winter savings area.

The only difference between Alternatives 2 and 3 is that Alternative 3 includes a larger winter savings area as depicted in Figure 4.12. The winter savings area considered in this alternative is identical to option C in the 1983 draft herring FMP (Figure 4.2). This area encompasses the majority of the area used by overwintering herring stocks (Funk et al. 1990). As with Alternative 2, only a PSC limit of 1% is evaluated in Section Six.

4.1.4 Alternative 4 (Preferred): Frameworked PSC Limit with expanded time/area closures along the Alaska Peninsula and an intermediate winter savings area.

Alternative 4 is the Council's preferred alternative. It differs from Alternatives 2 and 3 only in terms of the definitions of the savings areas. The winter savings area would be similar to that of Alternative 2, but would extend northward to 60° N. as depicted in Figure 4.13. The second summer time/area closure along the Alaska Peninsula would extend to 167° W, slightly further west than in Alternatives 2 and 3. The dates of the savings areas are identical to those of Alternatives 2 and 3. PSC limits of

1%, 2%, and 4% of the eastern Bering Sea herring biomass are evaluated for this alternative in Section Six.

4.2 Herring Biological Background

Significant herring spawning occurs at 9 locations along the eastern shore of the Bering Sea (Figure 4.14). All of these locations support sac roe herring fisheries. Basic data on the biomass and sac roe fishery harvests on these stocks are given in Table 4.1 and catch and biomass histories are given in Table 4.2. In the fall of each year, the Alaska Department of Fish and Game prepares stock abundance and catch forecasts for the following year for each of these herring stocks (see Funk and Savikko 1990 for the 1990 forecasts). Herring harvest projections are based on a number of sources of information. For the major stocks harvested during spring sac roe fisheries, estimates of the spawning biomass and age composition of the stock are derived each spring. In the eastern Bering Sea spawning biomass is estimated either from spawn deposition surveys or from aerial surveys.

The age composition of the spawning biomass is estimated by sampling the commercial catch and from test fishing conducted by the Department of Fish and Game. Catch-age analysis, incorporating annual abundance indices as auxiliary information is also being used in some areas to refine abundance estimates. Herring stock assessment forecasts for 1990 consisted of projecting the numbers and average weight of each age class of the population, as assessed in 1989, forward to 1990, allowing for an age-specific level of natural mortality over the course of the year. Attempts are also made in some cases to predict the number of recruit age-class fish (age 3 or 4, depending on the area) that will appear in the following year's spawning population for the first time. In most cases these estimates are derived from the number of 2 and 3 year old fish which appeared on the spawning grounds the previous year. The age 3 (or 4) recruitment estimates contain a very large amount of uncertainty.

Herring stocks are declining in all Bering Sea areas except in Norton Sound (Table 4.1; Figure 4.15). The very strong 1977-78 year classes have been sustaining most eastern Bering Sea herring stocks through the 1980s. These year classes are aged 12 and 13 in 1990 and are rapidly senescing out of the population. Except in Norton Sound, no substantial year classes have recruited to eastern Bering Sea herring stocks since the 1977-78 year classes. Herring biomass was below the threshold for a commercial harvest at Nunivak Island in 1990 and was only very slightly above threshold at Nelson Island. Nelson Island and Nunivak Island herring stocks are projected to be below threshold biomass levels in 1991.

Herring that spawn from Port Moller through Norton Sound are referred to as "eastern Bering Sea herring", in the aggregate. Herring stocks from Kuskokwim Bay south migrate clockwise around Bristol Bay and then up the continental shelf edge, arriving on the wintering grounds northwest of the Pribilof Islands in fall (Figure 4.3). Herring stocks from Port Moller through the Kuskokwim Bay are assumed to intermingle during this migration, so that trawl harvests come from mixed stocks. Stock identification studies conducted in the Dutch Harbor food/bait fishery in July and August established that herring in that fishery were predominantly of Togiak origin (Rowell 1986, Rogers and Schnepf 1985, Rogers et al. 1984, Walker and Schnepf 1982). This result was expected since the Togiak stock has been by far the largest herring stock in the eastern Bering Sea in recent years. Other stocks were indicated as being present in the area, although at lower levels. Some scales were classified as being of Nelson Island origin in the most recent and intensive study (Rogers and Schnepf 1985), but because of small sample sizes and insufficient precision the study could not conclusively state that Nelson Island fish were present.

Recent analysis of herring bycatch in the 1983-88 joint venture and foreign fisheries clearly established that there is a large clockwise movement of herring around Bristol Bay during the summer months (Funk 1990). A large zone of herring bycatch moved northwest along the continental shelf edge to the wintering area northwest of the Pribilofs in late summer and early fall. Although there was intense trawling effort along the Alaska Peninsula and in other areas of the Bering Sea, herring did not occur in areas other than the northwest Pribilof area in the fall and winter.

Because the entire mature component of the herring stock conducts these annual migrations, the size distribution harvested by trawlers is assumed to be identical to that seen inshore on the spawning grounds. Herring spawning activity is usually age-stratified with older ages spawning first. The age separation by time appears to continue throughout the migration to the wintering area (Rumyantsev and Darda 1970). Therefore, if trawl bycatches occur early during the passage of the herring migration through an area, age distributions will tend to be older than that for the entire spawning population. If trawl bycatches occur during the end of the herring migration through an area, age distributions will be younger than that for the population average. Immature herring may not follow the migratory pattern of older herring and may remain on the wintering grounds year-round.

The timing of trawl bycatch could also determine which of the herring stocks the bycatch originated from. Herring spawning generally occurs later at more northerly latitudes, resulting in a progression of spawning dates from Togiak through Norton Sound. Presumably the timing of the post-spawning migration is also delayed for more northerly stocks. However, the results of stock identification studies conducted to date have not been conclusive in confirming delayed migration along the Alaska Peninsula for more northerly stocks. The Port Moller stock does not follow the spawn timing pattern for other eastern Bering Sea stocks, as the timing of spawning at Port Moller is usually well after Togiak.

Herring are easily damaged by contact with trawl nets. Trawl mortality is assumed to be 100%, even for herring released from cod-ends which are opened immediately on the surface. Mortality has been found to be significant for herring which are live-trapped for spawning on artificial substrate in impoundments. Although some herring may appear to survive immediately after handling, herring scales are easily dislodged which increases susceptibility to delayed mortality from disease.

In estimating biological and socioeconomic impacts, herring taken by trawl gear are subtracted from the following spring's sac roe fishery quotas. However, not all herring captured by trawls would have survived until the following spring. Herring growth and natural mortality rates for the Togiak stock given in Funk and Savikko (1990) were used to compute the "spring spawner equivalents" of trawl herring bycatch. For this analysis, all trawl herring bycatch was assumed to occur in September, approximately midway through the herring spawning year. Allowing for growth and natural mortality, a biomass equivalent to 83% of the trawl herring catch would have survived until the following spring. Because of the short six month time interval involved, discount rates were not applied to the potential value of the foregone herring harvest.

4.2.1 Estimation of Herring Bycatch Rates by Mid-water and Bottom Trawls

Herring bycatch rates were estimated from the 1983-88 joint venture and foreign observer records (see Funk et al. 1990 and Funk 1990 for detailed descriptions). The weights of herring bycatch and total groundfish catches were recorded by observers aboard joint venture and foreign groundfish vessels from 1983 through 1988. These data were summarized by month, 1/2° latitude by 1° longitude area, and target fishery category. Target fishery categories were arbitrarily assigned in the observer records based on the species composition of the catch, using criteria established by the NMFS observer program.

These criteria assigned catches to a "flatfish" category if flatfish comprised more than 20% of the catch. If more than 95% of the catch was pollock, catch was assigned to the mid-water trawl category. If pollock and cod combined comprised more than 50% of the catch and cod was less than 5% of the catch, the "pollock bottom trawl" category was assigned. If pollock and cod were more than 50% of the catch and cod was more than 5% of the catch, an "other bottom trawl" category was assigned. If Atka mackerel comprised more than 20% of the catch, the catch was assigned to the Atka mackerel category. Tows not meeting these criteria were pooled into the "other bottom trawl" category.

Herring bycatch rates were averaged over the 1983-88 period because herring stock size was relatively constant over this period (Figure 4.16). For the bycatch prediction model, the average 1983-88 herring bycatch rates were adjusted for the ratio of projected herring stock size to the 1983-88 average herring stock size. For the 1990 projected herring stock size used in the present model configuration, herring bycatch rates were reduced to 49% of the 1983-88 average herring bycatch rates. Herring bycatch rates were assumed to be zero in the turbot fishery. Rock sole herring bycatch rates were assumed to be the same as for flatfish fisheries in general.

Because herring bycatch rates were not available for all 1/2° by 1° blocks for each month and target fishery, an interpolating and smoothing procedure[1] was applied to fill out the complete grid of 1/2° by 1° blocks. The distribution of herring bycatch rates are depicted in Figures 4.4 through 4.9, and herring bycatch rates are summarized by NMFS statistical area, month, and target fishery in Table 5.1.d.

Initial examination of bycatch rates by gear indicated that bottom trawl bycatch rates were consistently higher than mid-water trawl bycatch rates in these data. Further analysis revealed that the large difference in bycatch rates between mid-water and bottom trawl gear resulted from the method used to assign gear type in the observer data. In the initial analysis vessels had been assigned to the mid-water trawl gear type if pollock comprised more than 95% of the total catch, where the total catch included the catch of prohibited and other non-groundfish species. This would have caused hauls containing only herring and pollock to be classified as bottom trawl gear if the herring comprised more than 5% of the catch. Subsequently the gear classification algorithm for the observer data was modified to use only groundfish species composition, so that trawl hauls were assigned to the mid-water gear category only if the catch of pollock was more than 95% of the total groundfish catch.

To further examine the differences in herring bycatch rate between bottom and mid-water trawl gear, the 1983-88 average bycatch rates by 1/2° latitude by 1° longitude area and month were screened to identify only those areas of significant herring bycatch and non-trivial levels of groundfish catch. Only those 1/2° latitude by 1° longitude area and month cells in which total groundfish catch by both mid-water and bottom trawl gear was greater than 350 tons and in which bycatch rates by either mid-water or bottom trawl gear exceeded 0.1% were used. This screening process essentially identifies cells in the center of the herring distributions shown in Figures 4.4 to 4.9 that also had significant bottomfish catch. The ratio of bottom trawl to mid-water trawl bycatch rates in each of these cells was computed. The frequency distribution of the ratio of bottom trawl to mid-water trawl bycatch rates indicates that bottom trawl bycatch rates are similar to those of mid-water trawl bycatch rates in both

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[1]The smoothing and interpolating algorithm for scattered data of Akima(1978) was used, as implemented in the SAS statistical package (SAS 1988), procedure G3Grid.

foreign and joint venture data (Figure 4.16). The median bottom trawl to mid-water trawl herring bycatch ratio for foreign and joint venture data combined was 0.63 while the mean was 25.4, indicating that in a few cells bottom trawl bycatch rates were much higher than mid-water trawl bycatch rates.

The available 1989 joint venture observer data were also examined. These data are available only by NMFS regulatory zone (511-540) and month. Only three cells met the screening criteria used for the 1983-88 data. The ratio in subarea 517 in September was 20.37, and in subarea 521 in September was 0.89 and in October was 1.33. The mean (7.53) and distribution of this small data set are consistent with the 1983-88 results.

Records of landed discard of herring reported on fish tickets by domestic vessels in 1989 were also examined for differences in bycatch rates by bottom and mid-water trawl vessels (see Funk et al. 1990 for a detailed description). The data were from area 517 in the "horseshoe" area. Identical screening criteria were used as for the 1983-88 joint venture and foreign data. In July the ratio of bottom to mid-water trawl bycatch rates was 3.34, in August it was 0.113, in September it was 83.39 and in October it was 153.8. The mean (60.2) and distribution of this small data set indicate slightly higher bottom trawl bycatch rates than the 1983-1988 joint venture and foreign results.

Because herring bycatch rates are similar for bottom and mid-water trawl gears, the amount of herring taken as bycatch is expected to be relatively insensitive to changes in the proportion of the total pollock TAC harvested by mid-water trawl gear. However, bottom and mid-water trawl gears tend to be used in different areas and times of the year, so that differences in annual herring bycatch rates between the two gear types might result from differences in the spatial and temporal distribution of effort between the two gear types.

4.2.2 Marine Mammal Interactions

Pacific herring is a major prey of a number of marine mammal species in the Bering Sea. Historically, herring may have been the staple prey of northern sea lions (Eumetopias jubatus) wintering in the central Bering Sea (Tikhomirov 1964). Herring composed upwards to 10% of the prey of northern fur seals (Callorhinus ursinus) foraging near the Pribilof Islands during June-October, 1958-74 (Perez and Bigg 1986). Spotted seals (Phoca largha) also feed upon herring, following them inshore during the spring (Lowry and Frost 1981; Bukhtiyarov et al. 1984). Fin (Balaenoptera physalus), and humpback (Megaptera novaeangliae) whales also feed to a certain degree on herring (Nemoto 1959, 1970; Tomilin 1957; Klumov 1963). All of these species, save spotted seals, are currently considered depleted under the Marine Mammal Protection Act, and except for fur seals, are also listed under the Endangered Species Act. Note further that spotted seal abundance has been reported to have declined in the Nunivak and Nelson Island areas (L. L. Lowry personal communication), perhaps in association with declining herring stocks there. All of the alternatives which reduce the bycatch of Pacific herring could potentially have beneficial effects on these stocks of marine mammals.

Table 4.1 Summary of the 1989 Alaska herring season and the preliminary forecast for the 1990 season. Harvests and spawning biomasses are listed in short tons (2,000 lbs).

Stock/Fishery	1989 Opening or First Harvest	1989 Harvest	1990 Harvest	1990 Exploitation Rate	1990 Mean Wt. (g)	1990 Spawning Biomass	Stock Status Level	Stock Status Trend
Southeastern								
Kah Shakes	3/20	592	0			3,300	Depressed	Declining
Sitka	3/31	12,135	4,150	15.0%	118	27,000	Moderate	Declining
Seymour Canal	4/28	547	312	10.2%		3,150	Depressed	Declining
Lynn Canal	Closed due to low stock abundance						Depressed	Stable
Hoonah Snd. Pound			11[a]			4,000	High	
Food and Bait	1/01	3,400	3,400				Moderate	Stable
Prince Wm. Sound								
Seine	Closed due to oil		6,038					
Gill Net	Closed due to oil		353					
Pound Kelp	Closed due to oil		118[a]					
Wild Kelp	Closed due to oil		106[a]					
Food and Bait	11/01	656	1,694[b]					
Total			10,392[c]	20.1%[d]	142	51,692[d]	High[d]	Stable[d]
Lower Cook Inlet								
Eastern and Outer Districts	Closed due to oil		700					
Southern District	4/20	171	175					
Kamishak District	4/20	4,800	2,292	10.0%[e]	201	28,653	High	Stable
Upper Cook Inlet								
Sac Roe	4/22	172	80			Unknown	Depressed	Increasing
Food and Bait	4/30	45	50			Unknown	Depressed	Increasing
Kodiak								
Sac Roe	4/15	2,249	2,100		200		Moderate	Stable
Food and Bait								
Eastern Shelikof	8/01	327	573					
Other Kodiak	8/01	13	278		200	Unknown	Moderate	Stable
Chignik Sac Roe	4/15	66	65			Unknown		
Alaska Peninsula								
Port Moller	5/28	745	375		220	2,500	Moderate	stable
South Peninsula	5/13	310	400		250	Unknown	Moderate	stable
Dutch Harbor Food and Bait	7/16	3,101	679					
Bristol Bay (Togiak)								
Seine	5/12	9,413	6,769					
Gill Net	5/09	2,843	2,256					
Spawn on Kelp	5/14	280[a]	175[a]					
Total		16,857[f]	11,206[f]	20.0%	361	56,020	Moderate	Declining
Kuskokwim Area								
Security Cove	5/17	554	235	15.0%		1,560	Moderate	Declining
Goodnews Bay	5/23	616	350	15.0%		2,330	Moderate	
Cape Avinof	6/04	129	300	15.0%		2,020		
Nunivak Island	5/22	116	[g]	15.0%		320		Declining
Nelson Island	5/28	233	[g]	10.0%		2,050		Declining
Cape Romanzof	5/26	926	360	15.0%		2,410		Declining
Norton Sound								
Gill Net	5/27	4,381						
Beach Seine	5/27	390						
Total		4,771	3,300	20.0%		16,520	Moderate	Stable
Port Clarence	No harvest		165					
Sac Roe Harvest Total:[h]		41,387	30,775					
Food and Bait Harvest Total:		7,542	6,674					
Total Herring Harvest:		48,929	37,449					

"Bering Sea Herring Stocks"

[a] Harvest of spawn-on-kelp product in short tons.
[b] Preliminary 1989 food/bait guideline. The 1990 guideline will be set after 1990 sac-roe season.
[c] Includes mortality allowances of 1,532 and 863 tons for pound and wild spawn on kelp fisheries.
[d] Preliminary forecast pending evaluation of Exxon Valdez oil spill impacts. Subject to revision.
[e] Kamishak District exploitation rate includes the eastern Shelikof food and bait harvests.
[f] Togiak total harvest includes an allowance for 1,500 tons mortality for the spawn-on-kelp fishery.
[g] Projected biomass below minimum for commercial harvest; fishery will be opened if threshold biomass observe
[h] Sac roe statewide total harvests do not include allowances for spawn-on-kelp fishery mortality.

Table 4.2 Trawl herring bycatch, directed sac roe and food and bait herring catch, eastern Bering Sea herring biomass, bycatch exploitation fraction and herring bycatch rate, 1983-1990.

	1983	1984	1985	1986	1987	1988	1989[a] Lo		1989[a] Mid	1990[b]
Trawl Bycatch (mt)										
Foreign	1,400	1,300	1,500	300			0		0	
Joint Venture	1,100	1,800	3,100	3,765	468	239	2,588		2,588	
Domestic	?	?	?	?	?	?	1,933	to	5,477	
Total Bycatch	2,500	3,100	4,600	4,065	468	239	4,521	to	8,065	
Sac Roe and Bait Herring Harvest (mt)										
Port Moller	569	391	650	806	464	267	676			340
Togiak	22,092	16,015	21,288	13,423	12,807	12,688	11,120			11,158
Dutch Harbor	3,236	3,246	3,157	2,172	2,271	1,818	2,798			819
Security Cove	973	304	665	681	284	294	503			212
Goodnews Bay	395	650	657	505	291	438	559			408
Cape Avinof	0	0	0	0	0	316	117			64
Nelson Island	0	0	886	804	837	703	211			186
Nunivak Island	0	0	325	464	376	0	105			0
Cape Romanzoff	740	1,075	1,178	1,692	1,217	1,015	840			298
Norton Sound	4,157	3,322	3,219	4,712	3,703	4,238	4,328			5,655
Total	32,162	25,004	32,025	25,259	22,251	21,777	21,257			19,142
Eastern Bering Sea Herring Biomass (mt)										
Port Moller	2,844	1,955	3,248	4,032	2,322	1,334	3,379			1,701
Togiak	127,961	102,939	120,130	85,629	80,818	122,213	89,780			65,317
Security Cove	5,806	4,627	4,445	3,357	2,087	4,454	2,567			1,415
Goodnews Bay	2,903	3,719	3,901	2,722	1,814	4,064	3,665			2,114
Cape Avinof	0	0	0	0	0	3,729	2,522			1,833
Nelson Island	0	0	8,618	6,622	7,348	6,486	3,012			2,449
Nunivak Island	0	0	5,171	5,443	3,992	2,540	562			473
Cape Romanzoff	4,990	5,534	6,350	6,804	6,532	5,987	3,992			2,186
Norton Sound	25,492	20,956	18,144	25,492	29,393	30,772	23,569			31,752
Total	169,996	139,730	170,007	140,101	134,305	181,580	133,048			109,240
Exploitation Fraction										
Trawl Bycatch:	1.5%	2.2%	2.7%	2.9%	?	?	3.4%	to	6.1%	?
Sac Roe and Bait	18.9%	17.9%	18.8%	18.0%	16.6%	12.0%	16.0%			17.5%
Total:	20.4%	20.1%	21.5%	20.9%	16.9%	12.1%	19.4%	to	22.0%	?
Bycatch Rate										
Groundfish TAC	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000		2,000,000	2,000,000
Herring Bycatch Rate (as % of TAC):	0.13%	0.16%	0.23%	0.20%	?	?	0.23%	to	0.40%	?

[a]From Funk et al. (1990).
[b]Preliminary 1990 estimates.

Table 4.3 Herring bycatch rates computed from 1983-88 foreign and joint venture records and those computed after adjusting for the ratio of 1990 projected herring stock size to the 1983-88 average herring stock size. Averages for NMFS subareas (511-540) and quarters were computed from observer data in 1/2° latitude by 1° longitude by month cells by weighting by the domestic catch in each cell.

1983-88 Foreign-JV Average Herring Bycatch Rates:

	Other Bottom Trawl					Midwater Trawl				
	QUARTER					QUARTER				
Subarea	1	2	3	4	Annual	1	2	3	4	Annual
511	0.00%	0.21%	3.47%	0.00%	0.44%	0.00%	0.02%	0.18%	0.00%	0.02%
513	0.02%	0.51%	0.51%	0.38%	0.08%	0.00%	0.00%	0.01%	-	0.01%
514	-	0.03%	-	-	0.03%	-	-	-	-	0.07%
515	0.00%	0.07%	10.28%	0.01%	2.76%	0.00%	0.00%	0.17%	0.00%	0.03%
517	0.00%	0.31%	4.05%	0.04%	0.84%	0.00%	0.00%	0.18%	0.00%	0.06%
521	0.00%	0.01%	0.87%	0.04%	0.14%	-	-	0.13%	0.05%	0.11%
522	-	0.13%	0.00%	0.00%	0.12%	-	0.01%	0.04%	0.02%	0.02%

Bycatch rates after adjusting for the 49% reduction in herring stock size in 1990 from the 1983-88 average:

	Other Bottom Trawl					Midwater Trawl				
	QUARTER					QUARTER				
Subarea	1	2	3	4	Annual	1	2	3	4	Annual
511	0.00%	0.10%	1.71%	0.00%	0.22%	0.00%	0.01%	0.09%	0.00%	0.01%
513	0.01%	0.25%	0.25%	0.19%	0.04%	0.00%	0.00%	0.00%	0.00%	0.00%
514	0.00%	0.01%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.03%
515	0.00%	0.03%	5.07%	0.00%	1.36%	0.00%	0.00%	0.08%	0.00%	0.01%
517	0.00%	0.15%	2.00%	0.02%	0.41%	0.00%	0.00%	0.09%	0.00%	0.03%
521	0.00%	0.00%	0.43%	0.02%	0.07%	0.00%	0.00%	0.06%	0.02%	0.05%
522	0.00%	0.06%	0.00%	0.00%	0.06%	0.00%	0.00%	0.02%	0.01%	0.01%

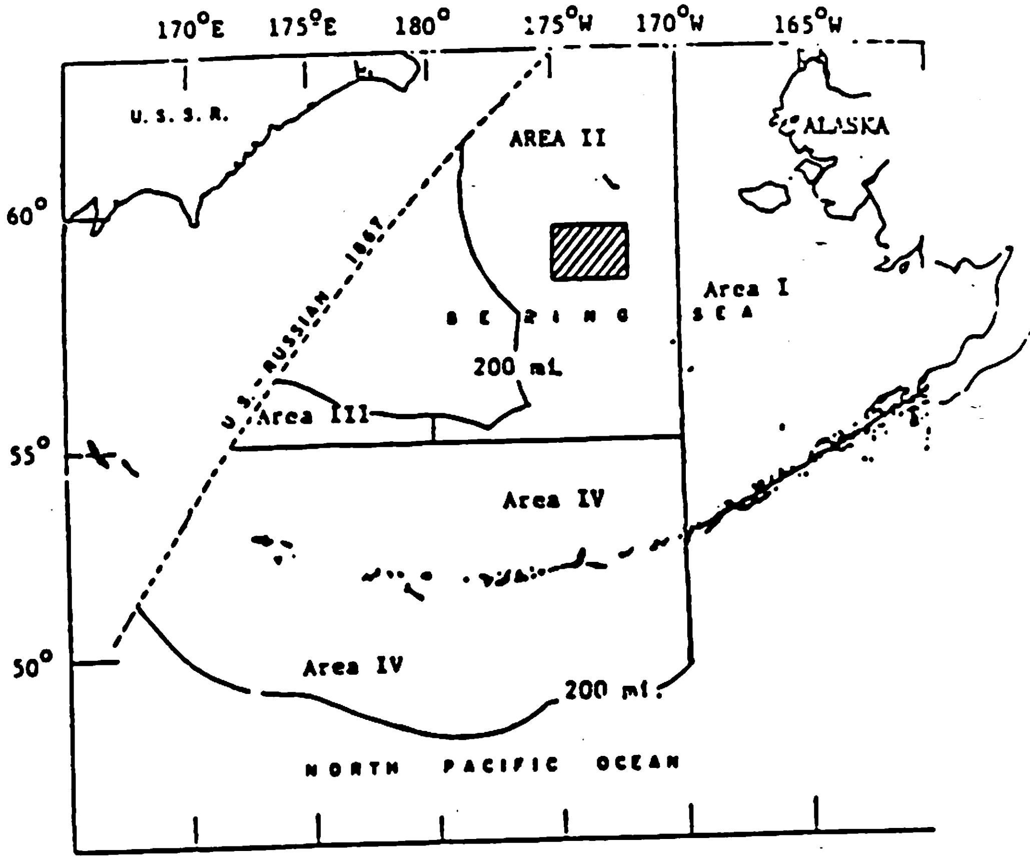

Figure 4.1 Fishing areas of the Bering Sea and Aleutian Islands. 1/

[1] For the purposes of § 611.4 only, and for the period September 1 through April 30, the term "fishing area" shall, for all foreign trawl vessels subject to the requirements of § 611.93, also mean the area described in § 611.93(d)(1). This area is represented by the cross-hatched portion of Fishing Area II, above.

The cross-hatched area is the special herring zone described in the foreign fishing regulations (172°W-175°W and 58°N-59°30'N).

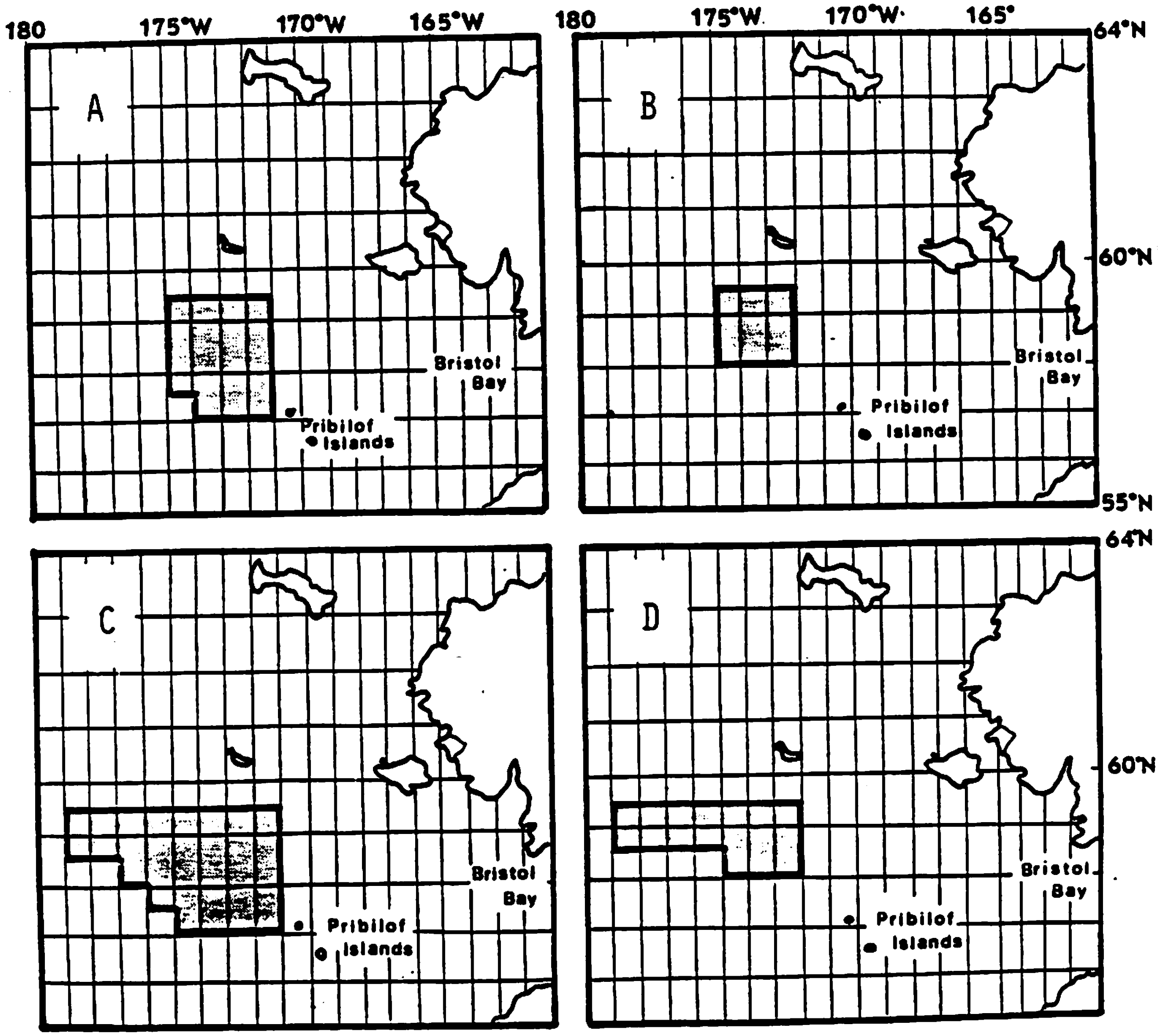

Figure 4.2 Options considered for the Herring Savings Area. Area C provides the maximum protection to the wintering herring populations.

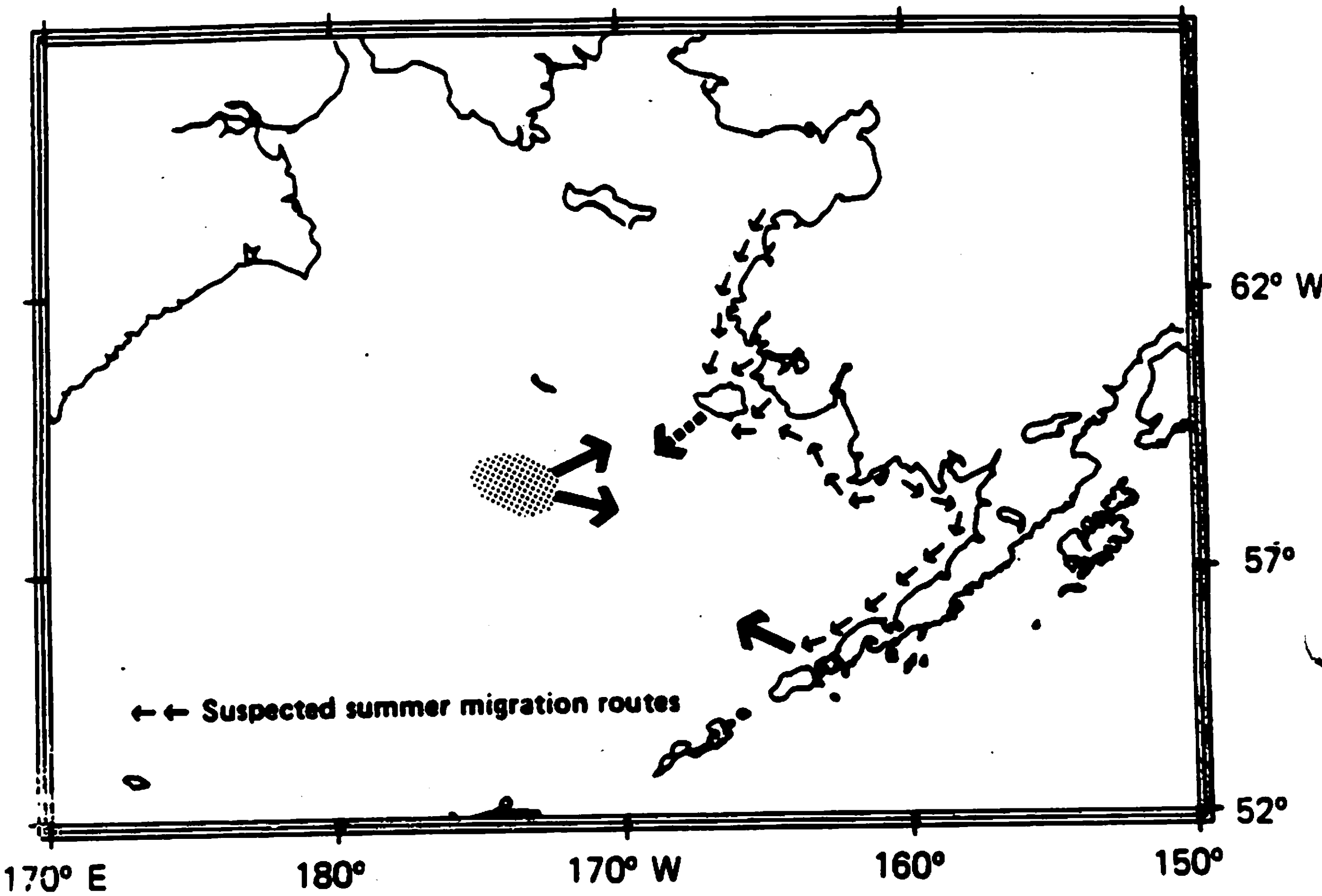

Figure 4.3 Herring migration routes to and from eastern Bering Sea winter grounds. Large solid arrow: direction of movement in offshore waters as determined by Soviet research and Japanese catches. Large dashed arrow: area of autumn reappearance in offshore waters reported from Soviet research. Small arrows: possible summer feeding routes and autumn migration routes (from Wespestad and Barton 1981).

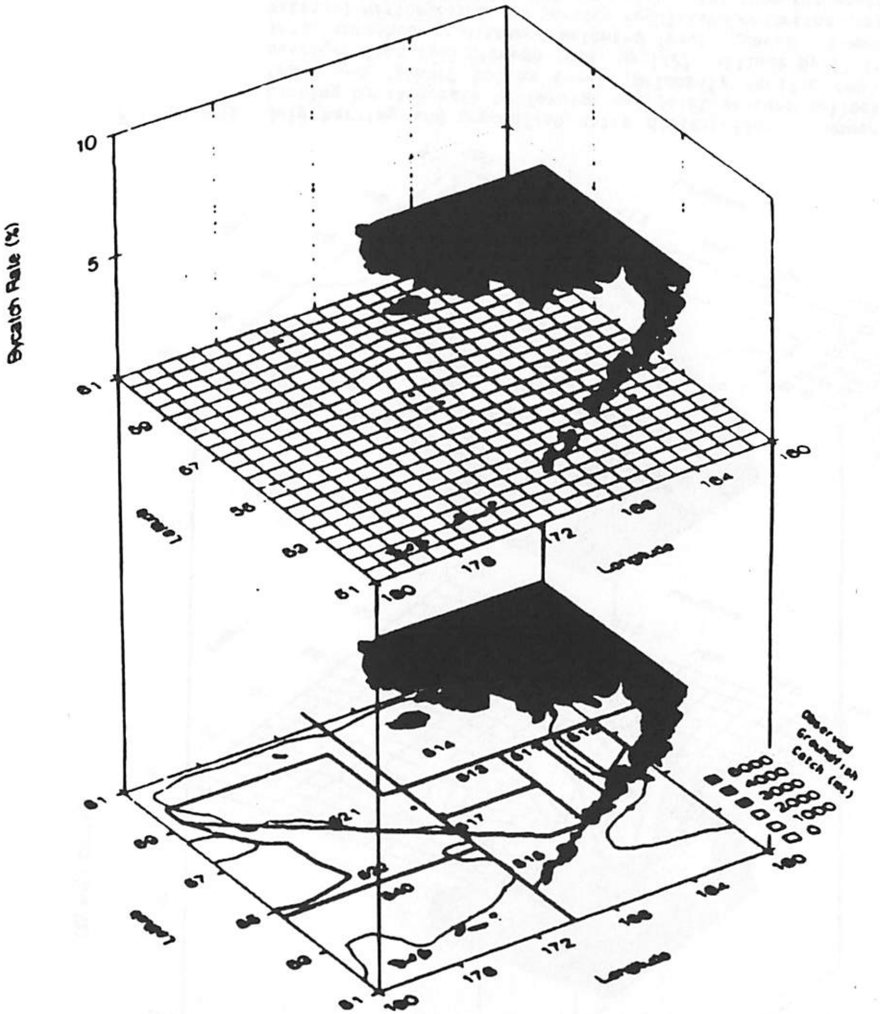

Figure 4.4 May herring and groundfish catch distributions. Upper panel: herring bycatch rate by foreign and joint venture pollock bottom trawl and "other" bottom trawl (primarily Pacific cod) gears, averaged from 1983 through 1988, by 1/2° latitude by 1° longitude area, smoothed by distance-weighted least squares. Lower panel: National Marine Fisheries Service regulatory reporting areas (511-540), contour lines of herring bycatch rates from the upper panel, and the distribution of observed foreign and joint venture observed catches for pollock and "other" bottom trawls from 1983-1988 (shaded areas).

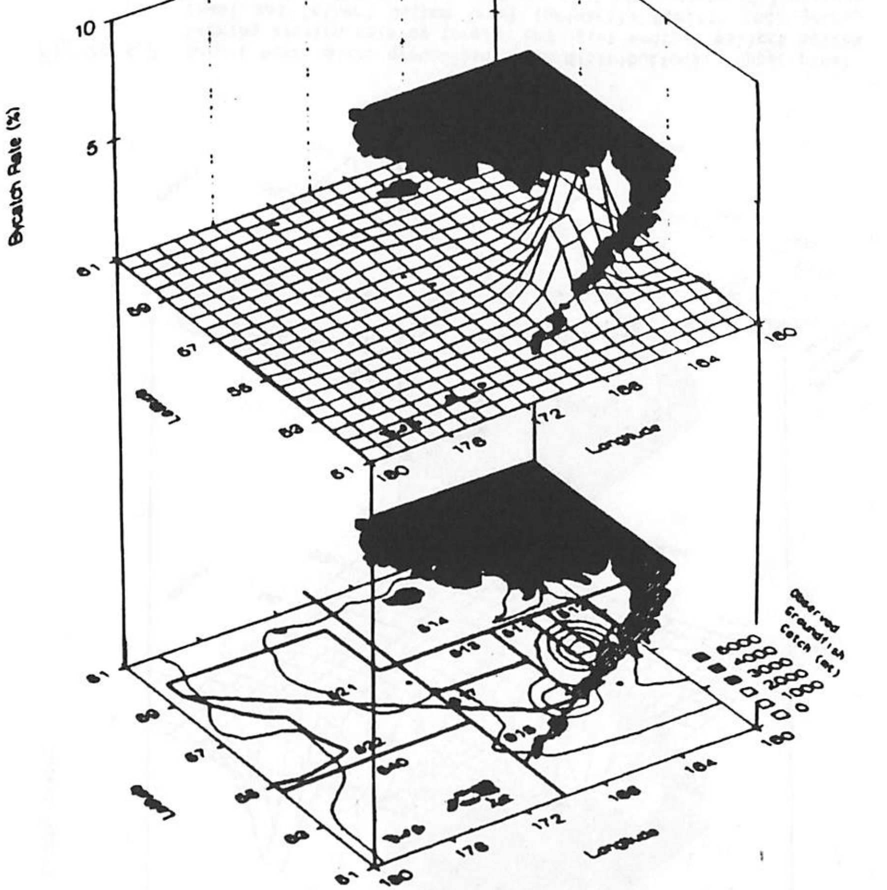

Figure 4.5 June herring and groundfish catch distributions. Upper panel: herring bycatch rate by foreign and joint venture pollock bottom trawl and "other" bottom trawl (primarily Pacific cod) gears, averaged from 1983 through 1988, by 1/2° latitude by 1° longitude area, smoothed by distance-weighted least squares. Lower panel: National Marine Fisheries Service regulatory reporting areas (511-540), contour lines of herring bycatch rates from the upper panel, and the distribution of observed foreign and joint venture observed catches for pollock and "other" bottom trawls from 1983-1988 (shaded areas).

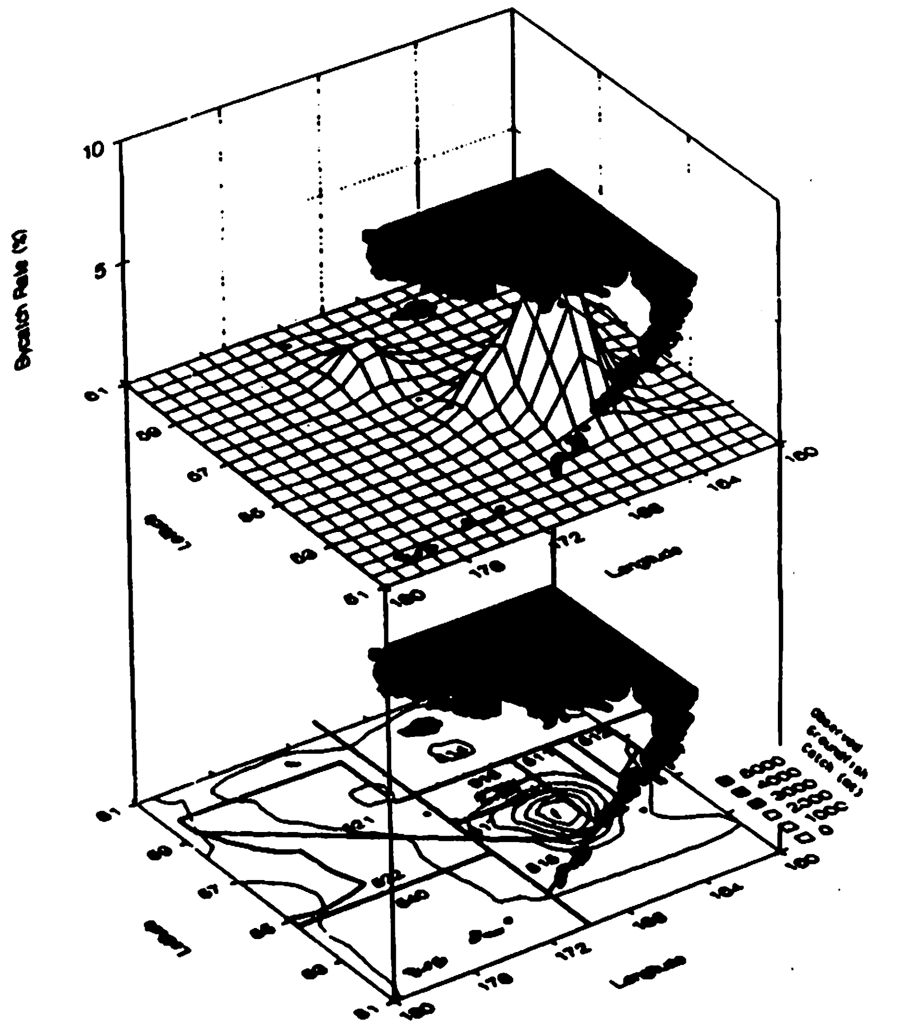

Figure 4.6 July herring and groundfish catch distributions. Upper panel: herring bycatch rate by foreign and joint venture pollock bottom trawl and "other" bottom trawl (primarily Pacific cod) gears, averaged from 1983 through 1988, by 1/2° latitude by 1° longitude area, smoothed by distance-weighted least squares. Lower panel: National Marine Fisheries Service regulatory reporting areas (511-540), contour lines of herring bycatch rates from the upper panel, and the distribution of observed foreign and joint venture observed catches for pollock and "other" bottom trawls from 1983-1988 (shaded areas).

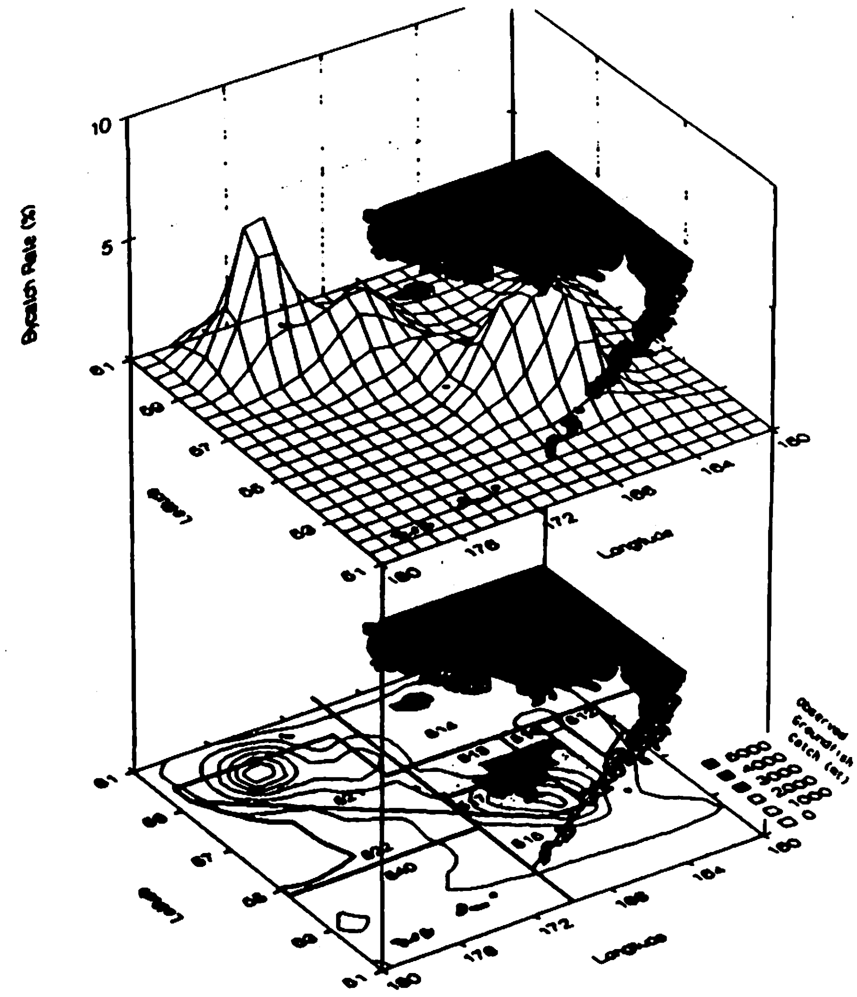

Figure 4.7 August herring and groundfish catch distributions. Upper panel: herring bycatch rate by foreign and joint venture pollock bottom trawl and "other" bottom trawl (primarily Pacific cod) gears, averaged from 1983 through 1988, by 1/2° latitude by 1° longitude area, smoothed by distance-weighted least squares. Lower panel: National Marine Fisheries Service regulatory reporting areas (511-540), contour lines of herring bycatch rates from the upper panel, and the distribution of observed foreign and joint venture observed catches for pollock and "other" bottom trawls from 1983-1988 (shaded areas).

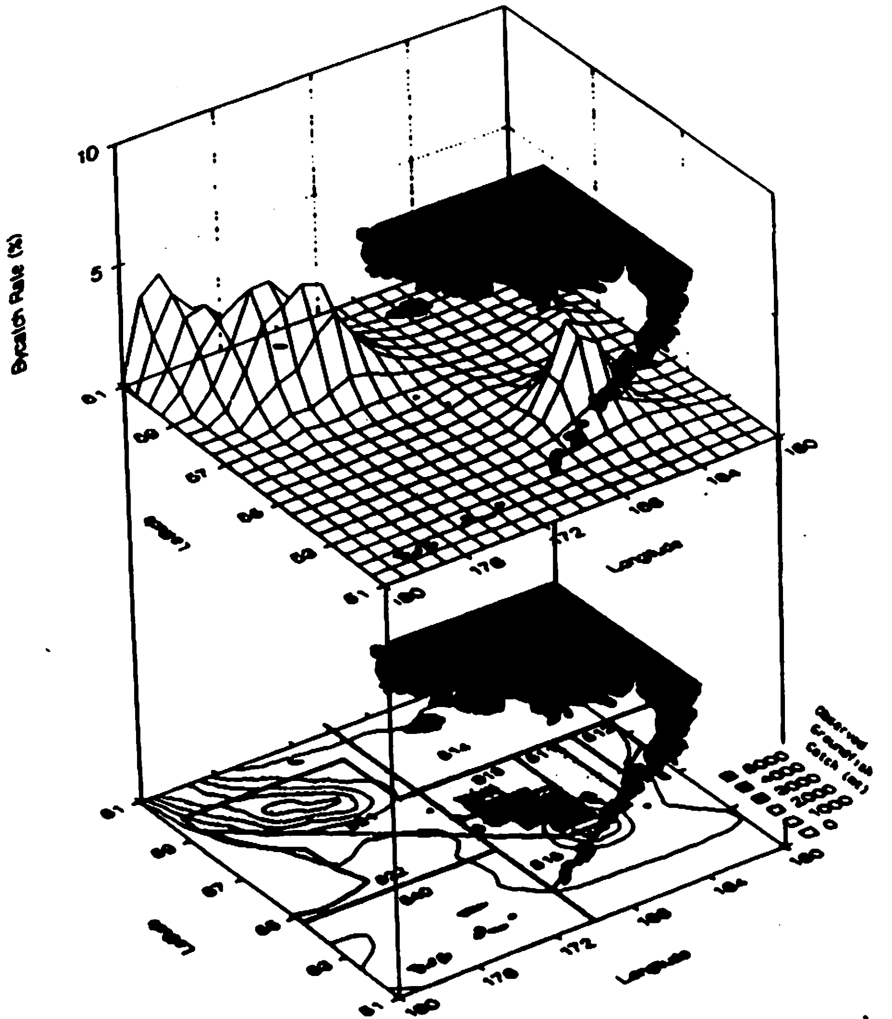

Figure 4.8 September herring and groundfish catch distributions. Upper panel: herring bycatch rate by foreign and joint venture pollock bottom trawl and "other" bottom trawl (primarily Pacific cod) gears, averaged from 1983 through 1988, by 1/2° latitude by 1° longitude area, smoothed by distance-weighted least squares. Lower panel: National Marine Fisheries Service regulatory reporting areas (511-540), contour lines of herring bycatch rates from the upper panel, and the distribution of observed foreign and joint venture observed catches for pollock and "other" bottom trawls from 1983-1988 (shaded areas).

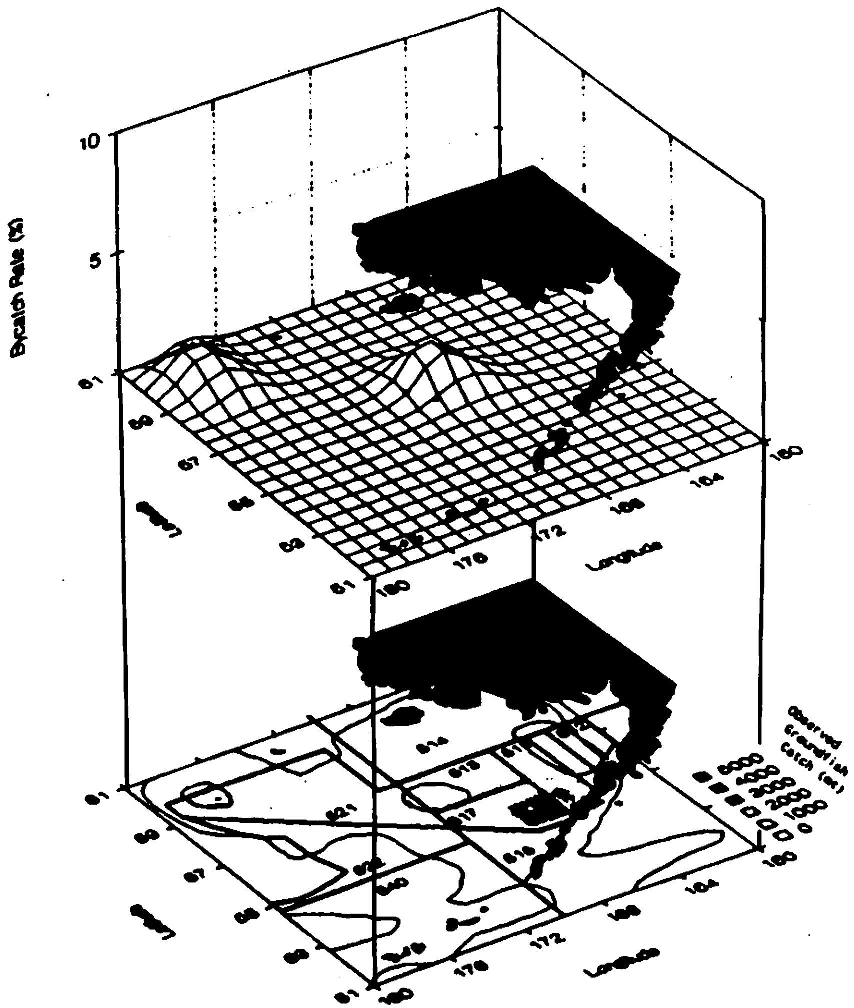

Figure 4.9 October herring and groundfish catch distributions. Upper panel: herring bycatch rate by foreign and joint venture pollock bottom trawl and "other" bottom trawl (primarily Pacific cod) gears, averaged from 1983 through 1988, by 1/2° latitude by 1° longitude area, smoothed by distance-weighted least squares. Lower panel: National Marine Fisheries Service regulatory reporting areas (511-540), contour lines of herring bycatch rates from the upper panel, and the distribution of observed foreign and joint venture observed catches for pollock and "other" bottom trawls from 1983-1988 (shaded areas).

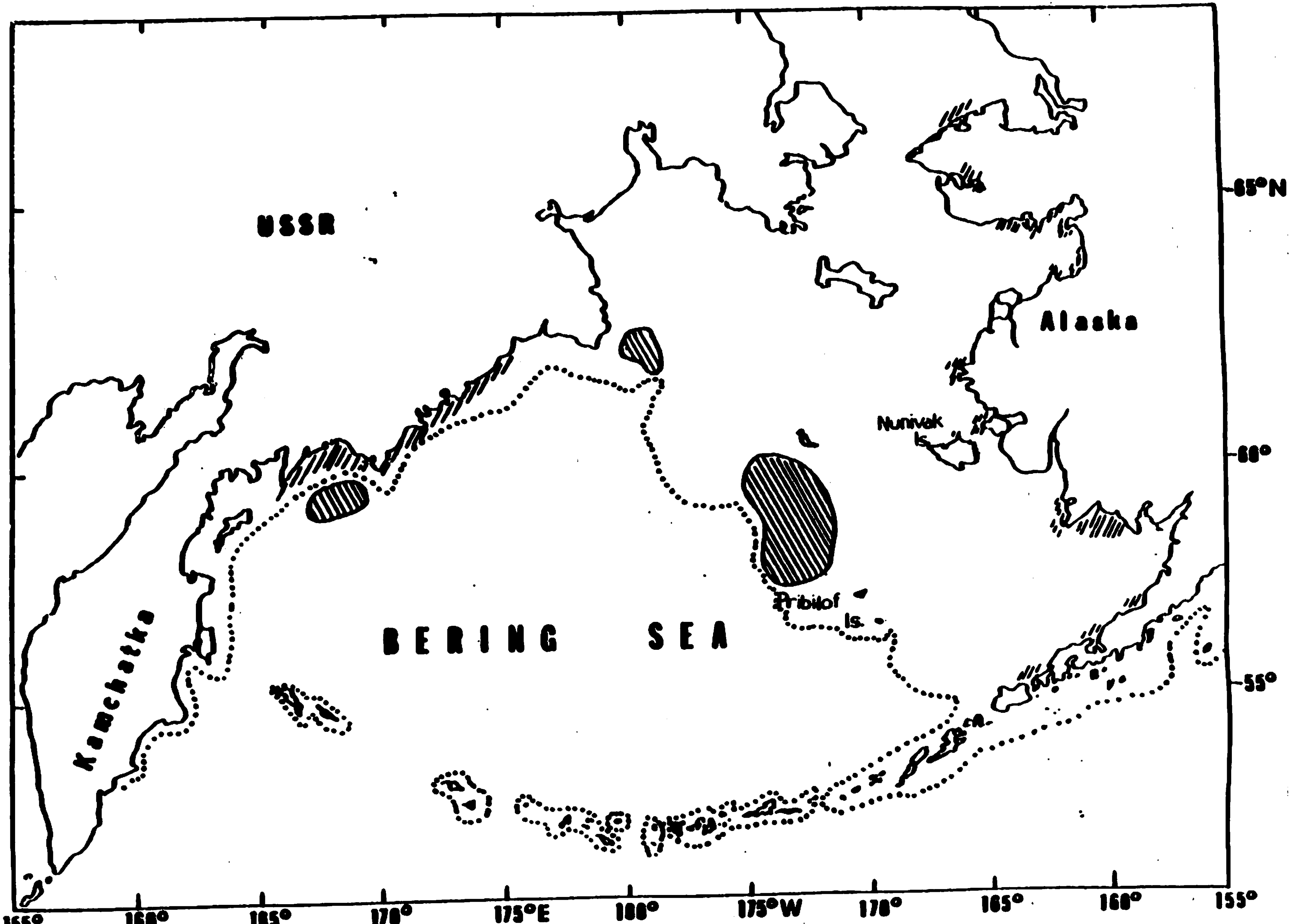

Figure 4 Location of the spawning and winter grounds (oval areas) of main eastern and western Bering Sea herring stocks (from NPFMC 1983).

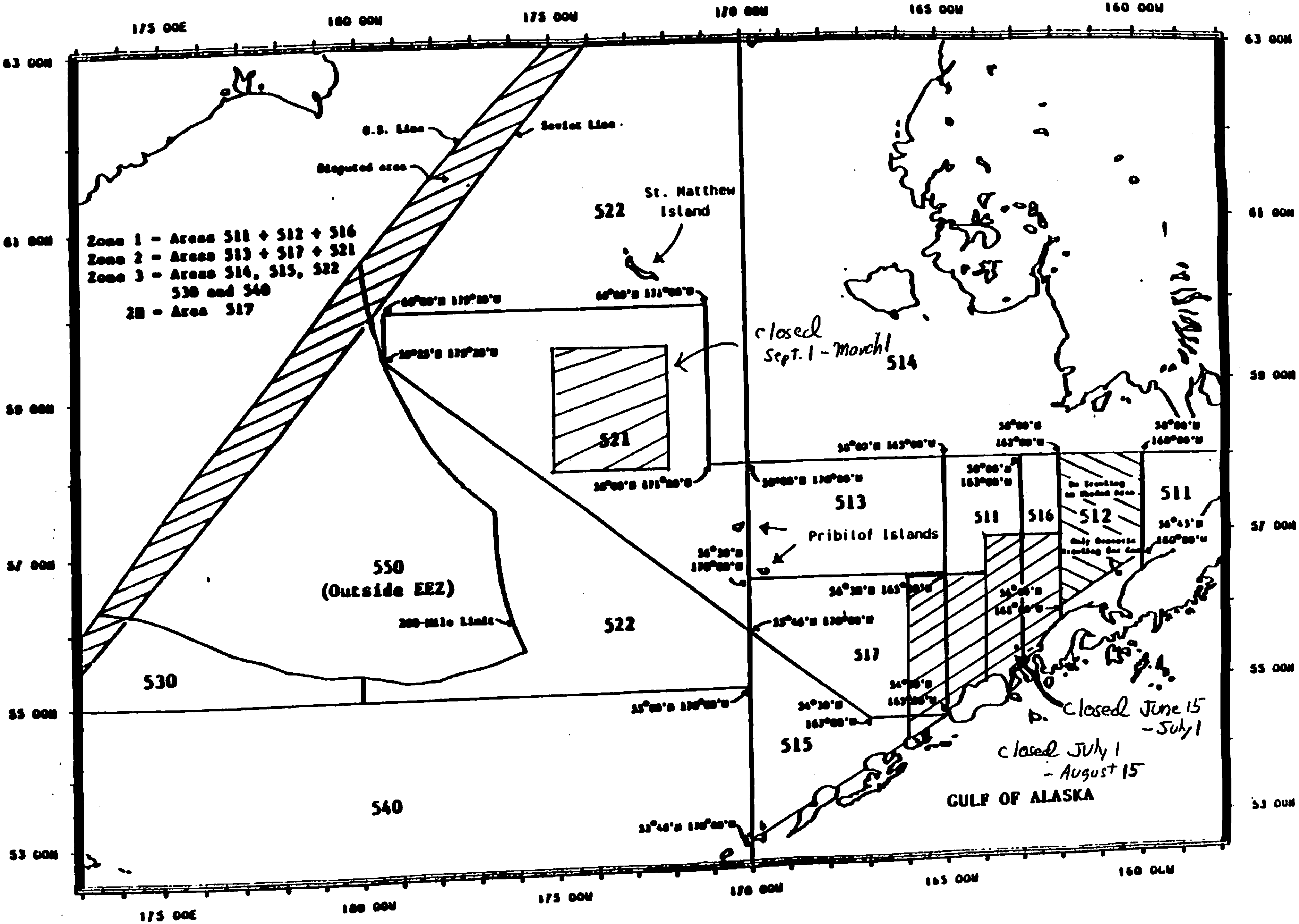

Figure 4.11 Herring Savings areas under Alternative 2.

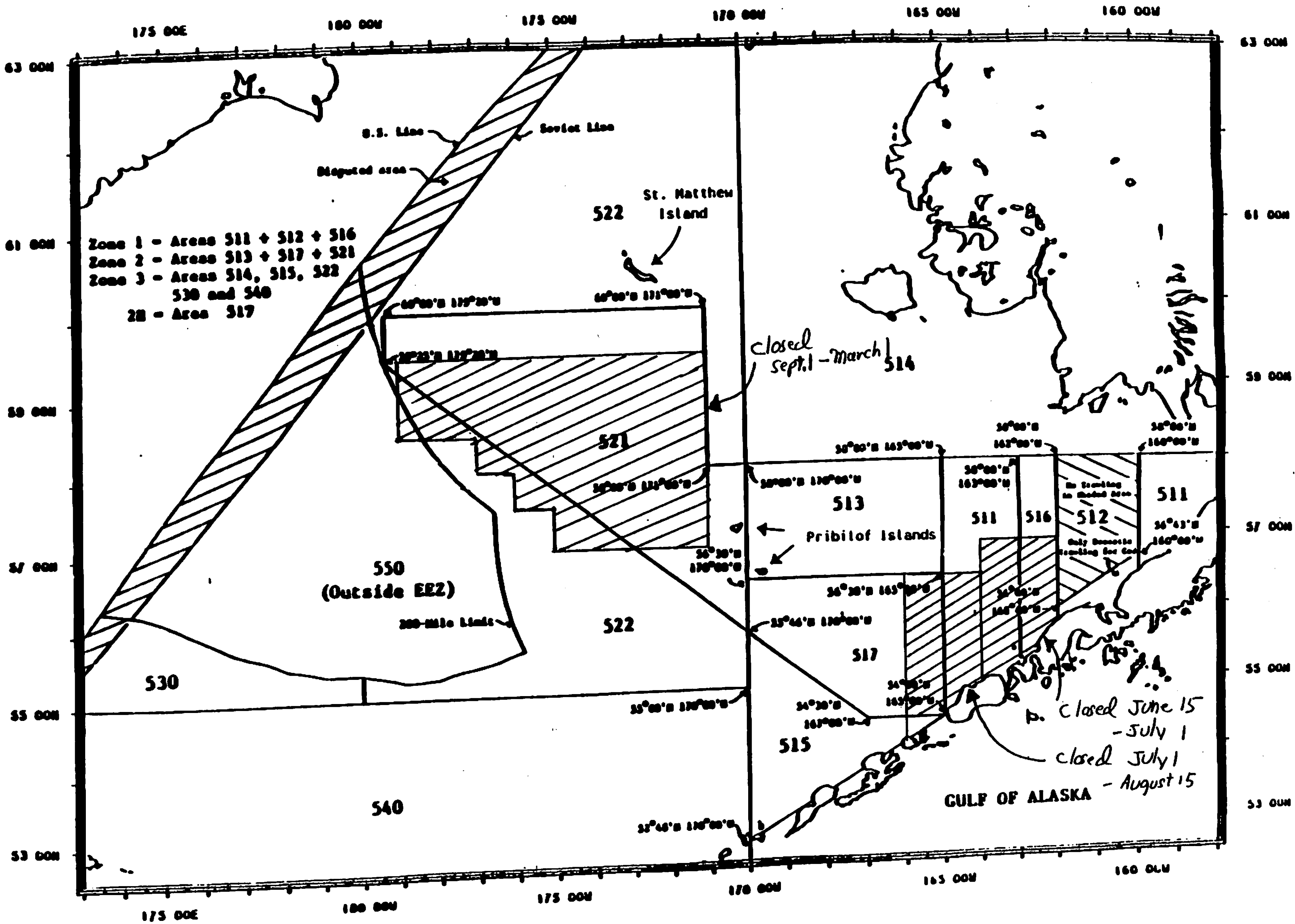

Figure 4.12 Herring Savings areas under Alternative 3.

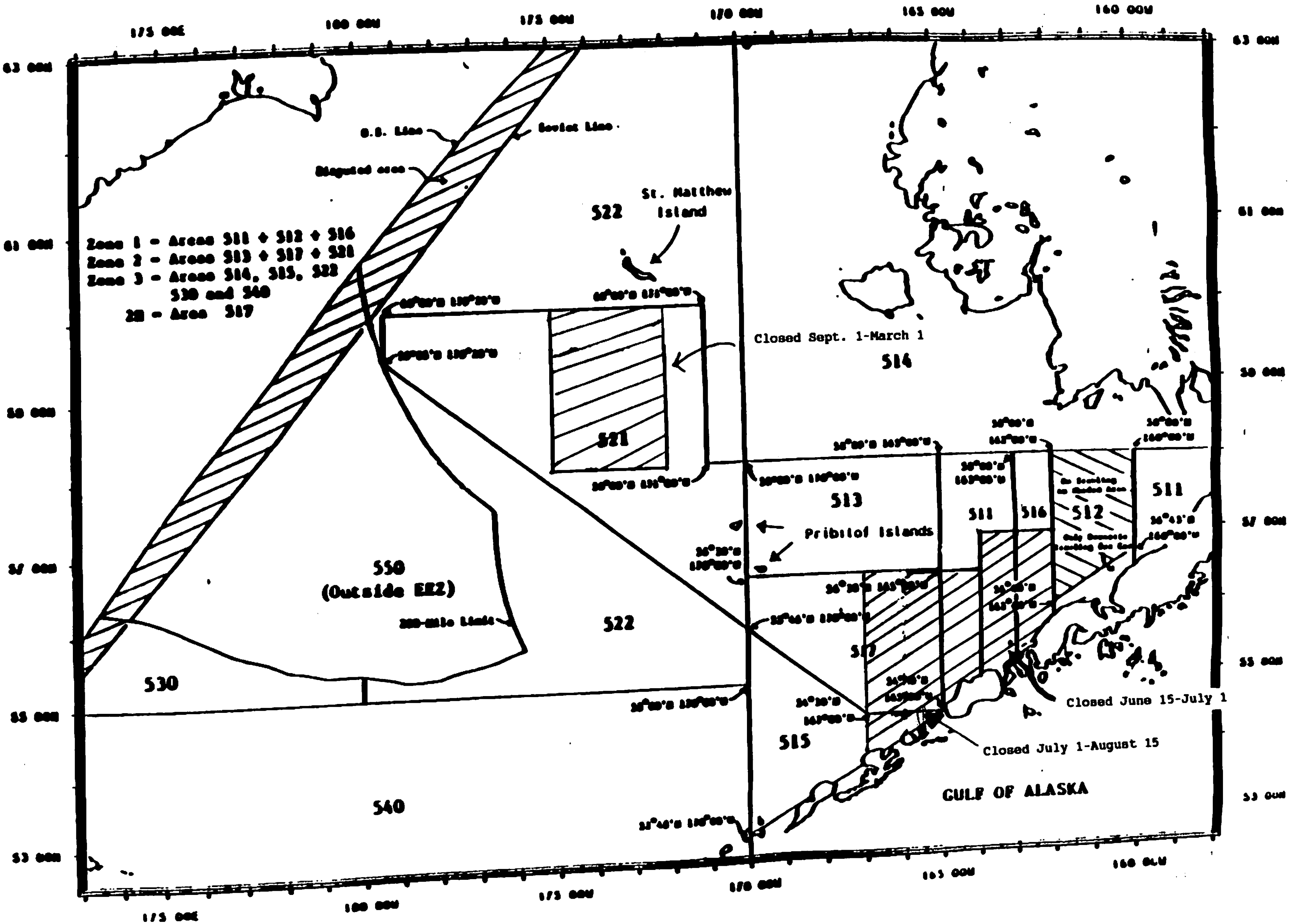

Figure 4.13 Herring Savings areas under Alternative 4.

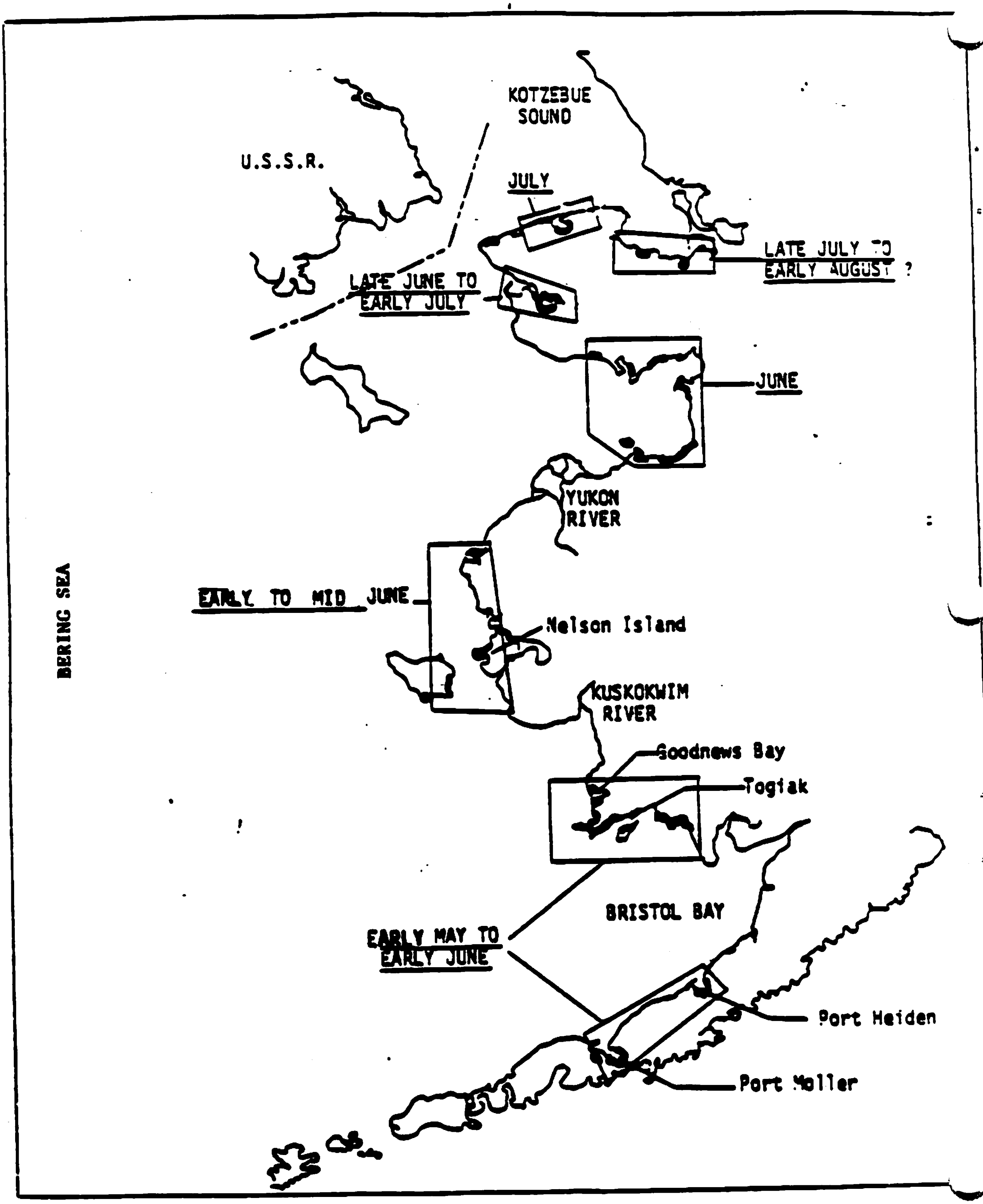

Figure 4.14 Timing and distribution of Pacific herring spawning in the eastern Bering Sea.

Figure 4.15 Spawning biomass of eastern Bering Sea herring stocks from 1983 through 1989, and the projected 1990 spawning biomass.

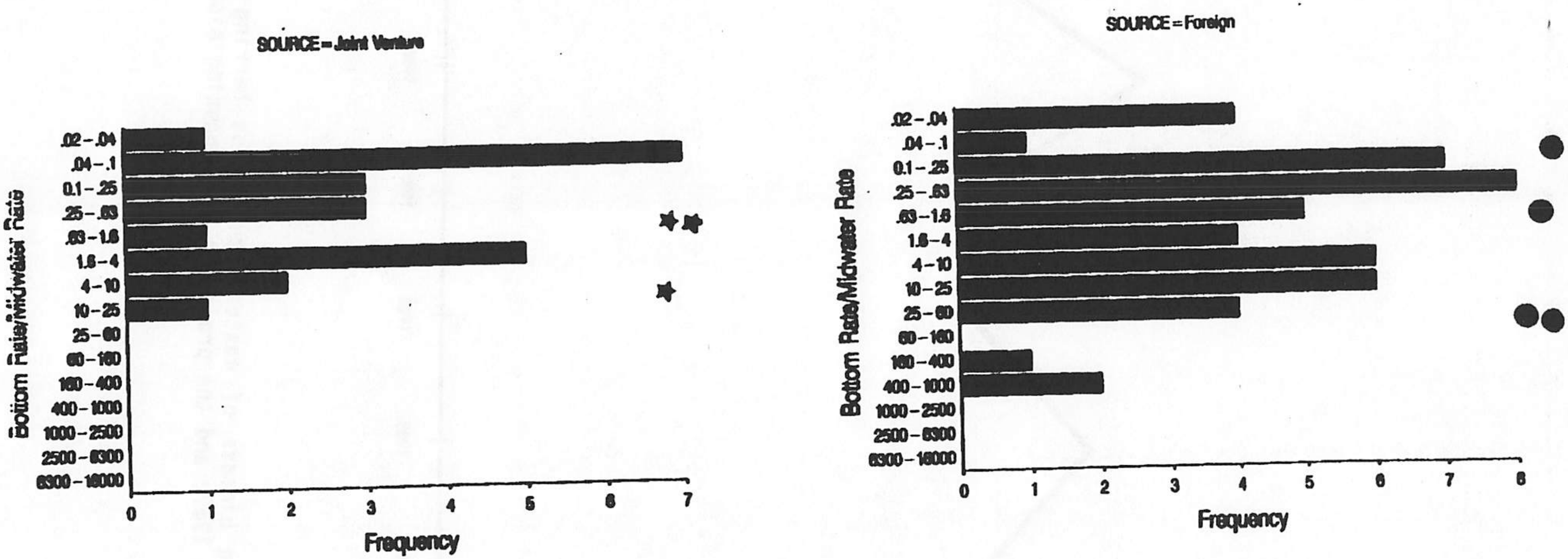

Figure 4.16 Frequency distribution of the ratio of bottom trawl herring bycatch rates to midwater trawl herring bycatch in 1983-88 joint venture and foreign observer records from 1/2° latitude by 1° longitude areas and months. Data from each cell were screened to include only observations where the groundfish catch by each gear exceeded 350 tons and the herring bycatch rates by one of the two gears exceeded 0.1%. For comparison, also shown are limited 1989 observations from:

★ 1989 joint venture observations.
● 1989 domestic landed discard observations (from fish tickets).

5.0 DESCRIPTION OF THE BYCATCH MODEL

A bycatch simulation model was used to estimate the effects of: (1) a limit on the amount of the pollock TACs that may be taken in the directed bottom trawl pollock fishery and (2) the herring bycatch control measures that were considered. It was not used to evaluate the inseason authority to close bycatch hot spots. The model extends the bycatch simulation model described by Smith et al. (1988), which has been used by the Council to evaluate the impacts of alternative crab and halibut bycatch control measures for Amendments 12a and 16.

5.1 Changes to the Model

The model differs from the model used for Amendment 16 in several ways. The model was extended to simultaneously estimate the effects of bycatch alternatives for crab, halibut, and herring. This change was made because the effects of alternatives to control herring bycatch depend on the crab and halibut alternative that is in place, just as the effects of a crab and halibut alternative depend on what herring alternative is in effect. The number of fisheries separately identified in the model was increased to allow for differences in bycatch rates between, for example, the bottom trawl pollock and cod fisheries. Weekly timesteps were used to approximate more closely the timing of fishery closures. Half by one degree catch areas were approximated to allow an evaluation of herring closures that do not coincide with the 3-digit statistical areas used for crab and halibut bycatch management. The matrix inversion, that had been used since the original Smith model to apportion TACs among fisheries, was eliminated. Instead of apportioning TACs among fisheries prior to the start of the simulation, the model closes fisheries once TACs are reached. This more closely approximates how the TACs are managed. Cost estimates that were a function of catch per unit of effort (CPUE) were replaced by costs estimates based on gross wholesale value because neither the CPUE data nor the relationship between CPUE and costs were adequate to provide reasonable estimates of costs. The other major change was in the software used to implement the model. The Excel spreadsheet model was replaced with a SAS programming language model. This greatly increased the flexibility of the model and made error checking much less difficult. It did, however, make the model less accessible to the public. Although SAS is available for personal computers, it is not used as widely as is Excel. There was also a change made in how the model was used to estimate the effects of the various alternatives. Because the Council has established the 1991 apportionments of the PSC limits, those apportionments were used by the model. In the past, unconstrained model runs were used to estimate the apportionments.

5.2 Model Inputs

The model inputs are: (1) historical bycatch rates by fishery, 3-digit statistical area, and quarter (Tables 5.1.a-5.1.d); (2) crab and halibut bycatch rates adjusted to reflect the estimated effects of a vessel incentive program (Tables 5.2.a-5.2.c); (3) catch composition by fishery, 3-digit statistical area, and quarter (Table 5.3); (4) TACs and projected distribution of target species catch by fishery, quarter and area in the absence of PSC limits (i.e., the unconstrained distribution of catch) (Tables 5.4 and 5.5); (5) catch data by half by one degree area, fishery, and month; (6) estimates of gross and net wholesale value per metric ton of groundfish catch (Table 5.6); (7) estimates of the impact cost per unit of bycatch (Table 5.7); and (8) the 1991 apportionments of PSC limits recommended by the Council at its December 1990 meeting (Table 5.8).

NMFS Observer Program catch and bycatch data for 1990 were used as the basis of the crab and halibut bycatch rate data used in the model as well as the catch composition data. If adequate data were not available for 1990, 1986 through 1989 joint venture data were used to estimate bycatch rates and catch composition. Herring bycatch rates were estimated from the 1983-88 joint venture and foreign observer records (see Funk et al. 1990 and Funk 1990 for detailed descriptions). The weights of herring bycatch and total groundfish catches were recorded by observers aboard joint venture and foreign groundfish vessels from 1983 through 1988. These data were summarized by month, half by one degree area, and target fishery category. A more complete discussion of the method used to estimate the herring bycatch rates used in the model was presented in Section 4.2.1.

Adjustment factors were applied to the historically based bycatch rates for crab and halibut to account for the effects of the revised vessel incentive program of Amendment 16. The adjustment factor for each fishery is equal to the ratio of two bycatch rates. The first bycatch rate was calculated using 1990 NMFS Observer Program catch and bycatch data for each vessel that did not have a monthly bycatch rate greater than twice the standard recommended by the Council. The second rate was the quarterly mean observed bycatch rate for a fishery.

In some instances, the adjusted bycatch rates for crab were greater than the unadjusted rates. This occurred when the vessels with halibut bycatch rates that exceeded the halibut standard by more than 100% had lower average bycatch rates for crab than did the vessel with lower halibut bycatch rates. This demonstrates the importance of remembering that bycatch is a multispecies problem and that an action taken to reduce the bycatch of one species can increase that of another.

The distributions of TACs among fisheries, areas, and seasons are difficult to estimate because the domestic fishery has been growing and changing rapidly in the last few years and because random factors, such as water temperatures, ice coverage, and market conditions, affect the distributions. In the absence of adequate historical data on which to base projections of the distributions of TACs, estimates provided by the groundfish industry were used together with catch distribution data from 1989 and 1990 to estimate the unconstrained catch distributions used in the model.

1989 fish tickets are the source of the half by one degree catch data used in the model. Catch within a 3-digit statistical area, fishery, and quarter from the industry projections was distributed over months and half by one degree areas according to the distribution of catch within the 3-digit statistical area, fishery, and quarter in the 1989 fish ticket data.

The 1991 TACs recommended by the Council in December were used in the model. Based on the Council's recommendation concerning the apportionment of TACs between DAP and JVP fisheries, no joint venture apportionments were made.

For the domestic (DAP) fisheries, the first wholesale values of the resulting processed products were used. Observer program data for 1990 were used to estimate the proportion of catch that was retained. Variable costs were assumed to be a fixed proportion of the gross value per metric ton of catch. The proportions, which differed by fishery, were based on information provided by Pat Burden (pers. comm.).

The estimates of bycatch impact cost per crab are based on the expected growth and natural mortality that would occur between the typical ages of capture as bycatch in the groundfish fishery and retention in the crab fishery.

For herring, the average age of capture in sac roe herring and groundfish fisheries was assumed to be similar. Most trawl herring bycatch occurs in the late summer and fall, approximately six months before the sac roe fishery. To allow for growth and natural mortality effects over this six month period, the estimated impact cost per metric ton of herring was computed using the spring spawner-equivalent of the trawl bycatch. This was computed by multiplying 1 mt of trawl bycatch by 0.83 to allow for mortality and growth effects from the time that the bycatch occurred until the spring spawning period. Sac roe harvests were valued at $683/ton, the average price received for Bering Sea herring in 1989. If herring bycatch reduces subsistence catch as well as commercial catch, the impact cost per unit of bycatch is underestimated by the difference in benefits per unit of catch in the subsistence and commercial herring fisheries.

It is difficult to estimate the impact cost of herring bycatch because the impact cost depends on which herring stocks and fisheries are affected by the bycatch. For example, the impact costs of decreasing the size of the Togiak commercial fishery by 100 mt would probably be much less than those of decreasing catch in the Nelson Island subsistence fishery by 100 mt. The lack of definitive information on the migratory patterns of various stocks makes it difficult to-determine which stocks will be affected by herring bycatch.

Under the Alaska National Interest Lands Conservation Act (ANILCA), subsistence uses of fish and game are assigned a higher priority than commercial or recreational uses. When insufficient resources are available to meet both subsistence and other needs, ANILCA provisions specify that subsistence users receive first access to the resource. The State of Alaska adopted statutes (AS 16.05.528) to comply with ANILCA, and the Alaska Board of Fisheries has adopted regulations (5 AAC 99.010) to implement the priority placed on subsistence uses under ANILCA. These statutory provisions indicate that subsistence catches are assigned a higher value than commercial catches.

The economic and cultural dependence of some communities on both the subsistence and commercial herring fisheries is discussed in the Appendix.

A different method is used to estimate the impact cost per unit of halibut bycatch because the quotas in the halibut fisheries are adjusted based on estimated bycatch mortality. In the past, the IPHC reduced the total quota for the halibut fishery by about 1.6 mt for each 1 mt of estimated bycatch mortality in the groundfish fishery. The policy of the IPHC is now to maintain reproductive output (egg production) at the same level it would be in the absence of bycatch. This results in bycatch in one year affecting halibut quotas over a 9-year period. Based on IPHC estimates of the effect by year for each of the nine years (Bill Clark pers. comm.), the discounted present value of the resulting change in quotas is approximately 1.32 mt of halibut for each 1 mt of halibut bycatch mortality. This means that if the dressed weight exvessel price of halibut is $1.51 per pound, as it was on average in 1989, if the dressed weight recovery factor is 0.75, and if the exvessel price is not affected by the decrease in halibut catch, each 1 mt of halibut bycatch mortality will decrease the discounted present value of halibut fishery gross exvessel value by about $3,300 (2,205 lbs x 1.32 x 0.75 x $1.51).

5.3 Model Outputs

The model generates estimates of: (1) catch and bycatch; (2) gross revenue for the groundfish industry and gross revenue net of variable costs; and (3) bycatch impact costs. The method used to make these estimates is described below.

Finer time-area stratification was needed for the herring analysis than had previously been used for the crab and halibut analysis. The boundaries of areas considered for herring savings areas differ considerably from the NMFS statistical areas (Figures 4.1, 4.2 and 4.11-4.13). The model was extended from more aggregated areas and time periods to track catch by half by one degree area and week. Catch data from 1989 fish tickets was used to allocate catch within NMFS statistical areas to the smaller areas. The model divides catch within a month into four equal portions to simulate weekly catches. Although the simulation model uses weekly time steps, and bycatch rate data are maintained in the quarterly aggregates. These larger time-area aggregates help to smooth out some of the variability inherent in the bycatch rate data. This allowed catch and bycatch to be aggregated more flexibly into areas with different boundaries. Because the herring migration down the Alaska Peninsula occurs rather rapidly, and because herring bycatch can accumulate rapidly, a relatively small time step was needed to properly simulate closure of fisheries when PSC limits were attained. Weekly time steps were chosen for the simulation model as these approximate the limits attainable by the actual inseason management process.

In each model run, a fishery is closed in an area once it takes its apportionment of a PSC limit or once the TAC is taken, which ever occurs first. When a fishery is closed due to a PSC limit, the catch that would have been taken from the closed area in each future month is proportionately redistributed among the areas that remain open. For example, if it was assumed that the March catch for a fishery will be 50,000 mt, 60,000 mt, and 90,000 mt, respectively, in Zones 1, 2, and 3, and if Zone 1 is estimated to be closed at the end of February, the March catches would be 0 mt, 80,000 mt, and 120,000 mt for the three zones.

The estimates of total catch generated by the model are combined with estimates of discards, product recovery rates, and first wholesale prices to estimate the gross first wholesale value of the groundfish catch. The model estimates discards that would occur once a TAC is taken and a groundfish species becomes a prohibited species. Other (i.e., voluntary) discards are accounted for by using estimated discard rates to estimate retained catch and value per metric ton of catch.

The estimates of gross value are used with estimates of variable costs as functions of gross value to estimate gross value net of variable costs.

The estimates of the bycatch impact costs are generated as the products of estimated bycatch and estimates of the impact cost per unit of bycatch. It is assumed that bycatch mortality is 100%. The impact costs can be adjusted to reflect alternative mortality assumptions by multiplying the impact costs presented in this report by alternative mortality rates. The estimated impact costs are in terms of the present discounted value of foregone gross exvessel value. A real discount rate of 5% is used. As noted above, the impact costs for herring is underestimated to the extent that the value per unit of herring is higher for subsistence catch than for commercial catch if bycatch reduces subsistence catch.

Substantial uncertainty concerning the effects of the alternatives on catch and bycatch results from the following: (1) the temporal and spatial variability of bycatch rates; (2) the uncertainty about future TAC's and their distributions among fisheries, time periods, and areas; and (3) the highly speculative estimates of the effects of the vessel incentive program. The variability in product prices, discard rates, variable costs, and other factors that determine the gross and net value per unit of catch has a similar result with respect to the estimates of economic performance. Similarly, the variability of the factors that determine impacts costs per unit of bycatch result in uncertainty concerning the total bycatch impact costs associated with each set of bycatch management measures.

Table 5.1.a.--Quarterly (Months 1-3, 4-6, 7-9, and 10-12) Red King Crab Bycatch rates by Subarea and Fishery with No Vessel Incentive Program.

Target Fishery:	Subarea	Jan #/mt	Feb #/mt	Mar #/mt	Apr #/mt	May #/mt	Jun #/mt	Jul #/mt	Aug #/mt	Sep #/mt	Oct #/mt	Nov #/mt	Dec #/mt
Atka Mackerel Trawl	515	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	540	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pollock Bottom Trawl	511	0.102	0.102	0.102	0.020	0.020	0.020	0.060	0.060	0.060	0.060	0.060	0.060
	513	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	.	.	.
	515	.	.	.	0.000	0.000	0.000	0.000	0.000	0.000	.	.	.
	517	0.002	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	521	.	.	.	0.000	0.000	0.000	0.001	0.001	0.001	0.000	0.000	0.000
Deepwater Flatfish	515	0.008	0.008	0.008	0.080	0.080	0.080	0.171	0.171	0.171	0.171	0.171	0.171
	517	.	.	.	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	521	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	522	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	540	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Flatfish Trawl	511	4.163	4.163	4.163	2.390	2.390	2.390	1.300	1.300	1.300	0.272	0.272	0.272
	513	0.044	0.044	0.044	0.070	0.070	0.070	0.122	0.122	0.122	0.020	0.020	0.020
	514	.	.	.	0.011	0.011	0.011	0.015	0.015	0.015	0.008	0.008	0.008
	516	6.546	6.546	6.546	3.000	3.000	3.000	2.000	2.000	2.000	0.400	0.400	0.400
	517	0.004	0.004	0.004	.	.	.	.	.	.	.	.	.
JV Flatfish Trawl	511	4.163	4.163	4.163	2.390	2.390	2.390	1.300	1.300	1.300	0.272	0.272	0.272
	513	0.044	0.044	0.044	0.070	0.070	0.070	0.122	0.122	0.122	0.020	0.020	0.020
	514	.	.	.	0.011	0.011	0.011	0.015	0.015	0.015	0.008	0.008	0.008
	516	6.546	6.546	6.546	3.000	3.000	3.000	2.000	2.000	2.000	0.400	0.400	0.400
	517	0.004	0.004	0.004	.	.	.	.	.	.	.	.	.
Midwater Pollock	511	0.102	0.102	0.102	0.017	0.017	0.017	0.000	0.000	0.000	0.100	0.100	0.100
	513	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	515	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	517	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.003	0.003	0.000	0.000	0.000
	521	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	522	.	.	.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	540	.	.	.	.	.	.	.	.	.	0.000	0.000	0.000
Other Bottom Trawl	511	0.004	0.004	0.004	0.061	0.061	0.061	0.033	0.033	0.033	0.033	0.033	0.033
	513	.	.	.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	515	0.002	0.002	0.002	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001
	517	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	521	0.000	0.000	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
	540	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	.	.	.
Rock Sole Trawl	511	0.471	0.471	0.471	.	.	.	.	.	.	0.471	0.471	0.471
	516	3.342	3.342	3.342	.	.	.	.	.	.	3.342	3.342	3.342
	517	0.000	0.000	0.000	.	.	.	.	.	.	.	.	.

Table 5.1.b.--Quarterly (Months 1-3, 4-6, 7-9, and 10-12) Bairdi Tanner Crab Bycatch rates by Subarea and Fishery with No Vessel Incentive Program.

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Target Fishery:	Subarea	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt
Atka Mackerel Trawl	515	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	540	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Pollock Bottom Trawl	511	6.930	6.930	6.930	2.659	2.659	2.659	4.800	4.800	4.800	4.800	4.800	4.800
	513	0.214	0.214	0.214	0.646	0.646	0.646	1.571	1.571	1.571	.	.	.
	515	.	.	.	0.043	0.043	0.043	0.637	0.637	0.637	.	.	.
	517	1.163	1.163	1.163	0.465	0.465	0.465	0.806	0.806	0.806	0.806	0.806	0.806
	521	.	.	.	0.494	0.494	0.494	1.211	1.211	1.211	0.154	0.154	0.154
Deepwater Flatfish	515	0.025	0.025	0.025	0.380	0.380	0.380	0.760	0.760	0.760	0.760	0.760	0.760
	517	.	.	.	2.000	2.000	2.000	1.954	1.954	1.954	2.000	2.000	2.000
	521	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
	522	0.300	0.300	0.300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	540	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
Flatfish Trawl	511	14.522	14.522	14.522	2.460	2.460	2.460	5.100	5.100	5.100	7.800	7.800	7.800
	513	10.122	10.122	10.122	14.500	14.500	14.500	18.993	18.993	18.993	13.394	13.394	13.394
	514	.	.	.	0.000	0.000	0.000	0.665	0.665	0.665	1.220	1.220	1.220
	516	13.289	13.289	13.289	2.460	2.460	2.460	5.100	5.100	5.100	7.800	7.800	7.800
	517	11.506	11.506	11.506	.	.	.	.	.	.	.	.	.
JV Flatfish Trawl	511	14.522	14.522	14.522	2.460	2.460	2.460	5.100	5.100	5.100	7.800	7.800	7.800
	513	10.122	10.122	10.122	14.500	14.500	14.500	18.993	18.993	18.993	13.394	13.394	13.394
	514	.	.	.	0.000	0.000	0.000	0.665	0.665	0.665	1.220	1.220	1.220
	516	13.289	13.289	13.289	2.460	2.460	2.460	5.100	5.100	5.100	7.800	7.800	7.800
	517	11.506	11.506	11.506	.	.	.	.	.	.	.	.	.
Midwater Pollock	511	0.097	0.097	0.097	0.277	0.277	0.277	0.013	0.013	0.013	0.013	0.013	0.013
	513	0.008	0.008	0.008	0.011	0.011	0.011	0.013	0.013	0.013	0.013	0.013	0.013
	515	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.002	0.001	0.001	0.001
	517	0.040	0.040	0.040	0.014	0.014	0.014	0.194	0.194	0.194	0.000	0.000	0.000
	521	0.246	0.246	0.246	0.373	0.373	0.373	0.043	0.043	0.043	0.076	0.076	0.076
	522	.	.	.	0.000	0.000	0.000	0.007	0.007	0.007	0.009	0.009	0.009
	540	.	.	.	.	.	.	.	.	.	0.000	0.000	0.000
Other Bottom Trawl	511	18.905	18.905	18.905	18.859	18.859	18.859	18.900	18.900	18.900	18.900	18.900	18.900
	513	.	.	.	2.084	2.084	2.084	2.084	2.084	2.084	2.084	2.084	2.084
	515	2.214	2.214	2.214	0.099	0.099	0.099	0.099	0.099	0.099	0.099	0.099	0.099
	517	3.654	3.654	3.654	4.479	4.479	4.479	4.400	4.400	4.400	4.400	4.400	4.400
	521	0.284	0.284	0.284	0.735	0.735	0.735	0.000	0.000	0.000	0.500	0.500	0.500
	540	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	.	.	.
Rock Sole Trawl	511	8.602	8.602	8.602	.	.	.	.	.	.	8.602	8.602	8.602
	516	16.317	16.317	16.317	.	.	.	.	.	.	16.317	16.317	16.317
	517	7.886	7.886	7.886	.	.	.	.	.	.	.	.	.

Table 5.1.c.--Quarterly (Months 1-3, 4-6, 7-9, and 10-12) Halibut Bycatch rates by Subarea and Fishery with No Vessel Incentive Program.

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Target Fishery:	Subarea	kg/mt	kg/mt	kg/mt	kg/mt	kg/mt	kg/mt	kg/mt	kg/mt	kg/mt	kg/mt	kg/mt	kg/mt
Atka Mackerel Trawl	515	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200
	540	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200
Pollock Bottom Trawl	511	8.400	8.400	8.400	7.400	7.400	7.400	8.000	8.000	8.000	8.000	8.000	8.000
	513	0.900	0.900	0.900	4.600	4.600	4.600	0.400	0.400	0.400	.	.	.
	515	.	.	.	5.400	5.400	5.400	2.800	2.800	2.800	.	.	.
	517	4.900	4.900	4.900	4.200	4.200	4.200	1.300	1.300	1.300	1.000	1.000	1.000
	521	.	.	.	2.200	2.200	2.200	0.800	0.800	0.800	0.200	0.200	0.200
Deepwater Flatfish	515	134.600	134.600	134.600	0.200	0.200	0.200	1.700	1.700	1.700	0.200	0.200	0.200
	517	.	.	.	2.200	2.200	2.200	10.700	10.700	10.700	1.600	1.600	1.600
	521	0.900	0.900	0.900	0.400	0.400	0.400	0.300	0.300	0.300	1.400	1.400	1.400
	522	0.900	0.900	0.900	0.500	0.500	0.500	0.200	0.200	0.200	0.900	0.900	0.900
	540	0.900	0.900	0.900	0.500	0.500	0.500	0.200	0.200	0.200	0.900	0.900	0.900
Flatfish Trawl	511	10.600	10.600	10.600	9.000	9.000	9.000	9.000	9.000	9.000	9.000	9.000	9.000
	513	1.100	1.100	1.100	1.100	1.100	1.100	0.600	0.600	0.600	1.600	1.600	1.600
	514	.	.	.	1.200	1.200	1.200	1.700	1.700	1.700	1.200	1.200	1.200
	516	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300
	517	7.500	7.500	7.500	.	.	.	.	.	.	.	.	.
JV Flatfish Trawl	511	10.600	10.600	10.600	9.000	9.000	9.000	9.000	9.000	9.000	9.000	9.000	9.000
	513	1.100	1.100	1.100	1.100	1.100	1.100	0.600	0.600	0.600	1.600	1.600	1.600
	514	.	.	.	1.200	1.200	1.200	1.700	1.700	1.700	1.200	1.200	1.200
	516	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300
	517	7.500	7.500	7.500	.	.	.	.	.	.	.	.	.
Midwater Pollock	511	0.500	0.500	0.500	0.700	0.700	0.700	0.000	0.000	0.000	1.200	1.200	1.200
	513	0.300	0.300	0.300	0.400	0.400	0.400	0.200	0.200	0.200	0.300	0.300	0.300
	515	0.000	0.000	0.000	0.100	0.100	0.100	0.000	0.000	0.000	0.100	0.100	0.100
	517	0.700	0.700	0.700	0.300	0.300	0.300	0.000	0.000	0.000	0.100	0.100	0.100
	521	0.800	0.800	0.800	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
	522	.	.	.	0.100	0.100	0.100	0.000	0.000	0.000	0.100	0.100	0.100
	540	.	.	.	.	.	.	.	.	.	0.100	0.100	0.100
Other Bottom Trawl	511	13.900	13.900	13.900	21.500	21.500	21.500	17.700	17.700	17.700	17.700	17.700	17.700
	513	.	.	.	14.600	14.600	14.600	0.000	0.000	0.000	0.000	0.000	0.000
	515	19.500	19.500	19.500	17.900	17.900	17.900	18.700	18.700	18.700	18.700	18.700	18.700
	517	15.200	15.200	15.200	29.200	29.200	29.200	22.200	22.200	22.200	22.200	22.200	22.200
	521	5.000	5.000	5.000	12.900	12.900	12.900	9.000	9.000	9.000	9.000	9.000	9.000
	540	15.300	15.300	15.300	15.300	15.300	15.300	15.300	15.300	15.300	.	.	.
Rock Sole Trawl	511	16.500	16.500	16.500	.	.	.	.	.	.	16.500	16.500	16.500
	516	9.600	9.600	9.600	.	.	.	.	.	.	9.600	9.600	9.600
	517	24.800	24.800	24.800	.	.	.	.	.	.	.	.	.

Table 5.1.d.--Quarterly (Months 1-3, 4-6, 7-9, and 10-12) Herring Bycatch rates by Subarea and Fishery with No Vessel Incentive Program.

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Target Fishery:	Subarea	mt/mt	mt/mt	mt/mt	mt/mt	mt/mt	mt/mt	mt/mt	mt/mt	mt/mt	mt/mt	mt/mt	mt/mt
Atka Mackerel Trawl	515	.	.	.	.	.000000	.000000	.	.	.	.	.	.
	540	.	.	.	.000000	.000000	.000000	.	.	.	.	.	.
Pollock Bottom Trawl	511	.000001	.000000	.000001	.000018	.000097	.006721	.	.	.	.	.	.000000
	513	.	.000000	.	.000000	.000089	.	.	.	.000443	.	.	.
	517	.000000	.000029	.000000	.000003	.000000	.000232	.007148	.003896	.002641	.005600	.000010	.000000
	521	.	.	.	.000036	.000290	.	.	.	.000069	.002757	.	.000000
Deepwater Flatfish	515	.	.	.	.000000	.000000	.000000	.000000	.	.000000	.	.	.
	517	.	.	.	.	.000000	.000000	.000000	.000000	.000000	.	.	.
	521	.	.	.	.000000	.	.	.000000	.	.	.	.	.
	540	.	.	.	.000000	.000000	.000000	.000000	.000000	.000000	.	.	.
Flatfish Trawl	511	.	.	.	.	.	.	.015028	.	.	.000000	.000000	.000000
	513	.	.	.	.	.	.	.	.	.000128	.000084	.000000	.000000
	514	.	.	.	.	.	.	.	.012368	.000000	.	.000000	.000000
	516	.	.	.	.	.	.	.001189	.	.	.000016	.	.
Midwater Pollock	511	.000001	.000000	.000002	.000005	.	.000526	.014095	.018448	.	.	.	.000000
	513	.001879	.000003	.000000	.000001	.000034	.	.000120	.	.003077	.001454	.	.
	515	.000000	.000000	.000000	.000000	.	.	.108108	.010486	.049884	.000181	.000000	.000000
	517	.000001	.000006	.000004	.000021	.000029	.003080	.006469	.013848	.003286	.000393	.000017	.000001
	521	.	.	.000000	.000006	.000023	.000035	.000023	.007522	.007616	.004903	.	.
	522	.	.	.	.	.000000	.000000	.000000	.000000	.	.000000	.000000	.000000
	540	.	.	.	.	.	.	.	.	.	.	.000000	.000000
Other Bottom Trawl	511	.000000	.000001	.000002	.000016	.000014	.000291	.008609	.007485	.002764	.	.	.000000
	515	.000000	.000000	.000000	.000000	.000000	.000000	.043171	.075391	.147842	.	.	.
	517	.000000	.000001	.000000	.000055	.000003	.000000	.001983	.006943	.005443	.003839	.000007	.000000
	521	.000000	.000000	.000000	.000000	.000000	.000000	.	.	.000029	.	.	.
	540	.000000	.000000	.000000	.000000	.000000	.000000	.000000	.000000	.000000	.	.	.
Rock Sole Trawl	511	.000009	.000003	.000078	.	.	.	.	.	.	.000000	.000000	.000000
	516	.	.000000	.000000	.	.	.	.	.	.	.000000	.000001	.000000
	517	.000000	.000000	.000000	.	.	.	.	.	.	.	.	.

Table 5.2.a.--Quarterly (Months 1-3, 4-6, 7-9, and 10-12) Red King Crab Bycatch rates by Subarea and Fishery with A Vessel Incentive Program.

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Target Fishery:	Subarea	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt
Atka Mackerel Trawl	515	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	540	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pollock Bottom Trawl	511	0.102	0.102	0.102	0.020	0.020	0.020	0.060	0.060	0.060	0.060	0.060	0.060
	513	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	.	.	.
	515	.	.	.	0.000	0.000	0.000	0.000	0.000	0.000	.	.	.
	517	0.002	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	521	.	.	.	0.000	0.000	0.000	0.001	0.001	0.001	0.000	0.000	0.000
Deepwater Flatfish	515	0.008	0.008	0.008	0.080	0.080	0.080	0.171	0.171	0.171	0.171	0.171	0.171
	517	.	.	.	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	521	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	522	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	540	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Flatfish Trawl	511	4.163	4.163	4.163	2.390	2.390	2.390	1.300	1.300	1.300	0.272	0.272	0.272
	513	0.044	0.044	0.044	0.070	0.070	0.070	0.122	0.122	0.122	0.020	0.020	0.020
	514	.	.	.	0.011	0.011	0.011	0.015	0.015	0.015	0.008	0.008	0.008
	516	6.546	6.546	6.546	3.000	3.000	3.000	2.000	2.000	2.000	0.400	0.400	0.400
	517	0.004	0.004	0.004	.	.	.	.	.	.	.	.	.
JV Flatfish Trawl	511	4.163	4.163	4.163	2.390	2.390	2.390	1.300	1.300	1.300	0.272	0.272	0.272
	513	0.044	0.044	0.044	0.070	0.070	0.070	0.122	0.122	0.122	0.020	0.020	0.020
	514	.	.	.	0.011	0.011	0.011	0.015	0.015	0.015	0.008	0.008	0.008
	516	6.546	6.546	6.546	3.000	3.000	3.000	2.000	2.000	2.000	0.400	0.400	0.400
	517	0.004	0.004	0.004	.	.	.	.	.	.	.	.	.
Midwater Pollock	511	0.102	0.102	0.102	0.017	0.017	0.017	0.000	0.000	0.000	0.100	0.100	0.100
	513	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	515	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	517	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.003	0.003	0.000	0.000	0.000
	521	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	522	.	.	.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	540	.	.	.	.	.	.	.	.	.	0.000	0.000	0.000
Other Bottom Trawl	511	0.004	0.004	0.004	0.065	0.065	0.065	0.033	0.033	0.033	0.033	0.033	0.033
	513	.	.	.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	515	0.002	0.002	0.002	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001
	517	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	521	0.000	0.000	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
	540	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	.	.	.
Rock Sole Trawl	511	0.245	0.245	0.245	.	.	.	.	.	.	0.471	0.471	0.471
	516	1.738	1.738	1.738	.	.	.	.	.	.	3.342	3.342	3.342
	517	0.000	0.000	0.000	.	.	.	.	.	.	.	.	.

Table 5.2.b.--Quarterly (Months 1-3, 4-6, 7-9, and 10-12) Bairdi Tanner Crab Bycatch rates by Subarea and Fishery with A Vessel Incentive Program.

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Target Fishery:	Subarea	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt	#/mt
Atka Mackerel Trawl	515	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	540	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Pollock Bottom Trawl	511	6.930	6.930	6.930	2.659	2.659	2.659	4.800	4.800	4.800	4.800	4.800	4.800
	513	0.214	0.214	0.214	0.646	0.646	0.646	1.571	1.571	1.571	.	.	.
	515	.	.	.	0.043	0.043	0.043	0.637	0.637	0.637	.	.	.
	517	1.163	1.163	1.163	0.465	0.465	0.465	0.806	0.806	0.806	0.806	0.806	0.806
	521	.	.	.	0.494	0.494	0.494	1.211	1.211	1.211	0.154	0.154	0.154
Deepwater Flatfish	515	0.025	0.025	0.025	0.380	0.380	0.380	0.760	0.760	0.760	0.760	0.760	0.760
	517	.	.	.	2.000	2.000	2.000	1.954	1.954	1.954	2.000	2.000	2.000
	521	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
	522	0.300	0.300	0.300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	540	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
Flatfish Trawl	511	14.522	14.522	14.522	2.460	2.460	2.460	5.100	5.100	5.100	7.800	7.800	7.800
	513	10.122	10.122	10.122	14.500	14.500	14.500	18.993	18.993	18.993	13.394	13.394	13.394
	514	.	.	.	0.000	0.000	0.000	0.665	0.665	0.665	1.220	1.220	1.220
	516	13.289	13.289	13.289	2.460	2.460	2.460	5.100	5.100	5.100	7.800	7.800	7.800
	517	11.506	11.506	11.506	.	.	.	.	.	.	.	.	.
JV Flatfish Trawl	511	14.522	14.522	14.522	2.460	2.460	2.460	5.100	5.100	5.100	7.800	7.800	7.800
	513	10.122	10.122	10.122	14.500	14.500	14.500	18.993	18.993	18.993	13.394	13.394	13.394
	514	.	.	.	0.000	0.000	0.000	0.665	0.665	0.665	1.220	1.220	1.220
	516	13.289	13.289	13.289	2.460	2.460	2.460	5.100	5.100	5.100	7.800	7.800	7.800
	517	11.506	11.506	11.506	.	.	.	.	.	.	.	.	.
Midwater Pollock	511	0.097	0.097	0.097	0.277	0.277	0.277	0.013	0.013	0.013	0.013	0.013	0.013
	513	0.008	0.008	0.008	0.011	0.011	0.011	0.013	0.013	0.013	0.013	0.013	0.013
	515	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.002	0.001	0.001	0.001
	517	0.040	0.040	0.040	0.014	0.014	0.014	0.194	0.194	0.194	0.000	0.000	0.000
	521	0.246	0.246	0.246	0.373	0.373	0.373	0.043	0.043	0.043	0.076	0.076	0.076
	522	.	.	.	0.000	0.000	0.000	0.007	0.007	0.007	0.009	0.009	0.009
	540	.	.	.	.	.	.	.	.	.	0.000	0.000	0.000
Other Bottom Trawl	511	18.905	18.905	18.905	18.105	18.105	18.105	18.900	18.900	18.900	18.900	18.900	18.900
	513	.	.	.	2.001	2.001	2.001	2.084	2.084	2.084	2.084	2.084	2.084
	515	2.214	2.214	2.214	0.095	0.095	0.095	0.099	0.099	0.099	0.099	0.099	0.099
	517	3.654	3.654	3.654	4.300	4.300	4.300	4.400	4.400	4.400	4.400	4.400	4.400
	521	0.284	0.284	0.284	0.706	0.706	0.706	0.000	0.000	0.000	0.500	0.500	0.500
	540	0.027	0.027	0.027	0.026	0.026	0.026	0.027	0.027	0.027	.	.	.
Rock Sole Trawl	511	6.452	6.452	6.452	.	.	.	.	.	.	8.602	8.602	8.602
	516	12.238	12.238	12.238	.	.	.	.	.	.	16.317	16.317	16.317
	517	7.807	7.807	7.807	.	.	.	.	.	.	.	.	.

Table 5.2.c.--Quarterly (Months 1-3, 4-6, 7-9, and 10-12) Halibut Bycatch rates by Subarea and Fishery with A Vessel Incentive Program.

		Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Target Fishery:	Subarea	kg/mt	kg/mt	kg/mt	kg/mt	kg/mt	kg/mt	kg/mt	kg/mt	kg/mt	kg/mt	kg/mt	kg/mt
Atka Mackerel Trawl	515	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200
	540	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200
Pollock Bottom Trawl	511	8.400	8.400	8.400	7.400	7.400	7.400	8.000	8.000	8.000	8.000	8.000	8.000
	513	0.900	0.900	0.900	4.600	4.600	4.600	0.400	0.400	0.400	.	.	.
	515	.	.	.	5.400	5.400	5.400	2.800	2.800	2.800	.	.	.
	517	4.900	4.900	4.900	4.200	4.200	4.200	1.300	1.300	1.300	1.000	1.000	1.000
	521	.	.	.	2.200	2.200	2.200	0.800	0.800	0.800	0.200	0.200	0.200
Deepwater Flatfish	515	134.600	134.600	134.600	0.200	0.200	0.200	1.700	1.700	1.700	0.200	0.200	0.200
	517	.	.	.	2.200	2.200	2.200	10.700	10.700	10.700	1.600	1.600	1.600
	521	0.900	0.900	0.900	0.400	0.400	0.400	0.300	0.300	0.300	1.400	1.400	1.400
	522	0.900	0.900	0.900	0.500	0.500	0.500	0.200	0.200	0.200	0.900	0.900	0.900
	540	0.900	0.900	0.900	0.500	0.500	0.500	0.200	0.200	0.200	0.900	0.900	0.900
Flatfish Trawl	511	10.600	10.600	10.600	9.000	9.000	9.000	9.000	9.000	9.000	9.000	9.000	9.000
	513	1.100	1.100	1.100	1.100	1.100	1.100	0.600	0.600	0.600	1.600	1.600	1.600
	514	.	.	.	1.200	1.200	1.200	1.700	1.700	1.700	1.200	1.200	1.200
	516	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300
	517	7.500	7.500	7.500	.	.	.	.	.	.	.	.	.
JV Flatfish Trawl	511	10.600	10.600	10.600	9.000	9.000	9.000	9.000	9.000	9.000	9.000	9.000	9.000
	513	1.100	1.100	1.100	1.100	1.100	1.100	0.600	0.600	0.600	1.600	1.600	1.600
	514	.	.	.	1.200	1.200	1.200	1.700	1.700	1.700	1.200	1.200	1.200
	516	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300
	517	7.500	7.500	7.500	.	.	.	.	.	.	.	.	.
Midwater Pollock	511	0.500	0.500	0.500	0.700	0.700	0.700	0.000	0.000	0.000	1.200	1.200	1.200
	513	0.300	0.300	0.300	0.400	0.400	0.400	0.200	0.200	0.200	0.300	0.300	0.300
	515	0.000	0.000	0.000	0.100	0.100	0.100	0.000	0.000	0.000	0.100	0.100	0.100
	517	0.700	0.700	0.700	0.300	0.300	0.300	0.000	0.000	0.000	0.100	0.100	0.100
	521	0.800	0.800	0.800	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
	522	.	.	.	0.100	0.100	0.100	0.000	0.000	0.000	0.100	0.100	0.100
	540	.	.	.	.	.	.	.	.	.	0.100	0.100	0.100
Other Bottom Trawl	511	10.286	10.286	10.286	14.405	14.405	14.405	12.390	12.390	12.390	12.390	12.390	12.390
	513	.	.	.	9.782	9.782	9.782	0.000	0.000	0.000	0.000	0.000	0.000
	515	14.430	14.430	14.430	11.993	11.993	11.993	13.090	13.090	13.090	13.090	13.090	13.090
	517	11.248	11.248	11.248	19.564	19.564	19.564	15.540	15.540	15.540	15.540	15.540	15.540
	521	3.700	3.700	3.700	8.643	8.643	8.643	6.300	6.300	6.300	6.300	6.300	6.300
	540	11.322	11.322	11.322	10.251	10.251	10.251	10.710	10.710	10.710	.	.	.
Rock Sole Trawl	511	14.850	14.850	14.850	.	.	.	.	.	.	16.500	16.500	16.500
	516	8.640	8.640	8.640	.	.	.	.	.	.	9.600	9.600	9.600
	517	21.328	21.328	21.328	.	.	.	.	.	.	.	.	.

Table 5.3 Groundfish catch composition by target fishery, area, and quarter.

Target Fishery Atka Mackeral Trawl

Subarea	Quarter	Pollock %	Pacific cod %	Flatfish %	Gr.Turbot/ Ar. Flounder %	Rock Sole %	Atka Mackerel %	Sablefish %	Rockfish %	Other species %	Total Grndfish Catch %
515	2	26	14	0	1	0	58	0	0	0	100
540	2	8	16	1	1	0	69	0	3	0	100

Target Fishery Pollock Bottom Trawl

Subarea	Quarter	Pollock %	Pacific cod %	Flatfish %	Gr.Turbot/ Ar. Flounder %	Rock Sole %	Atka Mackerel %	Sablefish %	Rockfish %	Other species %	Total Grndfish Catch %
511	1	78	13	4	1	4	0	0	0	0	100
	2	78	13	4	1	4	0	0	0	0	100
	4	78	13	4	1	4	0	0	0	0	100
513	1	86	10	2	0	2	0	0	0	0	100
	2	86	10	2	0	2	0	0	0	0	100
	3	86	10	2	0	2	0	0	0	0	100
517	1	84	12	2	1	1	0	0	0	0	100
	2	84	12	2	1	1	0	0	0	0	100
	3	84	12	2	1	1	0	0	0	0	100
	4	84	12	2	1	1	0	0	0	0	100
521	2	84	12	2	1	1	0	0	0	0	100
	3	84	12	2	1	1	0	0	0	0	100
	4	84	12	2	1	1	0	0	0	0	100
522	3	84	12	2	1	1	0	0	0	0	100

Table 5.3 cont.

Target Fishery Deepwater Flatfish

Subarea	Quarter	Pollock %	Pacific cod %	Flatfish %	Gr.Turbot/ Ar. Flounder %	Rock Sole %	Atka Mackerel %	Sablefish %	Rockfish %	Other species %	Total Grndfish Catch %
515	2	5	3	8	75	0	1	8	1	0	100
	3	2	1	3	29	0	0	60	5	1	100
517	2	8	0	28	19	0	0	29	16	0	100
	3	8	0	28	19	0	0	29	16	0	100
521	2	5	10	23	31	1	0	18	12	0	100
	3	4	14	21	36	1	0	14	10	0	100
540	2	0	9	16	20	0	0	45	9	0	100
	3	2	5	9	47	0	0	28	9	1	100

Target Fishery Flatfish Trawl

Subarea	Quarter	Pollock %	Pacific cod %	Flatfish %	Gr.Turbot/ Ar. Flounder %	Rock Sole %	Atka Mackerel %	Sablefish %	Rockfish %	Other species %	Total Grndfish Catch %
511	3	32	21	21	1	25	0	0	0	0	100
	4	32	21	21	1	25	0	0	0	0	100
513	3	21	19	42	2	16	0	0	0	0	100
	4	21	19	42	2	16	0	0	0	0	100
514	3	32	21	21	1	25	0	0	0	0	100
	4	32	21	21	1	25	0	0	0	0	100
516	3	32	21	21	1	25	0	0	0	0	100
	4	32	21	21	1	25	0	0	0	0	100

Table 5.3 cont.

Target Fishery JV Flatfish Trawl

Subarea	Quarter	Pollock	Pacific cod	Flatfish	Gr.Turbot/ Ar. Flounder	Rock Sole	Atka Mackerel	Sablefish	Rockfish	Other species	Total Grndfish Catch
		%	%	%	%	%	%	%	%	%	%
511	2	7	2	85	0	6	0	0	0	0	100
	3	7	2	85	0	6	0	0	0	0	100
513	2	20	8	62	1	9	0	0	0	0	100
	3	20	8	62	1	9	0	0	0	0	100
514	2	7	5	77	1	10	0	0	0	0	100
	3	7	5	77	1	10	0	0	0	0	100
516	2	7	2	85	0	6	0	0	0	0	100
	3	7	2	84	0	6	0	0	0	0	100
517	2	23	9	54	2	13	0	0	0	0	100
521	2	23	9	54	2	13	0	0	0	0	100

Target Fishery Rock Sole Trawl

Subarea	Quarter	Pollock	Pacific cod	Flatfish	Gr.Turbot/ Ar. Flounder	Rock Sole	Atka Mackerel	Sablefish	Rockfish	Other species	Total Grndfish Catch
		%	%	%	%	%	%	%	%	%	%
511	1	18	14	21	1	46	0	0	0	0	100
	4	18	14	21	1	46	0	0	0	0	100
513	1	2	11	2	0	77	0	0	0	8	100
	4	2	12	2	0	82	0	0	0	1	100
516	1	18	14	21	1	46	0	0	0	0	100
	4	18	14	21	1	46	0	0	0	0	100
517	1	8	14	31	3	45	0	0	0	0	100
521	1	0	3	1	0	96	0	0	0	0	100
	4	0	3	1	0	96	0	0	0	0	100

Table 5.3 cont.

Target Fishery Other Bottom Trawl

Subarea	Quarter	Pollock %	Pacific cod %	Flatfish %	Gr.Turbot/ Ar. Flounder %	Rock Sole %	Atka Mackerel %	Sablefish %	Rockfish %	Other species %	Total Grndfish Catch %
511	1	25	61	7	2	6	0	0	0	0	100
	2	25	61	7	2	6	0	0	0	0	100
	3	25	61	7	2	6	0	0	0	0	100
	4	25	61	7	2	6	0	0	0	0	100
515	1	3	86	3	2	1	5	0	0	0	100
	2	3	83	3	2	1	5	0	3	0	100
	3	3	86	3	2	1	5	0	0	0	100
	4	3	84	3	2	1	5	0	0	3	100
516	1	24	59	7	2	6	0	0	0	3	100
	2	24	59	7	2	6	0	0	0	3	100
	3	24	59	7	2	6	0	0	0	3	100
	4	22	56	6	2	5	0	0	0	8	100
517	1	15	75	5	2	4	0	0	0	0	100
	2	15	69	5	2	3	0	0	5	0	100
	3	14	68	5	2	3	0	0	6	0	100
	4	15	75	5	2	4	0	0	0	0	100
521	1	7	82	4	3	2	0	0	1	2	100
	2	7	78	4	3	1	0	0	6	0	100
	3	7	74	4	3	1	0	0	11	0	100
	4	7	80	4	3	1	0	0	1	4	100
522	3	2	97	1	1	0	0	0	0	0	100
540	1	13	13	4	4	0	0	11	54	0	100
	2	12	21	4	3	0	5	9	45	0	100
	3	13	13	4	4	0	0	11	54	0	100

Table 5.3 cont.

Target Fishery Midwater Pollock

Subarea	Quarter	Pollock %	Pacific cod %	Flatfish %	Gr.Turbot/ Ar. Flounder %	Rock Sole %	Atka Mackerel %	Sablefish %	Rockfish %	Other species %	Total Grndfish Catch %
511	1	98	1	1	0	1	0	0	0	0	100
	2	98	1	1	0	1	0	0	0	0	100
	3	98	1	1	0	1	0	0	0	0	100
	4	96	1	1	0	0	0	0	0	2	100
513	1	99	1	0	0	0	0	0	0	0	100
	2	99	1	0	0	0	0	0	0	0	100
	3	99	1	0	0	0	0	0	0	0	100
	4	99	1	0	0	0	0	0	0	0	100
515	1	100	0	0	0	0	0	0	0	0	100
	2	100	0	0	0	0	0	0	0	0	100
	3	100	0	0	0	0	0	0	0	0	100
	4	100	0	0	0	0	0	0	0	0	100
517	1	99	1	0	0	0	0	0	0	0	100
	2	99	1	0	0	0	0	0	0	0	100
	3	99	1	0	0	0	0	0	0	0	100
	4	99	1	0	0	0	0	0	0	0	100
521	1	99	1	0	0	0	0	0	0	0	100
	2	99	1	0	0	0	0	0	0	0	100
	3	99	1	0	0	0	0	0	0	0	100
	4	99	1	0	0	0	0	0	0	0	100
522	2	99	1	0	0	0	0	0	0	0	100
	3	99	1	0	0	0	0	0	0	0	100
	4	99	1	0	0	0	0	0	0	0	100
540	4	100	0	0	0	0	0	0	0	0	100

Table 5.4--Quarterly Distribution of Total Allowable Catch (TAC) by Target Fishery. Only 80% of the TAC for Pollock and Yellowfin Sole is given to the Midwater/Bottom Pollock Trawls and Flatfish Trawls, respectively, to allow for 20% bycatch by other fisheries. TAC for squid and other species not included.

Target Fishery	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total	TAC (mt)
Atka Mackeral Trawl		100%			100%	24,000
Cod Bottom Trawl	30%	30%	30%	10%	100%	229,000
Flatfish Trawl			30%	50%	80%	199,675
Rockfish - Aleutians	20%	40%	40%		100%	16,385
Rockfish - Bering Sea		40%	60%		100%	6,640
Rock Sole Trawl	90%			10%	100%	90,000
Sablefish - Aleutians	20%	30%	30%	20%	100%	3,200
Sablefish - Bering Sea		30%	70%		100%	3,100
Turbot & Arrowtooth		20%	80%		100%	27,000
Pollock						1,385,000
20% Bottom Trawl	4%	8%	4%	2%	18%	
60% Midwater Trawl	28%	8%	20%	6%	62%	
40% Bottom Trawl	8%	16%	8%	8%	40%	
40% Midwater Trawl	14%	8%	12%	6%	40%	
80% Midwater Trawl	28%	16%	24%	12%	80%	
TOTAL						1,984,000

Table 5.5 Assumed Area Distribution within Quarter by Detailed Fishery: Input Data for the Bycatch Simulation Model

		QUARTER			
		1	2	3	4
		Proportion	Proportion	Proportion	Proportion
Target Fishery:	Subarea				
Atka Mackerel Trawl	515	0.1634	0.10	.	1.00
	540	0.8466	0.90	.	.
	ALL SUBAREAS	1.0000	1.00	.	1.00
Pollock Bottom Trawl	Subarea				
	511	0.4541	0.3551	.	0.40
	513	0.3695	0.1553	0.2153	.
	517	0.1654	0.1846	0.2290	0.40
	521	.	0.2937	0.5500	0.20
	522	.	.	.	.
	ALL SUBAREAS	1.0000	1.0000	1.0000	1.00
COD BOTTOM TRAWL	Subarea				
	511	0.39	0.29	0.29	0.50
	515	0.20	0.21	0.21	.
	517	0.39	0.20	0.20	0.50
	521	0.02	0.30	0.30	.
	522	.	.	.	.
	540	.	.	.	.
	ALL SUBAREAS	1.00	1.00	1.00	1.00
Flatfish Trawl	Subarea				
	511	0.28	0.21	0.25	0.25
	513	0.18	0.24	0.25	0.25
	514	.	0.52	0.25	0.25
	516	0.42	0.03	0.25	0.25
	517	0.12	.	.	.
	ALL SUBAREAS	1.00	1.00	1.00	1.00
Midwater Pollock	Subarea				
	511	0.1397	0.0476	0.0410	0.0099
	513	0.1469	0.1479	0.0032	0.0354
	515	0.5291	0.0055	0.0110	0.0145
	517	0.1506	0.1890	0.4390	0.5518
	521	0.0338	0.5836	0.4916	0.3121
	522	.	0.0263	0.0142	0.0064
	540	.	.	.	0.0700
	ALL SUBAREAS	1.00	1.00	1.00	1.00

Table 5.5 --Continued

		QUARTER 1	QUARTER 2	QUARTER 3	QUARTER 4
		Proportion	Proportion	Proportion	Proportion
ROCKFISH-ALEUTIANS	Subarea				
	540	1.00	1.00	1.00	1.00
	ALL SUBAREAS	1.00	1.00	1.00	1.00
ROCKFISH-BS	515	.	0.15	.	.
	517	.	0.35	0.30	.
	521	1.00	0.50	0.70	.
	ALL SUBAREAS	1.00	1.00	1.00	.
Rock Sole Trawl	Subarea				
	511	0.64	.	.	0.65
	516	0.31	.	.	0.35
	517	0.05	.	.	.
	ALL SUBAREAS	1.00	.	.	1.00
SABLEFISH ALEUTIANS	Subarea				
	540	.	1.00	1.00	.
	ALL SUBAREAS	.	1.00	1.00	.
SABLEFISH BS	Subarea				
	515	.	.	0.33	.
	517	1.00	0.50	0.33	.
	521	.	0.50	0.33	.
	ALL SUBAREAS	1.00	1.00	1.00	.
TURBOT/ARROWTOOTH	Subarea				
	515	0.70	0.25	0.05	0.25
	517	.	.	.	0.45
	521	0.02	0.50	0.50	.
	522	0.06	.	.	.
	540	0.22	0.25	0.45	0.30
	ALL SUBAREAS	1.00	1.00	1.00	1.00

Table 5.6--Basis of estimates of gross wholesale value net of variable cost per metric ton of catch.

	Retention	PRR	Price/lb	Gross/mt	Net/Gross	Net/mt
m-w pollock	0.945	0.15	$0.815	$ 255	0.49	$125
P. cod	0.770	0.28	$2.20	$1,046	0.38	$397
b.t. pollock	0.810	0.22	$1.30	$ 511	0.38	$194
Atka mackerel	0.819	0.63	$0.57	$ 648	0.38	$246
Deep water turbot/sablefish	0.685	0.65	$1.19	$1,168	0.36	$421
Rock sole	0.516	0.60	$0.76	$ 518	0.36	$187
Other flatfish	0.558	0.65	$0.57	$ 456	0.36	$164
Rockfish	0.701	0.55	$0.86	$ 731	0.36	$263
JV flatfish	1.000	1.00	$0.076	$ 168	0.50	$ 84

Note: Retention is retained catch divided by total catch for the major groundfish species. Domestic observer program data were used to estimate retention by fishery. The product recovery rates (PRR) and prices are for one product for each fishery, they are as follows: surimi for mid-water pollock; fillets for cod and bottom trawl pollock; and headed and gutted for the other fisheries. It is assumed that 30% of the rock sole contained roe. The PRRs and prices were provided by Pat Burden with the exception of the rock sole price which was generated using information provided by Jerry Anderson. Gross is the first wholesale value FOB Alaska. Net is the gross reduced by variable cost. The net would include fixed costs and profits.

Table 5.7.--Estimated impact cost per unit of bycatch.

Bycatch Impact Costs	
Bairdi Tanner Crab	$ 1,870/1,000 crabs
Red King Crab	$17,600/1,000 crabs
Halibut	$ 3,300/t
Herring	$ 567/t

Notes: The impact cost are based on estimates of foregone gross exvessel value. The estimate for herring understates the actual cost to the extent that both the value per metric ton of herring is higher for subsistence catch than for commercial catch and bycatch reduces subsistence catch.

Table 5.8--Prohibited Species Cap Apportionments to Each Target Fishery for all Constrained Bycatch Model Runs.

	Target Fishery								All Target Fishery-Gear Groups
	Atka Mackerel Trawl	Pollock Bottom Trawl	Deepwater Flatfish	Flatfish Trawl	JV Flatfish Trawl	Midwater Pollock	Other Bottom Trawl	Rock Sole Trawl	
Halibut Cap	33	1,600	200	800	0	0	1,600	1,100	5,333
King Crab Cap	0	5,000	0	40,000	0	0	5,000	150,000	200,000
Zone 1 Tanner Crab Cap	0	100,000	0	100,000	0	0	100,000	700,000	1,000,000
Zone 2 Tanner Crab Cap	50	1,200,000	50,000	825,000	0	0	624,950	300,000	3,000,000
1% Herring Cap	0	140	8	83	0	584	18	0	833
2% Herring Cap	0	280	16	166	0	1168	36	0	1666
4% Herring Cap	0	560	32	332	0	2336	72	0	3332
Actual 1990 Herring Bycatch	0	915	0	10	-	1565	169	0	2661

6.0 ANALYSIS OF THE ALTERNATIVES

As described in Section Five, a bycatch simulation model was used to estimate the effects of management measures to limit herring bycatch and the size of the bottom trawl pollock fishery. The analysis of the modeled options is discussed in Sections 6.1 through 6.8, and the analysis of the hot spot authority is discussed in Section 6.9.

6.1 Description of the Model Runs Made to Evaluate the Options

The model was run 8 times to provide estimates for the status quo and various combinations of measures to limit both herring bycatch and the size of the bottom trawl pollock fishery. For each of these runs, it is assumed that the revised Amendment 16 vessel incentive program will be implemented. An additional 5 runs were made to determine whether the relative merits of the options are altered by this assumption. The 13 runs are defined below in the order in which they appear in Tables 6.1.1-6.1.3, and the changes between consecutive runs are identified with a "*". In each run, 20% of the pollock TACs are reserved for bycatch in the bottom trawl fisheries and the remaining 80% is apportioned between the mid-water and bottom trawl pollock fisheries.

The first and second groups of runs, respectively, are used to estimate the effects of limiting herring bycatch and the effects of limiting directed bottom trawl pollock fishing if the vessel incentive program is in place. Run 2 is included in both sets. The third set is used to estimate the effects of both types of management measures in the absence of the vessel incentive program.

Runs to evaluate herring PSC measures if there is a vessel incentive program.

Run 1:
Amendment 16 crab and halibut PSC measures,
A vessel incentive program,
60% of the pollock TACs is allocated to the mid-water trawl pollock fishery, and
No herring PSC measures.

Run 2:
Amendment 16 crab and halibut PSC measures,
A vessel incentive program,
60% of the pollock TACs is allocated to the mid-water trawl pollock fishery, and
* Herring PSC alternative 4 (closure D) with a 1% limit (<u>preferred herring PSC measures</u>).

Run 3:
Amendment 16 crab and halibut PSC measures,
A vessel incentive program,
60% of the pollock TACs is allocated to the mid-water trawl pollock fishery, and
* Herring PSC alternative 4 (closure D) with a 2% limit.

Run 4:
Amendment 16 crab and halibut PSC measures,
A vessel incentive program,
60% of the pollock TACs is allocated to the mid-water trawl pollock fishery, and
* Herring PSC alternative 4 (closure D) with a 4% limit.

Run 5:
Amendment 16 crab and halibut PSC measures,
A vessel incentive program,
60% of the pollock TACs is allocated to the mid-water trawl pollock fishery, and
* Herring PSC alternative 2 (closure B) with a 1% limit.

Run 6: Amendment 16 crab and halibut PSC measures,
A vessel incentive program,
60% of the pollock TACs is allocated to the mid-water trawl pollock fishery, and
* Herring PSC alternative 3 (closure C) with a 1% limit.

Runs to evaluate pollock allocations if there is a vessel incentive program.

Run 7: Amendment 16 crab and halibut PSC measures,
A vessel incentive program,
40% of the pollock TACs is allocated to the mid-water trawl pollock fishery, and
Herring PSC alternative 4 (closure D) with a 1% limit (preferred herring PSC measures).

Run 2: Amendment 16 crab and halibut PSC measures,
A vessel incentive program,
* 60% of the pollock TACs is allocated to the mid-water trawl pollock fishery, and
Herring PSC alternative 4 (closure D) with a 1% limit (preferred herring PSC measures).

Run 8: Amendment 16 crab and halibut PSC measures,
A vessel incentive program,
* 80% of the pollock TACs is allocated to the mid-water trawl pollock fishery. (There is no bottom trawl pollock fishery), and
Herring PSC alternative 4 (closure D) with a 1% limit (preferred herring PSC measures).

Runs to evaluate pollock allocations and herring PSC measures without a vessel incentive program.

Run 9: Amendment 16 crab and halibut PSC measures,
No vessel incentive program,
60% of the pollock TACs is allocated to the mid-water trawl pollock fishery, and
No herring PSC measures.

Run 10: Amendment 16 crab and halibut PSC measures,
No vessel incentive program,
* 40% of the pollock TACs is allocated to the mid-water trawl pollock fishery, and
No herring PSC measures.

Run 11: Amendment 16 crab and halibut PSC measures,
No vessel incentive program,
* 60% of the pollock TACs is allocated to the mid-water trawl pollock fishery, and
* Herring PSC alternative 4 (closure D) with a 1% limit (preferred herring PSC measures).

Run 12: Amendment 16 crab and halibut PSC measures,
No vessel incentive program,
* 40% of the pollock TACs is allocated to the mid-water trawl pollock fishery, and
Herring PSC alternative 4 (closure D) with a 1% limit (preferred herring PSC measures).

Run 13: Amendment 16 crab and halibut PSC measures,
No vessel incentive program,
* 80% of the pollock TACs is allocated to the mid-water trawl pollock fishery (There is no bottom trawl pollock fishery), and
Herring PSC alternative 4 (closure D) with a 1% limit (preferred herring PSC measures).

Due to the large number of options considered, this section contains only limited references to the results of each run (i.e., option) The results are summarized more fully in Tables 6.1 through 6.3. Tables 6.1.1-6.1.3 present estimates of bycatch, groundfish trawl catch, bycatch impact costs, gross revenue (i.e., first wholesale value) of the fishery products resulting from the groundfish trawl catch, net revenue (i.e., gross revenue net of variable costs), and net revenue minus bycatch impact costs. Table 6.2 lists the projected closures for each run. Table 6.3 provides comparisons between the PSC limits and estimated bycatches for each run.

6.2 Nature and Limitations of the Model's Estimates

The model's results can be misinterpreted if the nature and limitations of the estimates presented in this section and the summary tables are not understood. Therefore, the following discussion is presented before the summary of the results.

The bycatch control costs that are the result of voluntary actions to reduce bycatch rates due to the vessel incentive program are not considered in the estimates of the net revenue. Therefore, the estimates of net revenue for all the runs that include the vessel incentive program tend to be too high. This should not affect the comparison among the runs that include the vessel incentive program or among the runs that do not.

It is assumed that bycatch rates by area, fishery, and quarter are not affected by the levels of the PSC limits or the size of the herring savings areas. It is also assumed that fishing patterns are only affected by actual closures, not by the anticipation of closures. If fishermen would take actions to reduce bycatch rates in anticipation of closures, the model tends to estimate earlier closures than would occur, overstate the groundfish catch that would be foregone, and under estimate other bycatch control costs. Conversely, if fishermen would take actions that increase bycatch rates in anticipation of closures, the model tends to have the opposite effects. To the extent that the latter has occurred and is reflected in the bycatch rates used in the model, such behavior is accounted for by the model. The net effects on the estimates of bycatch impact costs and net revenues are not known.

As noted earlier, the estimates of bycatch impact cost are based on estimates of foregone catch multiplied by the exvessel price of the bycatch species. This tends to understate the impact cost of herring to the extent that bycatch reduces subsistence catch and the value per unit of catch is higher for subsistence catch than for commercial catch. The use of gross exvessel value, instead of first wholesale value net of variable harvesting and processing costs, tends to overstate bycatch impact costs because gross exvessel value is typically greater than net first wholesale value. However, the advantage of using gross wholesale value is that there is probably less uncertainty concerning what the exvessel value is.

The model does not reallocate pollock from the bottom trawl pollock fishery to the mid-water pollock fishery when the former is closed by the attainment of the BSAI other bottom trawl halibut PSC apportionment. Therefore, estimates for options that result in pollock being foregone due to a BSAI wide pollock bottom trawl closure tend to understate actual groundfish trawl catch and value. They also tend to understate bycatch and bycatch impact costs, particularly for herring. Therefore, the differences between runs which result in different amounts of the pollock TACs being foregone are probably overstated in terms of groundfish catch, revenue, bycatch, and bycatch impact cost.

There is a similar problem because the model does not include fixed gear fisheries and, therefore, does not reallocate cod, for example, from the trawl fishery to the longline and pot fisheries once there is a halibut bycatch induced closure of the BSAI bottom trawl cod and pollock fisheries. In this case estimates of the effects of options that result in more cod being foregone due to a bottom trawl closure, tend to understate actual groundfish catch and value for all gear groups as a whole. They also tend to understate bycatch and bycatch impact costs, particularly for halibut in this case.

The model does not account for the higher costs per unit of catch or product that probably occur when PSC limit induced closures result in redistributions of effort for the trawl fleet. Therefore, the model tends to understate the actual bycatch control cost that such closures impose on the trawl fishery.

The estimates are based on the PSC limit apportionment recommendations made by the Council at its December 1990 meeting. No attempt was made to find apportionments that would provide greater net revenue to the trawl fishery or a greater difference between net revenue and total bycatch impact cost for the status quo or for any of the other options considered.

If the objective is to minimize the cost of bycatch, if none of the options would result in the collapse of a stock, if the agency costs do not differ significantly among the options considered, and if the reallocation of catch from the trawl fishery to the fixed gear fisheries is ignored, as it is with the bycatch model, net revenue from the trawl groundfish catch minus bycatch impact cost provides a measure of the net benefits of each alternative. The accuracy of this measure is subject to the limitations of the estimates discussed above. The ratio of the estimated reductions in bycatch impact cost and gross revenue net of variable cost for an alternative compared to the status quo provides a measure of the merits of that option compared to the status quo. Different benefit-cost ratios would of course result if different weights were given to the estimates of net revenue in the groundfish trawl fishery and bycatch impact costs.

6.3 Estimated Effects of Various Alternatives With the Revised Vessel Incentive Program

6.3.1 Alternative 1: Status Quo (run 1)

The model estimates that, with the revised vessel incentive program of Amendment 16 but without any of the changes considered under Alternative 16a, bycatch in the BSAI groundfish trawl fisheries would be about 4,700 mt of halibut, 3,300 mt of herring, 119,000 red king crab, and 2.8 million C. bairdi Tanner crab (Table 6.1.1 run 1). The trawl fishery would take 1.56 million mt of groundfish valued at $704 million. The total bycatch impact cost, valued in terms of discounted foregone exvessel value, would be $24.7 million. The value of the trawl groundfish catch net of variable would be $289 million and the net value of the trawl catch minus total bycatch impact cost would be $264 million.

A key feature of all model runs is that the constraints of halibut and crab bycatch limits force the Bering Sea "Other" bottom trawl fishery to close before the herring migration along the Alaska Peninsula begins. If bottom trawl fishermen are able to reduce the bycatch of crab and halibut so that fishing continues into July, August and September when herring bycatch rates are high in statistical area 511, herring bycatch in this fishery could increase considerably. In completely unconstrained runs of the model with no PSC limits, herring bycatch was approximately 5000 metric tons, which may be an estimate of the upper limit of potential herring bycatch.

6.3.2 The effects of the herring PSC limits and closures.

The effects of Alternative 4 with various herring PSC limits and the effects of various herring savings areas with a 1% herring PSC limit are discussed separately in Sections 6.3.2.1 and 6.3.2.2.

6.3.2.1 The effects of Alternative 4 with various herring PSC limits (runs 1-4).

The effects of Alternative 4 (the preferred herring savings areas) compared to those of the status quo were evaluated for herring PSC limits of 1%, 2%, and 4%. The estimates of crab and halibut bycatches, groundfish trawl catch, trawl fishery gross revenue, trawl fishery revenue net of variable cost, and net groundfish trawl revenue minus total bycatch impact cost are about the same for the status quo and for Alternative 4 with a herring PSC limit of 1%, 2%, or 4% (Table 6.1.1 runs 1-4). Only the estimates of herring bycatch and total bycatch impact cost differ among these four runs. Estimated herring bycatch is 2,632 mt with a 1% limit, 3,126 mt with a 2% limit, 3,343 mt with a 4% limit, as opposed to 3,282 with no limit (i.e., the status quo). Compared to the status quo, the estimated herring bycatch is about 20% less with Alternative 4 and a 1% herring PSC limit. The estimated total bycatch impact cost is about $0.4 million less, this is less than a 2% reduction. The net revenue minus bycatch impact cost is $0.4 million higher than for the status quo, but this is less than a 0.15% increase.

These results indicate that, in terms of herring bycatch, total bycatch impact cost, or net revenue from the groundfish trawl catch minus bycatch impact cost, Alternative 4 with a 1% herring PSC limit is superior to the status quo or to Alternative 4 with limits of 2% or 4%. However, as stated above, the estimated net gain is small.

6.3.2.2 The effects of alternative area closures with a 1% herring PSC limit (runs 2, 5, and 6).

The herring Alternatives 2, 3, and 4 differ in only the areas that close to a fishery once it takes its apportionment of the herring PSC limit. The differences in the areas were explained in Section 4 and are depicted in Figures 4.11, 4.12 and 4.13. About 4,700 mt of halibut, 119,000 red king crab, and 2.8 million C. bairdi Tanner crab are estimated to be taken as bycatch in the groundfish trawl fishery with a 1% herring PSC limit for each of the three alternatives. The estimated herring bycatch is 2,723 mt for Alternative 2 (closures B), 2,470 mt for Alternative 3 (closures C), or 2,632 mt for Alternative 4 (closures D), which is the preferred set of closures. The estimated groundfish trawl catch is 1.56 million mt for each of the three alternatives. Neither gross nor net revenue in the groundfish trawl fishery differs among these three alternatives. Finally, total bycatch impact cost is about the same for each alternative.

It is difficult to differentiate among the three alternatives on the basis of the model's results. Compared to the status quo they each result in reductions in herring bycatch, relatively small decreases in total bycatch impact costs, and no measurable effects on the groundfish trawl fisheries. Therefore, each results in greater net benefits than the status quo. However, as stated above, the estimated net gain is small.

6.3.3 The effects of limiting the size of the bottom trawl pollock fishery if the preferred herring PSC limit and area closures are in place (runs 2, 7, and 8).

When the allocation to the bottom trawl pollock fishery is decreased from 40% to 20% of the pollock TACs: (1) halibut bycatch decreases, king crab bycatch increases, and Tanner crab bycatch increases, but each change is less than 2%; (2) herring bycatch increases by 16%; (3) total bycatch impact cost remains at $24.3 million; (4) groundfish catch increases by 15%; and (5) gross and net wholesale value increase by about $42 million and $25 million, respectively (Table 6.1.2 runs 2 and 7).

When the allocation to the bottom trawl pollock fishery is further decreased from 20% to 0% of the pollock TACs: (1) halibut, king crab, and Tanner crab bycatches decrease, but again each change is less than 2%; (2) herring bycatch increases by almost 32%; (3) total bycatch impact cost increases by less than $0.4 million or about 1.5%; (4) groundfish catch increases by 8%; and (5) gross and net wholesale value increase by about $25 million and $17 million, respectively (Table 6.1.2 runs 7 and 8).

These results suggest, that under the stated conditions, limiting catch in the bottom trawl pollock fishery is not an effective means of reducing the bycatch of crab or halibut and any reductions in crab and halibut bycatch would be more than offset by increased herring bycatch. As noted above, the model tends to overstate the effects of limiting bottom trawl pollock catch because the model does not reallocate unused pollock to the mid-water pollock fishery when the bottom trawl fishery is closed by the attainment of the BSAI other bottom trawl halibut PSC apportionment.

All else being equal, a redistribution of catch from the bottom trawl pollock fishery to the mid-water trawl fishery would tend to decrease halibut and crab bycatch and increase herring bycatch. The former did not occur with the model because the apportionment of the PSC limits was held constant. Therefore, the benefits of the decreased crab and halibut bycatch rates in the combined pollock fishery resulted in increased groundfish catch prior to closures, not reduced halibut and crab bycatch.

6.4 Estimated Effects of Various Alternatives Without the Revised Vessel Incentive Program

The estimates for the status quo and 4 previously defined options in the absence of the revised vessel incentive program are presented in Table 6.1.3. The estimates indicate that the merits of Alternative 4 with a 1% herring PSC limit as compared to the status quo are not measurably different without the revised vessel incentive program. The same is true when comparing the merits of various limits on bottom trawl pollock fishery catch.

6.5 Biological Implications

6.5.1 Halibut and Crab

The estimated differences in halibut or crab bycatch for the alternatives considered are not large enough to have a measurable effect on halibut or crab stocks.

6.5.2 Herring

The bycatch simulation model was used to evaluate the magnitude of the herring bycatch under various alternatives. Biological and economic impacts of the herring bycatch depend to a large degree on how the bycatch is distributed among the several Bering Sea herring stocks. One approach is to assume that during the migration, all herring stocks are randomly mixed, so that bycatch is taken from each stock in proportion to the relative biomass of each stock. However, herring spawning occurs at different times along the western Alaskan coast, so that different stocks begin their migration at different times. Therefore, particularly early in the herring migration, there is a potential for trawl bycatch to occur disproportionately on different herring stocks. Until additional information is available on the composition and migratory timing of Bering Sea herring stocks, it is difficult to fully analyze bycatch impacts.

6.6 Reporting Costs

Existing reporting practices would not need to be augmented to implement any of the alternatives. Observers are present aboard most groundfish fishing vessels and would be expected to provide estimates of catch regardless of what herring PSC limits are set. In order to completely report herring bycatch, observers would also have to estimate the herring bycatch in tows that are being dumped due to high prohibited species content. Estimating the quantity of these tows may slightly impact fishing observations, but is essential for complete recording of bycatch mortality.

6.7 Administrative, Enforcement, and Information Costs

The use of herring PSC limits and closures would result in the additional cost of the annual process of apportioning the PSC limits. There would also be additional costs associated with monitoring the apportionments and issuing closure notices once apportionments are taken. There would also be additional enforcement cost with each closure. Because bycatch monitoring systems are already in place for crab and halibut, the addition of herring monitoring would only cause a slight increase in costs. Because of the expanded number of time-area closures with the herring restrictions, a nominal increase in enforcement costs would also result.

6.8 Distribution of Costs and Benefits

The data in Tables 6.1.1-6.1.3 provide estimates of the distributions of benefits and cost that can be quantified more readily. Other benefits and costs that have not been quantified are discussed below.

As noted throughout this document, the estimates of the herring bycatch impact costs are based on the assumption that the reductions in herring catch due to herring bycatch in the groundfish fishery would be borne by the commercial herring fisheries, not the subsistence fisheries. To the extent that this assumption is incorrect and that the value per unit of catch is higher in the subsistence fishery, the estimates are too low.

The higher priority that the Nation and State have given to subsistence catch indicates that they place a higher value on subsistence catch. The dependence of some communities on both subsistence and commercial herring catch may also suggest that the value of the commercial catch in some areas may be under estimated. It is difficult to identify the degree to which the estimates of herring bycatch impact cost may understate the actual cost.

6.9 Analysis of Inseason Bycatch Hot Spot Closure Authority

This option is discussed separately because the bycatch model was not use to analyze it.

6.9.1 Discussion of Environmental Impacts.

The intent of the proposed inseason closure authority is to provide fishermen with a greater opportunity to harvest groundfish TAC amounts by guaranteeing a longer fishing period before PSC limits are reached and bottom trawl effort is curtailed. The potential environmental impacts of interim inseason closures of statistical areas or fisheries under the alternatives to the status quo are decreased by the vessel incentive program of Amendment 16, the PSC limits of other sections of this amendment, and the TACs for each target species or species group established by the Council during its annual specifications process.

An inseason closure of the type contemplated under this option would not directly affect either established limits or herring, halibut, and crab resources. However, inseason authority to close "hot spots" should reduce overall average bycatch rates in the BSAI area and decrease the possibility of exceeding established PSC limits due to fast-paced fisheries operating in areas associated with high bycatch rates. Thus, this option may provide additional protection to herring, halibut, and crab stocks to the extent that the inseason authority to close fisheries or areas exhibiting high bycatch rates will help maintain bycatch amounts within established limits.

6.9.2 Discussion of Socioeconomic Impacts.

Interim time/area closures could impact the groundfish industry through increased operating costs and/or loss of opportunity to harvest a specific target species. The associated reduction in average bycatch rates, could, however, offset these losses though increased harvests of groundfish prior to a PSC limit being reached. This option increases the ability of NMFS to respond to an unexpected change in the operations of the groundfish fishery that could substantially decrease its ability to harvest the TACs.

6.9.2.1 Impact on JVP flatfish fisheries

This discussion is hypothetical because the Council has recommended no JVP allocations for 1991. However, it is valuable as an illustration of how inseason authority to close bycatch hot-spots might have altered the 1990 JVP fishery.

Zone 1 was closed to the 1990 joint venture flatfish fishery on January 25 when that fishery reached its red king crab PSC limit of 50,000 crabs. The actual bycatch of red king crab is estimated at about 150,000 crab, exceeding the PSC cap by about 200 percent. Even with 100 percent observer coverage, the existing communication and information system creates data lags that will continue to hamper the ability of inseason managers to monitor bycatch in fast-paced fisheries in time to allow for the implementation of fishery closures before some bycatch caps are exceeded.

Limitations of existing information systems aside, if the Regional Director had the authority to close portions of Zone 1 to the JV flatfish fishery that exhibited high bycatch rates of red king crab, the 1990 red king crab PSC cap would not have been exceeded by the amount it was. Unless such a closure was implemented at the beginning of the fishing year, however, bycatch rates might not be reduced sufficiently to extend the JVP fishery in Zone 1 by a significant amount.

During the Zone 1 JV flatfish fishery, red king crab bycatch rates in area 516 (4.069 crab/mt groundfish) averaged 75 percent higher than those in area 511 (2.327 crab/mt groundfish). About 31,220 mt of groundfish was harvested by JV operations in area 516, or about 65 percent of the total JV groundfish harvest in Zone 1, whereas about 77 percent of the total red king crab bycatch was taken from area 516. If area 516 had been closed to JV operations and the entire groundfish harvest in Zone 1 had been displaced to area 511 instead, Zone 1 bycatch of red king could have been reduced by 33 percent. This reduction would have still resulted in a PSC bycatch in excess of the 50,000 crab PSC limit, but the overall rate of bycatch would have been reduced, allowing inseason managers a better opportunity to monitor bycatch amounts and close Zone 1 before the red king crab cap was exceeded by significant amounts.

The entire BSAI was closed to JV operations March 5 when it was determined that the halibut PSC limit apportioned to the JV flatfish fishery was reached. After the closure of Zone 1 to JV operations because of red king crab bycatch, the JV flatfish fishery operated in areas 513 and 517. The halibut bycatch rate in area 517 (.012 mt halibut/mt groundfish) averaged 71 percent higher than in area 513 (.007 mt halibut/mt groundfish). About 27,000 mt of groundfish was harvested by JV operations in area 517, or about 22 percent of the total JV groundfish harvest in the BSAI, whereas about 46 percent of the total halibut bycatch was taken from area 517. About 38 percent of the JV groundfish catch was harvested from area 513, which accounted for about 48 percent of the total halibut bycatch.

If area 517 had been closed to JV operations and the groundfish harvest from this area had been displaced to area 513 instead, the halibut bycatch from these two areas would have been reduced by 42 percent. Assuming that bycatch rates in area 513 were maintained at .007 mt halibut/mt groundfish, this reduction in overall halibut bycatch rates would have allowed JV operations to harvest an additional 35,909 mt groundfish before reaching the level of halibut bycatch that resulted in the 1990 closure of the BSAI to further JV fishing. At a gross exvessel value of $152/mt for blended JVP groundfish, this additional amount of groundfish would result in over $5.5 million of additional gross revenue to JV operations.

6.9.2.2 Impact on DAP fisheries.

The 1990 DAP flatfish fisheries in the BSAI were closed March 19 when these fisheries attained their apportioned amount of the halibut PSC (567 mt). Halibut bycatch also resulted in a May 30, 1990 closure of Zones 1 and 2H to the DAP bottom trawl fisheries for Pacific cod and pollock. The entire BSAI was closed to these fisheries due to halibut bycatch on June 30, 1990.

An analysis of vessel by vessel bycatch rates show that vessels targeting on Greenland turbot in areas 515, 517, and 522 exhibited high bycatch rates of halibut relative to other bottom trawl fisheries conducted in the same area. Most of the domestic effort for Greenland Turbot took place in areas 515, 517, 522, and 540. The weighted average halibut bycatch rates observed on vessels targeting on Greenland turbot in these areas were .1240, .3854, .2212, and .0090 mt halibut/mt groundfish, respectively. In terms of weeks fished, most of the effort for Greenland turbot occurred in areas 515 and 540, with two or less weeks of activity in the remaining areas.

The high halibut bycatch rates observed in the turbot fishery, particularly in areas 517 and 522, and the ensuing disproportionate share of the halibut PSC limit taken by these vessels could have been reduced if the inseason authority to close "hot spot" areas or fisheries had been available this year. Under this authority, the Regional Director could have either closed the Greenland turbot fishery or closed all or a part of the area(s) in which the fishery was operating to reduce overall halibut bycatch rates in the BSAI.

Closure of the Greenland turbot fishery would cause a loss in revenue to that portion of the US industry utilizing this species; given the 7,000 mt TAC for Greenland halibut and an average gross revenue value of $1,639/mt turbot/sablefish[2], losses at the ex-vessel level could approach $11.5 million. Closure of the Greenland turbot fishery would, however, decrease the average halibut bycatch rate exhibited by DAP fisheries, with the result that U.S. fishermen would have more opportunity to harvest groundfish before established apportionments of the halibut PSC limits were reached. At a maximum, closure of the Greenland turbot fishery could provide other groundfish fisheries with an additional 1,295 mt of halibut bycatch[3]. This amount of halibut could allow for a 77,545 mt harvest of mixed "other groundfish" species, including Pacific cod and rockfish, at the 1990 average halibut bycatch of 0.0167 mt halibut/mt "other groundfish." At a gross revenue value of $774/mt[4], this amount of groundfish represents a gross revenue value of over $60 million. The net benefit, therefore, of closing the Greenland turbot fishery and allowing other mixed groundfish fisheries to take halibut bycatch would be about $48.5 million. If the mixed groundfish fishery were constrained to areas 515 and 517, where the average halibut bycatch rate increases to 0.0351 mt, the net benefits would be reduced to $17.5 million.

6.9.3 Administrative, Enforcement and Information Costs

Under this option, administrative and enforcement costs would increase because of additional workload that would be necessary to identify, implement, and enforce inseason closures. Although this additional burden may require a shift in priorities of existing tasks, personnel costs would remain at levels currently projected for 1991.

Current administrative tasks costs associated with bycatch management include staff time developing analyses to predict the bycatch needs of groundfish fisheries, weekly or daily analyses of observer reports and reported groundfish catch, deriving appropriate control of different fisheries as they approach specific bycatch quotas, frequent communication with the industry on the status of PSC allowances; and drafting and publishing FEDERAL REGISTER closure notices.

6.9.4 Cost/Benefit Conclusions

Based on bycatch rates observed in the 1990 JVP and DAP fisheries, closure of areas or fisheries that demonstrated high bycatch rates would have positive benefits in terms of reducing average bycatch rates in the BSAI, reducing the probability of bycatch amounts exceeding established limits, and increasing the opportunity to harvest groundfish TAC amounts before PSC limits are reached. Future inseason closures to reduce bycatch rates within areas or fisheries under this alternative could be expected to have the type of impact that such closures would have had during 1990.

During 1990, inseason authority to close "hot spots" would probably not have extended JV fishing in Zone 1, although closure of area 516 would have reduced the amount by which the red king crab bycatch quota was exceeded. Furthermore, the JV flatfish fishery would have benefitted from a

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[2] NPFMC. 1990. EA/RIR/IRFA for Amendment 16 to the BSAI FMP. Gross revenue value assumes average finished product price of $1.18 lb and a yield of 63% for the headed and gutted product.

[3] Assumes an average halibut bycatch rate of .185 in the Greenland turbot fishery and that 100 percent of the turbot TAC is harvested in the directed fishery: (.185 mt halibut/mt turbot)(7000 mt turbot) = 1,295 mt halibut.

[4] NPFMC EA/RIR/IRFA for Amendment 16 to the BSAI FMP. A value of $774/mt groundfish assumes a finished product price of $1.17/lb and an average yield rate of 30%.

closure of area 517 in terms of reduced bycatch rates of halibut and additional groundfish harvest and associated revenues totaling about $5.2 million.

The DAP fisheries were also constrained by halibut bycatch during 1990. Closure of the Greenland turbot fishery, which demonstrated an intrinsically high bycatch rate of halibut, could have allowed for an additional 77,545 mt harvest of groundfish, with associated net benefits, of $48.5 million in gross revenues.

The North Pacific Fishery Management Council has recognized that high bycatch rates of red king crab in the Zone 1 flatfish fisheries and high bycatch rates of halibut in the Greenland turbot fishery are major contributors to premature fishery closures in the BSAI. The Council recommended several management changes under Amendment 16 and an associated regulatory amendment that will reduce the impact of these fisheries on other groundfish operations. These measures include the establishment of separate PSC limits for the Greenland turbot fishery and a season delay in the BSAI flatfish fishery. However, it would still be useful to have inseason authority to implement interim closures of areas to limit other fishery operations that may exhibit unexpectedly high bycatch rates.

Bycatch rates exhibit great variability from week to week and this variability creates some difficulty in determining whether bycatch rates in a fishery or area are intrinsically high, are an exhibition of "dirty fishing", or simply represent natural variability in an other wise "clean fishery" or area. Historical data should be examined, therefore, to determine whether consistent "hot spots" occur in the BSAI groundfish fisheries so that this information could be juxtaposed with variable inseason data to help determine whether an inseason closure is warranted to reduce overall bycatch rates.

Table 6.1.1. Evaluation of Herring PSC Limits Using the Bycatch Simulation Model.

	RUN 1 Incentive 60% MW Pol. No Herring	RUN 2 Incentive 60% MW Pol. 1% Herring Winter-D	RUN 3 Incentive 60% MW Pol. 2% Herring Winter-D	RUN 4 Incentive 60% MW Pol. 4% Herring Winter-D	RUN 5 Incentive 60% MW Pol. 1% Herring Winter-B	RUN 6 Incentive 60% MW Pol. 1% Herring Winter-C
BYCATCH AMOUNTS						
Halibut (mt)	4,690	4,694	4,691	4,691	4,693	4,694
Herring (mt)	3,282	2,632	3,126	3,343	2,723	2,470
Red king crab (no.)	118,861	118,782	118,861	118,862	118,803	118,805
C. bairdi (no.)	2,819,170	2,815,330	2,818,756	2,818,797	2,816,307	2,814,863
GROUNDFISH CATCH (mt)						
Atka Mackerel Trawls	34,817	34,817	34,817	34,817	34,817	34,817
Pollock Bottom Trawls	176,184	176,184	176,184	176,184	176,184	176,184
Deepwater Flatfish Trawls	34,627	34,627	34,627	34,627	34,627	34,627
Flatfish Bottom Trawls	180,283	180,283	180,283	180,283	180,283	180,283
JV Flatfish Bottom Trawls	0	0	0	0	0	0
Midwater Pollock Trawls	865,980	865,980	865,949	865,826	865,980	865,980
Other Bottom Trawls	202,438	202,438	202,438	202,438	202,438	202,438
Rock Sole Bottom Trawls	70,479	70,479	70,479	70,479	70,479	70,479
TOTAL	1,564,808	1,564,808	1,564,777	1,564,654	1,564,808	1,564,808
BYCATCH IMPACT COST ($1,000s)						
Halibut	$15,477	$15,490	$15,480	$15,480	$15,487	$15,490
Herring	$1,861	$1,492	$1,772	$1,895	$1,544	$1,400
Red king crab	$2,092	$2,091	$2,092	$2,092	$2,091	$2,091
C. bairdi	$5,272	$5,265	$5,271	$5,271	$5,266	$5,264
TOTAL:	$24,701	$24,337	$24,615	$24,739	$24,388	$24,245
GROSS REVENUE ($1,000s)						
DAP	$704,328	$704,328	$704,320	$704,289	$704,328	$704,328
JVP	$0	$0	$0	$0	$0	$0
TOTAL:	$704,328	$704,328	$704,320	$704,289	$704,328	$704,328
NET REVENUE = GROSS REVENUE - VARIABLE COST ($1,000s)						
DAP	$288,752	$288,752	$288,748	$288,733	$288,752	$288,752
JVP	$0	$0	$0	$0	$0	$0
TOTAL:	$288,752	$288,752	$288,748	$288,733	$288,752	$288,752
NET REVENUE - BYCATCH IMPACT COST ($1,000s)						
TOTAL:	$264,051	$264,415	$264,133	$263,994	$264,364	$264,507

Table 6.1.2. Evaluation of Pollock Allocations Using the Bycatch Simulation Model

	RUN 1 Incentive 60% MW Pol. No Herring	RUN 7 Incentive 40% MW Pol. 1% Herring Winter-D	RUN 2 Incentive 60% MW Pol. 1% Herring Winter-D	RUN 8 Incentive 80% MW Pol. 1% Herring Winter-D
BYCATCH AMOUNTS				
Halibut (mt)	4,690	4,749	4,694	4,690
Herring (mt)	3,282	2,219	2,632	3,462
Red king crab (no.)	118,861	116,606	118,782	118,143
C. bairdi (no.)	2,819,170	2,860,095	2,815,330	2,773,829
GROUNDFISH CATCH (mt)				
Atka Mackerel Trawls	34,817	34,817	34,817	34,817
Pollock Bottom Trawls	176,184	313,985	176,184	0
Deepwater Flatfish Trawls	34,627	34,627	34,627	34,627
Flatfish Bottom Trawls	180,283	180,283	180,283	180,283
JV Flatfish Bottom Trawls	0	0	0	0
Midwater Pollock Trawls	865,980	558,830	865,980	1,117,586
Other Bottom Trawls	202,438	169,890	202,438	251,416
Rock Sole Bottom Trawls	70,479	70,479	70,479	70,479
TOTAL	1,564,808	1,362,911	1,564,808	1,689,208
BYCATCH IMPACT COST ($1,000s)				
Halibut	$15,477	$15,672	$15,490	$15,477
Herring	$1,861	$1,258	$1,492	$1,963
Red king crab	$2,092	$2,052	$2,091	$2,079
C. bairdi	$5,272	$5,348	$5,265	$5,187
TOTAL:	$24,701	$24,330	$24,337	$24,706
GROSS REVENUE ($1,000s)				
DAP	$704,328	$662,376	$704,328	$729,688
JVP	$0	$0	$0	$0
TOTAL:	$704,328	$662,376	$704,328	$729,688
NET REVENUE = GROSS REVENUE - VARIABLE COST ($1,000s)				
DAP	$288,752	$264,195	$288,752	$305,447
JVP	$0	$0	$0	$0
TOTAL:	$288,752	$264,195	$288,752	$305,447
NET REVENUE - BYCATCH IMPACT COST ($1,000s)				
TOTAL:	$264,051	$239,865	$264,415	$280,741

Table 6.1.3. Evaluation of Pollock Allocations and Herring Limits without the Vessel Incentive Program Using the Bycatch Simulation Model.

	RUN 9 No Incentive 60% MW Pol. No Herring	RUN 10 No Incentive 40% MW Pol. No Herring	RUN 11 No Incentive 60% MW Pol. 1% Herring Winter-D	RUN 12 No Incentive 40% MW Pol. 1% Herring Winter-D	RUN 13 No Incentive 80% MW Pol. 1% Herring Winter-D
BYCATCH AMOUNTS					
Halibut (mt)	4,774	4,785	4,778	4,785	4,761
Herring (mt)	3,274	2,322	2,624	2,197	3,264
Red king crab (no.)	154,169	151,929	154,090	151,923	153,426
C. bairdi (no.)	2,830,908	2,859,754	2,827,068	2,859,082	2,832,036
GROUNDFISH CATCH (mt)					
Atka Mackerel Trawls	34,817	34,817	34,817	34,817	34,817
Pollock Bottom Trawls	134,121	221,106	134,121	221,106	0
Deepwater Flatfish Trawls	34,629	34,629	34,629	34,629	34,629
Flatfish Bottom Trawls	180,283	180,283	180,283	180,283	180,283
JV Flatfish Bottom Trawls	0	0	0	0	0
Midwater Pollock Trawls	865,980	558,896	865,980	558,830	1,117,578
Other Bottom Trawls	158,560	144,315	158,560	144,315	178,492
Rock Sole Bottom Trawls	62,569	62,569	62,569	62,569	62,569
TOTAL	1,470,959	1,236,615	1,470,959	1,236,549	1,608,368
BYCATCH IMPACT COST ($1,000s)					
Halibut	$15,754	$15,791	$15,767	$15,791	$15,711
Herring	$1,856	$1,316	$1,488	$1,245	$1,850
Red king crab	$2,713	$2,674	$2,712	$2,674	$2,700
C. bairdi	$5,294	$5,348	$5,287	$5,346	$5,296
TOTAL:	$25,617	$25,129	$25,254	$25,056	$25,558
GROSS REVENUE ($1,000s)					
DAP	$632,842	$584,085	$632,842	$584,068	$649,313
JVP	$0	$0	$0	$0	$0
TOTAL:	$632,842	$584,085	$632,842	$584,068	$649,313
NET REVENUE = GROSS REVENUE - VARIABLE COST ($1,000s)					
DAP	$261,670	$234,528	$261,670	$234,520	$274,986
JVP	$0	$0	$0	$0	$0
TOTAL:	$261,670	$234,528	$261,670	$234,520	$274,986
NET REVENUE - BYCATCH IMPACT COST ($1,000s)					
TOTAL:	$236,052	$209,399	$236,416	$209,463	$249,428

Table 6.2. History of Fishery Closure Events for All Constrained Bycatch Model Runs.

Run 1: Vessel incentive program, 60% MW Pollock, No herring caps or closure

	Month	Day	Target Fishery	Event	Cause		Species-Area	Action
On	Jan	1	Pollock Bottom Trawl	exceeded the	Atka Mackerel TAC	for	Bering Sea.	Species now is discard.
On	Jan	22	Pollock Bottom Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Feb	15	Rock Sole Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area is now closed.
On	Apr	1	Deepwater Flatfish	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	May	8	Other Bottom Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area closed to BPOL & OBOT.
On	Jun	8	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Aleutians.	Species now is discard.
On	Jun	15	Other Bottom Trawl	exceeded the	Halibut PSC	for	Bering Sea.	Area closed to BPOL & OBOT.
On	Jun	22	Atka Mackerel Trawl	exceeded the	Atka Mackerel TAC	for	Aleutians.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Sep	22	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Bering Sea.	Species now is discard.
On	Sep	22	Deepwater Flatfish	exceeded the	Gr.Turbot TAC	for	Bering Sea & Aleutians.	Area is now closed.
On	Sep	22	Deepwater Flatfish	exceeded the	Rockfish TAC	for	Aleutians.	Species now is discard.
On	Oct	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 2 (BTC).	Area is now closed.

Run 2: Vessel incentive program, 60% MW Pollock, 1% herring caps, D closure

	Month	Day	Target Fishery	Event	Cause		Species-Area	Action
On	Jan	1	Pollock Bottom Trawl	exceeded the	Atka Mackerel TAC	for	Bering Sea.	Species now is discard.
On	Jan	22	Pollock Bottom Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Feb	15	Rock Sole Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area is now closed.
On	Apr	1	Deepwater Flatfish	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	May	8	Other Bottom Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area closed to BPOL & OBOT.
On	Jun	8	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Aleutians.	Species now is discard.
On	Jun	15	Other Bottom Trawl	exceeded the	Halibut PSC	for	Bering Sea.	Area closed to BPOL & OBOT.
On	Jun	22	Atka Mackerel Trawl	exceeded the	Atka Mackerel TAC	for	Aleutians.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Jul	15	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Aug	22	Flatfish Trawl	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Aug	22	Midwater Pollock	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Sep	15	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	15	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	22	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Bering Sea.	Species now is discard.
On	Sep	22	Deepwater Flatfish	exceeded the	Gr.Turbot TAC	for	Bering Sea & Aleutians.	Area is now closed.
On	Sep	22	Deepwater Flatfish	exceeded the	Rockfish TAC	for	Aleutians.	Species now is discard.
On	Oct	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 2 (BTC).	Area is now closed.

Table 6.2. Continued

Run 3: Vessel incentive program, 60% MW Pollock, 2% herring caps, D closure

	Month	Day	Target Fishery	Event	Cause		Species-Area	Action
On	Jan	1	Pollock Bottom Trawl	exceeded the	Atka Mackerel TAC	for	Bering Sea.	Species now is discard.
On	Jan	22	Pollock Bottom Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Feb	15	Rock Sole Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area is now closed.
On	Apr	1	Deepwater Flatfish	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	May	8	Other Bottom Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area closed to BPOL & OBOT.
On	Jun	8	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Aleutians.	Species now is discard.
On	Jun	15	Other Bottom Trawl	exceeded the	Halibut PSC	for	Bering Sea.	Area closed to BPOL & OBOT.
On	Jun	22	Atka Mackerel Trawl	exceeded the	Atka Mackerel TAC	for	Aleutians.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Aug	1	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Aug	1	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Aug	22	Flatfish Trawl	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Aug	22	Midwater Pollock	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Sep	15	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	15	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	22	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Bering Sea.	Species now is discard.
On	Sep	22	Deepwater Flatfish	exceeded the	Gr.Turbot TAC	for	Bering Sea & Aleutians.	Area is now closed.
On	Sep	22	Deepwater Flatfish	exceeded the	Rockfish TAC	for	Aleutians.	Species now is discard.
On	Oct	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 2 (BTC).	Area is now closed.

Run 4: Vessel incentive program, 60% MW Pollock, 4% herring caps, D closure

	Month	Day	Target Fishery	Event	Cause		Species-Area	Action
On	Jan	1	Pollock Bottom Trawl	exceeded the	Atka Mackerel TAC	for	Bering Sea.	Species now is discard.
On	Jan	22	Pollock Bottom Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Feb	15	Rock Sole Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area is now closed.
On	Apr	1	Deepwater Flatfish	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	May	8	Other Bottom Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area closed to BPOL & OBOT.
On	Jun	8	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Aleutians.	Species now is discard.
On	Jun	15	Other Bottom Trawl	exceeded the	Halibut PSC	for	Bering Sea.	Area closed to BPOL & OBOT.
On	Jun	22	Atka Mackerel Trawl	exceeded the	Atka Mackerel TAC	for	Aleutians.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Aug	8	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Aug	22	Flatfish Trawl	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Sep	15	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	22	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Bering Sea.	Species now is discard.
On	Sep	22	Deepwater Flatfish	exceeded the	Gr.Turbot TAC	for	Bering Sea & Aleutians.	Area is now closed.
On	Sep	22	Deepwater Flatfish	exceeded the	Rockfish TAC	for	Aleutians.	Species now is discard.
On	Sep	22	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Oct	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 2 (BTC).	Area is now closed.

Table 6.2. Continued.

Run 5: Vessel incentive program, 60% MW Pollock, 1% herring caps, B closure

	Month	Day	Target Fishery	Event	Cause	Species-	Area	Action
On	Jan	1	Pollock Bottom Trawl	exceeded the	Atka Mackerel TAC	for	Bering Sea.	Species now is discard.
On	Jan	22	Pollock Bottom Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Feb	15	Rock Sole Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area is now closed.
On	Apr	1	Deepwater Flatfish	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	May	8	Other Bottom Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area closed to BPOL & OBOT.
On	Jun	8	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Aleutians.	Species now is discard.
On	Jun	15	Other Bottom Trawl	exceeded the	Halibut PSC	for	Bering Sea.	Area closed to BPOL & OBOT.
On	Jun	22	Atka Mackerel Trawl	exceeded the	Atka Mackerel TAC	for	Aleutians.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Jul	15	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Aug	22	Flatfish Trawl	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Aug	22	Midwater Pollock	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Sep	15	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	15	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	22	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Bering Sea.	Species now is discard.
On	Sep	22	Deepwater Flatfish	exceeded the	Gr.Turbot TAC	for	Bering Sea & Aleutians.	Area is now closed.
On	Sep	22	Deepwater Flatfish	exceeded the	Rockfish TAC	for	Aleutians.	Species now is discard.
On	Oct	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 2 (BTC).	Area is now closed.

Run 6: Vessel incentive program, 60% MW Pollock, 1% herring caps, C closure

	Month	Day	Target Fishery	Event	Cause	Species-	Area	Action
On	Jan	1	Pollock Bottom Trawl	exceeded the	Atka Mackerel TAC	for	Bering Sea.	Species now is discard.
On	Jan	22	Pollock Bottom Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Feb	15	Rock Sole Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area is now closed.
On	Apr	1	Deepwater Flatfish	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	May	8	Other Bottom Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area closed to BPOL & OBOT.
On	Jun	8	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Aleutians.	Species now is discard.
On	Jun	15	Other Bottom Trawl	exceeded the	Halibut PSC	for	Bering Sea.	Area closed to BPOL & OBOT.
On	Jun	22	Atka Mackerel Trawl	exceeded the	Atka Mackerel TAC	for	Aleutians.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Jul	15	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Aug	22	Flatfish Trawl	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Aug	22	Midwater Pollock	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Sep	15	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	15	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	22	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Bering Sea.	Species now is discard.
On	Sep	22	Deepwater Flatfish	exceeded the	Gr.Turbot TAC	for	Bering Sea & Aleutians.	Area is now closed.
On	Sep	22	Deepwater Flatfish	exceeded the	Rockfish TAC	for	Aleutians.	Species now is discard.
On	Oct	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 2 (BTC).	Area is now closed.

Table 6.2 Continued

Table 6.2. Continued

Run 7: Vessel incentive program, 40% MW Pollock, 1% herring caps, D closure

	Month	Day	Target Fishery	Event	Cause		Species-Area	Action
On	Jan	1	Pollock Bottom Trawl	exceeded the	Atka Mackerel TAC	for	Bering Sea.	Species now is discard.
On	Jan	15	Pollock Bottom Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Feb	15	Rock Sole Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area is now closed.
On	Apr	1	Deepwater Flatfish	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Apr	22	Other Bottom Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area closed to BPOL & OBOT.
On	May	15	Pollock Bottom Trawl	exceeded the	Halibut PSC	for	Bering Sea.	Area closed to BPOL & OBOT.
On	Jun	22	Atka Mackerel Trawl	exceeded the	Atka Mackerel TAC	for	Aleutians.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Jul	8	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Aleutians.	Species now is discard.
On	Jul	22	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Aug	22	Flatfish Trawl	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Aug	22	Midwater Pollock	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Sep	15	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	15	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	22	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Bering Sea.	Species now is discard.
On	Sep	22	Deepwater Flatfish	exceeded the	Gr.Turbot TAC	for	Bering Sea & Aleutians.	Area is now closed.
On	Oct	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 2 (BTC).	Area is now closed.

Table 6.2. Continued

Run 8: Vessel incentive program, 80% MW Pollock, 1% herring caps, D closure

	Month	Day	Target Fishery	Event	Cause		Species-Area	Action
On	Jan	1	Other Bottom Trawl	exceeded the	Atka Mackerel TAC	for	Bering Sea.	Species now is discard.
On	Feb	1	Other Bottom Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Feb	15	Rock Sole Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area is now closed.
On	Apr	1	Deepwater Flatfish	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Jun	8	Other Bottom Trawl	exceeded the	Sablefish TAC	for	Aleutians.	Species now is discard.
On	Jun	15	Other Bottom Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area closed to BPOL & OBOT.
On	Jun	22	Atka Mackerel Trawl	exceeded the	Atka Mackerel TAC	for	Aleutians.	Area is now closed.
On	Jun	22	Other Bottom Trawl	exceeded the	Rockfish TAC	for	Aleutians.	Species now is discard.
On	Jul	1	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Jul	1	Other Bottom Trawl	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Jul	8	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Aug	8	Other Bottom Trawl	exceeded the	Halibut PSC	for	Bering Sea.	Area closed to BPOL & OBOT.
On	Aug	22	Flatfish Trawl	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Aug	22	Midwater Pollock	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Aug	22	Other Bottom Trawl	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Sep	15	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	15	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	22	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Bering Sea.	Species now is discard.
On	Sep	22	Deepwater Flatfish	exceeded the	Gr.Turbot TAC	for	Bering Sea & Aleutians.	Area is now closed.
On	Oct	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 2 (BTC).	Area is now closed.

Run 9: No vessel incentive program, 60% MW Pollock, No herring caps or closures.

	Month	Day	Target Fishery	Event	Cause		Species-Area	Action
On	Jan	1	Pollock Bottom Trawl	exceeded the	Atka Mackerel TAC	for	Bering Sea.	Species now is discard.
On	Jan	22	Pollock Bottom Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Feb	8	Rock Sole Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area is now closed.
On	Apr	1	Deepwater Flatfish	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Apr	15	Other Bottom Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area closed to BPOL & OBOT.
On	May	8	Pollock Bottom Trawl	exceeded the	Halibut PSC	for	Bering Sea.	Area closed to BPOL & OBOT.
On	Jun	22	Atka Mackerel Trawl	exceeded the	Atka Mackerel TAC	for	Aleutians.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Jul	15	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Aleutians.	Species now is discard.
On	Sep	22	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Bering Sea.	Species now is discard.
On	Oct	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 2 (BTC).	Area is now closed.

Table 6.2. Continued.

Run 10: No vessel incentive program, 40% MW Pollock, No herring caps or closures.

	Month	Day	Target Fishery	Event	Cause		Species-Area	Action
On	Jan	1	Pollock Bottom Trawl	exceeded the	Atka Mackerel TAC	for	Bering Sea.	Species now is discard.
On	Jan	15	Pollock Bottom Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Feb	8	Rock Sole Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area is now closed.
On	Apr	1	Deepwater Flatfish	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Apr	8	Other Bottom Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area closed to BPOL & OBOT.
On	Apr	22	Pollock Bottom Trawl	exceeded the	Halibut PSC	for	Bering Sea.	Area closed to BPOL & OBOT.
On	Jun	22	Atka Mackerel Trawl	exceeded the	Atka Mackerel TAC	for	Aleutians.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Jul	22	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Aleutians.	Species now is discard.
On	Sep	22	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Bering Sea.	Species now is discard.
On	Oct	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 2 (BTC).	Area is now closed.

Run 11: No vessel incentive program, 60% MW Pollock, 1% herring caps, closure D.

	Month	Day	Target Fishery	Event	Cause		Species-Area	Action
On	Jan	1	Pollock Bottom Trawl	exceeded the	Atka Mackerel TAC	for	Bering Sea.	Species now is discard.
On	Jan	22	Pollock Bottom Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Feb	8	Rock Sole Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area is now closed.
On	Apr	1	Deepwater Flatfish	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Apr	15	Other Bottom Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area closed to BPOL & OBOT.
On	May	8	Pollock Bottom Trawl	exceeded the	Halibut PSC	for	Bering Sea.	Area closed to BPOL & OBOT.
On	Jun	22	Atka Mackerel Trawl	exceeded the	Atka Mackerel TAC	for	Aleutians.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Jul	15	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Aleutians.	Species now is discard.
On	Jul	15	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Aug	22	Flatfish Trawl	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Aug	22	Midwater Pollock	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Sep	15	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	15	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	22	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Bering Sea.	Species now is discard.
On	Oct	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 2 (BTC).	Area is now closed.

Table 6.2. Continued.

Run 12: No vessel incentive program, 40% MW Pollock, 1% herring caps, D closure

	Month	Day	Target Fishery	Event	Cause		Species-Area	Action
On	Jan	1	Pollock Bottom Trawl	exceeded the	Atka Mackerel TAC	for	Bering Sea.	Species now is discard.
On	Jan	15	Pollock Bottom Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Feb	8	Rock Sole Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area is now closed.
On	Apr	1	Deepwater Flatfish	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Apr	8	Other Bottom Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area closed to BPOL & OBOT.
On	Apr	22	Pollock Bottom Trawl	exceeded the	Halibut PSC	for	Bering Sea.	Area closed to BPOL & OBOT.
On	Jun	22	Atka Mackerel Trawl	exceeded the	Atka Mackerel TAC	for	Aleutians.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Jul	22	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Aleutians.	Species now is discard.
On	Jul	22	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Aug	22	Flatfish Trawl	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Aug	22	Midwater Pollock	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Sep	15	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	15	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	22	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Bering Sea.	Species now is discard.
On	Oct	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 2 (BTC).	Area is now closed.

Run 13: No vessel incentive program, 80% MW Pollock, 1% herring caps, D closure

	Month	Day	Target Fishery	Event	Cause		Species-Area	Action
On	Jan	1	Other Bottom Trawl	exceeded the	Atka Mackerel TAC	for	Bering Sea.	Species now is discard.
On	Feb	1	Other Bottom Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Feb	8	Rock Sole Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area is now closed.
On	Apr	1	Deepwater Flatfish	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Apr	22	Other Bottom Trawl	exceeded the	Halibut PSC	for	Halibut Zone 1&2H.	Area closed to BPOL & OBOT.
On	May	22	Other Bottom Trawl	exceeded the	Halibut PSC	for	Bering Sea.	Area closed to BPOL & OBOT.
On	Jun	22	Atka Mackerel Trawl	exceeded the	Atka Mackerel TAC	for	Aleutians.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	Red King Crab PSC	for	Zone 1 (RKC).	Area is now closed.
On	Jul	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 1 (BTC).	Area is now closed.
On	Jul	8	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Aleutians.	Species now is discard.
On	Jul	8	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 2.	Area is now closed.
On	Aug	22	Flatfish Trawl	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Aug	22	Midwater Pollock	begins fishing after	herring closure ended	for	Herring Zone 2.	First effort in area.
On	Sep	15	Flatfish Trawl	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	15	Midwater Pollock	exceeded the	Herring PSC	for	Herring Zone 3.	Area is now closed.
On	Sep	22	Deepwater Flatfish	exceeded the	Sablefish TAC	for	Bering Sea.	Species now is discard.
On	Oct	1	Flatfish Trawl	exceeded the	bairdi PSC	for	Zone 2 (BTC).	Area is now closed.

Table 6.3.--A comparison of total bycatch from the Bycatch Simulation model runs.

Species	Area	16a Caps	RUN 1 Incentive 60% MW Pol. No Herring	RUN 2 Incentive 60% MW Pol. 1% Herring Winter-D	RUN 3 Incentive 60% MW Pol. 2% Herring Winter-D	RUN 4 Incentive 60% MW Pol. 4% Herring Winter-D	RUN 5 Incentive 60% MW Pol. 1% Herring Winter-B	RUN 6 Incentive 60% MW Pol. 1% Herring Winter-C
Red King Crab	Zone 1	200,000	111,513	111,513	111,513	111,513	111,513	111,513
C. bairdi	Zone 1	1,000,000	924,802	924,724	924,790	924,802	924,724	924,724
	Zone 2	3,000,000	1,894,368	1,890,606	1,893,966	1,893,995	1,891,584	1,890,140
Halibut	Zones 1 & 2H	4,400 mt	4,265	4,267	4,267	4,267	4,267	4,269
	Bering Sea	5,333 mt	4,690	4,694	4,691	4,691	4,693	4,694
Herring	Bering Sea	No Limit	3,282					
	1%	833 mt		2,632			2,723	2,470
	2%	1,666 mt			3,126			
	4%	3,332 mt				3,343		

Table 6.3.--Continued.

Species	Area	16a Caps	RUN 7 Incentive 40% MW Pol. 1% Herring Winter-D	RUN 8 Incentive 80% MW Pol. 1% Herring Winter-D	RUN 9 No Incentive 60% MW Pol. No Herring	RUN 10 No Incentive 40% MW Pol. No Herring	RUN 11 No Incentive 60% MW Pol. 1% Herring Winter-D	RUN 12 No Incentive 40% MW Pol. 1% Herring Winter-D	RUN 13 No Incentive 80% MW Pol. 1% Herring Winter-D
Red King Crab	Zone 1	200,000	109,394	110,822	146,838	144,719	146,838	144,719	146,147
C. bairdi	Zone 1	1,000,000	923,805	940,005	1,023,929	1,022,943	1,023,851	1,022,932	1,039,132
	Zone 2	3,000,000	1,936,290	1,833,824	1,806,979	1,836,812	1,803,218	1,836,151	1,792,904
Halibut	Zones 1 & 2H	4,400 mt	4,533	3,864	4,408	4,616	4,410	4,617	4,442
	Bering Sea	5,333 mt	4,749	4,960	4,774	4,785	4,778	4,785	4,761
Herring	Bering Sea	No Limit			3,274	2,322			
	1%	833 mt	2,219	3,462			2,624	2,197	3,264

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8.0 EFFECTS ON ENDANGERED SPECIES AND ON THE ALASKA COASTAL ZONE

None of the alternatives would constitute actions that "may affect" endangered species or their habitat within the meaning of the regulations implementing Section 7 of the Endangered Species Act of 1973. Thus, consultation procedures under Section 7 on the final actions and their alternatives will not be necessary.

Also, for the reasons discussed above, each of the alternatives would be conducted in a manner consistent, to the maximum extent practicable, with the Alaska Coastal Management Program within the meaning of Section 307(c)(1) of the Coastal Zone Management Act of 1972 and its implementing regulations.

9.0 OTHER EXECUTIVE ORDER 12291 REQUIREMENTS

Executive Order 12291 requires that the following three issues be considered:

(a) Will the amendment have an annual effect on the economy of $100 million or more?

(b) Will the amendment lead to an increase in the costs or prices for consumers, individual industries, Federal, State, or local government agencies or geographic regions?

(c) Will the amendment have significant adverse effects on competition, employment, investment, productivity, innovation, or on the ability of U.S. based enterprises to compete with foreign enterprises in domestic or export markets?

Regulations do impose costs and cause redistribution of costs and benefits. If the proposed regulations are implemented to the extent anticipated, these costs are not expected to significant relative to total operational costs.

The amendment will not have significant adverse effects on competition, employment, investment, productivity, innovation, or on the ability of U.S. based enterprises to compete with foreign enterprises in domestic or export markets.

The amendment should not lead to a substantial increase in the price paid by consumers, local governments, or geographic regions since no significant quantity changes are expected in the groundfish markets. Where more enforcement and management effort are required, costs to state and federal fishery management agencies will increase.

This amendment should not have an annual effect of $100 million, since although the total value of the domestic catch of all groundfish species is over $100 million, this amendment is not expected to substantially alter the amount or distribution of this catch.

10.0 IMPACT OF THE AMENDMENTS RELATIVE TO THE REGULATORY FLEXIBILITY ACT

The Regulatory Flexibility Act (RFA) requires that impacts of regulatory measures imposed on small entities (i.e., small businesses, small organizations, and small governmental jurisdictions with limited resources) be examined to determine whether a substantial number of such small entities will be significantly impacted by the measures. Fishing vessels are considered to be small businesses. A total of 1,348 vessels may fish for groundfish off Alaska in 1990, based on Federal groundfish permits issued by NMFS through March 29, 1990. While these numbers of vessels are considered substantial, regulatory measures will only affect a smaller proportion of the fleet.

11.0 FINDINGS OF NO SIGNIFICANT IMPACT

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

____ ____________________
Assistant Administrator for Fisheries Date

12.0 COORDINATION WITH OTHERS

The Gulf of Alaska Groundfish Plan Team and the Bering Sea/Aleutian Islands Groundfish Plan Team consulted extensively with representatives of the Alaska Department of Fish and Game (ADF&G), National Marine Fisheries Service (NMFS), members of the Scientific and Statistical Committee and Advisory Panel of the Council, and members of the academic and fishing community.

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Appendix
The Importance of Herring in the Traditional Culture and Economy of the Central Yup'ik Eskimo of the Nelson Island Area

Three categories of fisheries would experience socioeconomic impacts from the alternative actions: the trawl groundfish fishery, commercial sac roe herring fisheries, and subsistence herring fisheries. Analysis of socioeconomic impacts for the first two fisheries is similar to the case for crab and halibut bycatch controls and used the simulation model approach that was used to evaluate Amendments 12a and 16 alternatives. The analysis of the socioeconomic impacts on subsistence fisheries is more difficult to evaluate quantitatively.

The central Bering Sea coast of Alaska in the vicinity of Nelson Island and Nunivak Island is the home of several traditional Yup'ik Eskimo groups, which currently reside in eight winter villages, with a combined 1988 population of about 2,559 people (Alaska Department of Revenue 1989) (Table 1). The ancestors of this Yup'ik Eskimo population have continuously occupied the area since before historic contact, probably for a period of more than 1,500 years. The eight villages are united into three traditional societies, which represent historically distinct marriage universes (endogamous kinship groups) with separate sociopolitical identities (Shinkwin and Pete 1984). The people of the Nelson Island vicinity (living in the villages of Newtok, Nightmute, Toksook Bay, Tununak) are called the Qaluyaarmiut. The people of Nunivak Island (living in the village of Mekoryak) are called the Nunivaarmiut. The people of the northern Kuskokwim Bay (living in Chefornak, Kipnuk, Kongiganek, and Kwigillingok) are called the Caninermiut (however, the appropriate boundaries and designations for this social group are less well documented in the scientific literature).

Currently, each of these communities has traditional tribal governments, organized under the Indian Reorganization Act and recognized by the United States government. The tribal governments of Nelson Island villages are further organized into the United Villages of Nelson Island, a regional political organization. All the tribal governments also are affiliated with the Association of Village Council Presidents, a larger regional group representing the traditional tribal governments of the Yukon-Kuskokwim Delta area.

The peoples of the Nelson Island and Nunivak Island area are part of a larger cultural group referred to in the ethnographic literature as the "Central Yup'ik Eskimos", after the primary dialect of the Eskimo-Aleut language family spoken in the area (Burch 1984). The Central Yup'ik Eskimo currently number about 17,000 people in about 70 villages, stretching from southern Bristol Bay to northern Norton Sound along the Bering Sea coast and up the major river systems draining into the Bering Sea. The Central Yup'ik are still primarily engaged in a traditional fishing and hunting economy, speak Yup'ik as the first language, and practice a complex system of indigenous sociocultural traditions.

In part because of geographic isolation, the area's indigenous peoples have remained relatively intact throughout the historic period (since circa 1833). The Nelson Island area is one of the most remote parts of the United States. The area has no road system, and access into the region is by plane, by boat during ice free months, and by snowmachine or dog team (mid-October to early May). The Qaluyaarmiut, Caninermiut, and Nunivaarmiut are among the most traditional of the Central Yup'ik groups. They continue to maintain a traditional culture and economy, modified in particular aspects by the incorporation of certain features of the outside Euro-American culture and market economy.

The people of the Nelson Island and Nunivak Island area participate in what can be called a "mixed, subsistence-market economy" (Wolfe 1984, Wolfe and Walker 1987). There are three components to the economy: (1) traditional subsistence fishing and hunting; (2) monetary income earned through sales of fish and furs produced and marketed through local, small-scale commercial fishing and fur trapping industries; and (3) monetary income earned through limited, local wage employment, usually through public sector grants. The economy is an example of a "domestic mode of production", in that traditional kinship relationships and groups provide the primary social organization of economic production (in contrast to the non-kinship economic firms of industrial-capitalism) (Wolfe et al. 1984).

The societies of the Nelson Island and Nunivak Island area are still essentially hunter-gatherer groups. Most economic activity is organized around traditional fishing, hunting, gathering, and trapping for local uses, including direct family consumption and customary distribution and sharing. Subsistence harvests of wild foods in the area are large: the communities annually harvest an estimated 700 to 900 lbs of wild resources per person each year, comprising most of the local food supply. By comparison, Americans purchase an estimated 1,370 lbs of food annually, of which 220 lbs are meat, fish, and poultry. In addition to the subsistence foods, the Nelson Island and Nunivak Island area communities import modest quantities of certain food products, especially flour, sugars, coffee, tea, rice, and some fats.

Herring is a major subsistence resource harvested by the communities of the Nelson Island and Nunivak Island area. The per capita subsistence herring harvest in Nelson Island communities was estimated to be 308 lbs per person (Pete and Kreher 1986:43). Subsistence herring constituted about one-quarter to half of the total subsistence food supply of those communities.

The second component of the local mixed, subsistence-market economy are small-scale fisheries and fur trapping for commercial sale on export markets. Traditionally, commercial fur trapping of mink, land otter, white fox, and red fox has contributed income to the local economy. Currently, unstable world market prices for furs have meant this activity contributes at most only about 10 percent of the total earned monetary income by families in the Central Bering Sea region. The development of local commercial fisheries has created the potential for a more stable source of cash income for communities of the Central Bering Sea Coast. In the Nelson and Nunivak Island area, fishermen have begun to participate in new, small-scale commercial fisheries for herring, halibut, and salmon. These fisheries have the potential for producing a sustainable source of income to the region, but only if they can be managed to allow local fishermen an opportunity to successfully compete with the outside commercial fleet (Wolfe 1984). Currently, the sociopolitical mechanisms for developing commercial fisheries make this a difficult goal to achieve. "Super exclusive fishing areas" and "limited entry fishing" are management approaches being applied to the commercial herring fishery at Nelson Island to achieve this goal, but with only limited success.

Wage employment, the third component of the local, mixed economy, is extremely limited in the Central Bering Sea region. The primary source of wage employment is in state, federal, and local government-funded services, providing a few local wage jobs in schools and municipal services. In general, there is no private business sector in the communities providing wage employment. State and federal capital improvement projects have provided temporary local wage employment in construction of housing and schools during Alaska's oil-boom period from 1978 to 1986, but this source of employment decreased in the late 1980s with falling state oil revenues.

The market-wage component of the mixed economy is not strong. Because of limited wage opportunities, unemployment is among the highest anywhere in the United States: real unemployment rates in January have been calculated at 48.8 percent in the Central Bering Sea region. The Central

Bering Sea region is the poorest in Alaska because of its limited commercial and wage sector, as illustrated by 1980 census figures. The area's census districts (Wade-Hampton and Bethel) were at the bottom in per capita personal income out of 29 districts statewide:

Rank	Census District	Per Capita Income
29th	Wade-Hampton (Lower Yukon Coast)	$ 2,737
26th	Bethel (Lower Kuskokwim Coast)	$ 5,772
	Alaska Statewide Average	$11,152

In 1982, the latest year for which statistics are published, the communities of the Nelson Island area had average taxable incomes ranging between $6,942 to $8,019 per income tax return, among the lowest in the state. As a comparison, Anchorage had an average taxable income of $23,590 per income tax return (Alaska Department of Revenue 1985). Comparisons of dollar incomes tend to over state the differences between income in Western Alaska communities and other areas because much of the income in the former is not in dollars but rather in goods and services. However, other more comprehensive measures of income would also indicate a large difference between these communities and the largest communities in Alaska.

Income from commercial herring fishing supplies a substantial portion of the annual dollar income in many of the smaller western Alaskan communities. Table 2 lists the average gross earnings by fishing area, census district, and gear for Bering Sea herring sac roe fisheries. Commercial salmon fishing opportunities are limited or non-existent in communities in the vicinity of Nelson and Nunivak Islands. Herring provide the only available commercial fishery.

In addition to these low incomes, cost of living is extremely high in Central Bering Sea Coast communities. The price of store foods imported into the region are estimated at about 200 percent Anchorage prices because of the high cost of shipping. This means foods which cost $1.00 in Anchorage cost $2.00 in the Nelson Island area. The high living costs erodes the purchasing power of the limited cash incomes of families.

As illustrated by these figures, the region's communities could not survive on the low monetary incomes without subsistence fishing and hunting. The communities' most secure economic adaptation is to participate in a traditional mixed economy, combining subsistence fishing and hunting with cash earnings from limited wage employment and commercial fishing. The money generated in the commercial-wage sector of the economy enables families to capitalize in the subsistence sector, producing a substantial portion of the local food supply.

One important fact about the traditional economy and culture of the Central Bering Sea Coast is that, while the Yup'ik Eskimo communities of the area appear to be "poor" in terms of monetary income, they are "affluent" in most other ways. The people eat a varied, plentiful, and relatively healthful traditional diet. The traditional culture is strong, as shown by the continued use of Yup'ik language, ascription to traditional belief systems and customs, and the practice of rich ceremonial systems and ritual (Fienup-Riordan 1983). The traditional, kinship-based social order is intact and functioning successfully, as evidenced by the kinship groups producing large volumes of traditional foods during the annual subsistence cycle (Pete and Kreher 1986). The communities are vigorous and growing.

Monetary measures are not designed to adequately account for most of the values derived from traditional, indigenous cultural systems like that of the Central Yup'ik Eskimo. The values derived from the indigenous culture and economy are traditional ones, embedded within traditional systems of kinship, beliefs, customs, and ritual which are substantially different from those of market-oriented, Euro-American systems.

Ascribing a value to subsistence herring within the traditional Yup'ik Eskimo communities is difficult because of the markedly different cultural and economic contexts of the subsistence use. Because monetary measures cannot adequately represent the true value of herring to these indigenous groups, the value of herring also should be described in social, cultural, and psychological terms congruent with the group's own traditional sociocultural perspectives.

From the point of view of the indigenous culture, herring has great value because of its central position in the traditional economy, culture, and social system of the Yup'ik Eskimo in the Nelson Island and Nunivak Island area. First, it has great value as a primary source of food. Herring supplies a substantial portion of the nutritional requirements (primarily proteins and fats) of the indigenous population. Without a continued supply of herring, the communities would face substantial nutritional hardships. For a variety of reasons, it would be extremely difficult for the Nelson Island communities to consistently replace herring through increased harvests of other local subsistence resources which are harvested in the area, such as seal, salmon, and halibut. For instance, seal are not as reliable a resource as herring because of variable ice conditions and migration patterns. Salmon runs are not large and consistent enough in the Nelson Island area to substitute for herring. Halibut are more costly and difficult to procure in substantial quantities. Herring plays a central nutritional role in the local economies because of its large volume, annual reliability, and inexpensive procurement costs. It provides security and stability to the local subsistence economy in ways that other resources cannot.

In addition to its nutritional value, herring is important for its social and spiritual values to the community. Subsistence fishing and hunting are more than mere occupations in indigenous Yup'ik culture, they are activities central to the functioning of family and community, and central to the personal psychological integrity of the individual Yup'ik. The Yup'ik as a people traditionally define themselves in terms of the mutual social and spiritual relationships of kinship and the natural world. The traditional work tasks of catching and processing subsistence foods for the kin group are primary social roles of men and women. The Yup'ik word for "man" (angun, "human male"), literally means "something that chases something for food" (from the root angu-, "to catch after chasing", and the lexical stem -n, "instrument") (Jacobson 1984:500). A nukalpiaq, "a young man in his prime", also means "a good hunter and provider" (and on Nunivak Island, it means a "rich" man, showing the conceptional equating of abundant subsistence food and economic well being) (Jacobson 1984:268). Thus hunting and fishing are more than just character-defining occupations for men, they define gender itself. Similarly, processing subsistence foods is a primary social role for women in Yup'ik culture, defining her important position in the social order. Once the subsistence kill is turned over to the woman for processing, she owns and controls the subsistence product. The woman determines its disposition, and can keep or give it away as she chooses.

Subsistence herring is harvested and processed within large, extended kinship networks in the Nelson Island area (Pete and Kreher 1984). Almost all family groups in the communities are mobilized for harvesting and processing herring. The production unit is usually a multiple household, kin-based group, most commonly composed of primary kin relations (parents, children, grandchildren, and siblings). Each production group has "rack managers", typically a married couple, or a widow(er) and her or his eldest son or daughter, who control the drying rack facilities and who direct operations. The relationships of harvesters and processors to managers is that of son or son-in-law and daughter or daughter-in-law to parents or parents-in-law. For instance, in the community of Tununak in 1986, there were 37 kinship groups producing herring containing a mean of 2.5 fishermen (range 1-4) and 2.6 processors (range 1-5), involving 160 of the 323 persons in the community, and involving 56 of the 65 community households (Peter and Kreher 1984:47).

Thus, the high value of herring in the local Yup'ik culture is due in part to its central position in the functioning of families in the traditional annual cycle of subsistence activities. Production of herring is probably one of the major social functions of the extended family group in the Nelson Island area. Because of the traditional domestic mode of production for herring, negative impacts on subsistence herring production have direct negative impacts on the functioning of family groups. The elimination of herring and herring production activities would directly disrupt primary social functions of families. It is hard to predict the types and extent of negative effects, but it is highly probable that the elimination of central subsistence activities like herring production would have severe negative social and psychological consequences for particular families, such as increased alcoholism and domestic violence. These in turn would have ramifications for the entire community and culture.

The high value of herring in the Nelson Island area also is related to its importance in the networks of non-market distribution and exchange of subsistence products between households in the community. Households which cannot fish and hunt for themselves due to age or other personal circumstance receive subsistence foods from productive households, usually along lines of kinship or traditional exchange relations. Negative impacts on subsistence production would compromise these traditional social support networks, especially for the elderly and unmarried mothers with dependent children. Because of the large volume produced, herring is one of the major food products flowing through these traditional distribution and exchange networks.

Subsistence foods also are primary items for ritualized exchange relations between families. Reciprocal and ceremonial exchange relations are primary social mechanisms for unifying communities in Central Yup'ik culture, and for expressing spiritual relationships between humans and animals. There are a variety of ceremonial contexts through which the exchange of food expresses spiritual values. For instance, the first subsistence activities of young children (such as the first seal killed by a boy, or the first seagull eggs gathered by a girl) are ritually celebrated with feasts (kalukaq, or nerevkarin). Subsistence foods (raw and cooked) typically are distributed in the name of the young child among the guests, which include unrelated kin groups from the larger community. These ceremonies involve spiritual and reproductive symbolisms, for the sharing of the first fruit is to help the child's future hunting and fishing success and marriage prospects, which in turn supports the community's future reproductive success (Fienup-Riordan 1984). They also express on-going mutual obligations between humans and the spirit owners of the animals, by properly using the subsistence product, so that the animals will continue to offer themselves to humans in the future. Without subsistence foods, the rites linking humans and animals in the traditional cosmology would not be possible, and the future of the human race jeopardized.

Clearly, herring and other subsistence resources have values to the indigenous Central Yup'ik cultures which go beyond their nutritional and economic values. Without these subsistence activities and uses, the indigenous cultures could not survive in their traditional forms. Thus, the elimination of subsistence opportunities means the destruction of traditional, indigenous cultures.

There is growing international concern that the survival of indigenous, culturally diverse groups should be a central social goal in relations between national and ethnic groups. That is, the existence of culturally diverse, indigenous groups is a desirable social end (and in fact, a social right of the indigenous group). The loss of a traditional culture is usually irreversible. And the lost values of that culture is a loss to the world.

It is difficult to put an economic value to the survival of traditional cultures like the Central Yup'ik. Fortunately there are two reasons why this may not be necessary to make a rational decision concerning actions that may reduce the subsistence or commercial herring catch adjacent to some communities. First, the availability of alternative subsistence or commercial resources decrease the probability that the survival of a culture is dependent on the availability of herring. Second, an alternative to estimating the cost of such a loss is estimating the cost of preventing that loss by providing alternative comparable subsistence and commercial activities. For example, it is possible that a diminished ability of the residents of Nelson Island to harvest herring on their traditional fishing grounds could be replaced by increased access either to other species on those fishing grounds or to herring on other grounds. There would be costs involved in providing improved access to other resources; however, these costs would probably be significantly less than those associated with the loss of a culture.

This alternative measure of the cost of decreasing the availability of herring on traditional fishing grounds is only relevant in determining the appropriate use of herring resources if the alternatives to the herring fishery would be provided. If there is no provision for this to occur, the higher costs associated with the potential loss of a culture should be measured.

Table 1 **Communities and 1988 Populations in the Nelson Island Vicinity.**

Community	Population	Group
Chefornak	293	Caninermiut
Kipnuk	392	Caninermiut
Kongiganek	283	Caninermiut
Kwigillingok	264	Caninermiut
Mekoryak	190	Nunivaarmiut
Newtok	220	Qaluyaarmiut
Nightmute	161	Qaluyaarmiut
Toksook Bay	421	Qaluyaarmiut
Tununak	335	Qaluyaarmiut
Total	2,559	

Source: Alaska Department of Labor, 1988 Estimates of Alaska's Population, News Release, July 10, 1989 (No. 90-03), Juneau, Alaska

Table 2 Bering Sea Sac Roe Herring Average Gross Earnings Summary by Fishing Area, Census Area, and gear for 1986-1988. A value of . (period) indicates either no data or confidential data (less than 4 permits in stratum). (source: Alaska Commercial Fisheries Entry Commission).

		1986 Average Earnings	1987 Average Earnings	1988 Average Earnings	1986-88 Average Earnings
FISHING AREA: Cape Avinof					
GEAR	RESIDENCE CENSUS AREA				
Gillnet	Bethel			$2,539	$2,539
	Bristol Bay Borough			.	.
	Non-Resident			.	.
	All Areas:			$2,539	$2,539
FISHING AREA: Goodnews Bay					
GEAR	RESIDENCE CENSUS AREA				
Gillnet	Bethel	$2,923	$689	$6,335	$3,316
	Dillingham	.	.	.	.
	Bristol Bay Borough	.	.	.	.
	Anchorage	.	.	.	.
	City & Borough of Juneau	.	.	.	.
	Ketchikan Gtwy. Borough	.	.	.	.
	Non-Resident	$4,333	.	.	$4,333
	All Areas:	$3,628	$689	$6,335	$3,570
FISHING AREA: Nelson/Nunivak					1986-88
GEAR	RESIDENCE CENSUS AREA				
Gillnet	Wade Hampton	.	.	.	.
	Bethel	$2,777	$2,291	$3,916	$2,995
	Dillingham	.	.	.	.
	Bristol Bay Borough	.	.	.	.
	Anchorage	.	$5,956	.	$5,956
	Kodiak Island Borough	.	.	.	.
	Haines Borough	.	.	.	.
	City & Borough of Juneau	.	.	.	.
	Wrangell-Petersburg	$22,432	$16,077	.	$19,255
	Non-Resident	$7,251	$10,444	.	$8,848
	All Areas:	$10,820	$8,692	$3,916	$8,893

Table 2 continued

FISHING AREA: Norton Sound

GEAR	RESIDENCE CENSUS AREA	1986 Average Earnings	1987 Average Earnings	1988 Average Earnings	1986-88 Average Earnings
Beach Seine	Nome Census Area	.	$1,624	.	$1,624
	Southeast Fairbanks	.	.	.	.
	Dillingham	.	.	.	.
	Matanuska-Susitna Bor.	.	.	.	.
	Anchorage	.	.	.	.
	Kenai Peninsula Borough	.	$2,647	.	$2,647
	Kodiak Island Borough	.	.	.	.
	Valdez-Cordova	.	.	.	.
	Skagway-Yakutat-Angoon	.	.	.	.
	Ketchikan Gtwy. Borough	.	.	.	.
	Non-Resident	.	.	.	.
	All Areas:	.	$2,136	.	$2,136
Gillnet	RESIDENCE CENSUS AREA				
	North Slope Borough	.	.	.	.
	Kobuk Census Area	.	$4,226	.	$4,226
	Nome Census Area	$6,876	$3,278	$7,762	$5,972
	Yukon-Koyukuk	.	.	.	.
	Fairbanks N. Star Bor.	$6,345	$3,556	.	$4,950
	Southeast Fairbanks	.	.	.	.
	Wade Hampton	$5,893	$2,501	$9,035	$5,810
	Bethel	.	.	$15,949	$15,949
	Dillingham	.	$5,073	.	$5,073
	Bristol Bay Borough	.	$4,226	.	$4,226
	Aleutian Islands	.	.	.	.
	Matanuska-Susitna Bor.	$5,682	$3,697	$9,451	$6,277
	Anchorage	$9,520	$5,646	$14,594	$9,920
	Kenai Peninsula Borough	$9,781	$4,725	$22,689	$12,398
	Kodiak Island Borough	.	.	.	.
	Valdez-Cordova	$12,673	$4,861	.	$8,767
	Skagway-Yakutat-Angoon	.	.	.	.
	City & Borough of Juneau	.	$4,519	.	$4,519
	Wrangell-Petersburg	$16,764	$6,147	.	$11,455
	Ketchikan Gtwy. Borough	.	.	.	.
	Non-Resident	$13,070	$5,872	$16,019	$11,654
	All Areas:	$9,623	$4,487	$13,643	$8,291

Table 2 continued

FISHING AREA: Cape Romanzof

GEAR	RESIDENCE CENSUS AREA	1986 Average Earnings	1987 Average Earnings	1988 Average Earnings	1986-88 Average Earnings
Gillnet	Fairbanks N. Star Bor.	*	*	*	
	Wade Hampton	$9,891	$3,898	$6,895	
	Bethel	*	*	*	
	Anchorage	*	*	*	
	Kenai Peninsula Borough	*	$7,933	$7,933	
	Kodiak Island Borough	*	*	*	
	Valdez-Cordova	*	*	*	
	City & Borough of Juneau	*	*	*	
	City & Borough of Sitka	*	*	*	
	Non-Resident	$28,849	$14,004	$21,426	
	All Areas:	$19,370	$8,611	$12,915	

FISHING AREA: Security Cove

GEAR	RESIDENCE CENSUS AREA	1986 Average Earnings	1987 Average Earnings	1988 Average Earnings	1986-88 Average Earnings
Gillnet	Fairbanks N. Star Bor.	*	*	*	*
	Southeast Fairbanks	*	*	*	*
	Bethel	*	*	*	*
	Dillingham	$2,968	$2,626	*	$2,797
	Bristol Bay Borough	$7,753	$3,734	*	$5,743
	Matanuska-Susitna Bor.	*	*	*	*
	Anchorage	$5,276	$3,808	$10,512	$6,532
	Kenai Peninsula Borough	*	*	*	*
	Valdez-Cordova	*	*	*	*
	City & Borough of Juneau	*	*	*	*
	Wrangell-Petersburg	*	*	*	*
	Ketchikan Gtwy. Borough	*	*	*	*
	Non-Resident	$7,052	$4,348	$9,429	$6,943
	All Areas:	$5,762	$3,629	$9,970	$5,751

Table 2 continued

FISHING AREA: Togiak

GEAR	RESIDENCE CENSUS AREA	1986 Average Earnings	1987 Average Earnings	1988 Average Earnings	1986-88 Average Earnings
Purse Seine	Nome Census Area	.	.	.	.
	Fairbanks N. Star Bor.	.	.	.	.
	Dillingham	$18,822	$29,853	$52,209	$33,628
	Bristol Bay Borough	.	$19,292	.	$19,292
	Aleutian Islands	.	.	.	.
	Matanuska-Susitna Bor.	.	.	$115,696	$115,696
	Anchorage	$17,293	$26,754	$33,714	$25,921
	Kenai Peninsula Borough	$34,974	$47,329	$95,789	$59,364
	Kodiak Island Borough	$31,385	$76,867	$50,835	$53,029
	Valdez-Cordova	$48,884	$44,707	$37,603	$43,732
	City & Borough of Juneau	$19,948	.	.	$19,948
	Wrangell-Petersburg	$30,480	$26,754	.	$28,617
	Pr. Wales-Out. Ketchikan	.	.	.	.
	Ketchikan Gtwy. Borough	$22,014	.	.	$22,014
	Non-Resident	$25,492	$45,188	$49,102	$39,927
	All Areas:	$27,699	$39,593	$62,135	$41,708
Roe on Kelp	RESIDENCE CENSUS AREA				
	Nome Census Area	.	.	.	.
	Fairbanks N. Star Bor.	.	.	.	.
	Southeast Fairbanks	.	.	.	.
	Wade Hampton	.	.	.	.
	Bethel	$1,680	.	$2,078	$1,879
	Dillingham	$1,219	$989	$1,398	$1,202
	Bristol Bay Borough	.	.	.	.
	Aleutian Islands	.	.	.	.
	Matanuska-Susitna Bor.	.	.	.	.
	Anchorage	.	.	$1,171	$1,171
	Kenai Peninsula Borough	.	.	.	.
	Kodiak Island Borough	.	.	.	.
	Valdez-Cordova	.	.	$1,284	$1,284
	Wrangell-Petersburg	.	.	.	.
	Non-Resident	.	.	$725	$725
	All Areas:	$1,449	$989	$1,331	$1,318
Gillnet	RESIDENCE CENSUS AREA				
	Nome Census Area	.	.	.	.
	Yukon-Koyukuk	.	.	.	.
	Fairbanks N. Star Bor.	.	.	.	.
	Southeast Fairbanks	.	.	.	.
	Bethel	$7,554	$4,430	$5,293	$5,759
	Dillingham	$7,982	$5,249	$5,813	$6,348
	Bristol Bay Borough	$11,408	$6,480	$6,248	$8,045
	Aleutian Islands	.	.	.	.
	Matanuska-Susitna Bor.	$9,367	$8,949	$6,304	$8,207
	Anchorage	$8,791	$6,677	$7,064	$7,511
	Kenai Peninsula Borough	$13,517	$8,876	$4,115	$8,836
	Kodiak Island Borough	.	.	$11,786	$11,786
	Valdez-Cordova	.	.	$4,409	$4,409
	City & Borough of Juneau	.	.	.	.
	Wrangell-Petersburg	.	.	.	.
	Ketchikan Gtwy. Borough	.	.	.	.
	Non-Resident	$11,215	$7,609	$7,960	$8,928
	All Areas:	$9,976	$6,896	$6,555	$7,700

AMENDMENT 16A
TEXT TO AMEND THE FMP FOR THE GROUNDFISH FISHERY
OF THE BERING SEA AND ALEUTIAN ISLANDS AREA

1. In Chapter 2.0, Section 2.1 entitled "History and Summary of Amendments," add the following:

Amendment 16a implemented on _____________, 1991.

(1) Established inseason authority to temporarily close statistical areas, or portions thereof, to reduce high prohibited species bycatch rates;

(2) Provided authority to the Regional Director, in consultation with the Council, to set a limit on the amount of the pollock TACs that may be taken with other than pelagic trawl gear;

(3) Established a framework for determining an annual herring PSC limit as 1% of the estimated herring biomass, attainment of which triggers trawl closures in three Herring Savings Areas.

2. In Chapter 14 entitled "Management Regime," the following sections are affected:

A. Section 14.4.2.1

Retitle Section 14.4.2.1 to read "Prohibited Species Bycatch Limitation Zones and Areas.

Append a new subsection E, Herring Savings Areas:

Herring Savings Areas means any of the three areas described as follows:

(1) Summer Herring Savings Area 1 means that part of the Bering Sea subarea that is south of 57° N. latitude and between 162° & 164° W. longitude from 12:00 noon Alaska Local Time (ALT) June 15 through 12:00 noon ALT July 1 of a fishing year.

(2) Summer Herring Savings Area 2 means that part of the Bering Sea subarea that is south of 56°30' N. latitude and between 164° and 167° W. longitude from 12:00 noon ALT July 1 through 12:00 noon ALT August 15 of a fishing year.

(3) Winter Herring Savings Area means that part of the Bering Sea subarea that is between 58° and 60° N. latitudes and between 172° and 175° W. longitudes from 12:00 noon ALT September 1 through 12:00 noon ALT March 1 of the succeeding fishing year.

[Insert Figure 27c for the Herring Savings Areas]

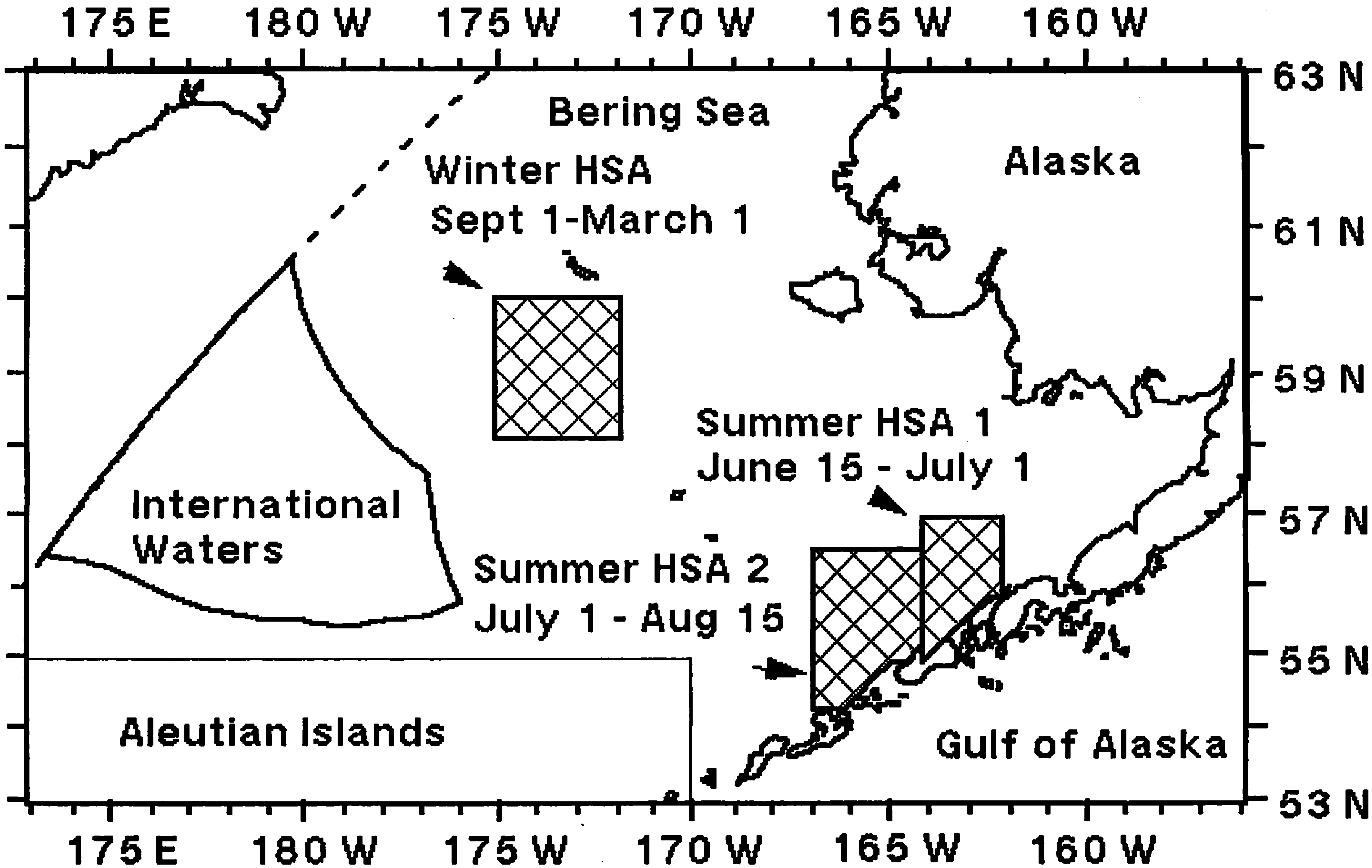

FIGURE 27c HERRING SAVINGS AREAS (HSAs) IN THE BERING SEA AND ALEUTIAN ISLANDS

B. Section 14.4.2.2 Prohibited Species Catch Limits

Append a new subsection E:

E. The annual PSC limit of Pacific herring caught while conducting any DAH trawl fishery for groundfish in the Bering Sea and Aleutian Islands area management unit is 1 percent of the annual biomass of eastern Bering Sea herring.

C. Section 14.4.8 Inseason Adjustments

[INSERT AFTER FIRST PARAGRAPH]

Other inseason actions may be necessary to promulgate interim fishery closures in portions of the Bering Sea and Aleutian Islands management areas to reduce prohibited species bycatch rates and the probability of premature attainment of prohibited species catch (PSC) limits and allowances. The intent of such interim closures would be to provide fishermen with a greater opportunity to harvest groundfish quota amounts by guaranteeing a longer fishing period before PSC limits or allowances are reached and bycatch zones or areas are closed to specified fisheries or gear types.

Ideally, the need to implement interim closures of areas to limit fishery operations that exhibit unexpectedly high bycatch rates would be identified through an examination of bycatch data collected inseason by observers. At times, however, data on bycatch rates may not be timely enough for effective implementation of season closures. Alternatively, the fishery bycatch rates may vary so much from week to week that the Regional Director may have difficulty in determining whether bycatch rates in a fishery or area are intrinsically high, are an exhibition of "dirty fishing", or simply reflect natural variability in an otherwise '"clean" fishery or area. Historical data could be used, therefore, to determine whether consistent "hot spots" occur in the Bering Sea and Aleutian Islands area groundfish fisheries. Historical information may then be compared with variable inseason data to help determine whether an inseason closure is warranted to reduce overall bycatch rates.

The need for inseason action for conservation purposes may be related to several circumstances. . . .

[INSERT AFTER 5TH PARAGRAPH]

The Regional Director may also promulgate an inseason closure of an area to reduce prohibited species bycatch rates provided the closure period extends no longer than the time period specified in regulations. Interim closures must be based upon a determination that such closures are necessary to prevent;

(A) a continuation of relatively high bycatch rates in a statistical area, or portion thereof;

(B) the take of an excessive share of PSC limits or allowances established under Section 14.4.2 by vessels fishing in an area;

(C) the closure of one or more directed groundfish fisheries due to excessive prohibited species bycatch rates occurring in a specified target fishery; and

(D) the premature attainment of established PSC limits or allowances and associated loss of opportunity to vessels to harvest the groundfish OY.

[REPLACE PARAGRAPH 6 WITH THE FOLLOWING PARAGRAPH]

The types of information which the Regional Director will consider in determining whether conditions exist that require an inseason adjustment or action are described, as follows, although he is not precluded from using information not described but determined to be relevant to the issue.

(a) The effect of overall fishing effort within an area;

(b) Catch per unit of effort and rate of harvest;

(c) Relative distribution and abundance of stocks of target groundfish species and prohibited species within an area;

(d) The condition of a stock in all or part of an area;

(e) Inseason prohibited species bycatch rates observed in target groundfish fisheries in all or part of a statistical area;

(f) Historical prohibited species bycatch rates observed in target groundfish fisheries in all or part of a statistical area;

(g) Economic impacts of fishing businesses being affected or

(h) Any other factor relevant to the conservation and management of groundfish species or any incidentally-caught species which are designated as a prohibited species or for which a PSC limit has been specified.

D. In section 14.4.9, add a new paragraph, as follows:

14.4.9 Gear allocations

The following gear allocations are specified by this plan:

Pollock: The Regional Director, in consultation with the Council, may limit the amount of pollock that may be taken with trawls other than pelagic trawls. Prior to the Regional Director's determination, the Council will recommend to him a limit on the amount of pollock that may be taken with other than pelagic trawl gear. The Regional Director shall make the

Council's recommendations available to the public for comment under the annual TAC specification process set forth under section 11.3.

The following information must be considered by the Council when determining whether a limit will be recommended and what that limit should be:

(a) PSC limits established under section 14.4.2;

(b) projected prohibited species bycatch levels with and without a limit on the amount of pollock that may be taken with other than pelagic trawl gear;

(c) the cost of the limit on the bottom-trawl and pelagic trawl fisheries; and

(d) other factors that determine the effects of the limit on the attainment of FMP goals and objectives.

Sablefish: . . .

3. Appendix III, entitled "Descriptions of Closed Areas".

Append a new paragraph 7.

7. Herring Savings Areas shown in Figure 27c are defined as follows:

(1) Summer Herring Savings Area 1 means that part of the Bering Sea subarea that is south of 57°. latitude and between 162° & 164° W. longitude from 12:00 noon Alaska Local Time (ALT) June 15 through 12:00 noon ALT July 1 of a fishing year.

(2) Summer Herring Savings Area 2 means that part of the Bering Sea subarea that is south of 56°30' N. latitude and between 164° and 167° W. longitude from 12:00 noon ALT July 1 through 12:00 noon ALT August 15 of a fishing year.

(3) Winter Herring Savings Area means that part of the Bering Sea subarea that is between 58° and 60° N. latitudes and between 172° and 175° W. longitudes from 12:00 noon ALT September 1 through 12:00 noon ALT March 1 of the succeeding fishing year.