MEMORANDUM

TO: Council and AP Members

FROM: Clarence G. Pautzke
Executive Director

DATE: April 10, 1995

SUBJECT: Halibut Grid-Sorting Amendment

ESTIMATED TIME
1 hour

ACTIONS REQUIRED:

(a) Receive report from Ad Hoc Grid-sorting Working Group

(b) Approve for public review the regulatory amendment for grid-sorting of Pacific halibut in the non-pelagic trawl groundfish fisheries.

BACKGROUND

In October 1993, the International Pacific Halibut Commission (IPHC), Highliners Association, and NMFS-AFSC conducted an experiment to evaluate methods of increasing survival of halibut taken as bycatch in bottom trawls. The experiment, conducted aboard the F/T *Northern Glacier*, sorted halibut from the groundfish catch more rapidly than currently practiced and evaluated subsequent changes in discard mortality rates.

In June 1994, the IPHC staff presented a report of the results and implications of the study. The Council recommended preparation of a regulatory amendment for grid-sorting of Pacific halibut in the non-pelagic trawl groundfish fisheries.

In January 1995, the Council reviewed the draft analysis and delayed release of the document to the public so that an ad hoc working group could be convened to recommend changes to expand and clarify the potential improvement for halibut mortality rates in the analysis. The working group met by conference call on February 17; a summary of their recommendations is provided in Item D-2(d)(1) and D-2(d)(2).

The revised analysis is included as Item D-2(d)(3) for review. The alternatives analyzed are:

Alternative 1. Status quo.

Alternative 2. Amend the federal regulations to require that factory trawlers and shore-based trawlers that fish with non-pelagic trawl and dump directly to a stern hold before sorting use a grid over the entrance to the hold to sort out as much halibut bycatch as practicable for immediate return to the sea. The grid over the hold would slow down the dumping process and allow sorting of halibut from the stream of groundfish moving across the deck; the grid would actually filter only larger halibut (larger than 15 to 25 pounds). No sorting of other species would be allowed. The regulations would give the Council and the Alaska-Region Director authority, through the regulatory amendment process, to determine which fisheries would participate in grid sorting, and the size of grid required. The regulations will require that the vessel assist the observer if on-deck samples are required, and that groundfish from a haul being sampled by an observer may not be sorted in the factory until the observer finishes on deck and is ready to sample in the factory.

OPTION 1) Require vessels to grid-sort all halibut, but observers would not collect data for grid-sorted halibut.

OPTION 2) Require vessels to grid-sort only the hauls that the observer does not intend to sample.

OPTION 3) Require vessels to grid-sort all hauls, and observers count, measure, and determine viability on a subsample of grid sorted halibut.

SUBOPTION 1) Vessel deck crews would be required to sort halibut for the entire catch, regardless of time to sort.

SUBOPTION 2) Vessel deck crews would be required to sort halibut only for the first 20 minutes of dumping, and could not sort after 20 minutes; the observer would be on deck for all sorting.

SUBOPTION 3) Vessel deck crews would be required to grid-sort halibut on deck only for the first 20 minutes of dumping, and additional sorting would be voluntary; the observer would be on deck for all sorting.

Enforcement comments on this action are included in Item D-2(d)(4).

AGENDA D-2(d)(1)
APRIL 1995

INTERNATIONAL PACIFIC HALIBUT COMMISSION

ESTABLISHED BY A CONVENTION BETWEEN CANADA AND THE UNITED STATES OF AMERICA

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MEMO

To: Rick Lauber, Chair

April 10, 1995

RST

From: Bob Trumble, Halibut Grid-sorting Ad Hoc Working Group

Subj: Revisions to EA/RIR for Regulatory Amendment for grid-sorting

At the direction of the Council, the drafting team for the EA/RIR for a Regulatory Amendment to require grid-sorting revised the document originally presented to the Council in January 1995. The Council, SSC, and AP provided a series of concerns to be addressed in the new draft. The Ad Hoc Working Group for grid-sorting reviewed the new draft by teleconference on February 17. The Work Group asked for some minor clarifications that have been incorporated into the draft now available for the Council. In general, the Work Group found that the revised draft satisfactorily answered the concerns, and may be sent out for public review.

The Work Group also discussed alternatives that could augment grid-sorting, or that could replace it. Five alternatives recommended for further review are: 1) Bycatch would not be monitored for a short time after the codend comes on board (a discard window); 2) Require all factory trawlers to have a conveyor from the holding tank directly to a discharge chute (as on the *Northern Glacier*); 3) All observer sampling would occur on deck, rather in the factory; 4) Create industry pools for an incentive program; and 5) Re-examine individual Bycatch Quotas (IBQs).

The new document has been reorganized and expanded to accommodate the necessary changes. The Alternatives, Section 3.4, were moved earlier in the document so that all analyses could more easily be compared against the alternatives. The SSC asked for discussion of the special projects required for Options 1 and 2 of Alternative 2, of the biases and variability associated with the alternatives, and of the way bycatch and bycatch mortality would be calculated under the alternatives. These items are in Section 3.5. Most discussion by the Council and AP involved the need for more justification for reductions in discard mortality rates. Section 3.6 more clearly lays out the rationale for the reductions, evaluating relative changes, absolute changes, and overall changes. Section 3.8 discusses the five alternative to grid-sorting identified by the Work Group. More detail on the IBQ alternative is provided in Appendix 3; this alternative was brought back following a report from Bob Babson, NOAA GC, that penalties under individual incentives need not occur in-season to be effective. Section 5.2.1.4 and Appendix 4 address the SSC request to determine if the VIP program could be revised to be compatible with grid-sorting.

Halibut Grid-Sorting Working Group Panel members:

Bob Trumble - IPHC, chair
Jane DiCosimo - NPFMC
Bill Karp - NMFS Observer Program
Steve Meyer - NMFS Enforcement
Scott Highleyman - AP, AMCC
Shari Gross - HANA
Steve Hughes - UCB.

Also participating in the February 27, 1995 conference call:

Ron Berg, Sue Salveson, and Russell Kappenman - NMFS
Bob Babson and Susan Auer - NOAA GC
Dave Benson - AP
Brent Paine - UCB

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BY FAX ONLY: 1 PAGE

February 28, 1995

Bob Trumble
International Pacific Halibut Commission
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fax #: 206 632-2983

RECEIVED
FEB 28 1995
I.P.H.C.

Dear Bob,

I was not able to attend the teleconference this week to discuss the revised sections of the EA on halibut grid sorting. I will not be able to participate in the ad hoc working group (that I never asked to be on). However, here are my comments on the Feb. 16 revisions you sent me.

Still missing from the analysis is any discussion of the baseline mortality rate that the experiment on the Northern Glacier calls into question. The results of the experiment were 66% (deck sorting), 76% (enhanced), and 87% (control). The current rate credited for such an operation is 65% for Pacific cod and 77% for pollock. The current mortality rate is estimated from a single study conducted over 15 years ago in the low-volume, low-intensity Canadian trawl fishery. Therefore, the most significant result from the experiment is the doubt cast on current assumptions.

The EA fails to explain this discrepancy other than to note that the results "should be compared cautiously with the rates from the commercial fishery." However, none of the reasons for this caution are compelling. And none of the alternatives discuss establishing the base rate first. Without establishing the base rate first, it is simply indefensible to make any assumptions about halibut mortality savings from grid sorting. Like the Billy Preston song goes, "nothing from nothing leaves nothing."

AMCC has several other concerns about the EA such as the need for a greater explanation of any of the options' negative effect on VIP and on the groundfish database. However, the issue above is the fundamental one that must be cleared up before these other important concerns can be discussed and, perhaps, resolved.

Sincerely,

Scott Highleyman
Scott Highleyman
Executive Director

People throughout Alaska working to protect the health and diversity of our marine ecosystem
A program of Alaska Conservation Foundation

AGENDA D-2(d)(3)

DRAFT FOR COUNCIL REVIEW

ENVIRONMENTAL ASSESSMENT/REGULATORY IMPACT REVIEW/

INITIAL REGULATORY FLEXIBILITY ANALYSIS

FOR

DECK-SORTING OF PACIFIC HALIBUT

IN THE

NON-PELAGIC TRAWL GROUNDFISH FISHERIES

IN THE

GULF OF ALASKA AND BERING SEA/ALEUTIAN ISLANDS

Prepared by

Staff
International Pacific Halibut Commission
North Pacific Fishery Management Council

April 1995

1.0 EXECUTIVE SUMMARY

The primary management goal of in-season management is to conserve groundfish resources while promoting attainment of Total Allowable Catch (TAC), avoiding unnecessary waste and discards of groundfish, and limiting mortality of prohibited species in the groundfish fisheries. Reducing halibut mortality attributable to the groundfish fisheries is consistent with the goals of both the International Pacific Halibut Commission and the North Pacific Fishery Management Council.

The specific objective of this proposed regulatory amendment is to evaluate a potential requirement that the deck crew on all factory trawlers and catcher boats that dump groundfish directly to a stern tank before sorting use a grid over the entrance to the hold and sort out as much halibut bycatch as practicable for immediate return to the sea.

Two alternatives are considered:

Alternative 1. Status quo. Normal sorting in the factory below deck. Typically, a single, short conveyer leads from the hold to the exit chute.

Alternative 2. Require that the deck crew on all factory trawlers and catcher boats that dump groundfish directly to a stern tank before sorting use a grid over the entrance to the hold and sort out as much halibut bycatch as practicable for immediate return to the sea. Specific fisheries may be selected. The grid will be of 9 in by 11 in dimensions.

2.0 INTRODUCTION

This document is the draft Environmental Assessment/Regulatory Impact Review/IRFA for Amendment 3x to the Bering Sea and Aleutian Islands (BSAI) FMP and Amendment 3y for the Gulf of Alaska (GOA) FMP. It addresses the reduction of halibut bycatch mortality from factory trawlers by sorting and discarding halibut on deck, rather than below deck in the factory. The analysis is based to a large degree on an experiment an board the F/T *Northern Glacier*. Halibut survival has been demonstrated using grid sorting over the hold when dumping groundfish catches below deck, by removing halibut from the groundfish catch and returning them over the side. The grid did not filter the halibut (except for the largest ones), but slowed down dumping so that the deck crew could find and remove halibut. The experiment was designed to evaluate relative changes in halibut discard mortality among sorting methods, not to establish absolute rates for specific fisheries.

The document is being released for public review in preparation for final Council action at its June 1995 meeting. If the Council recommends specific changes to the bycatch management regime, and the Secretary approves, the Council will give notice to the fishermen for regulations to be implemented for the start of the 1996 fishery.

The groundfish fisheries in the Exclusive Economic Zone (EEZ) (3 to 200 miles offshore) of the Gulf of Alaska and Bering Sea and Aleutian Islands are managed under the Fishery Management Plan (FMP) for the Groundfish Fisheries of the and GOA the FMP for the Groundfish Fisheries of the BSAI. Both FMPs were developed by the Council under the Magnuson Fishery Conservation and Management Act (Magnuson Act). The GOA FMP was approved by the Secretary of Commerce and became effective in 1978 and the BSAI FMP became effective in 1982.

Actions taken to amend FMPs or implement amendments to regulations governing the groundfish fisheries must meet the requirements of Federal laws and regulations. Among the most important of these are the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), Executive Order (E.O.) 12866, and the Regulatory Flexibility Act (RFA).

NEPA, E.O. 12866, and the RFA require a description of the purpose of and need for the proposed action as well as a description of alternative actions which may address the problem. This information is included in Section 2.1 of this document. Sections 3 and 4 contain information on the biological and environmental impacts of the alternatives as required by NEPA. Impacts on endangered species and marine mammals are addressed in section 4. Section 5 contains a Regulatory Impact Review (RIR) which addresses the requirements of both E.O. 12866 and the RFA that economic impacts of the alternatives be considered.

2.1 Relationship of the Proposal to Previous Action

Because groundfish fisheries use non-selective harvesting techniques, incidental catches (bycatches) are taken as a byproduct of the groundfish catch. The bycatch species include crab, halibut, salmon, and herring. A conflict occurs when bycatch is thought to impact measurably 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 these alternative uses of crab, halibut, salmon, or herring very differently, depending on the fishery they pursue.

The current prohibited species bycatch management regime for the BSAI groundfish fisheries principally have been established by Amendments 16, 16a, revised Amendment 16, Amendment 19, and Amendment 21.

Amendment 16 extended beyond 1991 the previously established prohibited species catch limits for halibut and crab in the groundfish trawl fisheries. Specific time/area closures are triggered when a PSC limit or allowance is taken.

Amendment 16a established herring bycatch management measures and provided the Regional Director with the authority to: (1) limit the proportion of the pollock TACs that may be taken in the bottom trawl pollock fishery and (2) temporarily close limited areas in-season due to high bycatch rates. The latter is referred to as "hot spot authority."

Amendments 16 and 16a also established procedures to apportion PSC limits to specified trawl fishery categories as prohibited species bycatch allowances. Annual fishery bycatch allowances may be further allocated into seasonal fishery bycatch apportionments. The attainment of a prohibited species bycatch allowance or seasonal apportionment triggers a fishery specific time/area closure.

Revised Amendments 16 implemented a vessel incentive program to reduce prohibited species bycatch rates in specified groundfish trawl fisheries. The incentive program was implemented on May 6, 1991.

Amendment 19: (1) improved the hot spot authority; (2) expanded the vessel incentive programs for halibut to all trawl fisheries; (3) delayed the start of the trawl fisheries; (4) for 1992 only, established a 750 metric ton halibut PSC mortality limit for the non-trawl fisheries and reduced the PSC limit for the trawl fisheries from 5,333 metric tons to 5,033 mt; (5) changed the PSC limit allowance groups for the trawl fisheries; (6) changed the definitions of fisheries; and (7) changed the directed fishing standards.

Amendment 21: (1) established halibut bycatch limits in terms of halibut mortality rather than halibut bycatch; (2) established halibut bycatch mortality limits for trawl and non-trawl gear fisheries in regulations rather than in the FMP (i.e., 3,775 mt for trawl gear and 900 mt for non-trawl gear); (3) established the authority to annually apportion the non-trawl halibut bycatch mortality limit among fisheries and seasons as bycatch allowances, and exempted pot gear for 1993.

This document provides background information and assessments necessary for the Secretary to determine if the proposed regulatory amendment is consistent with the Magnuson Act and other applicable laws. It also provides the public with information to assess the alternatives that are being considered and to comment on the alternatives. These comments will enable the Council and Secretary to make more informed decisions concerning the resolution of the management problems being addressed.

The specific objective of this proposed regulatory amendment is to require that the deck crew on all factory trawlers and catcher boats that dump groundfish directly to a stern tank before sorting use a grid over the entrance to the hold and sort out as much halibut bycatch as practicable for immediate return to the sea. Reducing halibut mortality attributable to the groundfish fisheries is consistent with the goals of both the International Pacific Halibut Commission and the North Pacific Fishery Management Council.

2.2 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 environmental impact study (EIS) must be prepared if the proposed action may be reasonably expected to: (1) jeopardize the productive capability of the target resource species or any related stocks that may be affected by the action; (2) allow substantial damage to the ocean and coastal habitats; (3) have a substantial adverse impact on public health or safety; (4) affect adversely an endangered or threatened species or a marine mammal population; or (5) result in cumulative effects that could have a substantial adverse effect on the target resource species or any related stocks that may be affected by the action. Following the end of the public review period, the Council could determine that the proposed changes will have significant impacts on the human environment and proceed directly with preparation of an EIS. The EA is contained in Sections 3 and 4.

2.3 Regulatory Impact Review

Another part of the package is the Regulatory Impact Review (RIR) that is required by the 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 record-keeping requirements. This Act requires that the head of an agency must certify that the regulatory and record-keeping requirements, if promulgated, will not have a significant effect on a substantial number of small entities or provide sufficient justification to receive a waiver.

The RIR analyzes the impacts of proposed changes to the BSAI bycatch management regime. The SAFE document and its appendix provide a description of and an estimate of the number of vessels and processors (small entities) to which regulations implementing these amendments would apply. The RIR is contained in Section 5.

3.0 HALIBUT BIOLOGY, BYCATCH, PROBLEM ADDRESSED, AND DEFINITION OF THE ALTERNATIVES

The biology of halibut, historical bycatch levels, and the biological effects of bycatch are the topics of this chapter. Information for the Bering Sea-Aleutian Islands and the Gulf of Alaska are included because of stock interchange between management regions. Egg and larval drift and counter-migration by juvenile fish apparently create a homogeneous resource and prevent the development of separate populations. The IPHC manages halibut by regulatory area, but considers the resource as a single population.

3.1 Biology

Spawning occurs primarily during winter from northern British Columbia through the Gulf of Alaska into the Bering Sea, at depths of 150-250 fathoms. Eggs and larvae at depth drift passively with the ocean currents and gradually rise toward the ocean surface. Prevailing currents at spawning depth and near the surface tend to flow counterclockwise, paralleling the British Columbia and Alaska coastline. Halibut eggs and larvae drift for hundreds or thousands of miles with the ocean surface currents (Figure 3.1) before reaching shallow water where the larvae can settle to the bottom. Continuity of the halibut resource requires that the progeny move back to the east and south at some stage in the life history to counter the drift of eggs and larvae. Under this hypothesis, virtually all halibut off the coast of British Columbia and Washington, Oregon, and California migrate through Alaska. Few young-of-the-year halibut have been documented south of southeast Alaska, and the average age of juvenile halibut in survey catches increases from youngest in the Bering Sea and western Gulf of Alaska to oldest off British Columbia. IPHC documents present evidence that the counter-migration occurs primarily during the juvenile stage, and that most juveniles migrate while 2 through 6-years of age. Most counter-migration takes place by fish smaller than 65 cm.

Adult halibut undertake a seasonal migration from winter spawning grounds in deeper water to summer feeding grounds on the continental shelf. This is a separate migration pattern from the counter-migration noted for juveniles.

The Pacific halibut stock assessment uses a catch-at-age analysis conducted for each IPHC regulatory area. Information is gathered from catch, catch per unit effort (CPUE), age composition, and average weight data. These data are used to estimate the exploitable biomass. Available harvest is based on constant exploitation yield (CEY), by applying an optimum harvest rate of 0.35 to the exploitable biomass. Catch limit recommendations are determined by subtracting removals from other sources (bycatch, sport, waste, and subsistence) from the available harvest. Exploitable biomass, catch per unit effort, and recruitment of 8-year old halibut are all declining.

3.2 Bycatch

Pacific halibut are caught inadvertently by fisheries targeting on other species. Regulations require returning halibut to the sea in as good a condition as possible. The survival of discarded halibut varies from near zero to over 90 percent, depending on the type of fishery and the handling provided by fishermen. Coast-wide halibut bycatch mortality was relatively small until the early 1960s, when it increased rapidly due to development of foreign trawl fisheries off the North American coast. Total bycatch mortality (Figure 3.2), including several years of Japanese directed harvest authorized by the International North Pacific Fisheries Commission, peaked in 1962 at over 15,000 metric ton (25 million pounds). Bycatch mortality generally declined from 1962 through 1985, with temporary increases in the early 1970s and late 1970s. Estimated bycatch mortality was lower in 1985 than it had been since before 1960. Since then, it has increased to near the temporarily high level experienced in 1980.

It is very difficult to make precise estimates of the effects of bycatch on the commercial-sized component of the halibut stocks because bycatch is largely made up of younger migrating halibut. Growth, mortality, and migration greatly complicate the estimation procedures. If the same age composition occurred in both fisheries one could consider the bycatch removals as merely increasing the directed removals. Migration rates of juvenile halibut are not well known, so the impact of bycatch of juvenile halibut from specific areas on adult populations in those or other areas must be estimated indirectly.

Halibut bycatch are generally smaller fish than those harvested by the directed fishery. Consequently, factors such as maturity, reproductive capacity, survivorship, and growth substantially affect stock productivity. By allowing small halibut to remain at large for a longer period of time, a net gain in stock biomass occurs due to the greater cumulative gain in individual weight relative to losses incurred due to mortality. Smaller fish are less likely to be reproductively mature, and have less reproductive capacity. Those harvested earlier in their life history not only contribute less in terms of short term yield, but they also contribute less to the maintenance of future stock biomass or to future yields. Bycatch losses affect recruitment, future catch, and future reproductive potential of the stock.

The IPHC staff currently recommends catch limits for Pacific halibut based on limiting total annual removals to 30 percent of the exploitable biomass, which provides relatively high long term yields, yet does not force the spawning stock to low levels that may be risky to the resource. Bycatch is one of the sources of mortality that must be accounted for within the 30 percent rate. Since bycatch halibut are generally smaller, younger, and located in areas different from where they would reside as adults. The IPHC accounts for the halibut bycatch mortality through a series of computations that reflect these factors.

IPHC's approach for compensating the stock for bycatch losses is designed to leave the same reproductive potential (e.g., equivalent number of eggs produced) in the spawning stock as if bycatch had not occurred. The compensation results in a forfeiture of allowable directed harvest. The compensation factor was determined to be one metric ton of catch limit reduction for each metric ton of bycatch mortality.

The impact on the halibut fishery consists of two parts: (1) the catch limit reduction to maintain reproduction, and (2) reduced recruitment to the directed halibut fishery from bycatch of pre-recruits.

Reproductive compensation for bycatch immediately deprives the directed fishery of one metric tons of yield for each metric ton of bycatch the previous year. But this amounts to leaving fish in the stock rather than catching them right away, and some are caught later. On the average, about 0.6 mt of the one metric ton bycatch compensation is eventually caught, so the net impact of reproductive compensation is 0.4 mt per mt of bycatch.

Bycatch eventually reduces recruitment to the directed fishery, and amounts to 1.3 mt of lost yield for each metric ton of bycatch.

The combined effects of reproductive compensation and lost recruitment shows a net loss to the directed fishery of 1.7 metric ton for each metric ton of bycatch: 0.4 metric ton from reproduction compensation and 1.3 metric ton from reduced recruitment.

If the reproductive compensation is calculated correctly and if the bycatch is estimated correctly, the halibut spawning stock size will remain in the same condition whether bycatch occurs or not. The directed halibut fishery pays for maintenance of the resource through lower catches.

The estimated 1994 coast-wide bycatch mortality of 9,700 metric tons round weight (16.0 million pounds net weight) represents about 16,500 metric tons (27.2 million pounds) of lost yield to the halibut fishery. About 8,500 metric tons (14.0 million pounds) of the bycatch mortality occurred in Alaska, and resulted in 14,400 metric tons (23.8 million pounds) of lost yield. Of the lost yield caused by bycatch in Alaska, the IPHC estimates that approximately 2,700 metric tons (4.5 million pounds) were lost to the Canadian halibut fishery. The loss is caused by interception of juvenile halibut migrating from Alaska to Canada.

3.3 Description of the problem and the need for action.

3.3.1 Background. Fisheries in the Bering Sea-Aleutian Islands (BSAI) and Gulf of Alaska (GOA) are prosecuted with a variety of gear types. Prohibited species catch (PSC) limits established by the North Pacific Fishery Management Council (NPFMC) may be apportioned among gear groups and fisheries as bycatch allowances. Gear groups and fisheries that reach seasonal PSC limits are closed through specific time periods, and those that reach annual PSC limits are closed for the balance of the year, often leaving large amounts of uncaught TACs. The Council has designed management actions to reduce bycatch and to maintain groundfish harvest. In the case of Pacific halibut, PSC limits are in terms of mortality rather than actual weight of halibut caught. Mortality limits provide a two-pronged approach to bycatch management: first, by reducing bycatch rates, and second, by increasing survival of discarded halibut. In 1993, the Council approved and NMFS implemented a careful release requirement for halibut from hook and line vessels (NPFMC 1992). For the Pacific cod longline fishery in the Bering Sea, most vessels achieved discard mortality rates at or below values predicted. However, about 10% of the vessels were documented with rates two to three times higher than predicted.

The survival of halibut returned to the sea from trawlers depends on the amount of time out of the water (Hoag 1975, Neilson et al. 1989, Pikitch and Erickson in press): the more quickly that halibut are returned, the better they survive. While survival may exceed 75% for halibut returned immediately after capture, survival drops to near zero for halibut on deck for more than 30-45 minutes. Williams and Wilderbuer (1994) used a modification of Hoag's (1975) methods to estimate discard mortality rates of trawl-caught halibut. Current federal regulations for trawls (CFR 50 675.20(c) for BSAI and CFR 50 672.20(e) for GOA) are silent on halibut release methods, except that halibut must be returned to the sea with a minimum of injury. Federal regulations (CFR 50 677.7), however, prohibit discard of prohibited species until after the federal observer, if any, has had an opportunity to sample the catch. On factory trawlers and shore-based trawlers that dump directly to the hold before sorting, halibut and other prohibited species may remain in the hold for several hours while the catch is being processed. Mortality of discarded halibut will approach 100% in these cases.

Mandatory on-deck sorting and discard of halibut from factory trawlers and shore-based trawlers that dump directly to the hold before sorting could substantially reduce the amount of time that some halibut will remain out of the water. While not every halibut can be sorted on deck, increased survival of deck-sorted halibut should increase the average survival of the entire halibut bycatch.

Monitoring of deck-sorting compliance will be easier to achieve in the BSAI than in the GOA because of significantly higher observer coverage. Trawling in the GOA is conducted with a large number of vessels less than 125 feet in length that require only 30% observer coverage, and from vessels smaller than 60 feet that do not require observers. On average, 25-30% of the trawl-caught groundfish in the GOA is from observed vessels. In the BSAI, most of the trawlers are longer than 125 feet and require 100% observer coverage. On average, about 80-90% of the trawl-caught groundfish in the BSAI is from observed vessels. Observers cannot observe all trawl hauls while on board.

Mandatory on-deck sorting to observed or unobserved vessels will have important implications. Fishermen on unobserved vessels probably will partially comply with the regulations. Giving them credit for full participation will underestimate true bycatch mortality. Conversely, giving credit only to observed vessels will create a cost to those unobserved vessels that do comply but will not provide them benefit.

3.3.2. Need for mandatory action. If analysis shows that increased net benefits accrue from deck-sorting halibut from trawl vessels, why are mandatory regulations necessary, and why shouldn't the fleet take these actions voluntarily? Deck-sorting to reduce halibut bycatch mortality is in the best interests of the group as a whole, but may cause (or be perceived to cause) some costs to individuals. If only some participate, they will accrue costs that nonparticipants do not, yet the nonparticipants will also benefit from extended seasons. Mandatory action lets the individual's best interests more closely coincide with the group's interest.

3.4. The Alternatives.

The alternatives for deck-sorting of Pacific halibut caught in the non-pelagic trawl groundfish fisheries are listed below. The Council and NMFS may choose a different alternative in either the GOA or BSAI, or different alternatives for separate fisheries within an area. The experiment upon which this analysis is based was conducted on a factory trawler. To avoid extrapolating beyond the available data, this analysis will apply only to factory trawlers or the catcher vessels that sort below decks from the hold. For alternatives that require observers to collect data on deck during deck-sorting, the vessel must assist the observer by providing halibut in a manner that allows the observer to efficiently process the halibut and return them quickly to the sea. To allow an observer to obtain bin-volume estimates, to get certain species from the entire haul as it is processed, and to sample from all portions of the catch, groundfish from a haul being sampled by an observer may not be sorted in the factory until the observer finishes on deck and is ready to sample in the factory. Current regulations prohibit discarding halibut before the observer has had an opportunity to take samples. The NPFMC, at the June 1994 meeting, initiated a plan amendment to lower the halibut PSC limit based on mortality savings from grid sorting, if approved, and the longline careful release program. The proponents of this amendment have proposed an option of splitting the PSC savings equally between the groundfish fisheries and the directed halibut fishery. Such an amendment could not go into effect until 1997. Data collection and analysis to determine the effects of the careful release requirements for trawl and longline fishing could cause further delays.

3.4.1. Alternative 1. Status quo.

Adoption of this alternative would maintain the current requirement for returning halibut to the sea with a minimum of injury, and would continue to prohibit presorting prior to observer sampling.

3.4.2. Alternative 2. Amend the federal regulations to require that factory trawlers and shore-based trawlers that fish with non-pelagic trawl and dump directly to a stern hold before sorting use a grid over the entrance to the hold to sort out as much halibut bycatch as practicable for immediate return to the sea. The grid over the hold would slow down the dumping process and allow sorting of halibut from the stream of groundfish moving across the deck; the grid would actually filter only larger halibut (larger than 15 to 25 pounds). No sorting of other species would be allowed. The regulations would give the Council and the Alaska-Region Director authority, through the regulatory amendment process, to determine which fisheries would participate in grid sorting, and the size of grid required. The regulations will require that the vessel assist the observer if on-deck samples are required, and that groundfish from a haul being sampled by an observer may not be sorted in the factory until the observer finishes on deck and is ready to sample in the factory.

OPTION 1) Require vessels to grid-sort all halibut, but observers would not collect data for grid-sorted halibut.

> This option would address the goal of reducing halibut mortality (which should show up in reduced bycatch mortality rates if effective) and the concerns regarding increased observer workloads and potential dangers associated with working on deck. A delay in processing the catch should not be necessary. The bycatch rates would not reflect any mortality or injury to the halibut caught and released on deck, and it would no longer be possible to directly estimate the total catch of halibut to compare with historical data. However, some assumptions would be made for the fraction of halibut sorted on deck, and the factory-sorted component of bycatch could be expanded to account for total halibut bycatch. Assumptions on deck-sorted discard mortality rates would be based on special-project observer tests (see section 3.5.1 for discussion of special projects), and are a necessary component for this option to be viable. This option would conflict with the existing vessel incentive program requirements (see Section 5.2.1.4).

OPTION 2) Require vessels to grid-sort only the hauls that the observer does not intend to sample.

> This option, if effective, would reduce the halibut mortality even though it would not be evident in the observed bycatch rates or halibut viability calculated from the observer-sampled tows. It would neither increase the observer's workload, nor cause problems with the data base, but would reduce potential discard mortality savings because fewer hauls would be sorted on deck. Vessel operators would receive no benefits unless assumptions are made about the sorting that occurs in unobserved hauls. Assumptions would be developed with an observer special-project to estimate discarded halibut amounts and viabilities from a subset of the vessels required to deck-sort, and are a necessary component for this option to be viable. However, the observer would have a difficult time monitoring compliance of sorting unobserved hauls. Information from observers, documented in their logbooks, could be an integral part of any subsequent enforcement action against vessels that did not comply with the sorting requirement. This option would allow the vessel incentive program to continue without change.

OPTION 3) Require vessels to grid-sort all hauls, and observers count, measure, and determine viability on a subsample of grid sorted halibut.

This option would best address the goal of reducing halibut mortality but has the greatest impact on observer workload, observer safety and the observer database. While data would be available for halibut, the additional workload would require reducing the number of hauls sampled with a consequent decrease in the precision of overall halibut and groundfish estimates. This option would conflict with the existing vessel incentive program requirements.

SUBOPTION 1) Vessel deck crews would be required to sort halibut for the entire catch, regardless of time to sort.

The suboption would cause the largest impact on observer workload and safety. The observer would be on deck for the entire time that sorting occurs on deck. Increased work load on deck would cause reductions in number of hauls sampled.

SUBOPTION 2) Vessel deck crews would be required to sort halibut only for the first 20 minutes of dumping, and could not sort after 20 minutes; the observer would be on deck for all sorting.

This suboption would reduce the impact of deck-sorting on the observer work load and observer safety. The observers would spend less time on deck, and be able to sample more hauls compared to Suboption 1. Most of the on-deck halibut survival benefits would be achieved within the first 20 minutes. Determining when the 20 minute time period is reached could be difficult.

SUBOPTION 3) Vessel deck crews would be required to grid-sort halibut on deck only for the first 20 minutes of dumping, and additional sorting would be voluntary; the observer would be on deck for all sorting.

This suboption would reduce the impact on the deck-sorting on the observer work load and observer safety, to the degree that vessels chose to limit deck-sorting. The observers could spend less time on deck relative to Suboption 1, and have fewer duties related to deck-sorting, so may be able to sample more hauls.

Adoption of this alternative could require all non-pelagic trawl vessels to participate, regardless of the size of halibut in the bycatch. Bycatch mortality savings would occur regardless of the size of halibut in the bycatch, but the benefits would vary. However, the program could be implemented or modified on a fishery by fishery basis as information and experience becomes available. The fisheries for which experience is available are non-pelagic trawl pollock and Pacific cod, for which a grid of 9 in by 11 in was most appropriate.

3.5. Statistical and sampling effects of the alternatives.

3.5.1. Special projects.

Under Options 1 and 2 of Alternative 2, observers would not sample on deck as a regular activity, even though halibut bycatch would be sorted and discarded on deck. However, a special sampling program would be necessary to obtain on-deck data for calculating a fleet-wide proportion of halibut sorted on deck and a fleet-wide average discard mortality rate. The special project could be set up in two ways: each observer would collect on-deck data from a subsample of hauls; or a second observer on a sub-set of vessels would collect data from a subsample of hauls. In either case, hauls chosen for on-deck data would not be part of the normal groundfish and bycatch samples, but would be used only to estimate proportion of halibut sorted on deck and the discard mortality rate of halibut discarded on deck. The observer would count all halibut sorted on deck, and take length measurements and viability data from a systematic subsample of halibut sorted on deck. In the case of a single observer, the factory would not process the haul being sampled until the observer was ready to sample in the factory. The observer would then count all halibut sorted in the factory, and measure a subsample. For two observers working together, no factory delay is necessary.

The counts and lengths from deck and factory would be combined to estimate the proportion of deck sorting as follows. The weight of deck-sorted and factory-sorted halibut is calculated from the length frequency and a length-weight relationship. The ratio of the two weights is the proportion of deck-sorting, which would be used to expand the estimate of halibut bycatch obtained from regular observer sampling in the factory. Viability of deck-sorted halibut is calculated from the distribution of condition factors observed on deck. Length frequency of deck-sorted halibut from hauls in the regular observer sampling can be calculated by sorting numbers of fish from the special project data into length categories for deck sorting and factory sorting. Length frequencies observed in regular observer sampling in the factory can be expanded to deck-sorted halibut by the ratio of numbers from deck and factory sorting in each length category from the special project sampling.

3.5.2. Bias and variability.

Changes in sampling programs may introduce bias and increase variability from the status quo.

Bias may currently occur if the deck or factory crew are able to presort the catch before the observer has an opportunity to sample. Although illegal, presorting is known to occur. The extent of the problem is unknown. Bias may also occur if the observer does not sample systematically through the entire catch, although the observers are instructed to sample the entire catch. Presorting bias for species other than halibut could occur more easily under Alternative 2, Option 1. On-deck sorting of halibut at greater or lower proportions than assumed from the Special Project results would result in lower or greater estimates of halibut bycatch for Options 1 and 2. These biases are all violations of the sampling protocol. An additional bias that increases discard mortality rates above fleet-wide averages calculated from special projects would occur if deck crews discard halibut in an inappropriate manner, such as using pews or gaffs to discard halibut.

The sampling design for Alternative 2, Options 1, 2 and Option 3, Suboption 1 are all unbiased (William Clark, IPHC, pers. com). Option 3, Suboptions 2 and 3, however, are potentially biased because the entire haul will not be observed on deck. Unless the proportion of the catch that is observed on deck is known, the expansion of factory-sorted bycatch to the deck component will be in error. Additional bias will occur if the observer does not sample systematically through the entire catch.

Every Option of Alternative 2 causes some increased variability in the estimate for groundfish or prohibited species. Option 1 increases the variability of halibut bycatch and viability, because a proportion of the bycatch is not available for observation. Variability does not change from status quo for groundfish or other species. Option 2 increases variability of halibut bycatch because the grid-sorted halibut discards are totally unobserved. Variability does not change from status quo for groundfish or other species. The more consistently that vessels in the fleet process halibut, either in proportion of sorting or discard mortality rate on deck, the more representative the fleet-wide averages obtained from the special projects will be of the actual fleet performance. Option 3 causes sampling of fewer hauls by the observer (because of extra time on deck), so variability would increase for all Suboptions. Suboption 1 causes the greatest reduction in number of hauls sampled, and the greatest variability in groundfish estimates. Sampling of deck-sorted halibut will occur under Suboption 1, which will reduce variability of halibut bycatch estimates compared to Options 1 and 2. Suboptions 2 and 3 will cause less reductions in number of hauls sampled by the observer, which will decrease variability of groundfish estimates compared to Suboption 1.

3.5.3 Calculation of bycatch and bycatch mortality. Under Options 1 and 2, observers would collect no data, except for special projects, on deck during grid sorting. Therefore, an estimate of halibut discarded from the deck and the mortality of the discarded halibut would be made from the estimate of factory-sorted halibut and the on-deck special projects. No difference would occur in the method of calculating halibut bycatch or bycatch mortality from the factory. The special projects would give a fleet-wide average for the proportion of halibut sorted on deck, and the discard mortality rate. The amount of bycatch sorted on deck would be calculated from the ratio of deck-sorted to factory-sorted halibut bycatch. For example, if grid sorting removed an average of one-third of the halibut from the deck, then the fleet-wide amount of halibut bycatch from the deck would be 50% of the fleet-wide amount from the factory. The average discard mortality rate for the deck times the amount of bycatch equals the discard mortality. Summing fleet-wide factory bycatch (and bycatch mortality) and fleet-wide deck bycatch (and bycatch mortality) equals fleet-wide total bycatch (and bycatch mortality).

For Option 3, observers would collect data for deck-sorted halibut. A separate data base for the deck data would be developed. Observers would report both sources of data on a vessel by vessel basis, so adding factory- and deck-sorted bycatch would equal total bycatch for the vessel.

3.6. Discard mortality rates for deck-sorting. The *Northern Glacier* experiment was designed to determine relative changes in discard mortality rates among various sorting treatments. The three treatments used for the experiment were 1) Control--45 minute delay before sorting and discarding of halibut in the factory to simulate transit of discards through the factory (discards from the *Northern Glacier* went directly via a conveyor from the holding tank to a discharge chute); 2) Enhanced--immediate sorting and discarding of halibut in the factory to represent the optimum factory sorting; and 3) Grid Sorting--on-deck sorting and discarding of halibut with a 9" by 11" grid over the hold, with halibut sorting subsequently completed in the factory. Additionally, time-of-discard was recorded for each halibut for evaluation of effects of time out of water. The experiment was not designed to evaluate absolute discard mortality rates, because of differences from the experiment to the commercial fisheries. Although the experiment was designed to target Pacific cod, Pacific cod was much less available (lower CPUE) during the October experiment than during the target fishery in the spring. Consequently, halibut bycatch rates were higher during the experiment than experienced by the target fishery.

3.6.1. Relative changes in discard mortality rates. Time out of water rapidly degraded the condition factors of halibut bycatch (Figure 3.3), consistent with observations of Hoag 1975, Neilson et al. 1989, and Pikitch and Erickson in press. The number of Excellent condition halibut rapidly declined and the number of Poor condition halibut peaked over the first 30 minutes. After about 30 minutes, the number of Dead condition halibut increased rapidly, so that few Excellent or Poor condition fish were observed after an hour. Comparison of condition factors observed on the *Northern Glacier* showed that survival of halibut in the first 20 minutes of sorting was the same whether discarded from the deck or from the factory (Figure 3.4). These results demonstrate a fundamental conclusion of the experiment: decreasing time out of water is the key to increasing halibut discard survival, regardless of the location of discard.

Analysis of an experimental fishing survey, targeting Pacific cod and pollock aboard the factory trawler *Northern Glacier*, that compared the composite discard mortality rates from on-deck sorting with Control and Enhanced sorting below decks found that on-deck sorting improved survival (Appendix 1–Williams and Trumble 1994). No sorting or processing occurred in the factory during Grid Sort hauls until the scientific crew finished on deck and returned to the factory. The grid did not actually filter the halibut from the catch as expected, except for the largest halibut, but slowed down the dump rate to the hold from two to four minutes without grid sorting to eight to 15 minutes with grid sorting. The slower rate of dumping allowed the deck crew to sort halibut from the catch on deck. A larger grid opening (11" by 14") tested on the *Northern Glacier* allowed fish to pass too quickly, and was not effective in sorting halibut.

On-deck sorting provided the highest average survival of the three treatments, and Control sorting caused the most mortality (Williams and Trumble 1994). Control sorting had a mortality rate of 87%, and the Enhanced rate was 76%. Halibut sorted and discarded from the deck, about 50% of the weight of halibut bycatch, had a discard mortality rate of about 40%. The overall mortality from deck-sorting, including halibut sorted from the factory, was about 66%. The Grid Sort rate was 24% less than the Control rate, and 13% less than the Enhanced rate. As the proportion of vessels using enhanced methods increases, the relative savings from on-deck sorting decreases. Experience and learning through continued use of deck sorting with the grid could improve these savings.

Sorting time during the *Northern Glacier* experiment ranged from about an hour to over 3 hours. Sorting duration was longer than would have been the case for processing under a competitive commercial fishery: the factory crew was inexperienced and was not pressured to maximum efficiency; the vessel produced more products than normal; and sorting procedures for Pacific cod and pollock sometimes changed in mid stream if species composition or size distribution were different from that expected. Shorter sorting time would have caused quicker halibut discards for all treatments, and would have lowered the observed discard mortality rates.

The long duration of sorting permits evaluation of sort time for different discard procedures. As described in Section 3.4, options include no deck sorting, deck sorting with factory delay while the observer is on deck, and deck sorting without factory delay. In commercial fishing for Pacific cod, sort time from start to finish may be as short as 30 minutes. To assess the effects of sorting time and factory delay, calculation of discard mortality rates were made from the *Northern Glacier* "Enhanced Treatment" data for factory sorting time intervals of 30, 45, 60, 120, and 180 minutes. This analysis applies only to halibut that go immediately over the side after sorting, without extended delays in holding tanks.

To simulate deck sorting, we assumed that 40% by number of the halibut would be sorted on deck at a discard mortality rate of 42% (values observed on the *Northern Glacier*), and the condition distribution from the appropriate times from the Enhanced hauls would represent the discard mortality of the 60% of halibut assumed sorted in the factory. To simulate deck sorting without factory delay, we used the Enhanced data for appropriate time blocks to represent the factory component. To simulate the effects of deck sorting with an average 20 minute delay in the factory, the 0 to 20 minute interval of "Enhanced Treatment" data was deleted, and 20 minutes of additional data added to the time series. The condition factor distribution in the intervals analyzed was used to calculate discard mortality rates for the factory component, which was then combined with the deck-sorted component to calculate an overall discard mortality rate.

For hauls completely sorted in the factory in 45 minutes or less, the discard mortality rates were less than for sorting on deck with a 20 minute delay. After an hour to complete sorting, deck sorting with factory delay had lower discard mortality rates (Table 3.1). For example, a haul that takes about 30 minutes to completely sort groundfish and discard halibut in the factory would get more halibut overboard in better condition than deck-sorting the same haul, for which about half the halibut would be sorted on deck, and the remaining half would be sorted between 20 and 50 minutes. As might be expected, sorting on deck without a delay in the factory produced the lowest discard mortality rates (Table 3.1). While deck sorting with delay in the factory increases discard mortality rates (relative to no deck sorting) by 11 and 6% for 30 and 45 minute sorting completion, deck sorting without delay in the factory improves the rates by 5 and 8% (Table 3.1). The improvements with deck sorting at 2- and 3-hour sort times decreased discard mortality by 11 and 15% with delay and by 17 and 17% without delay. The effects of the 20 minute delay diminish with increasing sorting time.

3.6.2. Absolute changes in discard mortality rates. Discard mortality rates from the *Northern Glacier* experiment should be compared cautiously with the rates from the commercial fishery. The experimental fishing occurred at times and in areas that commercial fishing was closed. The experiment intended to target on Pacific cod, but actual catch (243 mt of Pacific cod and 496 mt of pollock, Appendix 1) resulted in a pollock target. Pacific cod was not available in large schools during the November experiment, as is typical of the commercial fishery in the spring.

The discard mortality rates from the experiment for Enhanced and Grid Sorted treatments were probably higher than could have been achieved for four operational reasons. First, the deck crew was inexperienced in deck-sorting halibut. Second, the factory crew was inexperienced, and took longer to sort the catch that would have been expected for an experienced crew. Third, more product forms were produced than was normal for the vessel, which complicated the sorting procedure; a decision on how to sort pollock and small and large Pacific cod was often changed if the species composition was different from expected. Fourth, the sorting crews normally worked the processing lines during towing, and often were not available for 5-15 minutes after the scientific team was ready to sort. These factors extended the sorting time of the hauls in the factory for all treatments, which shifted halibut from the excellent and poor categories and put more halibut in the poor and dead categories. These factors may occur on other vessels if grid sorting is required, but any improvement in any factor, relative to what was observed during the experiment, will improve the sorting time and lower the discard mortality rate of halibut bycatch. The scientific Team on board the *Northern Glacier* was able to collect much more data than could be expected from a single observer. With three people on each 12-hr shift, lengths, viabilities, and time out of water were collected for all halibut caught during the experiment.

Discard mortality rates for halibut discarded from trawlers (Table 3.2) are calculated from 1990-1992 observer data (Williams and Wilderbuer 1994) and from 1993 observer data (Williams 1995). These calculations derive from the distribution of condition factors, an index of survival, determined by on-board observers. Originally, five conditions categories (excellent, good, fair, poor, and dead) had discard mortality rates of 92%, 74%, 50%, 43%, and 18% for halibut larger than 80 cm, and discard mortality rates of 48%, 52%, 28%, 26%, and 3% for smaller halibut, respectively (Hoag 1975). Clark et al. (1993) re-evaluated the effects of halibut size, combined the five categories into three, and re-estimated the discard mortality rate for "excellent fish" at 20%, for "poor" condition fish at 55%, and for "dead" condition fish at 90%. Clark et al. noted that Hoag (1975) studied discard from Canadian trawlers, and that the large volume, high intensity fishery off Alaska may cause greater damage. Long durations in the hold may cause a condition of fish with zero chance of survival, so that the rate for "dead" halibut may underestimate actual mortality.

The overall deck-sorting discard mortality rate of 66% achieved during the experiment is 14% below the 77% discard mortality rate recommended by IPHC for the 1995 Bering Sea pollock fishery (Table 3.2).

3.6.3. Summary of changes in discard mortality rates. Under all sorting times and conditions experienced during the experiment, Grid Sorting without factory delay achieved the greatest decrease in discard mortality rates. For sorting and discard times less than an hour, Enhanced sorting was second best; after an hour, Grid Sorting with factory delay was better than Enhanced. Long delays in the holding tank before sorting, or long transit times for halibut discards, caused the highest discard mortality rates. We cannot completely characterize the processing procedures of the factory trawler fleet. Some vessels have factory layouts with conveyors that discard immediately to overboard discharge chutes, e.g., Enhanced sorting. These vessels will have lower discard mortality rates than vessels with longer transit times through the factory to the discharge. However, groundfish are often held for extended periods of time in holding tanks; if so, the benefits of Enhanced sorting are largely lost.

In every case, Grid Sorting without factory delay will provide the quickest sorting and the lowest discard mortality rates. Grid Sorting with factory delay will provide lower discard mortality rates than factory-only sorting, except when all sorting and discard occurs in less than an hour.

Grid Sorting without delay has discard mortality rates 5-18% lower than Enhanced sorting for sorting times of 30 minutes to 3 hours (greater benefits at longer sort times). Reductions in discard mortality rates increase for Grid Sorting as time increases in the holding tank before sorting begins or as transit time of discards through the factory increases. Compared to Control hauls, with an inherent long delay before discard, Grid Sorting without delay would show approximately 25-40% reductions. Because the fleet is composed of vessels that can perform Enhanced Sorting or Control Sorting, Grid Sorting would probably have reduction in discard mortality rates between 5-18% and 25-40%. Total reduction in discard mortality rates would likely fall in the 15-25% range. The actual discard mortality rates achieved by the factory trawler fleet will depend on which grid sorting option is selected, and on the sorting performance by the fleet as monitored by on-board observer data.

Sorting efficiency on deck depends on the size of halibut in the bycatch; smaller average size in the bycatch, or bycatch with fewer large fish, will make sorting less effective.

3.7. Alternatives considered but not pursued.

Requiring or allowing sorting of species other than halibut could have been considered in this package. However, the time and effort required by observers to process the needed biological data for other species on deck would have increased substantially. Observers would need to bring scales and other sampling gear from the factory to the deck. A large, but undetermined, amount of time needed for observers to complete this work would take away from other activities even more than would on-deck halibut sorting. Salmon and herring are nearly all dead or dying when they come on board, so no survival benefits accrue from deck sorting. Some crabs may survive, but discard mortality rates are not well known, and PSC limits are set as total bycatch, not mortality. If deck sorting for halibut proves to be effective, a future evaluation of deck sorting for other species can occur as more data become available.

3.8. Alternatives to grid sorting.

Grid sorting is one of several procedures that could be developed to reduce bycatch mortality in the groundfish fisheries. During discussions of the costs and benefits of grid sorting, five alternatives to grid sorting were identified (other alternatives may be identified in subsequent discussions). Some of these alternatives could be used with grid sorting to enhance benefits, or in place of grid sorting to achieve different or greater benefits. The Council could choose to add some or all of these alternatives to the grid sorting analysis (with a substantial delay), or start a separate analysis for any or all of the alternatives. A clear statement from the Council on its objectives for bycatch management would assist in this decision.

The five alternatives are: 1) A short time after the codend comes on board (a discard window) that bycatch would not be monitored; 2) A requirement for all factory trawlers to have a conveyor from the holding tank directly to a discharge chute (as on the *Northern Glacier*); 3) Do all observer sampling on deck, rather in the factory; 4) Industry pools for an incentive program; and 5) Individual Bycatch Quotas (IBQs).

3.8.1. Discard window. A discard window is a simple method of encouraging rapid return to the sea of prohibited species and other discards to reduce discard mortality rates. Under this alternative, halibut (and perhaps other species) bycatch would not be counted if discarded during the window, or an assumed discard rate and discard mortality rate for the window could be based on a special observer project, similar to those described in Section 3.5.1. This procedure would benefit all discarded species. A VIP-type program would be desirable under a discard window to hold down actual bycatch. Evaluation of this alternative will need to consider effects of the discard window on data integrity, and how the discard window would work with a VIP program.

3.8.2. Direct conveyor to discharge chute. A direct conveyor to the discharge chute on factory trawlers is a simple mechanical process to get prohibited species and other discards over the side quickly: fish to be retained are sorted off the conveyor, and all others go directly to the discharge. This process would provide survival benefits for all species if the haul is sorted immediately or shortly after the cod end is dumped to the holding tank, and benefits would diminish as the time in the holding tank increases. Evaluation of this alternative will need to consider the number of vessels that do not have a direct discharge route, the amount of time needed for discards to transit the factory for vessels without direct discharge, and the cost of retrofitting the factory. Also, evaluation of this alternative would need to be coordinated with the Council's evaluation of requiring measurements of total weight of groundfish catch (in-line scales, etc.).

3.8.3 Observer sampling on deck. Conversion of observer sampling from the factory to the deck would provide an opportunity for quick sorting and discard, with or without a grid over the hold. Survival of discards would improve, and the process would apply to all discarded species. On deck sampling would be compatible with the VIP program, because presorting prior to observer sampling would not need to occur. Evaluation of this alternative would need to consider safety of the observers and physical work space on deck.

3.8.4. Industry bycatch pools. Industry pools offer an opportunity to develop in-season, individual incentive, bycatch management. Due-process considerations preclude in-season incentive programs. However, the members of an industry pool can set up in-season management based on contractual agreements. The pool would be responsible for enforcing the agreement on its individual vessels, as the pool would be shut down from fishing when it passes mortality limits, discard proportions, or other standards. Evaluation of this alternative would need to evaluate the relationship between the government and the pools, the formation of pools, and penalties for pools if violations occur.

3.8.5. Individual bycatch quotas. An IBQ puts the responsibility for bycatch squarely on the vessels involved in the fishery, and is the method of choice for a wide variety of people involved in bycatch management. However, concerns for data quality sufficient to stand up in court, for due process with in-season enforcement, and the political nature of initial allocation of IBQs put the concept on hold. However, recent successes with data issues in the VIP program suggest that data quality should not be a fatal flaw. Bob Babson, NOAA GC (personal communication), reported that in-season penalties may not be necessary to provide an effective incentive program. If IBQs can successfully accommodate data quality and due process, then the concept should also be able to deal with the initial allocation questions. Appendix 2 presents the most recent report on IBQs by a Bycatch Working Group.

4.0 NEPA REQUIREMENTS/ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES

An environmental assessment (EA) is required by the National Environmental Policy Act of 1969 (NEPA) to determine whether the action considered will result in a significant impact on the human environment. The environmental analysis in the EA provides the basis for this determination and must analyze the intensity or severity of the impact of an action and the significance of an action with respect to society as a whole, the affected region and interests, and the locality. If the action is determined not to be significant based on an analysis of relevant considerations, the EA and resulting finding of no significant impact (FONSI) would be the final environmental documents required by NEPA. An environmental impact study (EIS) must be prepared if the proposed action may cause a significant impact on the quality of the human environment.

An EA must include a brief discussion of the need for the proposal, the alternatives considered, the environmental impacts of the proposed action and the alternatives, and a list of document preparers. The purpose and alternatives were discussed in Sections 1.1 and 1.3, and the list of preparers is in Section 7. This section contains the discussion of the environmental impacts of the alternatives including impacts on species listed as threatened and endangered under the Endangered Species Act (ESA).

The environmental impacts generally associated with fishery management actions are effects resulting from 1) overharvest of fish stocks which might involve changes in predator-prey relationships among invertebrates and vertebrates, including marine mammals and birds, 2) physical changes as a direct result of fishing practices affecting the sea bed, and 3) nutrient changes due to fish processing and discarding fish wastes into the sea. A summary of the effects of the 1994 groundfish total allowable catch amounts on the biological environment and associated impacts on marine mammals, seabirds, and other threatened or endangered species are discussed in the final environmental assessment for the 1994 groundfish total allowable catch specifications (NMFS, 1994a).

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4.1 Impacts of the alternatives on groundfish and prohibited species.

Few biological or environmental changes will occur by adopting any of the alternatives. Adopting alternative 2 would increase groundfish harvest (constrained by TACs), reduce reallocation of groundfish (especially Pacific cod from trawl to longline), and change from halibut wasted as bycatch mortality to halibut harvested by the directed halibut fishery. If halibut PSC limits currently set by the Council remain at status quo and are reached by a fishery, then the amount of dead halibut will not change as a result of any alternative. The groundfish harvest will increase as a result of lower discard mortality rates. However, if the discard mortality rates are reduced as anticipated under Alternative 2, the amount of dead halibut from bycatch will decline in the fisheries that practice deck sorting. The savings in halibut bycatch mortality can be used to reduce halibut PSC to make more halibut available for harvest by the halibut fishery, or can be used in other groundfish fisheries to increase groundfish harvest, or a combination of the two. In any event, the total amount of dead halibut will not change much, although the distribution between halibut bycatch mortality in the groundfish fisheries and harvest in the directed halibut fishery may.

Alternative 2 will reduce the precision of NMFS' overall estimates of groundfish and halibut catch. Options 1 and 2 will result in less data collected for halibut discards. Option 3 will decrease the amount of time observers have to complete existing duties, or reduce the number of hauls sampled (Appendix 3, section 1). Analyses indicate that reducing the number of hauls sampled results in increased uncertainty in overall catch estimation (Appendix 3, section 2).

While NMFS makes a single estimate of bycatch mortality, increased uncertainty widens the range of error in which halibut bycatch caps are estimated. In fisheries managed by bycatch limits, the possibility of overshooting or undershooting the limit would increase. In a situation where undershooting of the limit occurs, groundfish catch will be foregone, but lower bycatch mortality will increase future halibut abundance. Overshooting the limit will allow excess groundfish harvest and cause lower halibut abundance in the future. In any event, the groundfish harvest will be limited to TACs set by the Council.

Unobserved hauls present an opportunity for vessels to cheat by not complying with the sorting requirement. The opportunity increases as the number of unobserved hauls increases. Spot checking by the observer on the presence of sorting grids when required and conduct of sorting can reduce the tendency to cheat. A second observer would essentially eliminate a cheating problem, and would improve the overall precision of groundfish and bycatch estimates by increasing the number of hauls observed. A decision on the proper number of observers would be made under the guidelines of the Research Plan that will establish observer coverage.

Released halibut experience some probability of mortality regardless of release method. However, time on deck and size of halibut have a great effect on the survival. Sorting on deck reduces time out of the water, which leads to reduced discard mortality. Mortality of discards will occur due to injuries suffered in the trawl, from time out of water on deck, in the hold, or in the factory, and from reduced fitness that may lead to attacks from predators after release or reduced ability to swim and forage. Discard mortality rates are expected to decline by 15-25% for the fisheries which practice deck sorting, based on relative changes in experimental rates. If deck crews can increase sorting efficiency through experience, as predicted by personnel from the *Northern Glacier*, additional declines in discard mortality rates will occur.

4.2. Impacts on Endangered, Threatened or Candidate Species Under the ESA

Species that are listed as threatened or endangered, or are candidates or proposed for listing under the Endangered Species Act (ESA), may be present in the BSAI and GOA. Additionally, non-listed species, particularly seabirds, also occur in those areas and may be impacted by fishing operations. A list of species and a detailed discussion regarding life history and potential impacts of the 1994 groundfish fisheries of the BSAI and GOA on marine species can be found in an EA for the 1994 TAC specifications for the GOA and BSAI (NMFS 1994a).

4.2.1 Salmon

Listed species of salmon, including the Snake River sockeye salmon (O. nerka), fall chinook and spring/summer chinook salmon (both Oncorhynchus tschawytscha) may be present in the BSAI or GOA. These areas are believed to be outside the range of another listed species, the Sacramento River winter-run chinook salmon. A Biological Opinion conducted on effects of the BSAI and GOA groundfish fisheries concluded that groundfish fisheries are not likely to jeopardize the continued existence of endangered or threatened Snake River salmon species (NMFS 1994b).

4.2.2 Seabirds

Listed or candidate species of seabirds include the endangered short-tailed albatross (Diomedea albatrus), the threatened spectacled eider (Somateria fischeri), and the candidate (category 1) Steller's eider (Polysticta stelleri), or (category 2) marbled murrelet (Brachyramphus marmoratus), red-legged kittiwake (Rissa brevirostris) or Kittlitz's murrelet (Brachyramphus brevirostris). A formal consultation conducted by the U.S. Fish and Wildlife Service (USFWS) on the potential impacts of groundfish fisheries and subsequent informal consultation on impacts of 1994 groundfish fisheries on these species concluded that groundfish fisheries adversely affect, but do not jeopardize, the existence of the short-tailed albatross (USFWS 1989, 1994) if the incidental take allowance of up to two short-tailed albatrosses per year was not exceeded. The informal consultation also concluded that groundfish fisheries were not likely to adversely affect the spectacled eider, Steller's eider, or marbled murrelet. The USFWS did not comment on remaining candidate species at that time.

Alternative 2 is not expected to adversely affect any listed or candidate seabirds in a manner not already considered in previous consultations.

4.2.3 Marine Mammals

As with salmon and seabirds listed under the ESA, fishing activities under this proposed action are not likely to impact the threatened Steller sea lion (Eumetopias jubatus), in a manner, or to an extent, not previously considered in informal section 7 consultations for 1994 groundfish fisheries (NMFS, 1994c; 1994d). The 10-nm annual trawl exclusion areas around Steller sea lion rookeries would be in place regardless of which alternative is chosen. These create refuges where no trawling can occur in areas important for sea lion breeding and foraging.

Other listed marine mammals include the endangered fin whale (Balaenoptera physalus), sei whale (Balaenoptera borealis), humpback whale (Megaptera novaeangliae), and sperm whale (Physeter catodon).

None of these species are anticipated to be adversely affected by this proposed amendment because total harvests and overall fishing effort would not change.

Alternative 2 is not expected to adversely affect any listed or candidate marine mammals in a manner not already considered in previous consultations.

4.3. Impacts on Marine Mammals not listed under the ESA

Marine mammals not listed under the ESA that may be present in the BSAI or GOA include cetaceans, [minke whale (Balaenoptera acutorostrata), killer whale (Orcinus orca), Dall's porpoise (Phocoenoides dalli), harbor porpoise (Phocoena phocoena), Pacific white-sided dolphin (Lagenorhynchus obliquidens), and the beaked whales (e.g., Berardius bairdii and Mesoplodon spp.)] as well as pinnipeds [northern fur seals (Callorhinus ursinus), and Pacific harbor seals (Phoca vitulina)] and the sea otter (Enhydra lutris). As previously mentioned, a list of species and detailed discussion regarding life history and potential impacts of the 1994 groundfish fisheries of the BSAI and GOA on those species can be found in an EA conducted on the 1994 Total Allowable Catch specifications for the GOA and BSAI (NMFS 1994a).

Alternative 2 is not expected to adversely affect any listed or candidate marine mammals in a manner not already considered in previous consultations.

4.4 Coastal Zone Management Act

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

4.5 Conclusions

Species that are listed, or proposed to be listed, under the ESA that may occur in the BSAI or GOA include the endangered fin whale (Balaenoptera physalus); sei whale (Balaenoptera borealis); humpback whale (Megaptera noveangliae); sperm whale (Physeter catodon); Snake River sockeye salmon (O. nerka) and short-tailed albatross (Diomedea albatrus); the threatened Steller sea lion (Eumetopias jubatus); Snake River fall and spring-summer chinook salmon (Oncorhynchus tshawytscha); and spectacled eider (Somateria fischeri). In summary, listed species of whales are not expected to be affected by the proposed alternative. Other listed species are not anticipated to be adversely affected in a manner, or to an extent not considered in previous consultations.

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

None of the alternatives is likely to significantly affect the quality of the human environment; preparation of an environmental impact statement for selection of any of the alternatives as the proposed action would not be required by Section 102(2)(C) of the National Environmental Policy Act or its implementing regulations.

5.0 REGULATORY IMPACT REVIEW
ECONOMIC AND SOCIOECONOMIC IMPACTS OF THE ALTERNATIVES

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

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

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

This section also addresses the requirements of both E.O. 12866 and the Regulatory Flexibility Act to provide adequate information to determine whether an action is "significant" under E.O. 12866 or will result in "significant" impacts on small entities under the RFA. E.O. 12866 defines a "significant regulatory action" as likely to result in (1) an annual effect on the economy of $100 million or more; (2) an adverse effect in a material way on the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local or tribal governments or communities; or (3) a novel legal or policy issue. Requirements of the RFA are addressed in Section 4.

5.1. Alternatives.

5.1.1. Alternative 1: Status Quo. Alternative 1 (status quo) would involve no change in the handling of halibut on board groundfish non-pelagic trawlers. Under this alternative, no change in industry costs, management costs, observer sampling, or halibut bycatch mortality rates will likely occur. The amount of time that halibut are out of the water aboard vessels that dump their catch directly into stern tanks before sorting will continue to be high, and will cause high mortality of bycaught halibut.

The race for fish under the Olympic system imposes costs to the nation of unnecessarily high bycatch mortality of high value species, while not allowing the benefit of attaining the TAC of target species. In the Bering Sea-Aleutian Islands management area, the directed Pacific cod non-pelagic trawl fishery closed prior to achieving TACs each year from 1990 through 1994 because halibut bycatch mortality exceeded mortality limits. In the Gulf of Alaska, the directed cod fishery closed for intermittent periods before achieving TACs in 1990 (5/29-6/30 and 11/20 through the end of the year) because of halibut bycatch mortality, but was not affected from 1991 through 1994. Under status quo, future BSAI cod trawl fisheries will likely leave a large portion of their cod allocation unharvested. The GOA may be less severely affected, with intermittent closures that do not restrict total harvest. If halibut abundance increases or cod abundance increases, or both, cod trawl TACs in particular and groundfish TACs in general will become increasingly difficult to achieve.

Under status quo, non-pelagic trawl fisheries for Pacific cod and pollock in the BSAI and deep and shallow water flatfish fisheries in the GOA were constrained by halibut bycatch in 1994. Other fisheries may leave

TACs unharvested in the future if halibut bycatch and halibut mortality rates worsen slightly. Target fisheries that may-under harvest catch quotas in the future are BSAI yellowfin sole, rock sole, other flatfish, Greenland turbot, and GOA shallow and deep water flatfish. Additionally, no reductions in halibut discard mortality rates will occur which could be used to reduce halibut bycatch mortality limits.

5.1.2. Alternative 2. Alternative 2 (species discretionary) would alter operations on affected vessels to some degree by: 1) increasing codend dumping time; 2) establishing on-deck halibut handling procedures for the deck crew and possibly for the observer; 3) decreasing fishing time; and 4) increase time between dumping and start of processing if the observer works on deck. Each of these impacts and potential benefits is discussed below. Some competitive costs or benefits will accrue for target fisheries selected for a deck-sorting requirement that will not apply to fisheries not selected, as those selected will have to do more for the benefit of lower discard mortality rates, while those not selected will do less but without lower discard mortality rates.

The grid used on the *Northern Glacier* was built by vessel personnel for a reported cost of "several hundred" dollars. Similar grids, as required by Alternative 2, are not commercially available so would likely be built by personnel from the vessels involved. Expected cost would be similar to that experienced by the *Northern Glacier.*

The vessels in the groundfish fleets affected by Alternative 2 will differ substantially between the BSAI and the GOA management areas. In the BSAI, all factory trawlers (about 60-65 vessels) using non-pelagic trawls could be affected because these vessels dump catch from the codend into stern holding tanks prior to sorting and processing. Additionally, about eight large catcher vessels would be affected. Alternative 2 would not apply to catcher vessels that normally sort on deck before moving fish below into refrigerated seawater for delivery shoreside. Under current regulations that allocate 10% of the Pacific cod TACs to the offshore fleet, factory trawlers and motherships in the GOA are effectively prohibited from directed Pacific cod fisheries, so would not be subject to the alternative. However, the onshore-offshore regulations expire at the end of 1995, so further allocation will require a separate FMP amendment.

Time required to dump catches through the grid and into the below-deck tanks under Alternative 2 will be increased compared to status quo operations. Increased codend dump times will vary by fishery, size of tow, and the amount of halibut bycatch. During the *Northern Glacier* grid tests, up to 25 ton tows of primarily pollock and Pacific cod required 10-12 minutes longer to sort using the grid than was required when dumping similar amounts directly into the stern tanks (Williams and Trumble 1994). Vessel personnel believe that the dumping and sorting time can be reduced further with practice and by bringing two people from the factory to the deck for sorting during the codend dumps. Time lost to grid sorting could commensurately reduce fishing time for vessels trying to reset gear as rapidly as possible. Fishing time could be reduced as much as one hour per 24-hour period, assuming 10 minutes delay per tow and six tows per day. Immediate setbacks are not always possible or desirable, however, given fishing conditions and the amounts of fish already on board for processing. Crew costs, based on a share of the catch, will not be affected if total catch remains the same. If this amendment increases total groundfish catch, crew shares should also increase.

Crew time on deck will be increased during grid sorting to effectively remove halibut from the catch. The crew will have an incentive to get the groundfish catch into the hold quickly to minimize time lost before re-setting can begin. Competing interests of speed on deck and decreased bycatch mortality rates make it difficult to predict actual deck-crew behavior. Increased crew work on deck to prevent halibut from entering the factory will decrease handling of halibut in the factory where work spaces are often cramped and halibut difficult to remove and return to the sea. Increased personnel (possibly including observers) on deck and for longer periods as required for deck sorting may increase insurance costs to the vessel.

Under Options 1 and 2, observers would not be on deck collecting data from deck-sorted halibut, except for limited special projects. Observer sampling requirements would cause no delays in the vessel operations, except for the special projects.

Under Option 3, the observer would be on deck for all sampled hauls. Assistance from the deck crew for the observer, necessary to complete sampling, would add time on deck for the crew. The crew will have an incentive to assist the observer, to decrease sorting time, and lessen delays before gear can be reset. Efficiency in reducing sorting time on deck will increase halibut survival. Under Option 3, the vessel cannot start processing a haul for which an observer is collecting data until the observer finishes on deck and returns to the factory. Delays for deck-sorting on the *Northern Glacier* normally added 8-15 minutes to the time before the factory could begin processing the haul being observed. Such delays could reach 30 minutes or possibly more for larger catches. Cost of the delay depends on the need for fish in the factory. As long as the factory can process fish without adding staff or causing the fishing operation to stall, no additional costs accrue. Inability to make the next haul while waiting for completion of fish processing will make a vessel less competitive than a vessel that does not experience delays. The tendency for some delay will affect all vessels to some degree, may tend to extend the time required over the season to catch the quota, and may increase variable costs (fuel, food, etc.). Potential reductions in discard mortality rates from Suboptions 2 and 3 of Option 3 need to be weighed against the biases that may occur for these Suboptions (Section 3.5.2).

The Observer Program has noted that the observers do not always receive cooperation from the crew, and have concerns that cooperation on deck may be limited. As an example of poor cooperation in spite of regulations, pre-sorting of halibut and other prohibited species may occur before the observers can obtain necessary samples, even after the observers bring pre-sorting requirements to the attention of the vessel. To date, no penalties have been imposed for vessels for pre-sorting. The Observer Program is concerned, from past experience, that some vessels will start processing groundfish below decks before the observers finish sampling on deck.

Increased survival of discarded halibut under Alternative 2 will increase the trawl fisheries ability to harvest the target species TAC under existing halibut mortality limits, and thereby achieve the allocation set by the North Pacific Fishery Management Council and maximize net benefits to the fishing industry. Halibut mortality will decrease if the trawl fishery reaches its cod allocation within its halibut mortality limit, as halibut mortality associated with reallocation of cod to the longline fleet will not be used. Halibut mortality limits may be decreased with larger groundfish harvest. Potential additional benefits may accrue through reallocation of halibut mortality limits.

Experience from the *Northern Glacier* suggested that halibut discard mortality rates may decline up to 25% for Pacific cod or pollock fisheries depending on the Option selected, and on the average sorting time of the hauls. Greatest savings occur with Option 1 for all sorting times. Option 3 has large savings if long sorting periods occur, but can actually impose additional mortality compared to hauls that are completely sorted quickly in the factory. Option 2 will be intermediate in savings, depending on the proportion of hauls observed.

Halibut bycatch and mortality data will be significantly degraded under Option 2, because little (only limited special projects) or no data will be collected for deck-sorted halibut. The vessel has little incentive to comply with the requirement. However, other observer data will not be affected. Option 3 provides the best halibut information, with full biological and mortality data collected on-deck and in the factory. Incentive for compliance is mixed. However, other observer data will be reduced, leading to less precise estimates. Option 1 will also degrade the data for halibut sorted on deck, and will require special projects to derive fleet-wide averages for proportion of halibut sorted on deck and discard mortality rates for deck-sorted halibut. Incentive to sort on deck will be high, because the amount of halibut observed in the factory will be expanded to estimate the halibut sorted on deck. Sorting less than the assumed fleet-wide average will cause estimates of bycatch higher than actual bycatch, and bycatch limits will be reached sooner. Sorting more than the assumed average will cause estimates lower than actual bycatch. Other observer data will not be affected.

Other fisheries (Alternative 2) will experience reductions in the discard mortality rates, but we cannot predict the magnitude of those savings without research on the effect of deck sorting in those fisheries. Flatfish fisheries may have fewer benefits from deck-sorting because small halibut and other flatfish have similar size and body shape, which makes sorting more difficult. Either lower sorting success at similar sort times or similar sorting success at longer sort times are likely, compared to the *Northern Glacier* results.

In 1994, the 191,000 mt Pacific cod BSAI TAC was split 54% trawl (103,140 mt), 44% fixed gear (84,040 mt), and 2% jig (3,820 mt). The Pacific cod trawl fishery closed May 7 after reaching the halibut bycatch limit, with a catch of 70,919 mt of Pacific cod, including the bycatch of Pacific cod in other trawl fisheries. Halibut bycatch rates were lower in 1994 than in previous years, but the Pacific cod trawl fishery closed with more than 30,000 mt remaining unharvested. In August, NMFS reallocated 8,000 mt of Pacific cod to the fixed gear fishery, reducing the trawl allocation to 95,140 mt. Subsequently, unanticipated need for Pacific cod bycatch in other trawl fisheries resulted in a trawl gear catch of about 101,000, which exceeded its revised allocation by 6%.

The trawl fisheries ended 1994 on the order of 2,000 mt short of their cod allocation. At an ex-vessel equivalent of $0.128 per pound round weight, and a primary processor value of $0.37 per pound, the unharvested Pacific cod was worth about $0.6 million ex-vessel and $1.6 million primary processor, after incidental cod catch in other fisheries is considered (Joe Terry, NMFS, AFSC, pers. comm.). If grid sorting had been required in 1994 and achieved a 15-25% reduction in discard mortality rates from those used in 1994, the Pacific cod fishery would have harvested its TAC of 84,000 mt, while using only 1,200-1,070 mt of halibut bycatch mortality. This would have been right on the 1,200 mt limit or would have saved 130 mt of halibut mortality. Alternatively, the 70,919 mt of directed Pacific cod harvest could have occurred at 1,021-900 mt of Pacific halibut bycatch mortality, 179-300 mt below the mortality limit.

If the Pacific cod allocation for trawl had been harvested within the halibut mortality limit, then halibut bycatch mortality from longline harvest of reallocated cod would not have occurred. Implementation of a deck-sorting requirement will reduce or prevent reallocation of Pacific cod from non-pelagic trawl to longline gear. Eight thousand mt of Pacific cod reallocated from the trawl allocation in 1994 would be worth approximately $2.4 million ex-vessel and $6.4 million primary processor (Joe Terry, NMFS, AFSC, pers. comm.). Longline harvest of these fish would be worth approximately $3.4 million ex-vessel and $6.4 million primary processor, at $0.18 per pound and $0.37 per pound, respectively (Joe Terry, NMFS, AFSC, pers. comm.). The longline fishery used about 125 mt of halibut bycatch mortality to harvest the 8,000 mt Pacific cod reallocation. This discussion is not an evaluation of the appropriateness of the Pacific cod allocation, only of the achievement of the allocation.

The 1994 pollock fishery harvested about 1.25 million mt of pollock with a halibut mortality limit of 1,257 mt. The non-pelagic trawl fishery closed on September 6 when it attained its halibut mortality allocation of 314 mt; the pelagic trawl fishery, in spite of the pelagic trawl definition for much of the season that allowed on-bottom fishing, closed because TAC was reached. At a 15-25% reduction in discard mortality rates, the non-pelagic trawl harvest taken at the time of the halibut PSC closure could have occurred between 269-234 mt, rather than 314 mt. The pollock harvested with the remaining 934 mt of halibut bycatch mortality during the pelagic-trawl only opening could have occurred with only 794-700 mt of halibut mortality at a 15-25% reduction in discard mortality rate. With the new definition of pelagic trawl that prevents most halibut bycatch, the pollock TAC may be taken with substantially less halibut bycatch mortality.

For 1995, the NPFMC assigned 1550 mt of halibut bycatch mortality to the BSAI Pacific cod fishery, and 455 mt to the non-pelagic pollock fishery. At 15-25% reductions in discard mortality rates, maximum savings of 300-500 mt of halibut mortality could occur. However, about 25-33% of the halibut bycatch mortality in the BSAI Pacific cod fishery and about 98% of the mortality in the non-pelagic trawl fishery in 1993 and 1994 occurred from factory trawlers (Andy Smoker, NMFS AK Region, pers. comm.). At the same proportions for 1995, savings from grid sorting limited to Pacific cod and non-pelagic pollock factory trawl fisheries could be reduced to around 150-250 mt. Any savings in halibut bycatch mortality that accrue could be used for increased groundfish harvest, for lower halibut mortality, or both.

As indicated above, the savings for other non-pelagic trawl fisheries cannot yet be predicted. However, other trawl fisheries were closed in 1994 after reaching halibut bycatch mortality limits: rock sole/other flatfish on July 5, and yellowfin sole on November 19. Rock sole achieved 93% of the TAC, other flatfish achieved 63% of the TAC, and yellowfin sole achieved 80% of the TAC, as of November 5, 1994. About 98% of the halibut bycatch in these non-pelagic fisheries occurs from factory trawlers.

The proponents of alternative 2 propose that non-pelagic trawl groundfish fisheries and directed halibut fishery share 50-50 the halibut mortality reductions that result from deck-sorting. Although working predictions of reductions in discard mortality rates ranged from 15-25%, actual savings will not be known until the deck-sorting requirement goes into effect. A separate fishery management plan amendment to adjust bycatch mortality limits was initiated by the Council in June, 1994.

5.2. Administrative, Enforcement, and Information Costs.

5.2.1 Impact on observers and observer data. A grid sorting requirement would affect three primary areas concerning the observers, observer program, and observer related regulations: 1) observer workload; 2) safety issues; and 3) observer data base and sampling issues. The effects on these areas are discussed below:

5.2.1.1. Observer workloads.

The grid sorting requirement proposed in Alternative 2, Option 3, would require observers to monitor the dumping of the catch into below-deck bins. If any halibut were sorted out on deck, the observer would receive them from the crew members, measure the length, determine the viability, and observe the halibut discard process. Subsampling halibut would assure that the observer would finish on deck at the same time that the crew finished dumping the haul. Options 1 and 2 do not require observers to work on deck to collect data from sorted halibut, except for potential special projects.

On-deck sorting aboard the *Northern Glacier* took 8 to 15 minutes for catches of 5 to 25 mt, compared to 1 to 3 minutes for catches dumped directly into the hold. In the commercial fisheries, non-pelagic trawl pollock catches can reach at least 100 mt, so it could take more than 30 minutes to dump the larger catches. Limiting deck-sorting with a grid to the first 20 minutes (Suboption 1) will set an upper bound on observer deck time, but still capture most of the survival benefits. An observer would be expected to monitor all deck-sorting operations (Option 3), whether the entire dumping process or the first 20 minutes to gather data on any halibut or other species that are sorted out. Observers who would normally basket sample or partial-haul sample for halibut in the factory will be forced to deal with more halibut under this program. With subsampling of halibut on deck, observers would have to spend an additional 10 to 20 minutes per haul handling the recording, transcription, length-to-weight conversion, summarization, and transmission of the data from the deck-sorted halibut.

A requirement for deck crew to assist with sorting and handling of halibut may reduce the time on deck needed by the observer on some vessels. Observers have found the crew to be very helpful on some vessels, but have found it difficult to get cooperation from the crew on other vessels.

Time spent performing deck-sorting functions will not be spent performing other sampling duties. This is likely to result in a reduction in other activities performed by the observer, or reduction in the number of hauls per day that the observer is able to sample, especially on catcher-processors, but also on catcher boats that sort their catch below deck. (Please see "Estimated effect of the grid sorting regulation on the number of hauls that an observer is able to sample" in Appendix 3 for a more thorough discussion.)

5.2.1.2. Observer safety.

Halibut grid sorting under Option 3 would require that observers spend part of their sampling time on deck mostly in the proximity of the stern during the dumping of the codend. A survey of observers (Appendix 3, Section 3) indicates that many vessels do not have a safe area on deck to collect halibut length frequencies and viabilities. However, vessels can adjust fishing operations to make the deck safer on less safe for the observer, depending on the operation. Requiring observers to work on deck during the dumping of the codend would result in increased occupational exposure to dangerous working conditions with consequent increased possibilities of occupational injury. Under these conditions, some observers will choose not to do the on-deck work for personal safety reasons and this will reduce the quantity of data collected. Where safety problems occur, observers could collect a reduced amount of halibut data by counting the discarded halibut but not collecting length or condition factor data. Viability and length frequency calculations for those hauls with counts-only would be made by applying averages from other hauls on the vessel, or from fleet-wide averages.

Current regulations provide that vessels must allow observers unobstructed access to the vessels' trawl decks. However, the vessel master is ultimately responsible for safety on board and observers have been refused access to the deck during unsafe operations. Vessel operators could impact an observer's ability to collect halibut length and condition factor data under a grid sorting requirement by restricting their access to the deck for safety reasons. Observers taking counts-only would be harder to restrict. Vessel operators able to totally restrict an observer's access to view the sorting may be able to dump the codend faster than would be possible with an observer present, and would benefit that vessel by increasing their fishing time over those vessels that sort codends with an observer present.

5.2.1.3. Observer data base and sampling issues.

The Observer Program's two data bases are currently unable to accept data from the sampling methods that would be implemented under a deck-sorting requirement. In order to generate bycatch rates and total bycatch amounts, on-deck observations and below-deck observations would have to be combined. Incorporating and combining data from the two sources would require substantial redesign of the database system and supporting procedures for acquisition and transmission of data. It is doubtful that these changes could be made given current NMFS Observer Program staffing constraints and existing workloads.

Alternative 2 creates additional data handling concerns. The sampling protocols for deck sorted halibut would have to be designed to accommodate other species sorted by the grid and current sampling protocols for catch composition estimation would require modification.

The issue of crew cooperation is critical under Alternative 2. Expectation is for cooperation in some, but not all, situations. The economic impact of delayed factory operations, and the increase in observer compliance monitoring that would occur, create the potential for jeopardizing an observer's ability to conduct his or her duties.

5.2.1.4. Vessel Incentive Program

A requirement to grid-sort halibut on deck would conflict with the existing regulations and underlying assumptions of the Vessel Incentive Program (VIP). The VIP program establishes bycatch rate standards for vessels. Vessels which exceed these standards based on unbiased observer sampling data may be subject to enforcement action. The VIP program was predicated on the understanding that vessels have some control over halibut bycatch, and thus some responsibility to keep bycatch below set standards. At present, several VIP cases are awaiting decision by an administrative law judge and several others are under investigation. Proceeding with the grid-sorting approach to bycatch management could jeopardize this ongoing work and could be premature without a comprehensive review of the efficacy of the VIP program.

Strict sampling protocols must be followed to establish VIP rates and these protocols could not be followed under a requirement to grid-sort halibut. Under VIP, the bycatch rate, the variance of the bycatch rate and the 95 percent confidence interval can only be made under conditions where the weight and numbers of halibut or red king crab and associated weight of groundfish sampled are actually measured. Typically, this work requires a sampling station for counting and weighing fish. On catcher trawlers, this work is accomplished on deck forward. On catcher-processor vessels, it is accomplished in the factory. To avoid bias and obtain representative rates, these samples must be made before any fish are removed from the catch. Under the VIP, presorting of the catch prior to sampling by an observer is considered to be a violation of the VIP regulations. The grid sorting alternative conflicts with the existing VIP requirements in that grid sorting mandates that halibut be sorted from the catch on deck. This would occur in most cases prior to the observer being able to obtain a catch sample for purposes of VIP.

Grid sorting on deck may be statistically compatible with the VIP program, but only after major changes in the design of the VIP program (Appendix 4). The changes to VIP would be difficult and expensive.

5.2.2. Enforcement concerns.

If the Council chooses to select certain fisheries to participate in the grid sorting requirement, then Enforcement will need to know when a vessel is fishing in those fisheries. The directed fishing standards define a fishery based on week-ending catch records. The catch composition on board during part of a week may not be the same at the end of a week. Under the current procedure, enforcement officers will not know during a boarding if a vessel should be using a grid. Enforcement would have to occur after the fact, by matching observer reports of use or non-use of a grid during a week, and the final catch composition at the end of that week. Fishing standard definitions should not be a problem for vessels intending to target on Pacific cod or non-pelagic trawl pollock. Vessels intending to target on mid-water pollock, but who catch more than the allowed amount of crab or other species, will fall under the non-pelagic trawl definition and grid-sorting requirement.

Compliance monitoring of grid requirements under Alternative 2 would be largely dependent on observer verification. Reliance on observer data to monitor compliance with a grid sorting requirement would place additional pressure on the observer while deployed on board a vessel. The observer normally takes a passive role when witnessing potential violations. Notation of the violation is noted in the observer log book, and reported to a debriefer. The Observer Program would then pass on the notes to Enforcement for possible action. Enforcement of a grid requirement could be facilitated if regulations required grids to be welded in place. This option, however, could create safety and operation problems that likely preclude it as a reasonable alternative.

6.0 SUMMARY AND CONCLUSIONS

6.1 Effects on Listed Species and on the Alaska Coastal Zone

Consultations pursuant to Section 7 of the ESA on the impacts of 1994 fishing activities under the FMPs concluded that those activities are not likely to adversely affect endangered or threatened species, or their habitat, under the jurisdiction of NMFS or the USFWS, in a manner, or to an extent, not already considered in prior consultations. None of the alternatives considered for the proposed regulatory amendment are expected to have any additional adverse impacts.

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

6.2 Executive Order 12866 Requirements

Executive Order 12866 requires that the Office of Management and Budget review proposed regulatory programs that are considered to be "significant". A "significant regulatory action" is one that is likely to result in a rule that may

1. have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, productivity, USFWS competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities;

2. create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

3. materially alter the budgetary impacts of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or

4. raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in Executive Order 12866.

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

None of the proposed alternatives is expected to result in a "significant" regulatory action as defined in E.O.

12866. None of the alternatives would alter groundfish TACs or fishery participation. Total fishing effort may increase if more groundfish harvest occurs as a result of lower discard mortality rates.

The proposed regulatory amendment would not create a serious inconsistency or otherwise interfere with an action taken or planned by another agency.

The proposed regulatory amendment would not materially alter the budgetary impacts of entitlements, grants, user fees, or loan programs or the rights and obligations of the recipients thereof.

The proposed regulatory amendment would not raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in Executive Order 12866.

The proposed regulatory amendment would not have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, productivity, competition, jobs, the environment, the public health or safety, or governments.

7.0 FINDING OF NO SIGNIFICANT IMPACT

For the reasons discussed above, implementation of the alternative to the status quo would not significantly affect the quality of the human environment, and the preparation of an environmental impact statement on the final action is not required under Section 102(2)(c) of the National Environmental Policy Act or its implementing regulations.

________________________ ______________________
Date

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Table 3.1. Comparison of discard mortality rates for Pacific halibut by sort time and factory delay, assuming all halibut are returned to the sea immediately after sorting.

		With Factory Delay		Without Factory Delay	
Sort Time (Min)	Factory	On-Deck	% Difference Frm Factory	On-deck	% Difference Frm Factory
30	47	52	11	45	-5
45	51	54	6	47	-8
60	56	57	2	50	-11
120	71	63	-11	59	-17
180	75	64	-15	62	-17

Table 3.2. Trend in halibut discard mortality rates during 1990 through 1993, and recommendations for discard mortality rates to use in monitoring halibut bycatch mortality in 1995. Rates shown under "Used in 1994" for hook & line fisheries represent rates applied to observed/unobserved vessels.

Region/Target	1990	1991	1992	1993	1992-93 Average	Used in 1994	Recommendation for 1995
BSAI TRAWL							
MWT Pollock	81	81	87	90	89	80	89
Atka mackerel	69	73	62	56	59	70	59
Rock	58	68	78	72	75	70	75
sole/Oflats[1]	68	60	67	62	65	60	65
Pacific cod	65	59	76	78	77	60	77
BT Pollock	62	54	59	78	69	60	69
Rockfish	73	74	77	75	76	70	76
Yellowfin sole[1]	57	41	-	-	-	40	49[2]
Arrowtooth	58	38	-	-	-	40	48[2]
Grnld. turbot							
GOA TRAWL							
MWT Pollock	63	74	69	63	66	75	66
Rockfish	61	65	69	62	66	60	66
BT Pollock	65	56	67/72[3]	81/54[3]	74/63[3]	55	74/63[3]
Shallwtr. flatfish	62	61	62	66	64	60	64
Pacific cod	61	55	59	56	58	55	58
Deepwtr. flatfish	57	52	59	59	59	55	59
BSAI H&L							
Pacific cod	17	21	18	18	18	12.5/15	18
Sablefish	13	18	19	14	17	12.5/15	17
Rockfish	18	29	-	-	-	12.5/15	24[2]
Grnld. turbot	-	-	17	21	19	12.5/15	19
GOA H&L							
Pacific cod	13	17	30	9	20	16/16	20
Sablefish	11	28	23	26	25	14/17	25
Rockfish	15	20	-	-	-	11.5/14	18[2]
BSAI POT							
Pacific cod	7	3	12	4	8	5	8
GOA POT							
Pacific cod	10	5	16	20	18	5	18

[1]During 1990 and 1991, "Other flatfish" was grouped with yellowfin sole. Since 1992, the target has been grouped with rock sole.

[2]Average of 1990 and 1991, the two most recent years.

[3]For the GOA BT pollock fishery, the first value represents at-sea processors, the second value represents vessels delivering to shoreside processors.

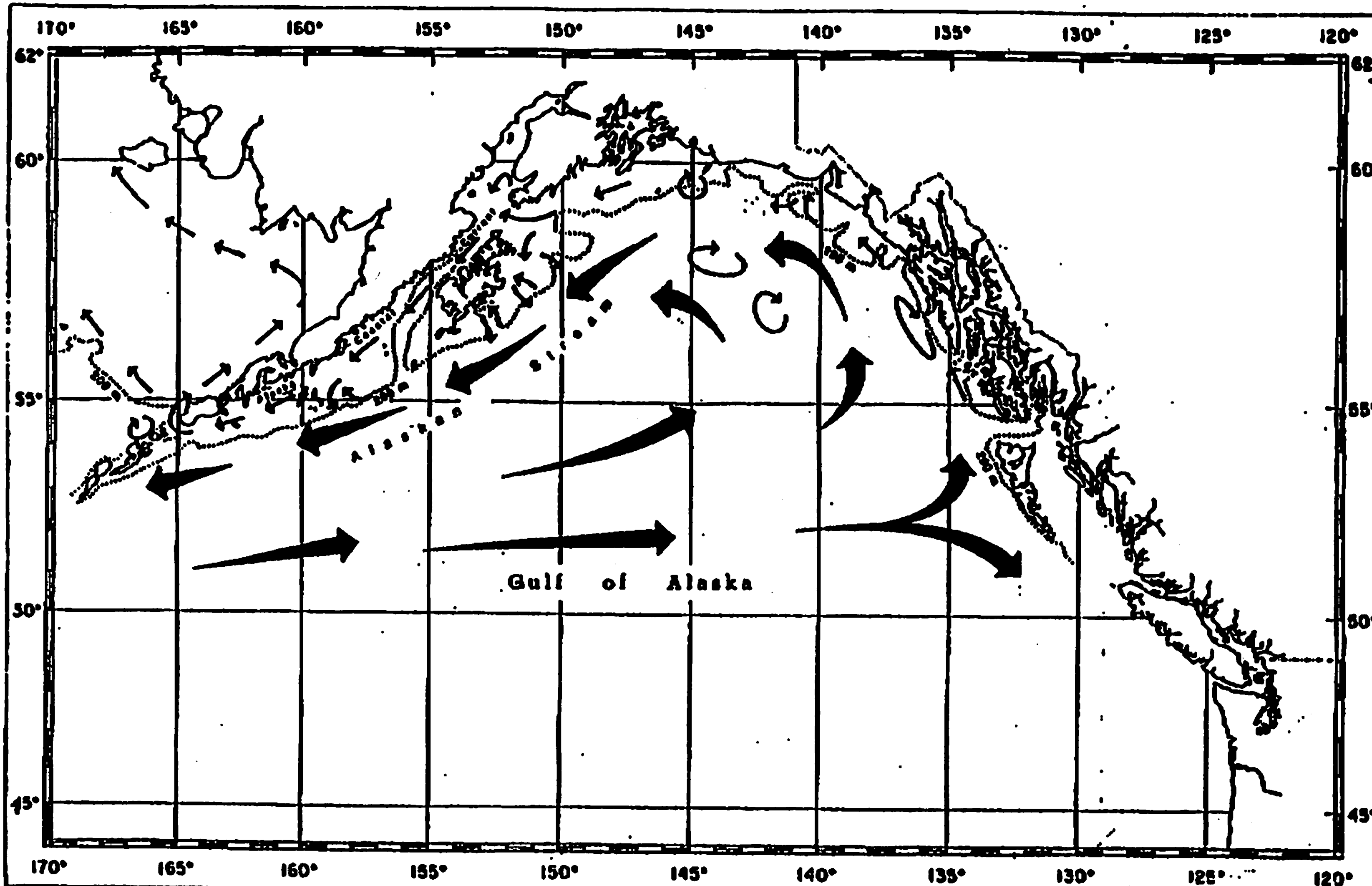

Fig. 3.1. General circulation and current patterns in the Gulf of Alaska and eastern Bering Sea.

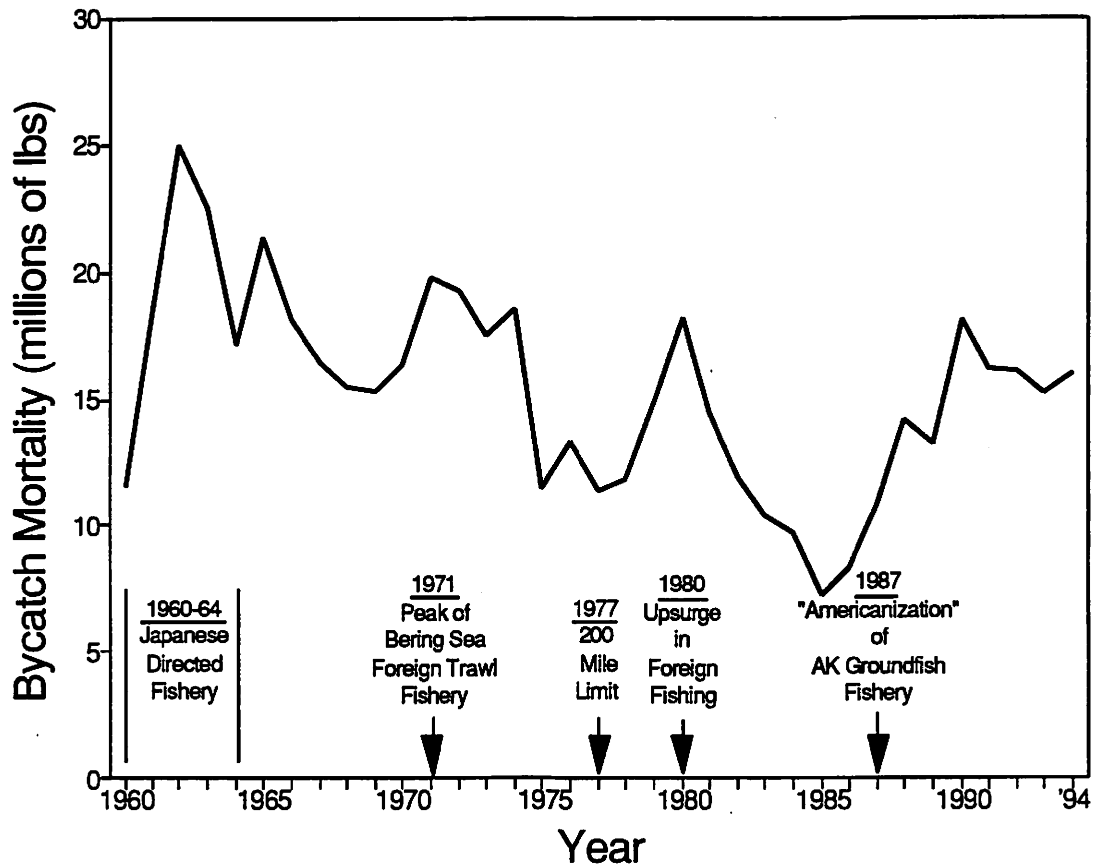

Figure 3.2. Pacific halibut bycatch mortality from 1960 through 1994.

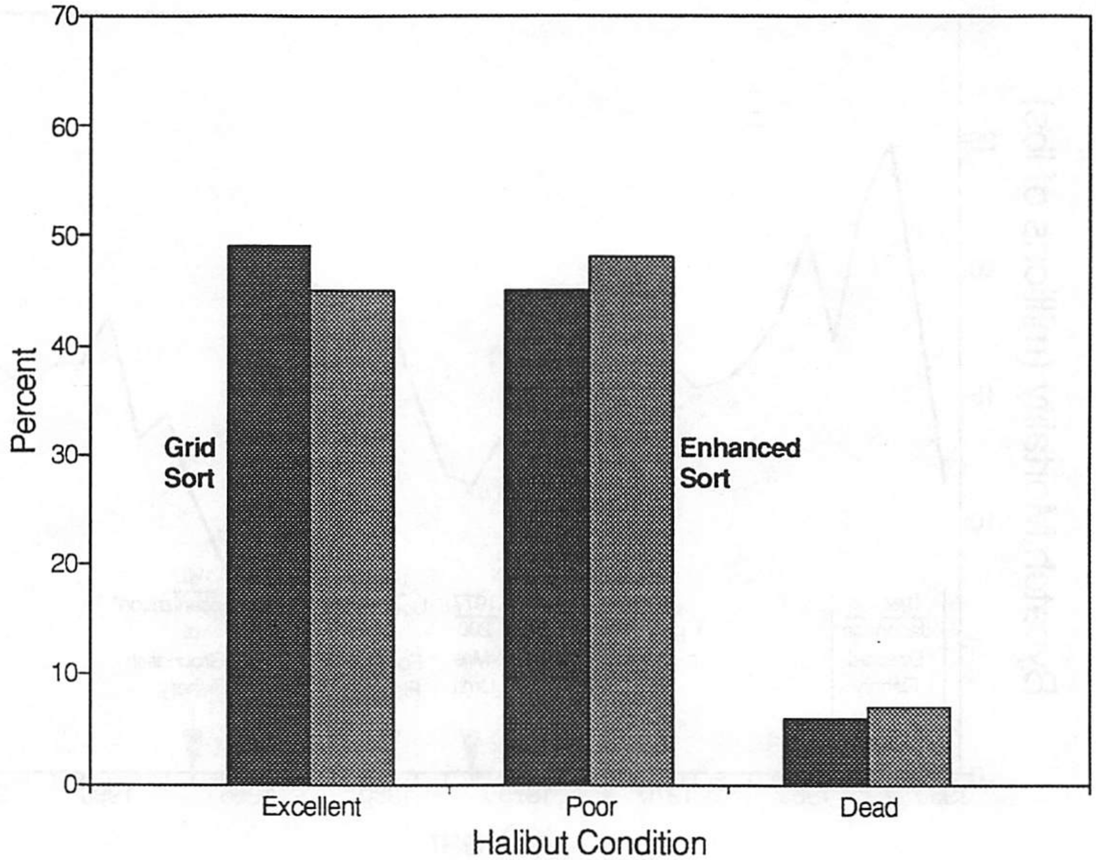

Figure 3.3. Condition factors for halibut sorted on deck and for the first 20 minutes in the factory.

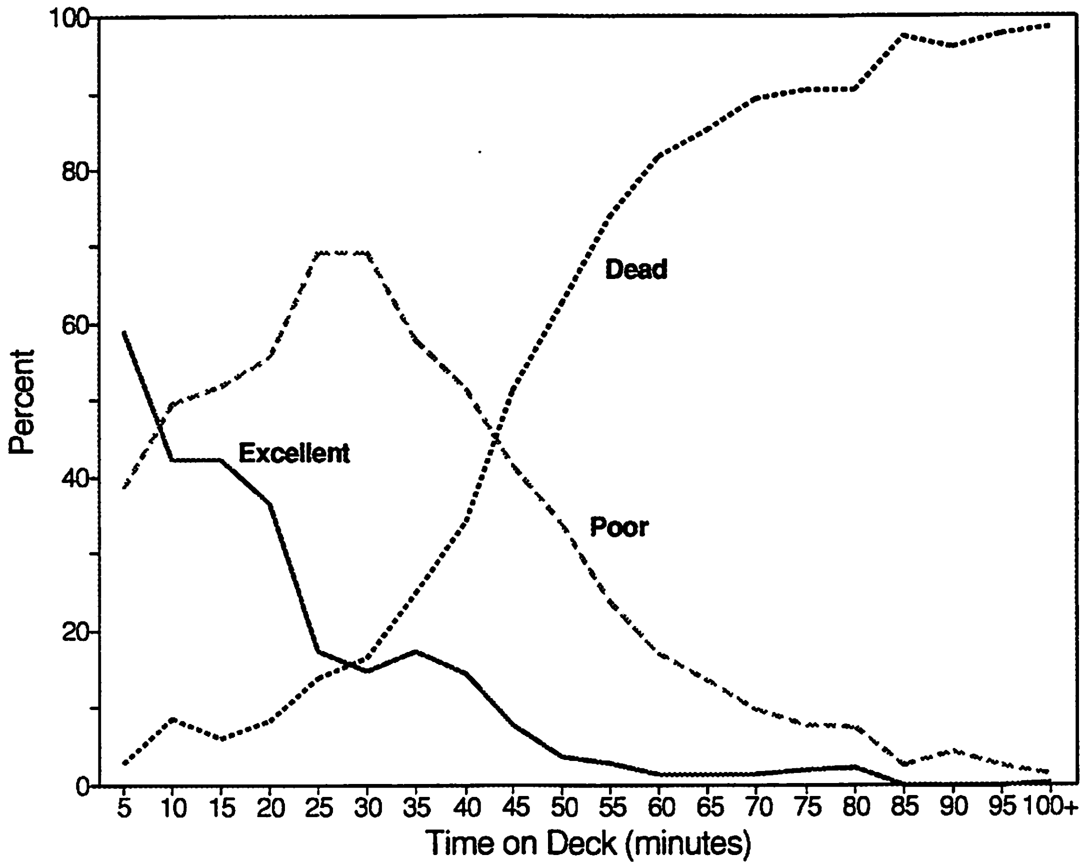

Figure 3.4. Change in condition factor over time for halibut sorted in the factory.

Appendix 1

Methods to Improve Survival of Pacific Halibut Bycatch Discarded From a Factory Trawler[1]

By

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May 27, 1994

INTRODUCTION

The International Pacific Halibut Commission (IPHC), the Highliners Association (with Natural Resource Consultants), and the National Marine Fisheries Service Alaska Fishery Science Center (AFSC) conducted an experiment to evaluate methods of increasing survival of discarded halibut bycatch from bottom trawls. The experiment involved sorting and discarding halibut from the groundfish catch more rapidly than is now current practice, and estimating the savings in halibut discard mortality rates. The experiment took place aboard the F/T *Northern Glacier* from October 6 through 29, 1993.

Halibut are caught as bycatch by most gear types used in North Pacific groundfish fisheries, but the majority are taken by trawls, especially those targeting on Pacific cod. Bycatch mortality could be reduced by improving survival and several methods have been suggested to accomplish this goal. One way would be to sort the halibut from the catch on deck, before groundfish and halibut are dumped into the below-deck holding tanks. A screen or grid has been suggested as a means of filtering halibut, particularly larger halibut, from the catch. Another possibility is to improve the sorting methods used in the factory, in a manner that returns halibut to the sea more quickly than is currently practiced. Termed Enhanced sorting, this practice could improve survival for the smaller fish that had previously passed through the grid. This experiment was designed to address these issues.

OBJECTIVES

The experiment involved sorting and discarding halibut from the groundfish catch more rapidly than is now current practice, and estimating the savings in halibut discard mortality rates.

The experiment addressed the following questions:

1) What percent of the total halibut bycatch can be screened by the grid?

2) What percent of the total halibut bycatch can be sorted during the period of Enhanced sorting?

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[1]This is the first of two reports presenting analytical results. The second report, containing results of additional, more extensive analysis, will be completed and available in the fall of 1994.

3) What is the survival rate of halibut discarded from the grid screening and the Enhanced sorting, compared to normal discards?

4) How much additional operating time accrues from the sorting procedures?

5) Will grid screening or Enhanced sorting increase overall survival of halibut bycatch from trawls?

Specific objectives were:

1) Determine the sorting capability of a grid or screen placed over the deck opening to the factory holding tanks.

2) Determine if overall halibut mortality is reduced by sorting large halibut out on deck and immediately returning them to the sea.

3) Determine if halibut mortality is reduced by "speed sorting" of bycatch from the groundfish in the factory.

EXPERIMENTAL DESIGN

The vessel targeted Pacific cod in a normal commercial manner over the full 24-hour period. The experiment focused on the bottom trawl Pacific cod fishery because it is allotted the greatest portion of halibut bycatch in the Bering Sea trawl fisheries. The vessel operated primarily in the Bering Sea (NMFS areas 517 and 521) and, to a lesser extent, on Sanak Bank in the Gulf of Alaska. Considerable exploratory fishing occurred in an attempt to find areas of good groundfish fishing with moderate amounts of halibut bycatch. Two NMFS observers, one supplied by the vessel and one by the AFSC, determined halibut viability from each haul and sampled the groundfish catch on most hauls.

Two specific experiments were conducted. The first experiment (the Grid Sorting Experiment) evaluated two improved methods of sorting halibut from groundfish against a Control method. For many factory layouts, halibut and other prohibited species and discards transit a series of conveyor belts to reach the exit chute. In some cases, 45 minutes or more may elapse for the discards to move from the hold to the exit chute. We considered this procedure for handling discards to be the Control method. The second experiment (Live Tank Holding) examined the relative survival of halibut within the established condition categories of excellent, poor, and dead.

For the Grid Sorting Experiment, three treatments were performed: (1) deck sorting with a grid; (2) enhanced sorting of the catch in the factory; and (3) normal sorting in the factory (the control). On the *Northern Glacier*, a single, short conveyor led from the hold to the exit chute. Retained fish were selected from the conveyor, and all else remained on the belt to be discarded. The regular procedure on the *Northern Glacier* was designated the Enhanced treatment, while the control treatment was simulated by delaying processing for 45 minutes. Thirty hauls for each treatment were conducted, for a total of 90 hauls. We randomized the order of treatments. Other factors monitored were tow duration, haul size, time on deck, and fish size.

The Live Tank Holding Experiment was conducted to test relative differences in survival of the three condition categories. Halibut sorted from the catch on deck and in the factory were placed in holding tanks with running seawater for 72 hours until near the end of the trip, when holding time was reduced to about 12 hours. Approximately 20 halibut at a time were selected for placement into a tank.

The first four hauls on the first fishing day were used to set up specific sampling procedures, and the first haul tested appropriate grid dimensions. The two grids examined (Figure 1) were (1) 9 inches by 11 inches and (2) 11 inches by 14 inches. These were based on an even division of the deck opening, the first yielding a grid 3 openings deep and 6 wide. The second provided 2 openings deep by 6 wide. The vessel had on-board welding equipment to modify the grid dimensions, which proved to be unnecessary.

Tow duration was not predetermined, but two duration strata of ≥ 3 hr and < 3 hr were established. The distribution of tow times was adjusted so that equal numbers of short and long hauls occurred for each treatment.

While no limit was set on the catch of groundfish or halibut, the following quantities of fish were anticipated to be caught:

Pacific cod	1,500 mt
Groundfish other than Pacific cod	700 mt
Pacific halibut	less than 50 mt

The vessel was allowed to retain, process, and sell the groundfish caught. Only the traditional prohibited species (crabs, salmon, halibut, herring) were required to be discarded.

DATA COLLECTION

Grid Sorting Experiment

During this experiment, data on length (cm), condition factor (excellent, poor, or dead) observations, and time of observation from the net coming on board were collected from each halibut encountered. NMFS observers conducted basket sampling to define the groundfish catch and determined halibut condition, so that these data are consistent with data collected in commercial fishery situations. During the second half of the cruise, the amount of time required to empty the codend of fish ("dumping time") was also recorded.

A schedule of the treatment for each haul alerted the bridge and the factory so that hauls could be made with factory processing capacity available. As each codend came on board, a biologist started a stopwatch; time of each halibut was recorded to the nearest minute. The observer and the skipper each estimated the groundfish catch. For grid sort treatments, the grid was placed over the hold, the deck crew grabbed halibut prior to the hatch and on the grid, and passed them to biologists for measurement and viability determination by the observer. When deck sampling was completed, the biological team moved to the factory where length, viability and time data were collected for all remaining halibut. For enhanced and control treatments, the sampling process started in the factory. Enhanced treatments started processing groundfish and sorting halibut quickly after dumping to the hold, while control treatments started processing 45 minutes after dumping to simulate the time needed for halibut to transit the factory to the exit chute typical of most trawl vessel factory layouts.

Live Tank Holding

Three specially-constructed deck-mounted holding tanks, each about 80 square feet by 36 inches high, with seawater circulation, an inside lip, dump door, and water overflow sump were used for holding halibut. Originally, only halibut sorted on deck were scheduled for these tanks, but halibut sorted out from the factory were also placed in these tanks when the factory tanks proved impractical. Initially, halibut collected from the factory were held in one or two 4'x4'x15' holding bins fed with circulating water. Water flow rates exchanged bin volumes about once per hour. Unfortunately, water jets in the holding bins, designed to lubricate large volumes of dead fish flowing to an exit, churned the water significantly, greatly diminishing survival. Halibut from the factory were carried as quickly as possible to the holding tanks on deck.

When a fish was selected for holding, a round, uniquely-numbered ID tag was placed on the tail using a nylon electrical tie. Selected fish were measured, condition factor assessed, and ID number noted on a form. Halibut were released after three days, and date and time of release, ID number, and condition noted on a separate form.

RESULTS

Groundfish and Halibut Catch

Ninety five hauls made during the experiment included four test hauls, one invalid haul caused by a ripped net, and the ninety hauls specified in the experimental design (Appendix Table 1). Catch weight ranged from about 5 mt to 35 mt per haul, but most were in the 10 to 15 mt range. The experimental hauls were divided into 30 hauls for each treatment, and the hauls of each treatment partitioned equally among $<$ 3 hr and $\geq$ 3 hr tows. Groundfish harvest totalled 1,189 mt, of which the retained portion was 243 mt of Pacific cod and 496 mt of pollock. The remaining 450 mt, mostly arrowtooth flounder, other flatfish, and Atka mackerel, were discarded. The total catch of Pacific cod was significantly below the anticipated catch of 1,500 mt, but pollock and discarded groundfish somewhat exceeded the 700 mt anticipated for other groundfish.

The number of halibut caught reached 13,887, at an estimated weight of 38,000 kg (2.75 kg/halibut). Approximately equal numbers of halibut were caught in each of the three treatments, with 4,714 in the grid sorting, 4,244 in the control sorting, and 4,903 in the Enhanced sorting (Table 1). The halibut bycatch rate was 32 kg/mt. Bycatch rates in numbers of fish were higher than expected, but the total quantity of halibut bycatch was less than the anticipated maximum of 50 mt. Had the anticipated 2,200 mt of groundfish been harvested, halibut catch would have reached approximately 70 mt.

Deck Sorting of Halibut Bycatch

In the grid sorting, 1,927 halibut (41%) were collected on deck. The larger sizes of halibut sorted on deck put the proportion of deck-sorted halibut at 52% by weight. At levels of 100 halibut or higher per tow, the sorting proportion remained about 40%, while sorting proportions were highly variable at lower numbers (Figure 2).

The grid selected for use, although the smaller of the two available, did not directly filter out many of the halibut. The high proportion of deck-sorted halibut was due to the slower rate of dumping catch from the cod end to the hold, and the opportunity for the deck crew to sort out halibut pouring from the cod end to the hatch. Sorting efficiency by the deck crew increased as the cod end was placed further forward from the hold. About 3 to 4 m seemed an efficient distance, as halibut passed too quickly past the sorters at shorter distances. Time required to dump a cod end after the net came on board normally ranged from about 90 seconds to 2½ minutes, while a grid sort took about 7 to 15 minutes to dump. Dumping time tended to increase with increased catch (Figure 3), but the relationship was stronger with grid-sorted catches (r^2=0.67) than for catches not sorted through the grid (r^2=0.30). The deck crew would slow down dumping if more halibut appeared, but let the fish pour across the deck if halibut were not visible.

The ability to sort halibut on deck is dependant upon being able to find the halibut as the catch is being dumped. Larger halibut are more easily spotted and captured than small halibut (Figure 4). For example, only 15% of the halibut less than 39 cm (0.6 kg, or 1-pound fish) were sorted on deck. The proportion at 50% or greater was not reached until roughly 65-70 cm (3-4 kg).

The size distribution of halibut in the bycatch has implications on the effectiveness of grid sorting requirements for various fisheries. Those fisheries with small (<50-60 cm) halibut may not gain much halibut survival by grid sorting, unless slower dumping speeds or smaller grid dimensions are practical to reach the level of deck sorting experienced in the experiment. The size distribution of halibut bycatch varies substantially by fishery (Figure 5) and the size distribution of the sorted halibut (Figure 6) only slightly overlaps the observed size distribution for several of the fisheries.

Halibut Viability

All halibut caught were examined for condition (excellent, poor, or dead) by one of two NMFS observers, using the same criteria as employed by NMFS fishery observers.

The number of halibut by condition category and calculated discard mortality rate for each treatment is summarized in Table 2. Halibut were in the best overall condition when sorted on deck, as was expected, with the percentage of halibut judged to be in excellent and poor condition similar. Halibut in dead condition were infrequently seen. Condition factor (Figure 7) and calculated survival of halibut sorted on deck were improved over the values from observer data in the 1992 Pacific cod trawl fishery in the Bering Sea. Once the fish were dumped below deck, the condition worsened considerably. The calculated discard mortality rates for halibut sorted in the factory were higher than the 60% rate used by NMFS in the Bering Sea/Aleutian Islands bottom trawl pollock and cod fisheries, and the combined deck mortality and factory mortality of the grid sorted halibut were comparable to the NMFS rate.

Only 9% of the halibut caught in enhanced sort tows were in excellent condition, much lower than the grid sort tows. This was much lower than expected, considering that sorting and discard began as soon as the catch was below deck. Halibut in control sort tows were in worse condition yet, illustrating the benefits that can be gained by sorting and discarding the catch as soon as is possible, rather than letting the catch sit in holding tanks or spend time travelling through the factory. In this experiment, enhanced sort and control sort tows had discard mortality rates 15% and 30% higher, respectively, than the grid sort tows.

For enhanced sorting or grid sorting in the factory, the majority of the halibut were in poor condition for about the first 40-50 minutes after the net came on board (Figure 8). Only a few excellent and dead halibut were noted. For control sorting and for enhanced or grid sorting after about 40-50 minutes, nearly all halibut were in dead condition, with occasional poor and the rare excellent halibut.

Live Tank Holding Experiment

Holding tank experiments did not provide as much useable data as anticipated, because of situations with high mortality of halibut in the tanks. Bleeding tanks in the factory did not work because the water flow system churned the water and severely disturbing the halibut. A sloped floor in the bleeding tanks that prevented halibut from resting without piling up may have also contributed to the mortality. Of three tanks on deck, only one provided consistent data. The best tank was nearly square, while the other two were long and narrow. Vessel movement caused traveling waves in the narrow tanks that disrupted the halibut. In cases of prolonged rough weather, nearly all halibut died, regardless of initial condition factor.

A total of 281 halibut from 17 hauls were placed in the live tanks for the standard three day holding period. Seventy-nine more from four hauls were held for 12 hours. Nine hauls of the long holding period were from grid sort hauls, three from control sort hauls, and five from Enhanced sort hauls. Three hauls from the short holding period were grid sort, and one was an Enhanced sort. Good to moderate weather occurred during the three-day holding period for 9 of the tows, representing 134 halibut. Of the total excellent, poor, and dead condition halibut placed in the tank for the longer holding period, 77%, 43%, and 3%, respectively, survived[2]. Of the halibut held during good or moderate weather, the comparable survival values were 93%, 67%, and 4%, respectively.

DISCUSSION

The experiment aboard the *Northern Glacier* was designed to simulate as close as possible the fishing practices of the bottom trawl fishery for Pacific cod. For the most part, this effort seemed very successful. However, several differences occurred. The experiment occurred in October, a time period that has not been fished for Pacific cod in many years. The location of fishing may not have been where a commercial fishery would operate at that time, in spite of extensive exploration of the grounds in the Bering Sea and Gulf of Alaska. The crew was very aware of the nature of the operations and the emphasis on improving survival of discarded halibut. We could not evaluate if the crew acted in different manner than would have occurred in the absence of the scientific party. The experimental design had originally intended for the treatment order to be unknown to the Captain prior to haulback, but this was abandoned. It was necessary to coordinate with the factory to keep product available, but without overwhelming the holding capacity. Observers collected data from the start to the finish of every haul, and condition factor was collected for each halibut. As a result, the distribution of halibut conditions factors during the experiment may be somewhat different from the distribution collected periodically through the haul.

The overall discard mortality rate of 66% for the grid sorting is about the same as the discard mortality rate currently used by NMFS for the Bering Sea Pacific cod fishery. There is no clear explanation for this difference. However, the relative rates for the three experimental treatments, and the pattern of mortality over time demonstrate the advantage of quickly returning halibut to the sea. While these results may not be directly applicable to the normal Pacific cod or bottom trawl pollock fishery, we conclude that discard mortality rates in these fisheries will decline 25-50% on factory trawlers that practice grid sorting. Experience and learning through continued use of grid sorting may well enable the deck crew to sort out a higher proportion of halibut than was the case for the crew of the *Northern Glacier*.

The holding experiment provided less information than expected, but did demonstrate that survival of halibut in the dead condition is possible. In addition, the survival of halibut held during all weather conditions was similar to the survival rates used by IPHC to determine discard mortality rates (80% for halibut in excellent condition, 45% for poor, and 10% for dead), but we consider the number of halibut to be minimal at best. The number of halibut held during periods of good and moderate weather was too low to draw quantitative conclusions on survival for condition factors, but clearly indicate the importance of research to improve the definition of condition factors and to develop new methods of estimating discard mortality rates.

SUMMARY

Ninety hauls equally divided among three sorting treatments provided 13,861 halibut for which condition factor, length, and time on deck were collected. On-deck sorting provided the highest survival, and control sorting caused the most mortality. Pollock and Pacific cod made up the retained catch. About 62% of the total groundfish catch was retained, and the remaining 38% was discarded. At 32 kg/mt, the halibut bycatch rate was higher than expected.

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[2]In this case, "survival" is defined as being in *either* excellent or poor condition at the end of the holding period.

Each of the experimental treatments increased halibut survival compared to the control. Deck sorting with the grid resulted in the best survival. Halibut sorted and discarded from the deck had an estimated discard mortality rate of about 40%. The over all grid sort discard mortality, including halibut discarded from the factory, was 66%. Enhanced sorting had a mortality of 76% compared to the control rate of 87%.

Holding tank experiments were less successful than anticipated. Tanks in the factory could not be used because of excessive mortality caused by tank design, and periods of rough weather caused mortality not related to condition factor in two of the three deck tanks. Periods of good weather during several holding periods permitted useable data from several hauls. The limited useable data suggested that survival of halibut in the dead condition is possible. In addition, the limited results closely resembled the survival rates used by IPHC in discard mortality rate studies.

Table 1. Preliminary catch totals of Pacific halibut during the 1993 Bycatch Sorting Experiment.

Treatment/ Location	**Numbers of halibut**		**Weight of halibut**		**Average Weight (kg)**
	No.	**%**	**kg**	**%**	
Grid Sort					
Deck	1,926	40.5	5,988	52.0	3.11
Factory	2,828	59.5	5,521	48.0	1.95
Overall	4,754	34.3	11,509	34.3	2.42
Enhanced Sort	4,903	35.3	12,437	37.1	2.54
Control Sort	4,214	30.4	9,575	28.6	2.27
Total	13,871	100.0	33,521	100.0	2.42

Table 2. Summary of halibut viability by sorting method, and calculated discard mortality rate.

Treatment/ Location	**No. of halibut**	**% Exc**	**% Poor**	**% Dead**	**Calculated Disc. Mort. Rate (%)**
Grid Sort					
Deck	1,926	45	48	7	42
Factory	2,828	3	14	83	83
Overall	4,754	20	28	52	66
Enhanced Sort	4,903	9	22	69	76
Control Sort	4,213	1	7	91	87

Appendix Table 1. Preliminary catch totals during 1993 Halibut Bycatch Survival/Sorting Study. Codes for treatment are CL=Control, ES=Enhanced Sort, and GS=Grid Sort. Haul 590 was considered invalid.

Date	Haul No.	Treatment	Number of Halibut Deck	Number of Halibut Factory	Number of Halibut Total	Cumul. Total	Live Tank	Cumul. Total
07-Oct	567	Test	20	n/a	20	20	-	-
	568	Test	88	173	261	281	-	-
	569	Test	105	n/a	105	386	-	-
	570	Test	66	n/a	66	452	-	-
08-Oct	571	GS	182	178	360	360	0	0
	572	CL	0	37	37	397	0	0
	573	ES	0	9	9	406	0	0
09-Oct	574	CL	0	13	13	419	0	0
	575	ES	0	57	57	476	0	0
	576	GS	94	38	132	608	14	14
	577	GS	41	23	64	672	7	21
	578	CL	0	68	68	740	4	25
10-Oct	579	ES	0	58	58	798	0	25
	580	CL	0	53	53	851	0	25
	581	GS	24	4	28	879	6	31
	582	ES	0	64	64	943	0	31
11-Oct	583	GS	60	14	74	1,017	0	31
	584	ES	0	8	8	1,025	0	31
	585	CL	0	29	29	1,054	0	31
12-Oct	586	ES	0	65	65	1,119	0	31
	587	CL	0	6	6	1,125	0	31
	588	GS	12	4	16	1,141	3	34
	589	CL	0	55	55	1,196	0	34
13-Oct	590							
	591	GS	53	9	62	1,258	15	46
	592	ES	0	69	69	1,327	13	59
	593	GS	2	37	39	1,366	0	59
14-Oct	594	ES	0	96	96	1,462	0	59
	595	CL	0	79	79	1,541	0	59
	596	ES	0	50	50	1,591	0	59
15-Oct	597	CL	0	2	2	1,593	0	59
	598	GS	4	6	10	1,603	0	59
	599	CL	0	54	54	1,657	0	59
	600	GS	2	25	27	1,684	0	59
	601	ES	0	52	52	1,736	0	59
16-Oct	602	GS	45	55	100	1,836	22	81
	603	ES	0	85	85	1,921	19	100

Table 1. (continued)

Date	Haul No.	Treatment	Number of Halibut: Deck	Factory	Total	Cumul. Total	Live Tank	Cumul. Total
17-Oct	604	CL	0	145	145	2,066	21	121
	605	ES	0	143	143	2,209	0	121
	606	CL	0	123	123	2,332	0	121
18-Oct	607	GS	32	109	141	2,473	0	121
	608	CL	0	27	27	2,500	0	121
	609	GS	111	116	227	2,727	0	121
	610	ES	0	479	479	3,206	0	121
	611	CL	0	172	172	3,378	0	121
	612	ES	0	196	196	3,574	0	121
19-Oct	613	GS	107	242	349	3,923	0	121
	614	ES	0	160	160	4,083	0	121
	615	GS	72	122	194	4,276	47	168
20-Oct	616	CL	0	118	118	4,394	0	168
	617	CL	0	149	149	4,543	19	187
	618	GS	52	113	165	4,708	0	217
21-Oct	619	ES	0	87	87	4,795	23	210
	620	GS	54	93	147	4,942	0	210
	621	CL	0	519	519	5,461	0	210
22-Oct	622	ES	0	107	107	5,568	0	210
	623	ES	0	119	119	5,687	0	210
	624	CL	0	272	272	5,959	0	210
	625	GS	68	125	193	6,152	15	225
	626	CL	0	191	191	6,343	0	225
	627	GS	19	13	32	6,375	0	225
23-Oct	628	ES	0	252	252	6,627	0	225
	629	GS	74	109	183	6,810	0	225
	630	ES	0	139	139	6,949	0	225
	631	CL	0	134	134	7,083	0	225
	632	ES	0	136	136	7,219	17	242
24-Oct	633	CL	0	214	214	7,433	0	242
	634	GS	139	227	366	7,799	0	242
	635	CL	0	201	201	8,000	0	242
	636	GS	80	144	224	8,224	0	242
	637	ES	0	221	221	8,445	19	261
	638	GS	82	186	268	8,713	0	261
25-Oct	639	ES	0	313	313	9,026	0	261
	640	CL	0	255	255	9,281	0	261
	641	ES	0	232	232	9,513	0	261
	642	CL	0	108	108	9,621	0	261
	643	GS	43	68	111	9,732	19	280
	644	CL	0	263	263	9,995	0	280

Table 1. (concluded)

Date	Haul No.	Treatment	Number of Halibut: Deck	Factory	Total	Cumul. Total	Live Tank	Cumul. Total
26-Oct	645	GS	97	174	271	10,266	0	280
	646	ES	0	273	273	10,539	0	280
	647	GS	37	107	144	10,683	0	280
	648	CL	0	187	187	10,870	0	280
	649	ES	0	163	163	11,033	0	280
27-Oct	650	ES	0	260	260	11,293	0	280
	651	CL	0	158	158	11,451	0	280
	652	GS	146	167	313	11,764	18	298
	653	CL	0	44	44	11,808	0	298
	654	GS	42	75	117	11,925	0	298
	655	ES	0	99	99	12,024	0	298
	656	GS	51	61	112	12,136	19	317
28-Oct	657	ES	0	281	281	12,417	0	317
	658	CL	0	351	351	12,768	0	317
	659	CL	0	207	207	12,975	0	317
	660	ES	0	630	630	13,605	22	339
	661	GS	99	183	282	13,887	20	359

Appendix 2

DRAFT

BYCATCH TEAM SUMMARY

March 11, 1992

I. COUNCIL DIRECTION FOR THE 1992 FMP AMENDMENT CYCLE.

At its January 1992 meeting, the Council directed staff to analyze the following seven management measures.

1. Establishment of 1993 halibut bycatch limits in the BSAI to address the scheduled 1992 sunset of the 5,033 mt trawl cap (which will revert back to 5,333 mt) and the 750 mt mortality limit for non-trawl gear.

    a. As part of the analysis on BSAI bycatch limits, staff (IPHC) will develop alternatives for mortality accounting of the BSAI trawl halibut limit.

    b. The alternative of authorizing changes to BSAI PSC limits through the regulatory amendment process, rather than FMP amendment process, will be analyzed.

2. Extend the sunset date for the king crab protection zones near Kodiak Island.

3. Improve chinook salmon bycatch management measures in the BSAI.

4. Prohibit bottom trawling adjacent to the Pribilof Islands.

5. Use individual bycatch quotas to allocate PSC limits among individual fishing operations.

6. Authority to preferentially allocate BSAI Pacific cod to fixed gear fisheries.

7. Close the Eastern Gulf east of 140 ° W. Longitude to trawl gear.

Because the first five measures principally address bycatch issues, they will be analyzed by the Bycatch Team. Of these, the first four measures will be included in a draft EA/RIR that will be prepared for the April 1992 Council meeting. The fifth measure will be more fully developed for the April meeting but probably will not be part of draft EA/RIR.

Because the sixth and seventh measure are not principally address bycatch issues, they will be analyzed by the Bycatch Team. A draft EA/RIR for Eastern Gulf closure is being prepared for the April meeting. The analysis of the cod allocation has begun, but the draft EA/RIR is not expected to be ready by the April meeting.

II. Justification for Regulatory Intervention

The Team prepared the following statement concerning the justification for current and future regulatory intervention to control bycatch in the groundfish fishery.

The total cost of bycatch includes: (1) benefits foregone from the species taken as bycatch; (2) the total cost of actions taken by groundfish fishermen to reduce bycatch (e.g., increased harvesting costs and foregone catch); and (3) agency costs associated with bycatch management. In the absence of any bycatch management measures, the total cost of bycatch will be too high, the levels of bycatch will be too high, the actions taken by groundfish fishermen to control bycatch will be inadequate, and the total cost will be borne principally by those who benefit from catch in the other fisheries. This is because, without regulatory intervention, groundfish fishermen bear much of the cost of controlling bycatch but do not receive the benefits. Therefore, some actions to control bycatch that would provide positive net benefits to society are not taken because, for the fisherman who decides what actions to take, the costs exceed the benefits. More succinctly, fishermen are making the wrong decisions from society's perspective because there are external benefits and costs. Therefore, regulatory intervention can increase the total benefits derived from the fisheries.

III. Goals and Objectives of Bycatch Management

The Team prepared the following goals and objectives statement.

The goal of bycatch management is to reduce bycatch to the level beyond which further reductions would be expected to increase the total cost of bycatch by preventing the groundfish OYs from being taken in a cost effective manner.

In interpreting this goal, costs are as broadly defined as is appropriate given the biological, conservation, and socioeconomic goals and objectives of the FMPs, the MFCMA, the Halibut Act, Federal law, and international treaties. The costs include those associated with: (1) not meeting conservation objectives; (2) disrupting and displacing traditional fisheries; (3) foregone catch; (4) decreased product prices; (5) increased harvesting and processing costs; and (6) waste.

The objectives of bycatch management are listed below.

1. Prevent overfishing and maintain the long term viability of the stocks.

2. Provide the groundfish fishery with incentives and the freedom to develop and use effective and efficient methods of reducing bycatch mortality.

3. Use bycatch management measures that minimize the cost of attaining specific reductions in bycatch mortality.

4. Improve our ability to estimate bycatch mortality and its effects.

5. Assist the groundfish fishery in identifying effective methods of reducing bycatch rates and discard mortality rates for all species.

IV. Definitions of Terms

In order to facilitate discussion of the issue and to avoid one potential source of confusion, the Team will be using the following definitions of commonly used terms.

Bycatch:	Any species, size class, or sex of fish and shellfish that a fisherman catches inadvertently under the current regulatory or economic environment.
Bycatch Mortality:	Any inadvertent fishing mortality.
Target fishery:	A management definition for regulatory use and enforcement purposes that categorizes the aggregate activity of a fishing vessel during a fishing trip.
Cost:	Costs are expressed as the opportunity value foregone or alternate use of the resource. This is not just monetary expenditures made by operators. Components of cost could include use of time, effort, money, etc that reflect their foregone value. The measurements would be compatible with the types of costs listed in Section E.
Benefit:	Benefits reflect the total private and public value or use gained from the resource. Again this is not necessarily limited to actual monetary expenditures.
Total Bycatch Cost:	The total cost of bycatch is the sum of the impact, control, and agency costs of bycatch.
Impact Cost:	Bycatch impact cost is the benefit foregone due to bycatch mortality. For example, it includes foregone benefits to halibut fishermen as the result of halibut bycatch mortality.
Control Cost:	Bycatch control cost is the total cost of actions taken by groundfish fishermen to reduce bycatch. It includes increased harvesting costs and the decrease in benefits to groundfish fishermen associated with foregone groundfish catch.
Agency Cost:	Bycatch agency cost is the cost borne by management agencies as the result of bycatch management.

Additional terms will be defined as is necessary.

V. Characteristics of a Comprehensive Long-Term Solution to the Bycatch Problem for the Groundfish Fishery

To provide a better understanding of what is meant by a comprehensive long-term solution to the bycatch problem for the groundfish fishery and to prevent false expectations concerning such a solution, the Bycatch Team prepared the following statement.

The following are among the characteristics of a comprehensive long-term solution to the bycatch problem.

1. It is based on a well defined problem and goal.

2. It addresses the source of the problem, not just the symptoms.

3. It provides the flexibility required to:

    a. be extended readily to other bycatch species and fisheries and

b. remain effective as biological and economic conditions change and as fishing operations respond to the bycatch management measures.

4. It is based on achievable data and information requirements.

5. It may be developed and implemented in stages so that the existing bycatch management measures can be supplemented or replaced gradually if necessary.

6. It will be constrained by a number of factors including:

   a. funding and staffing,

   b. the MFCMA, other laws, and international treaties. and

   c. the race for fish associated with open access fisheries.

7. It will have consistent bycatch management measures among areas, gear types, user groups, and species unless differences are justified.

8. It will maximize the net benefits that accrue to the nation from actions taken to control bycatch. The Council and Secretary must decide how to weight various benefits and costs. The weights given to different benefits and costs determine the net benefits of various alternatives. The benefits include reductions in the types of costs identified in the goal statement (Section E).

VI. Process for Selecting Short and Long-Term Alternatives

The Team recommends that the statements concerning the goal and objectives and the characteristics of a comprehensive long-term solution to the bycatch problem for the groundfish fishery be used to identify tentative solutions and that the list of measures to be considered then be narrowed based on feasibility with respect to:

1. time,
2. resources,
3. data,
4. legal issues, and
5. other constraints.

The severity of the problem a measure addresses should also be considered.

VII. Key Issues to be Resolved for IBQ Programs

Technical/Legal Issues

1. Can the observer program provide adequate estimates of absolute bycatch or bycatch mortality by operation for a fishing year as a whole for vessels with 100% observer coverage? Such estimates would be extrapolations from sampled hauls. Is an affirmative answer more likely if the lower bound of the confidence interval rather than the point estimate of bycatch is used, if the regulations say what will happen on the basis of estimated bycatch as opposed to actual bycatch and if the method of

estimation is specified clearly, if there is an industry advisory body to assist with appeals, and if through the permit process there is implied consent to being held accountable based on a specified estimation procedure. If the first answer is no, there is a fatal flaw for both types of programs and the rest of the issues are irrelevant.

1a. If the procedures for estimating bycatch are specified clearly, is there a limited time during which the procedures can be challenged, after which the only legal challenge is whether the procedures were followed?

2. Can a vessel with less than 100% observer coverage be held accountable for its bycatch or bycatch mortality based on the best available estimate of its bycatch? The considerations listed for item 1 also apply to this question. Does it matter if each vessel has the option of having 100% observer coverage, although perhaps at its own expense?

Policy/Equity Issues

1. Should vessels be exempted from the IBQ program when they do not have observer coverage?

2. Will the size of the PSC limits be addressed?

3. What will be the basis for allocating IBQs? The industry needs to be involved in this.

Implementation Issues

1. What additional monitoring/administration systems and resources are required by an IBQ program?

2. What changes in the observer program are required by an IBQ program?

3. If recommended by the Council, how long will it take to implement an IFQ program?

VIII. IBQ Options Discussed at February 13 Bycatch Team Meeting

1. The IBQ program will supplement not replace the existing bycatch management regimes for the BSAI and GOA groundfish fisheries.

    a. The existing PSC limits will be used.

    b. The existing PSC limit allowance group fisheries will be retained unless the initial allocation of IBQs makes this unnecessary.

    c. Retention of PSC species will continue to be prohibited.

    d. The existing time/area closures will be retained.

    e. The existing vessel incentive programs will be replaced with the IBQ program.

2. The IBQ program will apply to:

   2.1 all species for which there are PSC limits or

   2.2 just halibut.

3. IBQs will be transferable at a price determined by:

   3.1 the market or

   3.2 the Council/NMFS.

4. IBQs will be distributed annually to:

   4.1 groundfish fishing operations or

   4.2 other fishing operations.

If they are given to groundfish fishermen:

   4.1.1 groundfish operations could earn IBQs during the year based on their groundfish catch and a predetermined bycatch rate standards or

   4.1.2 the IBQs could all be issued to individual operations prior to the start of each fishing year based on a formula that would be specified in the FMPs or regulations.

If they are given to other fishing operations (e.g., halibut fishermen), they could be distributed based on each operation's catch for the previous year.

IX. Additional Thoughts

If some of the legal issues are resolved in a way that suggests that an IBQ program is feasible, we may want to have a one-year experimental IBQ program only for halibut and perhaps only for the BS/AI and a limited number of fisheries.

Appendix 3

Appendix 3
Section 1

<u>Estimated effect of the grid sorting regulation on the number of hauls that an observer is able to sample:</u>

Time that the observer spends monitoring the dumping process and dealing with deck-sorted halibut will be subtracted from the time that the observer has to sample the catch for species composition, incidence of prohibited species, length composition of target species, and to conduct special projects and other observer tasks. To estimate the time required of the observer, and to estimate the expected effect of that on the number of hauls that an observer is able to sample, certain assumptions were made. We estimate it would take approximately 8 to 30 minutes to dump codends of various sizes through a grid into a hold. Although the observer would be measuring and checking the condition of halibut as it is sorted out during the dumping process, in most cases the observer would have to continue to sample the halibut after the codend dumping has been completed. It is estimated that, with cooperation of the crew, this should be able to be completed 5 to 10 minutes after the last of the catch is dumped.

Handling the data from the grid-sorted halibut would also consume observer time. Observers would have to record the data, transcribe it onto data entry forms, and convert the lengths to weights using the halibut length/weight table (or a computer program based on that table). These data would then need to be summarized by haul and transmitted either daily or weekly to NMFS in Seattle, along with the information on the factory-sorted halibut and the other in-season observer data. On vessels with COMSAT communications, the observers enter all of this information on a computer for transmission. The additional time involved is estimated to take 15 to 30 minutes per haul. The total estimated time per haul that the observer would spend as a result of this regulation is as follows:

monitoring of the codend dumping:	8 to 30 minutes
sampling after codend is dumped:	5 to 10 minutes
handling extra data:	<u>15 to 30 minutes</u>
	28 to 70 minutes

Table A.1 applies the above estimated reduction in sampling time to the average number of hauls per day that observers sampled in 1993, by fishery. The additional time/day column was calculated by multiplying the lower and higher (28 and 70 minutes, respectively) estimates of additional time per haul times the average number of tows sampled by fishery. No data exist on the amount of time that it takes to sample a tow in the various fisheries, so approximate figures were calculated by dividing an 8 hour day into the average number of tows that were sampled. (Some observers work much longer per day, some work less, depending on many factors.) The minimum/maximum additional time per day was then divided by the estimated time to sample a tow in that fishery to obtain the expected reduction in the number of sampled tows. The final column gives the range of the estimated reduction in the number of tows sampled per day due to the additional time that the observer would have to spend performing the extra tasks required by the proposed action. The above figures assume that at least some halibut will be sorted out on deck. If no halibut were in the haul, or if very few halibut were sorted out on deck, then the observer would still be spending the additional time for the monitoring of the haul, but it might take less than 5 minutes to finish on deck, and the time spent in handling the extra data would be reduced, so the percent reduction in the number of tows sampled could be lower than indicated.

Sampling will be impacted on a variety of vessel types. Observer sampling on catcher-processors is expected to be impacted the most by the grid-sorting requirement, resulting in reductions in the number of tows sampled. Whether observer sampling on catcher boats is impacted depends on the way in which fish are handled on the individual vessels, and where the observer elects to sample for species composition. Catcher boats operating in mixed-fish fisheries commonly sort out the catch on deck, putting only the desired target species below, thus those vessels would not be required to use a grid, and observer sampling would be unaffected. Catcher boats operating in the bottom trawl pollock fishery commonly dump the catch below with minimal sorting, so they would be required to use a grid and the observer would have to spend additional time on deck monitoring and handling the halibut and other species sorted out. Observers on these vessels in the Bering Sea commonly sample the deliveries at the processing plants, and only estimate haul size, monitor for marine mammal takes, and sample for pollock length frequencies at sea, therefore, they may be able to do the extra sampling work without impacting the rest of their work load. Other observers, especially those on pollock trawlers in the Gulf of Alaska, sample for species composition at sea, so the size of their samples may be reduced by a grid sorting requirement. There are also some catcher boats in the pollock and cod fisheries (at least 8 vessels) that dump the catch below deck and sort it there before delivering to a processor. On these vessels the observer samples where the catch is sorted, so the observer's workload would be affected in the same manner as if they were catcher-processors. For this reason, the estimated effect on the number of hauls per day is listed in Table A.1 for catcher boats in the bottom pollock and cod fisheries, although this would apply only to part of the fleet.

TABLE A-1. EXPECTED EFFECT ON THE NUMBER OF HAULS PER DAY AN OBSERVER IS ABLE TO SAMPLE

FISHERY	AVERAGE # TOWS/DAY	AVERAGE # TOWS SAMPLED	AVERAGE. % SAMPLED PER DAY	MINIMUM AND MAXIMUM ADDITIONAL TIME PER DAY (MIN)	ESTIMATED TIME TO SAMPLE TOW (MIN)	EXPECTED REDUCTION IN SAMPLED TOWS	% REDUCTION IN TOWS SAMPLED
Catcher Processors							
Bottom Pollock	4.6	2.6	57	73 ⟶ 182	185	.4 ⟶ 1.0	15 ⟶ 38%
Pacific Cod	4.2	2.5	60	70 ⟶ 175	192	.4 ⟶ .9	16 ⟶ 36%
Yellowfin Sole	4.4	2.5	57	70 ⟶ 175	192	.4 ⟶ .9	16 ⟶ 38%
Rock Sole	6.0	3.1	52	87 ⟶ 217	155	.6 ⟶ 1.4	19 ⟶ 45%
Atka Mackerel	3.6	2.3	64	64 ⟶ 161	209	.3 ⟶ .8	13 ⟶ 35%
Rockfish	4.4	2.4	55	67 ⟶ 168	200	.3 ⟶ .8	12 ⟶ 33%
Other flatfish	5.2	2.8	54	78 ⟶ 196	171	.5 ⟶ 1.1	18 ⟶ 39%
Motherships							
Pelagic Pollock	6.1	3.0	49	84 ⟶ 210	160	.4 ⟶ 1.3	13 ⟶ 43%
Catcher Boats							
Bottom Pollock	2.6	2.3	88	64 ⟶ 161	209	.3 ⟶ .8	13 ⟶ 35%
Pacific Cod	2.8	2.3	82	64 ⟶ 161	209	.3 ⟶ .8	13 ⟶ 35%

Appendix 3
Section 2

Alaska Fisheries Science Center
Resource Ecology and Fisheries
Management Division
Sand Point Way, Northeast
Bin C15700, Building 4
Seattle, Washington 98115-0070
September16, 1994 F/AKC2:MWD

MEMORANDUM FOR: Richard Marasco, Bill Karp

FROM: Martin Dorn

SUBJECT: The effect of a halibut grid regulation on the precision of observer program catch estimates

The Alaska Fisheries Science Center Observer program uses a multi-stage cluster sampling design to estimate the total catch. Vessels are the primary units. The first stage of sampling consists of the placement of observers on vessels. The hauls made by a vessel are the secondary units. The observer's selection of hauls to sample is the second stage of sampling. For hauls that are sampled using partial haul sampling or basket sampling, there is a third stage of subsampling. Since the replicate information is not retained from this level of sampling it is not possible to estimate its contribution to the total variance.

For this analysis, I used observer data from selected fisheries in 1991 that was extracted from NORPAC for an analysis of observer coverage submitted to the council in 1992. The data consists of observer data and catch estimates (between 120 and 147 vessel-weeks) for 1) a mid-water trawl pollock fishery, 2) a bottom trawl Pacific cod fishery, 3) a flatfish fishery (primarily yellowfin sole), and 4) a targeted rock sole fishery. By selecting a roughly equal number of vessel-weeks for each fishery it is possible to use the data as a standardized "yardstick" for comparing the precision of catch estimates in different fisheries. Standard errors increase with the square root of the number of vessels participating in a fishery, so a large-scale fishery would have more precise catch estimates than a smaller fishery with the same characteristics. For each fishery, I estimated the total catch, the 95% confidence intervals, and the margin of error. The margin of error is half the range of the 95% confidence interval divided by the estimate, and is a useful measure of precision for comparing catch estimates that differ widely. For example, a margin of error of plus or minus 10% means that, in repeated sampling, 19 times out of 20 the true value will be within plus or minus 10% of the estimated value. To estimate catches and their associated variances, a ratio estimator to total catch for a two-stage cluster sampling design was used (Cochran 1977, page 312-13). Confidence intervals were constructed assuming log-normal error (Burnham et al. 1987).

The variance of a catch estimate depends on both the level of first stage sampling (vessel coverage) and second stage sampling (haul sampling fraction). The level of first stage sampling varies from fishery to fishery. Regulations currently require 100% vessel coverage for vessels greater than 125 feet, and 30% coverage for vessels between 60 and 125 feet. Estimates of precision were calculated for 30%, 65%, and

100% first-stage sampling fractions (vessel coverage). Most fisheries are made up of a mix of 30% and 100% vessels, so a level of 65% first-stage sampling is typical of groundfish fisheries in Alaskan waters, while 30% and 100% first-stage sampling are the low and high extremes.

The fraction of hauls sampled also varies considerably from fishery to fishery. For the data that I have available, the second stage sampling fraction ranged from a low of about 40 percent for the rock sole fishery to a high of about 65% for the pollock mid-water fishery.

A halibut grid regulation would affect the precision of catch estimates by reducing the level of second stage sampling. It is difficult to say with certainty by how much the second stage sampling would be reduced if there were a halibut grid regulation. The proposal has not been finalized, and the required amount of information collected on pre-sorted halibut will affect the observer workload. A reasonable guess would be that there would be a reduction of 5-10 percentage points from current levels. In Tables 1-4, estimates of precision are given for the current level of second-stage sampling, and for second-stage sample fractions 5 and 10 percentage points below that level. A halibut grid regulation would affect each fishery differently. For a midwater trawl pollock fishery, with low halibut bycatch rates, the increase in observer workload should be minor. For fisheries with high halibut bycatch rates, such as the Pacific cod bottom trawl fishery and the rock sole fishery, the amount of additional work required to sample a haul could be significant.

Summary of results: The statistics reported in Tables 1-4 are 1) the lower and upper 95% confidence intervals, 2) the margin of error, and 3) relative change in the margin of error from the baseline level of second-stage sampling. The relative change in the 95% confidence interval is equivalent to the relative change in the margin of error. The decrease in precision due to a halibut grid regulation ranged from a high of 25% for fisheries with 100% vessel coverage, to negligible decreases in precision for fisheries with low levels of vessel coverage. Decreases are larger for fisheries with high levels of vessel coverage because the between vessel component of variance is smaller, and the overall level of precision is higher for these fisheries.

In situations representative of most Alaska groundfish fisheries (65% vessel coverage, 10 percentage point decrease in second-stage sampling fraction due to a halibut grid regulation) the decrease in precision in the catch estimates of both target species and bycatch species is between 2 and 12%.

Fishery characteristics

A. Pollock mid-water fishery

Target species: Pollock
Total groundfish catch: 84,886 t
Number of vessel-weeks (primary sample units): 120
Number of hauls (subsample units): 1794 (1084 sampled)
Mean haul weight = 45.0 t
Percent pollock: 98.6%
Halibut catch rate: 0.147 kg/t of groundfish (6.6 kg per average tow)
Vessel coverage: 30-100%
Haul sample fraction: 65%
Effect of a halibut grid regulation: Low impact

B. Pacific cod bottom trawl fishery

Target species: Pacific cod
Total groundfish catch: 23,038 t
Number of vessel-weeks (primary sample : 126
Number of hauls (subsample units): 1583 (766 sampled)
Mean haul weight = 12.5 t
Halibut catch rate: 13.7 kg/t of groundfish (171.3 kg per average tow)
Vessel coverage: range 30-100%
Haul sample fraction: 50%
Effect of a halibut grid regulation: High impact

C. Bering Sea flatfish fishery

Target species: Flatfish
Total groundfish catch: 45,981 t
Number of vessel-weeks (primary sample units): 147
Number of hauls (subsample units): 2804 (1502 sampled)
Mean haul weight = 15.0 t
Halibut catch rate: 2.6 kg/t of groundfish (39.0 kg per average tow)
Vessel coverage: range 30-100%
Haul sample fraction: 55%
Effect of a halibut grid regulation: Moderate impact

D. Rock sole fishery

Target species: Rock sole
Total groundfish catch: 67,324 t
Number of vessel-weeks (primary sample units): 128
Number of hauls (subsample units): 3704 (1321 sampled)
Mean haul weight = 16.2 t
Halibut catch rate: 15.2 kg/t of groundfish (246.2 kg per average tow)
Vessel coverage: 30-100%
Haul sample fraction: 40%
Effect of a halibut grid regulation: High impact

References:

Cochran, W. G. 1977. Sampling techniques. John Wiley and Sons, New York, 428 p.

Burnham, K. P., D. R. Anderson, G. C. White, C. Brownie, and K. H. Pollock. 1987. Design and analysis methods for fish survival experiments based on release recapture. Amer. Fish. Soc. Monograph 5. 437 p.

cc: R. Methot
A. Hollowed

Table 1. Estimates of precision for target and bycatch species in the midwater trawl pollock fishery. Estimates for pollock, Pacific cod, rock sole, and Pacific halibut are in tons. Salmon estimates are in numbers of fish.

1st stage sampling	2nd stage sampling	Statistic	Species				
			Pollock	Pacific cod	Rock sole	Salmon (all sp.)	Halibut
100%	65%	Lower 95% CI	79252	544	29	122	6
100%	65%	Upper 95% CI	79380	628	38	230	20
100%	65%	Margin of error	0.1%	7.2%	13.9%	32.2%	59.2%
100%	65%	Rel. change	---	---	---	---	---
100%	60%	Lower 95% CI	79245	539	29	118	6
100%	60%	Upper 95% CI	79387	633	39	238	21
100%	60%	Margin of error	0.1%	8.0%	15.5%	35.9%	66.4%
100%	60%	Rel. change	11.3%	11.3%	11.3%	11.5%	12.0%
100%	55%	Lower 95% CI	79237	535	28	114	6
100%	55%	Upper 95% CI	79395	638	40	247	22
100%	55%	Margin of error	0.1%	8.8%	17.2%	39.9%	74.1%
100%	55%	Rel. change	23.3%	23.3%	23.4%	23.9%	25.1%

1st stage sampling	2nd stage sampling	Statistic	Species				
			Pollock	Pacific cod	Rock sole	Salmon (all sp.)	Halibut
65%	65%	Lower 95% CI	79144	485	23	98	5
65%	65%	Upper 95% CI	79489	704	49	286	26
65%	65%	Margin of error	0.2%	18.8%	39.7%	56.0%	95.2%
65%	65%	Rel. change	---	---	---	---	---
65%	60%	Lower 95% CI	79141	483	23	96	5
65%	60%	Upper 95% CI	79492	707	50	292	27
65%	60%	Margin of error	0.2%	19.1%	40.3%	58.4%	100.4%
65%	60%	Rel. change	1.6%	1.7%	1.5%	4.2%	5.5%
65%	55%	Lower 95% CI	79137	481	22	94	4
65%	55%	Upper 95% CI	79495	709	50	299	28
65%	55%	Margin of error	0.2%	19.5%	41.0%	61.1%	106.4%
65%	55%	Rel. change	3.5%	3.8%	3.3%	9.1%	11.7%

1st stage sampling	2nd stage sampling	Statistic	Species				
			Pollock	Pacific cod	Rock sole	Salmon (all sp.)	Halibut
30%	65%	Lower 95% CI	78977	406	16	67	3
30%	65%	Upper 95% CI	79657	841	71	420	43
30%	65%	Margin of error	0.4%	37.3%	81.7%	105.5%	179.3%
30%	65%	Rel. change	---	---	---	---	---
30%	60%	Lower 95% CI	78975	405	16	66	3
30%	60%	Upper 95% CI	79659	842	71	425	44
30%	60%	Margin of error	0.4%	37.4%	82.0%	107.0%	183.0%
30%	60%	Rel. change	0.4%	0.5%	0.4%	1.5%	2.1%
30%	55%	Lower 95% CI	78973	404	16	65	3
30%	55%	Upper 95% CI	79660	844	71	430	45
30%	55%	Margin of error	0.4%	37.6%	82.4%	108.8%	187.3%
30%	55%	Rel. change	0.9%	1.0%	0.9%	3.1%	4.5%

Table 2. Estimates of precision for target and bycatch species in the bottom trawl Pacific cod fishery. Estimates for Pacific cod, pollock, Pacific Ocean perch, and Pacific halibut are in tons. Tanner crab estimates are in numbers of individuals.

1st stage sampling	2nd stage sampling	Statistic	Pacific cod	Pollock	POP	Halibut	Tanner crab
100%	50%	Lower 95% CI	15799	3650	103	279	66385
100%	50%	Upper 95% CI	16699	4495	204	341	93394
100%	50%	Margin of error	2.8%	10.4%	34.7%	10.0%	17.2%
100%	50%	Rel. change	---	---	---	---	---
100%	45%	Lower 95% CI	15753	3610	100	276	65205
100%	45%	Upper 95% CI	16748	4545	211	345	95084
100%	45%	Margin of error	3.1%	11.5%	38.5%	11.1%	19.0%
100%	45%	Rel. change	10.6%	10.6%	10.8%	10.6%	10.6%
100%	40%	Lower 95% CI	15701	3565	96	273	63899
100%	40%	Upper 95% CI	16803	4602	220	349	97027
100%	40%	Margin of error	3.4%	12.8%	42.8%	12.3%	21.0%
100%	40%	Rel. change	22.5%	22.5%	23.2%	22.5%	22.7%
65%	50%	Lower 95% CI	15461	3399	85	245	56616
65%	50%	Upper 95% CI	17065	4827	249	390	109509
65%	50%	Margin of error	4.9%	17.6%	56.5%	23.5%	33.6%
65%	50%	Rel. change	---	---	---	---	---
65%	45%	Lower 95% CI	15435	3376	83	243	56085
65%	45%	Upper 95% CI	17094	4860	254	392	110546
65%	45%	Margin of error	5.1%	18.3%	59.1%	24.0%	34.6%
65%	45%	Rel. change	3.4%	3.9%	4.5%	2.0%	3.0%
65%	40%	Lower 95% CI	15403	3349	81	242	55448
65%	40%	Upper 95% CI	17129	4899	261	394	111815
65%	40%	Margin of error	5.3%	19.1%	62.1%	24.6%	35.8%
65%	40%	Rel. change	7.6%	8.5%	9.9%	4.5%	6.6%
30%	50%	Lower 95% CI	14854	2969	59	198	43104
30%	50%	Upper 95% CI	17762	5525	359	482	143836
30%	50%	Margin of error	9.0%	31.5%	103.4%	46.1%	64.0%
30%	50%	Rel. change	---	---	---	---	---
30%	45%	Lower 95% CI	14840	2958	58	197	42894
30%	45%	Upper 95% CI	17779	5546	363	483	144540
30%	45%	Margin of error	9.0%	31.9%	105.1%	46.3%	64.5%
30%	45%	Rel. change	1.1%	1.3%	1.6%	0.6%	0.9%
30%	40%	Lower 95% CI	14823	2944	57	197	42636
30%	40%	Upper 95% CI	17799	5572	368	485	145416
30%	40%	Margin of error	9.2%	32.4%	107.1%	46.7%	65.3%
30%	40%	Rel. change	2.4%	2.8%	3.6%	1.3%	2.0%

Table 3. Estimates of precision for target and bycatch species in the bottom trawl flatfish fishery. Estimates for Yellowfin sole, Rock sole, and Pacific halibut are in tons. Tanner and King crab estimates are in numbers of individuals.

1st stage sampling	2nd stage sampling	Statistic	Species				
			Yellowfin sole	Rock sole	Halibut	Tanner crab	King crab
100%	55%	Lower 95% CI	34980	2163	95	459276	10303
100%	55%	Upper 95% CI	35633	2444	115	618647	14812
100%	55%	Margin of error	0.9%	6.1%	9.5%	14.9%	18.3%
100%	55%	Rel. change	---	---	---	---	---
100%	50%	Lower 95% CI	34946	2149	94	452136	10108
100%	50%	Upper 95% CI	35668	2459	116	628415	15097
100%	50%	Margin of error	1.0%	6.7%	10.5%	16.5%	20.2%
100%	50%	Rel. change	10.6%	10.6%	10.6%	10.6%	10.6%
100%	45%	Lower 95% CI	34908	2134	93	444381	9898
100%	45%	Upper 95% CI	35706	2477	117	639383	15418
100%	45%	Margin of error	1.1%	7.5%	11.7%	18.3%	22.3%
100%	45%	Rel. change	22.2%	22.2%	22.3%	22.4%	22.4%

1st stage sampling	2nd stage sampling	Statistic	Species				
			Yellowfin sole	Rock sole	Halibut	Tanner crab	King crab
65%	55%	Lower 95% CI	34048	1869	81	372930	8435
65%	55%	Upper 95% CI	36609	2829	134	761883	18091
65%	55%	Margin of error	3.6%	20.9%	25.4%	36.5%	39.1%
65%	55%	Rel. change	---	---	---	---	---
65%	50%	Lower 95% CI	34039	1865	81	370466	8358
65%	50%	Upper 95% CI	36618	2834	135	766950	18257
65%	50%	Margin of error	3.7%	21.1%	25.8%	37.2%	40.1%
65%	50%	Rel. change	0.7%	1.0%	1.6%	1.9%	2.5%
65%	45%	Lower 95% CI	34028	1861	80	367540	8268
65%	45%	Upper 95% CI	36630	2841	135	773057	18457
65%	45%	Margin of error	3.7%	21.3%	26.3%	38.0%	41.2%
65%	45%	Rel. change	1.6%	2.1%	3.5%	4.3%	5.5%

1st stage sampling	2nd stage sampling	Statistic	Species				
			Yellowfin sole	Rock sole	Halibut	Tanner crab	King crab
30%	55%	Lower 95% CI	32802	1520	64	270638	6097
30%	55%	Upper 95% CI	38000	3477	170	1049849	25029
30%	55%	Margin of error	7.4%	42.5%	50.9%	73.1%	76.6%
30%	55%	Rel. change	---	---	---	---	---
30%	50%	Lower 95% CI	32797	1519	64	269767	6069
30%	50%	Upper 95% CI	38005	3480	171	1053241	25144
30%	50%	Margin of error	7.4%	42.6%	51.1%	73.5%	77.2%
30%	50%	Rel. change	0.2%	0.2%	0.4%	0.5%	0.7%
30%	45%	Lower 95% CI	32792	1517	64	268712	6036
30%	45%	Upper 95% CI	38011	3484	171	1057376	25283
30%	45%	Margin of error	7.4%	42.8%	51.4%	74.0%	77.9%
30%	45%	Rel. change	0.4%	0.5%	0.9%	1.2%	1.7%

Table 4. Estimates of precision for target and bycatch species in the bottom trawl rock sole fishery. Estimates for rock sole, Pacific cod, and Pacific halibut are in tons. Tanner and King crab estimates are in numbers of individuals.

1st stage sampling	2nd stage sampling	Statistic	Species				
			Rock sole	Pacific cod	Halibut	Tanner crab	King crab
100%	40%	Lower 95% CI	31563	6508	976	1684011	66342
100%	40%	Upper 95% CI	32897	7077	1073	2729802	92361
100%	40%	Margin of error	2.1%	4.2%	4.7%	24.4%	16.6%
100%	40%	Rel. change	---	---	---	---	---
100%	35%	Lower 95% CI	31489	6477	971	1639187	65122
100%	35%	Upper 95% CI	32974	7110	1079	2804449	94092
100%	35%	Margin of error	2.3%	4.7%	5.3%	27.2%	18.5%
100%	35%	Rel. change	11.3%	11.3%	11.3%	11.4%	11.3%
100%	30%	Lower 95% CI	31401	6440	965	1587401	63697
100%	30%	Upper 95% CI	33066	7151	1086	2895939	96198
100%	30%	Margin of error	2.6%	5.2%	5.9%	30.5%	20.8%
100%	30%	Rel. change	24.7%	24.7%	24.7%	25.1%	24.9%

1st stage sampling	2nd stage sampling	Statistic	Species				
			Rock sole	Pacific cod	Halibut	Tanner crab	King crab
65%	40%	Lower 95% CI	30753	6247	914	1323705	57045
65%	40%	Upper 95% CI	33763	7372	1147	3472842	107414
65%	40%	Margin of error	4.7%	8.3%	11.4%	50.1%	32.2%
65%	40%	Rel. change	---	---	---	---	---
65%	35%	Lower 95% CI	30720	6232	912	1306025	56483
65%	35%	Upper 95% CI	33799	7390	1150	3519854	108483
65%	35%	Margin of error	4.8%	8.5%	11.6%	51.6%	33.2%
65%	35%	Rel. change	2.3%	3.0%	2.0%	3.0%	3.2%
65%	30%	Lower 95% CI	30677	6212	909	1283609	55768
65%	30%	Upper 95% CI	33847	7414	1153	3581323	109873
65%	30%	Margin of error	4.9%	8.9%	11.9%	53.6%	34.6%
65%	30%	Rel. change	5.3%	6.9%	4.7%	6.9%	7.4%

1st stage sampling	2nd stage sampling	Statistic	Species				
			Rock sole	Pacific cod	Halibut	Tanner crab	King crab
30%	40%	Lower 95% CI	29465	5817	822	895535	43952
30%	40%	Upper 95% CI	35240	7917	1276	5133263	139414
30%	40%	Margin of error	9.0%	15.5%	22.2%	98.8%	61.0%
30%	40%	Rel. change	---	---	---	---	---
30%	35%	Lower 95% CI	29448	5809	821	889699	43725
30%	35%	Upper 95% CI	35260	7928	1277	5166937	140136
30%	35%	Margin of error	9.0%	15.6%	22.3%	99.7%	61.6%
30%	35%	Rel. change	0.6%	0.9%	0.6%	0.9%	1.0%
30%	30%	Lower 95% CI	29426	5799	819	882068	43428
30%	30%	Upper 95% CI	35286	7942	1279	5211633	141093
30%	30%	Margin of error	9.1%	15.8%	22.5%	101.0%	62.4%
30%	30%	Rel. change	1.5%	2.0%	1.3%	2.2%	2.3%

Appendix 3
Section 3

A survey of returning 1994 observers. Observers returning from at-sea deployments were surveyed in October of 1994 for the specific purpose of evaluating the feasibility of halibut grid sorting. Because of the limited time frame, the survey is weighted to the pollock fishery that most returning observers were working in.

VESSEL TYPE	TARGET	WAS THERE A SAFE AREA ON DECK TO COLLECT LENGTHS AND VIABILITY?	
		NO	YES
Catcher Processor	Pelagic pollock	9	4
	Bottom pollock	1	0
	Yellowfin sole	5	3
	Rockfish	1	1
	Shallow-water flatfish	2	2
	Rock sole	0	1
	Pelagic pollock/Bottom pollock	5	3
	Pelagic pollock/Shallow-water flatfish	0	1
	Rock sole/Yellowfin sole	0	1
	Yellowfin sole/Atka mackerel	1	0
	>2 targets	1	2
	Total- All targets	25	18
Catcher Only	Pelagic pollock	14	46
	Rock sole	0	1
	Bottom pollock	0	1
	Pelagic pollock/Yellowfin sole	1	0
	Pelagic pollock/Bottom pollock	0	1
	Total- All targets	15	49

Appendix 4

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Alaska Fisheries Science Center
Resource Ecology and
Fisheries Management Division
BIN C15700, Building 4
7600 Sand Point Way NE
Seattle, WA 98115-0070

February 23, 1995

MEMORANDUM FOR: Steven Pennoyer
Director, Alaska Region

William Aron
Science and Research Director, Alaska Region

FROM: Richard Marasco
Director, Resource Ecology and Fisheries Management Division

SUBJECT: Effect of the proposed halibut grid sorting amendment on the vessel incentive program (VIP).

The Council is considering amendments to the Gulf of Alaska and Bering Sea/Aleutian Islands Groundfish FMPs which would require factory trawlers and catcher vessels to use a grid placed over the hold entrance to slow down fish dumping so that halibut could be sorted from the catch and discarded as rapidly as possible. This requirement would be placed on vessels which dump their catch into a stern hold before sorting while they are fishing with non-pelagic gear. There is concern regarding possible effects of this amendment on the VIP.

Under the current VIP, observers use a random number table to select hauls for sampling. If grid sorting occurs during hauls which are to be sampled by an observer, sampling will need to take place on deck and in the factory. To combine both types of samples and compute an overall halibut bycatch rate it would be necessary to obtain an accurate measure of the total catch of allocated species. This would require a scale because uncertainty associated with alternative methods of estimating catch weight would undermine the statistical basis for evaluating VIP compliance. In addition, any changes in sampling would necessitate the development of a new halibut bycatch rate estimator which would be considerably different from the one that is currently in use.

At the last meeting of the SSC, Dr. Jack Tagart suggested that some proportion of the randomly-selected hauls be sampled only before on-deck sorting and the remaining hauls be sampled in the factory, after grid-sorting has taken place. This would provide the basis for determining weekly mean bycatch rates for both categories and, by subtraction, an estimate of the proportion removed during grid sorting. However, the number of samples available for monitoring VIP compliance would be small because only the on-deck samples could be used for this purpose. This would make it substantially more difficult to determine if non-compliance has occurred.

The Enforcement Committee reviewed this issue at its November 28-29, 1994 meeting. The committee's comments follow:

1) The committee concluded that a requirement for grid-sorting of halibut by all trawlers could be enforced more effectively than requirements for specific fisheries.

2) A safety issue concerning a possible requirement to weld the grid in place was raised. The inability to offload by smaller boats with the grid in place was discussed. The committee indicated that compliance concerns would be minimized if the grid was welded in place. However, vessel safety might be compromised because some small vessels could become unstable if large catches cannot be dumped below the deck quickly; offloading would be made very difficult if sorting grids were welded in place.

3) The committee was greatly concerned with the obvious conflict grid-sorting has with the Vessel Incentive Program, which requires standardized observer sampling of the entire catch. Pre-sorting of halibut precludes sampling protocols required for the VIP.

4) The program may foster additional noncompliance with VIP, and increase handling mortality, if a captain believes that the grid will sort out unwanted halibut bycatch. The committee acknowledged that the grid facilitates pre-sorting of the catch by slowing its transfer below deck, but does not sort the catch directly.

5) Fishery-specific grid-sorting requirements may be difficult to enforce because target fishery can not be identified by catch composition until the end of the fishing week.

6) A grid sorting requirement will increase sampling and compliance monitoring responsibilities for observers. To accommodate this, some current sampling activities would have to be reduced, or additional observers would be required. The requirement could also increase observer exposure to safety hazards and sampling interference. Delays in initiation of factory processing would occur because observers would have to complete on-deck sampling before beginning data collection in the factory. The committee agreed that the Council should address these concerns in evaluating appropriate action on grid sorting.

7) Since NMFS still supports VIP, the Council may need to balance the benefits of that program with the potential benefits of decreased halibut bycatch mortality and increased groundfish catches associated with the grid sorting requirement. The Council may wish to encourage continued research into alternative methods of reducing halibut discard mortality.