INTERNATIONAL PACIFIC HALIBUT COMMISSION

ESTABLISHED BY A CONVENTION BETWEEN CANADA

AND THE UNITED STATES OF AMERICA

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Mr. Chris Oliver
Executive Director
North Pacific Fishery Management Council
605 W. 4th Avenue, Suite 306
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Dear Chris:

In response to your letter of 27 December, 2010, which requested information on the impacts of reducing bycatch, changes to the IPHC stock assessment, and reduced halibut growth rates, our staff has assembled the enclosed report.

Drs. Ray Webster and Steven Hare will attend the upcoming Council meeting to present this information. Additionally, Gregg Williams will be attending the meeting and will be available to address other halibut-related issues that may arise.

Sincerely,

Bruce M. Leaman
Executive Director

cc: IPHC Commissioners

International Pacific Halibut Commission

Compiled by IPHC Staff
March, 2011

Item 1. Effect of reducing bycatch limits in the Gulf of Alaska on the halibut exploitable biomass and spawning potential, including downstream effects from halibut migration

Bycatch Impacts

The impact of halibut bycatch on lost yield and lost spawning biomass has been reported recently by Valero and Hare (2011). That report also estimated the effects of migration on the areas of impacts of under 32 in (U32) bycatch mortality, with migration separated into two components – juvenile (under 26 in, U26) and adult (over 26 in, O26) migration. The effect of migration on the relative area-specific losses due to U32 bycatch is not very sensitive to estimated rates of migration within each component, although we note that the proportion of each component and the relative rates by each component are more sensitive input parameters.

In general, migration of halibut in the Gulf of Alaska (GOA) occurs as a west-to-east process that diminishes with size and age. The major shift in Commission treatment of halibut migration in recent years arose from the results of a major tag and recapture program from 2003-2009. Those results indicated that halibut continue to migrate throughout their lives, whereas the Commission had previously considered that halibut migration effectively ceased after recruitment to the sizes exploited in the commercial fishery (currently about age 8 yr or 32 in). Migration rates are estimated based on the return rate of tags, which vary by area, hence the precision with which migration rates are estimated also varies by area. However, the total impact of bycatch mortality on the coastwide halibut stock is not subject to any of the concerns about migration rate estimation. Instead, the total losses in yield, spawning stock biomass, or egg production can be estimated with confidence because they are functions of the size composition of the bycatch and the known biological parameters of growth, mortality, and fecundity.

Estimates of the lifetime lost yield to the halibut fishery and lost spawning stock biomass arising from one pound of bycatch mortality in the Gulf of Alaska vary, depending on the area of origin of the bycatch (Valero 2011, Valero and Hare 2011). We used the average observed U32 size/age composition of 1996-2008 bycatch, by area, and the target halibut fishery harvest rate in calculating the impacts of U32 bycatch mortality on the coastwide halibut stock. Assuming that both juvenile and adult movement is considered, the cumulative lifetime estimated per lb impacts of U32 halibut bycatch mortality by area are as follows:

Area of One Pound of Bycatch Origin	Lost Yield	Lost Spawning Stock Biomass
Area 3B	0.9 lb	1.6 lb
Area 3A	1.1 lb	1.7 lb
Area 2C	1.1 lb	1.5 lb

The loss of spawning stock biomass has become a more significant portion of the impact of bycatch mortality as halibut size at age has decreased over the past decade (Hare 2011). While smaller size at age means that yield loss per lb of bycatch mortality is lower than in previous decades, this is not the case for losses to spawning stock biomass. Even with smaller sizes at age, female halibut mature into the spawning biomass near the same ages as usual and while many fish may not be vulnerable to the fishery until older ages than in past decades, they still contribute to the spawning biomass from the age of first maturity (8-11 yr). This is a reason why halibut spawning stock biomass can increase even when the exploitable biomass may decrease. The Commission's harvest policy is based on conservation of spawning stock biomass per recruit and the continued impact of bycatch mortality on this metric is of great concern to the Commission.

Timing of bycatch impacts

The variation in losses estimated for different areas of bycatch origin is accounted for by the both the sizes of halibut comprising the bycatch and the differences in growth and mortality that would be experienced by halibut in those areas. It should be noted that the lifetime losses resulting from U32 bycatch occur over an extensive time period, even with current exploitation rates. Valero and Hare (2011) estimated that only about 42% of lost yield occurs during the first eight years following the bycatch occurrence and about 87% after 16 years. The long period over which bycatch impacts are manifested renders migration patterns of significance to the areas of impact, though not to the total impact on the stock.

Bycatch estimation and levels in the Gulf of Alaska

In 1991, the Commission constituted a bilateral Halibut Bycatch Work Group as a response to concerns about bycatch mortality impacts on the halibut stock. The report of this group (Salveson et al. 1992) identified measures to address bycatch mortality, as well as targets for bycatch reduction and timelines for its achievement. The recommendations of this Work Group were adopted by the Commission at an extraordinary meeting in 1991 and forwarded for action by the U.S. and Canadian governments. Success at achieving the goals identified by the Work Group has been mixed and while monitoring of bycatch and some reductions have been achieved in the Bering Sea/Aleutian Islands (BSAI), bycatch in the GOA remains poorly estimated. Observer coverage is only partial (30%) for a substantial portion of the groundfish fleet and not required for the remainder. Recent proposed restructuring of the National Marine Fisheries Service (NMFS) observer program which will place control of observer deployment under the authority of the NMFS could provide potential improvements to bycatch estimation. In the GOA, the ratio of halibut mortality to groundfish catch is more than twice as high as that in the BSAI fisheries and renders improved estimation of halibut bycatch mortality of greater importance. In recent years, the Commission has been forced to reduce both the harvest rate (Area 3B) and the harvest levels of GOA catch (Areas 3A and 3B) as the stock biomass has not responded to management measures based on the harvest policy. The Commission's action to reduce harvest rates in Area 3B is based on a lack of response to these mitigative management measures and the inadequate knowledge of bycatch mortality in this area is a primary source of uncertainty in understanding stock dynamics and determination of appropriate yield.

The existing GOA Prohibited Species Cap (PSC) limits have been in place for trawl fisheries since 1986 and for fixed gear fisheries since 1996. The Commission staff believes that

these limits were based on inadequate data, that monitoring of both historical and current bycatch mortality is similarly inadequate, and that the PSC limit for trawl fisheries should be reduced as a precautionary measure until the improved observer procedures are implemented, at which time the estimated bycatch mortality levels can be re-evaluated in the context of halibut stock dynamics.

Item 2: Recent changes in stock assessment methods, harvest policies, and catch limit setting

Coastwide assessment

Since 2006, the IPHC stock assessment model has been fitted to a coastwide dataset to estimate exploitable biomass. For many years, the staff assessed the stock in each regulatory area by fitting a model to the data from that area, i.e., a closed area (CA) assessment. This procedure relied on the assumption that the stock of fish of catchable size in each area was closed, meaning that net migration was negligible. A growing body of evidence from both the assessments (Clark and Hare 2007) and a coastwide mark-recapture experiment (Webster and Clark 2007, Webster 2010) showed that there is a continuing and predominantly eastward migration of catchable fish from the western area (Areas 3 and 4) to the eastern area (Area 2). The effect of this unaccounted for migration on the closed-area stock assessments was to produce underestimates of abundance in the western areas and overestimates in the eastern areas. To some extent this has almost certainly been the case for some time, meaning that exploitation rates were well above the target level in Area 2 and a disproportionate share of the catches have been taken from there.

In order to obtain an unbiased estimate of the total exploitable biomass (EBio), beginning with the 2006 assessment, the staff built a coastwide data set and fitted the standard assessment model to it. Exploitable biomass in each regulatory area was estimated by partitioning, or apportioning, the total EBio in proportion to an estimate of stock distribution derived from the IPHC setline survey catch rates (WPUE). Specifically, an index of abundance in each area was calculated by multiplying weighted survey WPUE by total bottom area between 0 and 400 fm (Hare et al. 2010). The logic of this apportionment is that survey WPUE can be regarded as an index of density, so multiplying it by bottom area gives a quantity proportional to total abundance.

The current halibut assessment model has remained essentially unchanged since 2003. It has been thoroughly described in an IPHC Scientific Report (Clark and Hare 2006) and was subjected to a peer review by two external scientists from the Center for Independent Experts (Francis 2007, Medley 2007). Since the Commission's acceptance of a coastwide stock assessment model, much of the focus of the staff and the industry is now on how the coastwide estimate of exploitable biomass is apportioned among regulatory areas. For both these reasons, the assessment model for 2010 is identical to that used for the 2008 and 2009 assessments. In the interest of brevity, details of the model can be found in Clark and Hare (2006, 2007, and 2008).

Survey WPUE adjustments

Hook competition (catchability)

The IPHC setline assessment survey extends from Oregon northward to British Columbia and west to the Bering Sea and out the Aleutian Island chain. The survey catch of halibut is reduced by the number of baits taken by other species and regional differences in the strength of this effect would result in differences in survey catchability among areas. Clark (2008) developed an analytical method for determining the level of hook competition and an adjustment factor to the survey WPUE indices. The fraction of baits returned on the survey in each regulatory area is used to compute an adjustment factor. If a smaller than average proportion of

baits are returned, an area's WPUE index is adjusted upwards because higher competition for baits in that area would have had a negative effective on the halibut catch and therefore on that area's WPUE. Conversely, an area with more than the average rate of baits returned will have its WPUE index adjusted downwards. Calculation of the hook adjustment is done in the same manner each year, using the results from that year's survey. The Commission's approach to this problem has also been independently validated by another research team (Etienne et al., in press).

Effect of survey timing

The amount of commercial catch taken prior to the IPHC setline survey varies with both regulatory area and time (Webster 2009). It is plausible that survey WPUE is affected by the proportion of removals taken prior to the survey, as exploitable biomass is decreased by commercial and sport fishing and other forms of removals, leaving fewer fish for the survey to catch. In areas where removals are greater early in the season, survey WPUE could be expected to be lower on average than in areas where removals are spread evenly across the fishing season. Concern about the effect of commercial catch on survey WPUE is high in Area 2A, where typically over 80% of the catch is taken prior to the mean survey date, much higher than all other areas (Webster 2009, Webster and Hare 2010).

The IPHC staff's approach (Webster and Hare 2010) is to estimate what WPUE would have been for each area had 50% of removals been taken prior to the mean date of the setline survey in that area. Thus, for removals greater than 50%, survey WPUE is adjusted upwards; for removals less than 50%, survey WPUE is adjusted downwards.

Survey WPUE weighting

With the advent of the coastwide assessment approach, the IPHC has used the most recent three years' setline survey index values to apportion the estimated biomass among regulatory areas. The initial methodology employed an equal weighting of the three most recent years but the IPHC staff sought to develop a more statistically defensible approach.

Survey catch rates are more variable than commercial catch rates, for a number of reasons that may be unrelated to underlying stock abundance. While the surveys are spatially extensive, this variance is an inevitable consequence of the limited period in the year over which the surveys are conducted. To provide some stability to the mean catch rate index and make it less susceptible to sampling variance, the survey index can be, and has been for the past several years, averaged over the most recent three years in the data set. In 2010, the Commission followed a staff recommendation to continue with a three-year simple average of adjusted survey WPUE until the staff completed a proper statistical analysis of the survey data, to determine a time-averaging procedure which is appropriate for these data. That analysis (Webster 2011), which examined several methods for weighting of survey WPUE over recent years, used a Kalman filter approach to develop a reverse-weighting procedure for survey data, wherein more recent data receives greater weight than older data. The weighting scheme adopted for 2011 used a 75:20:5 ratio for averaging the past three years' data, with the most recent year receiving the highest weight.

Harvest Policy

Slow Up - Fast Down and Slow up - Full Down

One component of the Commission's harvest policy is the Slow Up – Fast Down (SUFastD) harvest control rule. This rule, in which 33% of increases or 50% of reductions in FCEY are captured in the staff's catch limit recommendations, has been generally applied since 2001. Following the 2006 Center for Independent Expert review (Francis 2007, Medley 2007), the SUFastD adjustment was formally investigated as part of the harvest policy and became official IPHC policy in 2008 (Hare and Clark 2009). The SUFastD was designed to avoid rapid increases or decreases in catch limits, which can arise from a variety of factors including true changes in stock level as well as perceived changes resulting from changes in the assessment model, as well as to apply a more precautionary approach to catch limit setting. The SUFastD approach is estimated to leave approximately 3% more stock biomass in the water, over the long term, than a straight FCEY approach to catch limit setting.

Over the past few years, however, as biomass declines have persisted, there has been a growing concern by the staff about continued use and application of the SUFastD adjustment because some of the current stock conditions were not included in the original evaluation of the SUFastD. The effect of its application on a declining stock is that the target harvest rate is never achieved. Instead, the procedure of taking only 50% of the identified reductions in FCEY has meant that the target harvest rate is consistently exceeded and the stock cannot realize the benefits of the harvest policy. The Commission's adopted catch limits have often resulted in even greater departures from the target harvest rates.

Staff analysis of the effect of using SUFastD, when biomass and size at age are declining and when the policy is initiated at a harvest rate that is well above target, shows exaggerated biomass declines and realized harvest rates continuing to be above targets (Hare 2011). This is the case for any combination of biological and management processes which results in removals exceeding surplus production. Considering the recent history of the stock, the application of the SUFastD harvest control rule and the subsequent Commission decisions on catch limits has resulted in a failure to achieve the Commission's stated harvest policy goals. For 2011, the IPHC staff recommended modifying the SUFastD policy to specify an adherence to the FCEY values for identified reductions in yield, i.e., a Slow Up – Full Down (SUFullD) policy. This means that 100% of any identified decreases in yield (i.e., when the current FCEY is lower than the previous year's catch limit) are recommended compared with only 50% of identified decreases under a SUFastD policy. The staff recommendations for 2011 catch limits and the Commission's adopted catch limits incorporated this change for 2011.

Accounting for U32 bycatch and wastage

Starting in 2011, the Commission adopted a standardized process for treatment of removals of halibut that are less than 32 inches but over 26 inches in length (U32/O26). Hare (2011) analyzed the impacts of various treatments of bycatch and wastage mortality (BAWM), motivated by a Commission directive to staff concerning how U32/O26 removals by different sectors were accounted for in the Commission's harvest policy. This analysis identified a procedure whereby there could be direct deductions from Total CEY for all U32/O26 removals, regardless of which sector gave rise to the removals, with no negative impact on the current spawning biomass per recruit level. While the previous procedure of accounting for this BAWM

through harvest rate reduction achieved the same goal, the revised procedure provides more transparent and consistent accounting for this BAWM.

Item 3. Possible causes of low growth rates and the effects on future exploitable biomass and spawning biomass

Halibut size-at-age has been declining since the mid-1980s. The cause(s) behind the ongoing decline are not well understood. First, some perspective on the scope of the changes in size-at-age. In the central Gulf of Alaska, a 15 year old female averaged approximately 100 (net) lbs in weight in the 1980s. In the late 2000s, a 15 year old female halibut in the central Gulf have averaged 28 pounds – a decline of 70% in 30 years. Similar, though slightly smaller, declines have been noted in all IPHC areas. The declines in size at age occur at all ages and for both sexes; the declines increase markedly with age.

A number of hypotheses for the decline have been suggested, and a few analyzed (Clark et al. 1999, Clark and Hare 2002). The timing of the decline in size-at-age correlates very strongly with the increase in halibut numbers that began following the environmental regime shift of the late 1970s. By the mid-1980s, several strong year classes had increased the total number of halibut in the ocean by at least a factor of two. At the same time, increased numbers of other flatfish, in particular arrowtooth flounder (*Atherestes stomias*), also occurred in the Gulf of Alaska and Bering Sea (Walters and Wilderbuer 2000). The most generally accepted cause of the decline in size-at-age has been a density-dependent decline in growth rate resulting from the greatly increased numbers, and biomass, of flatfish. It is worth noting here that, although the exploitable biomass of halibut has declined by 50% since the late 1990s, the **total** biomass of halibut has continued to increase. Additionally, the biomass of arrowtooth flounder estimated to be several times greater than the halibut biomass, has remained very high.

Other potential factors include: environmental effects (temperature, salinity), diet changes, fishery induced evolution, and size-selective fishing. No strong environmental correlate has been found. The possibility of fishery induced evolution, i.e., that halibut capable of producing fast-growing progeny have been "fished out" of the population is both unlikely over such a short time frame and is also countered by the observation that the current halibut size-at-age is similar to that of the 1930s. In other words, a cycle of change from small to large size-at-age has already been observed, and the increase in size-at-age occurred at a time of very low halibut abundance. The change in halibut size-at-age could, theoretically, be produced by the effects of size-selective fishing and not by a change in growth rate. Since larger halibut are targeted, a progressively smaller size-at-age would result in a fishery that systematically removed the larger individuals. Such an effect however, would be expected in a fishery imposed on a previously unfished stock, which has not been the case for halibut in 80+ years. Additionally, halibut size-at-age increased greatly through the 1960s and 1970s, a time when the stock was (and long had been) fully exploited.

The effects of reduced size-at-age are rather predictable. Given the commercial size limit and selectivity of both the harvesters and the gear, a continued reduction in size-at-age leads to a lowered exploitable biomass (EBio) for a given number of halibut. It has been conclusively demonstrated that EBio is a function of halibut size, not halibut age. Female spawning biomass, on the other hand, is a function of both age and size. Female spawning biomass has also declined over the past decade, but appears to have begun increasing starting in 2007-2008. This results from the several large year classes now entering the age at which a substantial fraction contribute to spawning (age of 50% maturity in halibut is around 12 years). Thus, the increase in biomass

from addition of new (though small) mature females now outpaces the declines from losses due to fishing and natural mortality as well as the decrease in size-at-age.

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NMFS Management Concerns

Specifying changes in the halibut PSC limit in the annual specification process poses several challenges for implementation and management of GOA groundfish fisheries. The following sections provide a brief perspective of the analysis that the Council would need to include as part of the harvest specification process if the GOA halibut PSC limit is modified.

First, under the CGOA Rockfish Program, the Council assumed that the GOA halibut PSC limit would be 2,000 mt when it adopted calculations for allocating halibut PSC between the catcher vessel and catcher/processor sector, when reallocating halibut PSC unused at the end of the fishing season, and when establishing halibut PSC sideboard limits during the month of July. Modifying the GOA halibut PSC limits would likely require the Council to analyze the potential effects on the CGOA Rockfish Program. This analysis would need to review the potential implications on allocations and fishery dynamics within the CGOA Rockfish Program fisheries.

Coordinating a review of the implications of modifying the GOA halibut PSC limit with the implementation of the CGOA Rockfish Program becomes more complicated if those processes are occurring simultaneously, as they would be if changes to the GOA halibut PSC limit were incorporated within the annual specification process. Regulations implementing the CGOA Rockfish Program are not yet effective. NMFS has scheduled publication of a final rule for November 2011, assuming approval by the Secretary of Commerce. Ideally, any analysis of the effects of changing the GOA halibut PSC limit on the CGOA Rockfish Program would occur either after the CGOA Rockfish Program has been implemented as a separate action, or as part of the CGOA Rockfish Program itself. Given the timing of the CGOA Rockfish Program rulemaking, the Council would not be able to analyze new GOA halibut PSC limits, analyze the effects on the CGOA Rockfish Program, and possibly revise CGOA Rockfish Program halibut PSC allocations within the timeframe NMFS has established to ensure the CGOA Rockfish Program is implemented by 2012. NMFS is preparing proposed regulations to implement the CGOA Rockfish Program and is scheduled to publish proposed regulations in Summer, 2011 to ensure that the program can be implemented for 2012. The earliest that the Council could take final action to implement a revised GOA halibut PSC limit is October 2011, after the publication of the Central GOA Rockfish Program proposed rule and just prior to the scheduled publication of a final rule.

Second, the AFA and Amendment 80 Program also establish GOA halibut PSC sideboard limits. These limits were established under the assumption that a 2,000 mt limit would apply when calculating the percentage of the GOA halibut PSC limit for AFA and Amendment 80 sideboards. As with the CGOA Rockfish Program, the Council would need to analyze the effects on fishery dynamics within these fleets.

Finally, any change in the GOA halibut PSC limits would require analysis of the effects of that change on fishery dynamics for the affected fleets other than those described previously (e.g., flatfish fisheries). The potential scope of the analysis required to assess the implications of changing the overall GOA halibut PSC could be substantial and could compromise the ability of the agency to complete the analytical and rulemaking processes required to implement the annual harvest specifications in a timely manner. At a minimum, NMFS has identified the need to analyze the potential impact of any proposed revisions on the Central GOA Rockfish Program, AFA and Amendment 80 sideboards, and other fisheries that use halibut PSC. Ideally, this potentially complicated analysis would be undertaken independent of the annual harvest specification process as a separate action.

GOA rockfish program excerpt

Allowance of halibut PSC to the rockfish cooperative program will be based on 87.5 percent of the historical average usage (during the qualifying years), calculated by dividing the total number of metric tons of halibut mortality in the CGOA rockfish target fisheries during the qualifying years, by the number of years, and multiplying by 0.875. The difference between the historical average usage and the allowance provided above will remain unavailable for use. The table below provides calculated halibut PSC allocation under the Central GOA Rockfish Program.

For the following rockfish sectors...	The following amount of halibut	Is multiplied by...	To yield the following amount of halibut PSC assigned to Rockfish CQ...	The following amount of halibut is not assigned as rockfish CQ, halibut PSC, or halibut IFQ for use by any person
Catcher vessel sector	134.1 mt	87.5	117.3 mt	27.4 mt (16.8 mt from the catcher vessel sector & 10.6 mt from the catcher/processor sector)
Catcher/Processor sector	84.7 mt		74.1 mt	

In addition, 55 percent of any cooperative's unused halibut PSC that has been allocated as CQ that has not been used by the cooperative will be added to the last seasonal apportionment for trawl gear during the current fishing year. Any remaining halibut PSC CQ not added to the last seasonal apportionment would remain unused for that fishing year.

GOA Pacific cod jig fishery

In Component 7, the Council recommended apportioning the GOA hook-and-line halibut PSC limit, between the CP and CV sectors in proportion to the total Western GOA and Central GOA Pacific cod allocations to each sector, after scaling the Pacific cod allocations to reflect the relative size of the Pacific cod TAC area apportionments (Table E-8). Area apportionments are determined during the annual harvest specifications process. No later than November 1, any remaining halibut PSC mortality, not projected by NMFS to be imposed by one of the hook-and-line sectors during the remainder of the year, would be made available to the other sector.

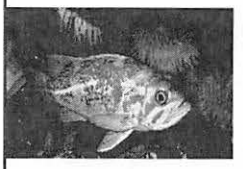
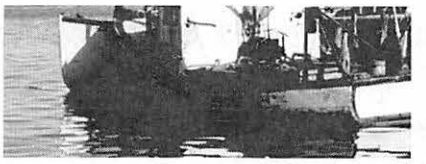
Table E-8 Halibut PSC allocations to hook-and-line CVs and CPs under Component 7

2009 Pacific cod ABC area apportionments: 56.5% CGOA, 38.7% WGOA[1]

Period	CV Allocation	CP Allocation	CV amount (mt)	CP amount (mt)
Preferred Alternative	54.4%	45.6%	157.7	132.3

[1] The Pacific cod area apportionments would be revised when the Pacific cod area allocations change in the annual harvest specifications.

Best Monitoring and Management Practices for Bycatch Reduction


Area 2A


Area 2A Halibut Catch Sharing

Catch Sharing Plan (1988):

Targeted Fisheries

- Tribal Commercial and Ceremonial and Subsistence Fisheries within Puget Sound and off WA Coast
- Non-Tribal Commercial Fishery (Divided in 1995):
  - South of Pt. Chehalis, WA (Directed) and Salmon Troll (Incidental)
- Recreational Fisheries

Incidental Fisheries

- Sablefish Fishery North of Pt. Chehalis, WA (2001)

Bycatch

- Trawl Fisheries
- Hook-and-Line Fisheries

Groundfish Bycatch Management

PFMC – Major Actions

- 1999 – Groundfish Strategic Plan
  - 50% Harvest Capacity Reduction in Each Sector
- 2001 – NMFS Groundfish Observer Program
- 2005 – Am 18: Bycatch Management Strategy

PFMC – Conservation Measures

- Depth Restrictions to Protect Overfished Rockfish Likely Reduced Halibut Bycatch
  - Trawl: Closed shore to 200 fm north of Cape Alava, and 75 fm to 200 fm off WA and OR
  - Non-Trawl: Closed shore to 100 fm off WA and 30 fm to 100 fm off OR

Groundfish Bycatch Monitoring

West Coast Groundfish Observer Program

- Established in 2001
- Estimate Total Catch Mortality, Including Halibut
- Coverage:
  - 20-30% for Bottom Trawl (pre-2011), Longline, and Pot Fisheries
  - 100% for At-Sea Whiting Fishery (200% on Processors)
- Average Rates Used for Expansion

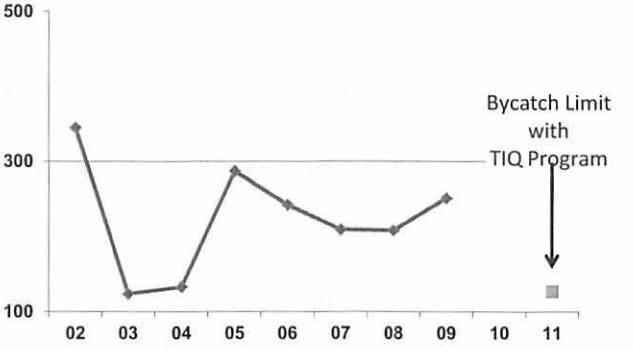
Electronic Monitoring and Logbooks

- Pilot Program Using Video Was Not Successful for Determining Rockfish Bycatch – Will Continue to Explore
- Mandatory Paper Logbook Currently in Place

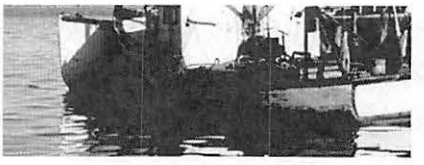
Trawl Individual Quota Program

- Implemented Jan 11, 2011
- Includes Individual Quotas for Most Trawl Species and Halibut Bycatch Quota
  - All Halibut Mortality Counts Against Quota
  - 10 mt Set Aside for At-Sea Whiting Fishery and South of 40°10' N. latitude
- 100% At-Sea Observer Coverage and 100% Dockside Monitoring
- Goal: 100% Sample of Trawl Halibut
  - Number and Length of Halibut
  - Disposition of Released Halibut for Discard Mortality

Area 2A Trawl Halibut



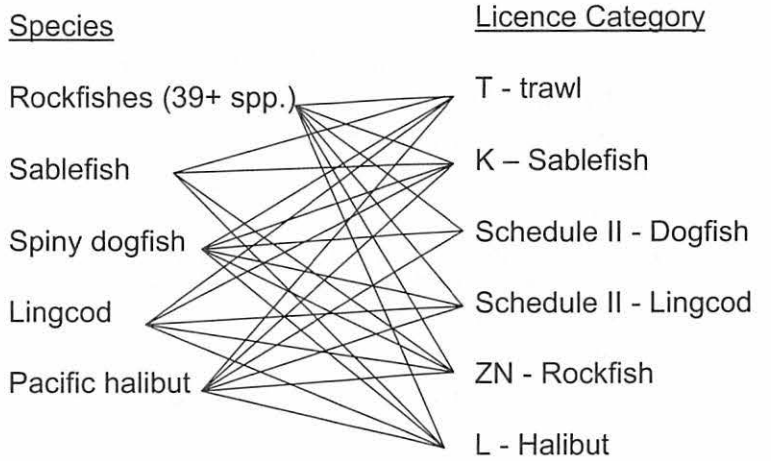
Area 2B


The Problem

- There is mortality associated with discarded fish (rockfish mortality is 100%)
- Discarding is wasteful and results in unreported or misreported catch data that impairs the sustainable management of the groundfish resources
- The management procedure did not make individual harvesters accountable for their bycatch nor provide a mechanism for them to fish responsibly

By-catch Issues



DFO Criteria

- DFO stated in 2003 that the following would be implemented in 2006:
  1. All rockfish must be accounted for;
  2. Rockfish catches will be managed to established rockfish management areas;
  3. Harvesters will be individually accountable for their catch;
  4. New monitoring standards (dockside and at sea) will be established and implemented to meet the above 3 objectives.

Commercial Groundfish Integration Program

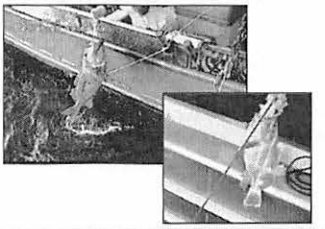
- In 2006 DFO implemented the Commercial Groundfish Integration Pilot Program:
  - 1 management plan, not 6
  - IQs in all fisheries (new for lingcod, dogfish, rockfish)
  - Individual vessel accountable for all catch (mortality) – whether retained or released; targeted or non-targeted
  - IQ trading between vessels and fisheries
  - 100% at-sea monitoring (at-sea for trawl; video for H&L)

Audit-Based Monitoring

Dockside Monitoring
+
Fishing Log

Catch Allocation and Quota Deduction

Electronic Monitoring



Evolution of Trawl Management

- Retention of halibut caught by trawl gear is prohibited.
- In the early 1990s Canada/US reached an agreement on a Halibut Bycatch Reduction plan to reduce halibut bycatch by half
- The bycatch cap for Canada was established at 1M lbs
- Prior to 1997 the Trawl fishery was managed using coastwide species TACs and trip limits
- Trip limits and TACs were being frequently exceeded
- Excessive TAC overages resulted in the trawl fishery being closed for 4½ months (Sept 1995 – Feb 1996)

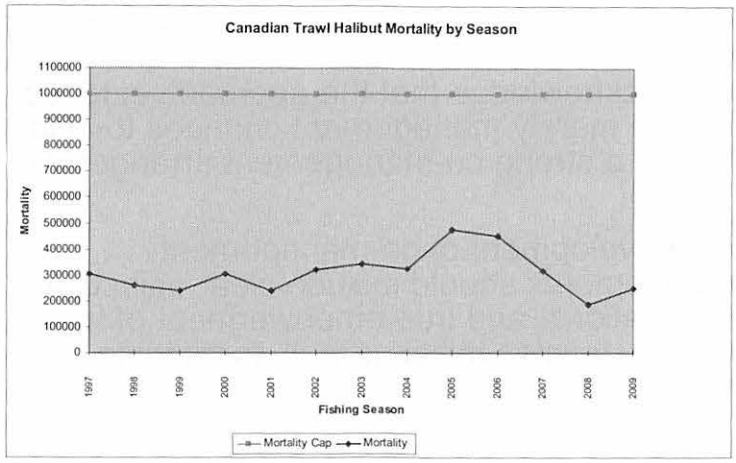
Trawl Management

- The trawl fishery reopened with a new management plan that addressed the Department's sustainability objectives
- Canada's trawl bycatch plan was implemented in 1995 with 100% at sea observers required in 1996.
- IVQ program adopted to manage the Canadian trawl fishery in 1997 that included individual vessel accountability for halibut mortality.
- Halibut mortality is determined by the onboard at sea observer and is charged against the vessel's individual quota holdings.

Trawl Management

- Halibut by-catch mortality IVQ can be reallocated only within the trawl sector
- Halibut catch in excess of a vessel's individual halibut by-catch holdings results in the vessel being restricted from bottom trawling coast-wide for the remainder of the fishing year, or until sufficient additional halibut by-catch quota is reallocated to cover the mortality

Trawl Mortality



Best Management Practices

- Multi-species fisheries aspiring to achieve "sustainability" status should consider including individual catch accountability as a founding principle.
- The only effective catch monitoring program is one that requires 100% at-sea monitoring either using electronic monitoring and an accompanying audit program or on-board observers.

Best Management Practices

- Fisheries wishing to move in the direction of an ecosystem-based approach to management must acknowledge that the approach extends beyond merely management changes to also include a strong co-management arrangement.
- The development of co-management arrangements should include clear objectives, expectations, and true empowerment of the body to develop initial as well as ongoing recommendations for consideration.

Areas 2C, 3 & 4



US National Standards for Fisheries Management

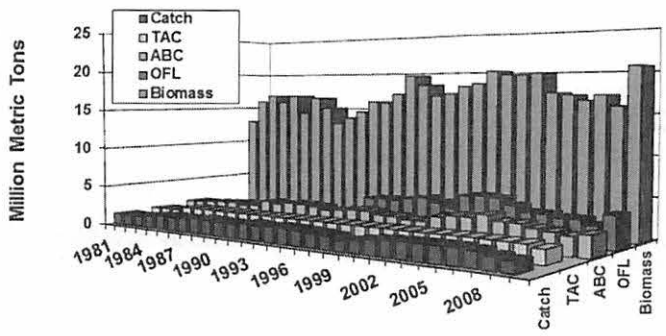
The North Pacific Fishery Management Council often must balance competing national standards in developing its fishery management policies.

National Standard 1. *Conservation and management measures shall* ***prevent overfishing*** *while achieving, on a continuing basis, the* ***optimum yield*** *from each fishery for the United States fishing industry.*

National Standard 9. *Conservation and management measures shall, to the extent practicable, (A)* ***minimize bycatch*** *and (B) to the extent bycatch cannot be avoided,* ***minimize the mortality*** *of such bycatch.*

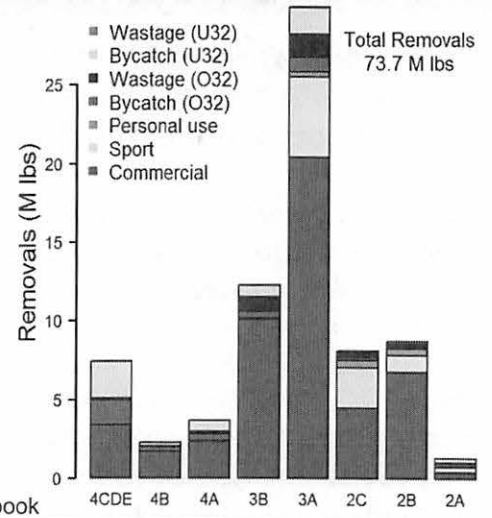
Bycatch Issues

Bering Sea & Aleutian Islands Groundfish Catch Limits 1981-2010



Commercial Alaska groundfish catches are constrained by incidental catches of Pacific halibut.

2010 Halibut Removals by Sector



Source: 2010 Bluebook

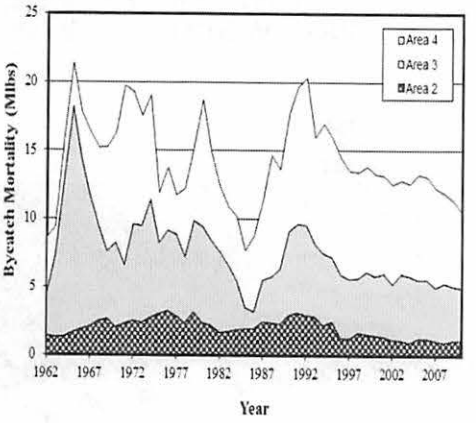
Evolution of Bycatch

2010 Halibut Bycatch Mortality

Area 2C - at relatively low levels (300,000 lb annually) compared to other areas. Observer coverage is poor.

Area 3 - gradual decrease, but similar to levels of past few years (3.9 M lb, a 3% decrease from 2009;1 M lb below the 4.9 M lb estimated in 2003; below the 10-year average of 4.4 M lb). Trawl fishery bycatch was 3 M lb (75% of the total 2010 bycatch). This was split into 2.2 M lb and 0.8 M lb for Areas 3A and 3B, respectively. Bycatch mortality in hook-&-line fisheries occurs in target fisheries for Pacific cod. Since 2006, slightly more than half of the bycatch mortality has been taken in Area 3B each year.

Area 4 - dropped 11% from 2009 (5.6 M lb) and significantly below the long-term average (6.9 M lb). Lower bycatch rates occurred in the trawl fisheries, where overall bycatch dropped 9% to 4.33 M lb . Hook-&-line fishery bycatch was also significantly lower in 2010. (Source: 2010 RARA)



Current Management Practices

- Halibut & Sablefish IFQ Longline Fishery
  (savings of 450 mt or .882 M lb)
- Commercial Groundfish Fisheries
  - Prohibited Species Catch Limits

    Area 2C and 3: 2,300 mt
    trawl: 2,000 mt (3.3 M lb net wgt.)
    fixed: 300 mt (.5 M lb net wgt)

    Area 4: 4,526 mt.
    trawl: 3,626 mt (6 million lb net wgt.)
    fixed: 900 mt (1.5 million lb net wgt)
  - Other Management Attempts in 1980s &1990s
    - Vessel Incentive Program
    - Halibut Mortality Avoidance Program, Vessel Bycatch Avoidance, Individual Vessel Bycatch Incentive Program

Best Management Practices

Commercial Groundfish Fisheries

- Central Gulf of Alaska Rockfish Program
  - savings of 27.4 mt (60,000 lb)
- Bering Sea/Aleutian Islands Pollock pelagic trawl only
  - savings of 100 mt (165,000 lb net wgt)
- BSAI Amendment 80
  - savings of .300 M lb net wgt by 2012
- BSAI Pacific Cod Allocations
  - no savings but sector allocations allow more groundfish to be harvested per ton of halibut bycatch allocation
- GOA Pacific Cod Allocations
  - no savings but sector allocations allow more groundfish to be harvested per ton of halibut bycatch allocation

Best Management Practices

Alaska Regional Catch Accounting System

- Enables in-season groundfish and PSC management in the BSAI and GOA
- Provides total accounting of halibut PSC in groundfish fisheries off Alaska
- Establish accounts that match the Annual Harvest Specifications (Catch Limits) tables (currently about 900 management quotas)
- Relies on observer data to estimate halibut bycatch rates that are applied to total groundfish catch
- Mandatory, electronic, reporting requirement for all groundfish catch provides timely estimates

Observer Program (cont.)

Number of observers, platforms observed, and observer days in the North Pacific, 2002-2009

Year	Number of observers/vessels observed/plants observed	Number of observer days
2009	380 observers, 267 vessels, 19 plants	35,681
2008	464 observers, 296 vessels, 21 plants	39,344
2007	427 observers, 296 vessels, 22 plants	35,313
2006	398 observers, 303 vessels, 24 plants	35,103
2005	366 observers, 304 vessels, 24 plants	35,677
2004	374 observers, 317 vessels, 21 plants	35,600
2003	355 observers, 325 vessels, 21 plants	36,685
2002	364 observers, 312 vessels, 20 plants	34,116

Source: NMFS, Observer Program Office..

Restructured Observer Program

Vessels and processors that are determined to need <100% observer coverage includes previously uncovered sectors such as the **commercial halibut sector and <60' groundfish sector**. NMFS would contract directly with observer companies to deploy observers according to a scientifically valid sampling and deployment plan, and industry would pay a fee equal to 1.25% of the ex-vessel value of the landings included under the program. It provides NMFS with flexibility to deploy observers in response to fishery management needs and to reduce the bias inherent in the existing program, to the benefit of the resulting data.

- The full coverage category includes: 1) catcher processors (CPs) and motherships;
  2) catcher vessels (CVs) under prohibited species catch (PSC) limits in conjunction with a catch share program (e.g., Bering Sea pollock and Gulf of Alaska rockfish); and
  3) shoreside and floating processors when taking deliveries of BS pollock.
- 100% coverage would not be required on: 1) CPs <60' with a history of CP and CV activity in the same year;
  2) any CP with an average daily production < 5,000 lb (round lb) in the most recent full calendar year of operation prior to January 1, 2010. These vessels would make a one-time election as to whether they will be in the <100% coverage category and pay an ex-vessel value based fee, or in the ≥100% coverage category and pay a daily rate directly to observer providers for coverage. (This provision provide flexibility for the smallest class of catcher processors, and those vessels that currently operate as both a CP and CV during the year).
- All other CV sectors would be included at <100% coverage and pay the 1.25% ex-vessel fee.
- **No observer coverage is planned for vessels <40' length overall in the first year(s) of the program.**
- Vessels participating in the State managed guideline harvest level (GHL) and non-groundfish fisheries (e.g., lingcod) are excluded. (Non-GHL groundfish taken incidentally in those fisheries (the catch of which is taken off a Federal TAC) that are landed by vessels with Federal Fishery Permits are included.)

Areas for Improvement

Areas of focus for improvement include:

- Providing statistically robust estimates of halibut PSC through a new observer deployment model that allows NMFS to deploy observers. The regulations and detailed deployment are currently in development.
- The NMFS Alaska Regional Office continues work on evaluating and improving estimation methods, evaluating the quality of data, and ensuring data is available to managers and researchers.
- Assessing the feasibility of electronic monitoring (EM) to augment observer information is an important area of research..
- Continued work by NMFS, NPFMC, and industry to develop innovative methods to reduce bycatch through gear modification and careful handling of halibut through the use of Exempted Fishing Permits.
- Emphasis on revising halibut PSC limits in the GOA for 2012 and BSAI in the future

AGENDA D2(b)
Supplemental
April 2011

Report of the Halibut Bycatch Work Group

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Objectives

At its 2010 Annual Meeting, the International Pacific Halibut Commission (IPHC, or Commission) decided to reconstitute the bilateral Halibut Bycatch Work Group (hereafter HBWG I). Originally formed by the Commission in 1991 to address several bycatch issues significant at that time, this updated Halibut Bycatch Work Group (hereafter HBWG II) was reformed for very different reasons.

In recent years, several issues have served to increase the need for greater understanding of the impacts of bycatch, including the decline in halibut exploitable biomass, and new information on migration by juvenile and adult halibut coming from the 2003 tagging study (Webster et al. 20xx). In addition, concerns about the adequacy of monitoring and the accuracy of estimates of bycatch provided to IPHC by domestic agencies have been raised. Thus, at its 2010 Annual Meeting, the Commission decided to form the HBWG II, with the goal of reviewing progress on bycatch control since 1991, bycatch monitoring programs, and examining how bycatch mortality is accounted for within the IPHC harvest policy.

Background Information

Bycatch has long been a subject of much research and discussion by the Commission in its management of the resource and fishery (Bell 1955, Hoag and French 1976). Sullivan et al. (1996) examined the impacts of groundfish fisheries on the directed setline fisheries in other areas, demonstrating the significant effects on yield and reproductive potential. The effect of bycatch in groundfish fisheries off Alaska on the directed halibut fishery in Canadian waters led to an impasse within the Commission to approve catch limits for the 1991 halibut fishery at that year's Annual Meeting. The ensuing discussions led to a resolution, in which the Commission formed the HBWG I and charged the group with the following tasks:

1. Review of management measures being implemented in each country to control and reduce bycatch, and to advise the Commission on their adequacy;
2. Recommend additional measures that could be implemented to reduce bycatch; and
3. Determine appropriate target levels for bycatch reduction.

The HBWG I met six times during February-June 1991 to discuss these issues. A special meeting of the Commission took place in July 1991, where the report of HBWG I (Salveson et al. 1992) was reviewed and received. The report contained several recommended actions for Canada and the United States to reduce incidental mortality of halibut in non-target fisheries. The IPHC adopted the following recommendations and transmitted them to the member governments for action.

U.S. Fisheries

1. Bring all groundfish fisheries off Alaska under existing caps in 1992 and ensure that all fisheries adhere to specified bycatch controls.
2. Support development and expansion of incentive programs in 1992.
3. Promote a downwards ratcheting of caps starting in 1993 at 10 percent per year based on a rate or vessel quota incentive program. The goal would be to reduce mortality as far as possible over time consistent with the need to harvest the groundfish resources. The foreign fishery levels achieved in the mid-1980s shall provide an initial yardstick for monitoring success.

4. Measures to address the estimation and control of bycatch off the Washington-Oregon coast should be developed, but as of this time, no data exist on which to base bycatch management measures. We therefore recommend that the IPHC develop procedures for estimation of bycatch in this area, using the best available information, and incorporate these estimates into yield estimation.

5. Pending analysis of the 1990 observer data, incorporate revised mortality assumptions, rather than total bycatch amounts, for the Bering Sea/Aleutian Islands (BSAI) trawl fisheries in the IPHC staff procedure used to develop annual setline catch quotas.

Canadian Fisheries

1. The HBWG I recommends that the Canadian observer program be expanded to cover all bottom-trawl fisheries and that DFO undertake research to examine the viability of trawl caught halibut in Canadian waters. Further, that the results of the observer program, and relevant U.S. experience, be used to develop and implement a bycatch control and reduction program for Canadian waters.

General

1. Continue the HBWG I and develop a schedule, with review and check points, to track progress of the issues and solutions. The progress would then be reported to the Commission during its "interim" and "annual" meetings.

2. Support the research recommendations of the HBWG I.

3. Recognizing the uncertainties associated with present bycatch compensation procedures, the HBWG I recommends that the IPHC continue its research into the adequacy of present procedures and develop alternative methodology where necessary.

Halibut bycatch and the associated impacts have continued to be a topic of considerable focus by the Commission and the fishing industry in the intervening years. Since 1991, new programs for managing groundfish fisheries have been introduced by both countries. Advances in gear technology and monitoring have also occurred. Some of these changes are a result of the 1991 goals but others may not. Thus, at its 2010 Annual Meeting, the Commission reconstituted the HBWG II and assigned it three tasks:

1. Review progress on reduction of halibut bycatch mortality;
2. Review target levels for reduction identified by the HBWG I report in 1991; and
3. Examine how best to incorporate halibut bycatch mortality into halibut assessment and management.

The HBWG II met in Seattle, WA on August 11 and held conference calls on September 27, December 1 and 20, 2010 as it worked to meet its charge. Additionally, staffs of the U.S. National Marine Fisheries Service (NMFS), IPHC, and Fisheries and Oceans Canada (DFO) produced and reviewed numerous documents and analyses in support of the HBWG II deliberation. This report presents the results of those deliberations.

West Coast

Management Practices Implemented to Reduce Halibut By-Catch

Halibut allocation, whether for harvest by directed fisheries or bycatch in groundfish fisheries, has been a highly contentious issue within the Pacific Fishery Management Council (Pacific Council) process. Halibut bycatch has typically been managed and measured in conjunction with groundfish bycatch and has been managed by providing the allowance for incidental catch landings in the sablefish longline fishery north of Point Chehalis, Washington; in the salmon troll fishery through the Council's Catch Sharing Plan; and, by using trip limits to control the harvest of targeted groundfish species that have halibut bycatch associated with them. Prior to the implementation of the West Coast Groundfish Observer Program, which is administered by the National Marine Fisheries Service Northwest Fisheries Science Center (NWFSC), halibut bycatch estimates were fairly uncertain. Since the observer program began in 2001, coverage has increased in terms of higher sampling rates and the scope of fisheries covered and, as a result, halibut bycatch estimates have become increasingly robust.

Halibut Catch Sharing Plan and Incidental Fisheries

In 1988, the Pacific Fishery Management Council operated under its first annual Pacific Halibut Catch Sharing Plan. Allocations through this plan were to four fishery groups—tribal fishery, non-tribal commercial fishery, Washington sport fishery, and Oregon/California sport fishery. At this time, the Council chose to allocate the non-tribal halibut quota for Washington for the primary benefit of the recreational fishery. Therefore, the directed commercial fishery was restricted to the area south of Point Chehalis, Washington, which is at the southern tip of the mouth of Grays Harbor.

In 1995, the non-tribal commercial fishery allocation was divided into two components—the directed fishery south of Point Chehalis and the incidental landing allowance in the salmon troll fishery. In the late 1990s, the Council developed alternatives for establishing the primary sablefish fishery using a tiered limit system. The final plan for the tiered limit system and permit stacking provisions was adopted by the Council in November 2000.

There were some fishers who believed that the initial halibut allocation was unfair to those who had traditionally fished for halibut commercially off northern Washington, either as part of a targeted fishery or through the retention of incidental catch when targeting sablefish, which tend to intermingle with halibut. However, at the time the Catch Sharing Plan was first adopted, the Area 2A total allowable catch (TAC) had been about 500,000 lbs and it was acknowledged that, with a growing recreational fishery, it would be difficult to accommodate both sport and commercial fisheries. The 2A TAC remained fairly steady (i.e., 450,000-650,000 lbs) for ten years until 1998, when it increased to 820,000 lbs. With this higher TAC, some fishers thought that a Washington sport and incidental commercial fishery could both be accommodated.

This issue was addressed in November 2000 at the same Council meeting where the Washington Department of Fish and Wildlife (WDFW) recommended that, in years of higher halibut abundance, the Washington recreational allocation would be modified to accommodate landings of incidental catches in the directed sablefish fishery north of Point Chehalis. Specifically, in years when the Area 2A TAC is greater than 900,000 lbs, the primary directed sablefish fishery north of Point Chehalis was to be allocated the Washington sport allocation that is in excess of 214,110 lbs provided that a minimum of 10,000 lbs would be available (i.e., at least 224,110 lbs is allocated to the Washington sport fishery). This change to the Catch Sharing Plan was adopted by the Council and became effective in 2001.

In 2002, the Area 2A TAC increased to 1.31 million lbs making almost 90,000 lbs available for the incidental sablefish fishery. WDFW met with representatives from the primary sablefish fishery and the recreational fishery and developed a compromise whereby the allocation would still occur in years of higher halibut abundance, but the amount of the allocation would be capped at 70,000 lbs. The amount above 70,000 lbs would be transferred back to the Washington sport fishery. This was agreeable to all and the primary sablefish fishermen who indicated that, given the trend in the sablefish stock and the landing ratio applied, 70,000 lbs would likely accommodate most of their incidental catch.

From 2001 through 2009, participants in the primary sablefish fishery were allowed to retain incidental catches of halibut because the TAC in Area 2A was above 900,000 lbs in those years. However, in 2010, the 2A TAC decreased to 810,000 lbs, so there was no allocation made to accommodate incidental catches in the sablefish fishery. The sablefish fishery extends from April 1 through October 31 with associated halibut landings allowed beginning in May. Fishers are subject to a landing ratio of halibut (lbs) to sablefish (lbs) with up to two additional halibut per fishing trip to provide some flexibility in complying with the regulation or are subject to trip limits. The landing ratio or trip limit is adopted annually through the Council process in March; the ratio applied from 2004-2008 has been 100 lbs of halibut per 1,000 lbs of sablefish. In 2009, the 2A TAC was 950,000 lbs, which resulted in an incidental allowance of 11,895 lbs for the sablefish fishery; for ease of monitoring catches against such a low quota, a limit of 100 lbs of halibut per trip was adopted.

The salmon troll fishery begins in May and may have a second opener in July if sufficient salmon quota remains. Fishers are also subject to a landing ratio of halibut (number of fish) to Chinook salmon (number of fish) with up to one additional halibut (again, to provide flexibility in complying with the regulation), and an overall trip limit of halibut. Since 2000, with the exception of 2008, the landing ratio has been one halibut for every three Chinook salmon with an overall trip limit of 35 halibut.

Groundfish Bycatch Management

In 1999, the Pacific Council embarked upon a two-year facilitated strategic planning process for the West Coast groundfish fishery. Overcapitalization of the groundfish fisheries was readily acknowledged and the Council determined that a 50% reduction in harvest capacity in each sector was needed for long-term resource and economic sustainability. The plan recommended management and harvest policies to reduce capacity and take a precautionary approach to protect weak stocks, and the exploration of incentives to encourage fishermen to use bycatch friendly gear or avoid known areas of higher bycatch. One of the primary recommendations of the plan was to immediately implement an at-sea groundfish observer program to quantify total groundfish catch and mortality.

In May 2001, the National Marine Fisheries Service established the West Coast Groundfish Observer Program with the goal of improving estimates of total catch and discard. Observers were stationed in ports throughout the West Coast from Bellingham, Washington, south to Santa Barbara, California. Initial coverage goals were 10% of vessel trips; over time, this coverage level has increased to 20% to 30%. All vessels, regardless of size, are subject to mandatory coverage and vessel selection occurs randomly across six bimonthly periods each year. Annual reports for halibut bycatch are provided to the Pacific Council in September of each year and forwarded to the International Pacific Halibut Commission for consideration; annual reports for all other groundfish bycatch are posted on the NWFSC website.

In 2005, the Pacific Council adopted Amendment 18 to the West Coast Groundfish Fishery Management Plan. Amendment 18 described the Council's strategy relative to bycatch management as: 1) gather data through a standardized total catch reporting methodology (i.e., the West Coast Groundfish Observer Program); 2) use federal/state/tribal agency partners to assess these data through bycatch models

that estimate when, where, and with which gear types bycatch of varying species occurs; and 3) develop management measures that minimize bycatch and bycatch mortality to the extent practicable.

In general, the Council uses catch restrictions to constrain the catch of more abundant targeted stocks that co-mingle with other stocks, such as overfished species, in times and areas where higher abundance of such species are expected to occur or when and where overfished species are most vulnerable to a particular gear type or fishery. These time and area restrictions were established and implemented for overfished species protection, but some of them have likely reduced halibut bycatch as well. For example, trawl Rockfish Conservation Areas (RCAs) off Washington and Oregon extend from 75 fms to about 200 fms throughout the year, with an additional area closure from the shore to 200 fms north of Cape Alava (48°10' N. latitude), Washington. This has likely reduced halibut bycatch significantly as the area north of Cape Alava is an area of high halibut abundance. Conversely, the commercial longline RCA extends from the shore to 100 fms year-round off Washington and Oregon, which may provide halibut protection in the nearshore areas.

Monitoring Practices Implemented to Reduce Halibut Bycatch

West Coast Groundfish Observer Program

Established in 2001, the West Coast Groundfish Observer Program (WCGOP) provides at-sea observations to estimate total catch mortality, including halibut bycatch. The coverage level by gear type and fishery ranges from about 20%-30% for the groundfish bottom trawl, longline, and pot fisheries, and up to 100% for the at-sea whiting fishery (motherships and catcher-processors). Observer coverage is mandatory regardless of vessel length. Because coverage of the non-whiting groundfish fleet is typically a fraction of the vessels in a particular sector, their observations must be expanded using statistical methods in order to estimate total catch across a sector. For some sectors, there may not be any direct observation or reporting of bycatch or coverage is very sparse; in such cases, average bycatch rates developed from observations of similar gear types may be used to estimate bycatch. A description of the Pacific halibut sampling protocols currently used by WCGOP and proposed changes for the West Coast trawl individual quota program are contained in Appendix 2.

Electronic Monitoring and Logbooks

The Pacific Council has considered the use of electronic monitoring methods (i.e., video cameras), and implemented a pilot program with the midwater trawl whiting fleet, which has a maximized retention component. Electronic monitoring could be useful in determining bycatch of some species, but not others (e.g., overfished rockfish), which tend to look alike. Currently, the Council has decided to not use video cameras in place of human observers, but will continue to explore the feasibility of electronic monitoring techniques for potential future application.

Relative to logbooks, a mandatory paper logbook system is in place with a high degree of compliance, but bycatch is typically not recorded. An electronic logbook system may be developed and implemented in the future.

British Columbia

Management Practices Implemented to Reduce Halibut Bycatch

The commercial groundfish fishery consists of seven fisheries: Lingcod, Dogfish, Rockfish outside, Rockfish inside, Halibut, Sablefish, and Groundfish Trawl. These fisheries are managed through a system of TACs, individual transferable quota (ITQs), caps and restrictions and include multiple licence categories, harvesting more than 20 different species. Historically management had been species-specific and monitoring was limited. The hook and line and trap fisheries were required to have approximately 10% to 15% of the vessels in the fishery use at-sea monitoring, either through an on-board observer or electronic monitoring (EM). The complexity of differently regulated single-species fisheries combined with the lack of accurate reporting of catches and releases, led to significant conservation concerns; of particular concern was the discard of bycatch. The practice of releasing fish at sea occurred because fleets were unable to restrict their harvest to their target species and the conditions of licence did not permit retention of the incidental catch. As such, harvesters were required to release most of their incidental catches. Harvesters had no incentive to accurately report their catch and the mortality associated with discarding, which was not fully monitored, raised conservation issues. To address these growing management problems, in 2003 DFO established principles to guide the development of a new management plan for groundfish. Those principles were:

a) All groundfish catch must be accounted for
b) Catches are managed according to established groundfish management areas
c) Harvesters are individually accountable for their catch
d) New monitoring standards will be established and implemented
e) Species and stocks of concern will be closely examined and actions such as reduction of TACs and other catch limits will be considered and implemented to be consistent with the Precautionary Approach

Stakeholders were advised that these five guiding principles must be met for the management of the commercial groundfish fisheries. Stakeholders were encouraged to develop a management proposal to address these principles by 2006 or alternatively, DFO would implement its own plan. In 2006 the Commercial Groundfish Integration Pilot Program (CGIPP), developed by the guidance of the Commercial Industry Caucus (CIC) stakeholder group, was introduced to address these principles. The Commercial Groundfish Integration Program (CGIP) was completed and made permanent in 2010. Essentially there are six critical components to the CGIP: the implementation of ITQs; the ability to retain other species that were previously identified as bycatch and discarded; individual vessel accountability; quota transferability between fisheries; new stock management areas, consistent between fisheries; and improved catch monitoring. Each is described in more detail below, with the exception of catch monitoring which is discussed in a later section.

<u>Establishment of Individual Transferable Quotas for All Groundfish Fisheries</u>

Rather than "racing for fish", harvesters are allocated a share of the TAC to be harvested during a predefined season. Known as Individual Transferable Quotas, these shares allow a harvester to maximize value and fishing safety by choosing when to fish (i.e. during optimal weather and market conditions). Moreover, to maximize value of their asset (ITQ) harvesters now have an incentive to improve the health of he resource.

The three fisheries not previously managed using ITQs (rockfish, lingcod, and dogfish) had ITQs introduced in 2006 for both directed and most non-directed catch. Generally speaking ITQs were only allocated to a licence for the target species (e.g. halibut quota allocated to a halibut licence), so to if

harvesters were to be accountable for all their catch, ITQs for target and non-target species must be transferable between all licence types. The trading of quota operated under the principle of willing buyer/willing seller. In addition to the trading of ITQs, effort controls such as trip limits were established for both quota and non-quota species (not all groundfish species have a TAC) continue to be used.

Ability to Retain Other Species

As described above, harvesters are held accountable for all their catch under the CGIP. Previously, the conditions of licence would not permit the retention of incidental catches, but under the CGIP harvesters are permitted to retain other groundfish species within monthly and annual limits. Table 1 illustrates the species each groundfish fishery is now permitted to retain.

Table 1. Summary of management techniques under the CGIP

Fishery	Management techniques by species group		
	Directed species	Rockfish	Other groundfish
Halibut	ITQs	Trip limits and annual vessel caps	Trip limits and annual vessel caps for sablefish, lingcod and dogfish
Sablefish	ITQs	Trip limits and annual vessel caps	Trip limits and annual vessel caps for halibut, lingcod and dogfish
Rockfish Outside	ITQs	n/a	Trip limits and annual vessel caps for sablefish, halibut, lingcod and dogfish
Rockfish Inside	ITQs	n/a	Trip limits and annual vessel caps for sablefish, halibut, lingcod and dogfish
Lingcod	ITQs	Trip limits and annual vessel caps	Trip limits and annual vessel caps for sablefish, halibut and dogfish
Dogfish	ITQs	Trip limits and annual vessel caps	Trip limits and annual vessel caps for sablefish, lingcod and halibut

The rationale for imposing limits on the amount of incidental catches by each fishery was Principle 9 in the original CIC proposal, which called for fishing fleets to protect the autonomy of their directed fishery (Diamond Management Consulting Inc., 2005). Essentially, each fishing fleet did not want others "targeting" fish considered incidental to their fishery. Limits were placed to require harvesters to be accountable for their incidental catch while participating in their directed fisheries.

Individual Vessel Accountability

Harvesters are required to acquire quota to cover the mortality for all catches, including those fish released at sea while fishing. Harvesters not acquiring quota or fishing within the prescribed limits outlined within the Integrated Fisheries Management Plan (IFMP) are unable to continue fishing. While variables such as gear types and the times and locations of fishing trips affect the amount of incidental catch intercepted, it is possible for a harvester to plan his/her fishery in such a way as to be able to expect and

account for a specified amount of incidental catch. Due to their high mortality rate, all rockfish caught while fishing must be retained; for all other species, a harvester can choose to either retain or release legal size fish. If released, the harvester is responsible for the mortality associated with releasing that fish, which varies by species and gear type. A harvester's behaviour is the most significant factor in his ability to access quota for incidental catch.

Quota Transferability Between All Groundfish Fisheries

To enable harvesters to account for all groundfish catch mortality, including fish released at sea, quotas need to be transferable between fisheries (different licence types). Reallocation of quotas between fisheries is only temporary (for the duration of one season), and limits have been placed on how much quota a licence can acquire. These limits are in place in part due to the autonomy of the sector described above, but also to keep incidental species quotas available and ensure that harvesters fish selectively.

For example, the commercial halibut TAC (including a "carryover" of some uncaught quota from the previous season) in the 2010 season for halibut was 6,598,560. A portion of the TAC is made available to each of the other sectors at the beginning of the season to allow each harvester to be individually responsible for their halibut catch, irrespective of the fishery in which it is caught. Table 2 illustrates the breakdown of the halibut quota that was acquired by each of the other commercial groundfish fishing sectors during the 2010 fishing season.

Table 2. Approximate total of acquired halibut quota by the hook and line sectors during 2010 fishing season (pounds).

Sector	Acquired Halibut Quota
Halibut	6,194,466
Sablefish	84,854
Rockfish Inside	661
Rockfish Outside	179,216
Lingcod	7,015
Dogfish	137,611
Total	6,603,823

Quota transfers are managed through a system of quota caps which place restrictions on the amount and method with which ITQ can be transferred. When a licence's catch exceeds its ITQ holdings, this is known as "overage". Overage is permitted, but only to a certain extent. If the amount of overage exceeds a defined amount, then this is "excess overage". Excess overage occurs when a license exceeds its total species ITQ holdings by more than 30% (or 10% in the case of rockfish inside licences and 10% of verified remaining quota for halibut licences) or 100 pounds (400 pounds for halibut licences), whichever amount is greater. When a vessel is in excess overage, it is restricted from fishing for the remainder of the year, or until sufficient ITQ has been reallocated to cover any overages. If at the end of the season, a licence has uncaught ITQ remaining, it may carryover a portion of this ITQ over into the next season and have the amount added to its total ITQ holdings.

In addition, individual fleets have developed annual vessel caps that provide sufficient incidental catch to pursue the target fishery but will not allow for the accumulation of large amounts of incidental quota on any one licence. Table 3 shows the various licence caps in place, as they pertain to halibut.

Table 3. 2010/2011 hook and line halibut quota caps

Licence	Caps
Lingcod Schedule II	Quota Holdings Cap: A licences halibut quota may not exceed 15% of the licence's Lingcod quota.
Dogfish Schedule II	Quota Holdings Cap: A licences halibut quota may not exceed 5.8% of the licence's dogfish quota.
	Quota Landings Cap: A license may land 23,000 pounds halibut if less than 200,000 pounds dogfish has been landed; 46,000 pounds halibut if less than 400,000 pounds dogfish has been landed.
	Trip Limits: Halibut landings may not exceed 30% of dogfish landed per trip during March 6-June 15 & Sept 15-Nov 15; landings may not exceed 20% of dogfish landed per trip during June 16-Sept 14 & Nov 15-Feb 20.
Rockfish Inside (ZNI)	Licence Species Cap: Temporary reallocations of up to 3,500 pounds halibut are allowed.
	Trip Limits: Limit of 800 pounds halibut per trip.
Rockfish Outside (ZNO)	Quota Landings Cap: A license may land 7,500 pounds halibut if less than 20,000 pounds rockfish has been landed; 10,000 pounds halibut if 20,000-40,000 pounds rockfish has been landed; 15,000 pounds halibut if 40,000-60,000 pounds rockfish has been landed; 20,000 pounds halibut if more than 60,000 pounds rockfish has been landed.
Sablefish (K)	Licence Species Cap: Temporary reallocations of up to 65,466 pounds halibut are allowed.
	Trip Limits: Landings (fresh, dressed head-off weight) may not exceed 15% of sablefish (round weight) landed per trip.

Consistent Management Areas

One of DFO's guiding principles included the establishment of common management areas. Prior to the CGIP, there were varying management areas for different fisheries and for different species. Common management areas allow DFO to manage stocks by area, which will improve stock assessment for groundfish species. Lastly, common management areas are especially critical when all species quotas are transferable between fisheries.

Halibut Bycatch Management in the Trawl Sector

The trawl industry has implemented a number of measures to reduce halibut bycatch that have evolved over the past 15 years. In 1995, the DFO created a three year plan to reduce halibut bycatch within the fishery. In 1995, a Pacific halibut bycatch mortality cap of 600,000 pounds was introduced for the Hecate Strait Area, which was then extended in 1996 to include the west coast of Vancouver Island with an additional 380,000 pounds. The Hecate Strait mortality cap was monitored on a quarterly basis; halibut mortality was calculated by applying a mortality incidence rate to any landed halibut. This method had been used in previous years to estimate halibut bycatch mortality. By September, estimates showed that the cap had been exceeded in Hecate Strait. As a consequence, a full review was carried out on all groundfish catches, especially those with a set TAC, which revealed that most TACs had also been reached or exceeded. All of area 2B was closed to the trawl fishery on October 1, 1995.

Fisheries and Oceans Canada held a series of meetings with the Groundfish Trawl Advisory Committee (GTAC) to initialize the development of a management plan that would allow year-round fishing, but would also ensure the conservation of groundfish species. By February 1996, the management plan was finalized. As a result of this plan, a number of monitoring measures were implemented. These included 100% at-sea monitoring through on-board observers, continued dockside monitoring, and individual vessel bycatch limits for halibut. The objectives of this plan were:

a) Provide more reliable information on removals
b) Reduce the quantity of fish discarded and wasted
c) Minimize incidental catches of non-target species, i.e. halibut & sablefish
d) Promote "cleaner" fishing practices
e) Allow a year-round fishery
f) Individual Accountability

In 1997 implementation of commercial ITQs in the groundfish trawl fishery was introduced, as well as the final expansion of the halibut bycatch mortality cap to include the entire coast of area 2B. The groundfish trawl fishery continues to operate under the coastwide bycatch mortality cap, which is 454 tonnes, or 1,000,000 pounds. The bycatch mortality cap is not part of the commercial TAC, and is not transferable to other groundfish fisheries where halibut can be retained .

The current management of trawl halibut bycatch is described under the Halibut Bycatch Management Plan, which is outlined in the groundfish IFMP. Under this plan, halibut bycatch is reduced through a series of caps, bycatch ITQs, and overage and underage carryovers, as follows:

a) Halibut Prohibition: Halibut caught while fishing under the authority of a groundfish trawl licence cannot be retained and must be returned to the water as quickly as possible.
b) Halibut Mortality Fleet Cap: For the 2010/2011 season, the halibut bycatch mortality cap for the trawl fleet is approximately 454 tonnes, or 1,000,000 pounds. All estimated halibut bycatch mortality will be deducted from a vessel's individual cap.
c) Halibut Species Mortality Cap: No trawl licence can permanently hold more than 4% of the total halibut bycatch mortality cap for the trawl fleet. No licence can temporarily hold more than 8% of the halibut bycatch mortality cap for the trawl fleet.
d) Halibut Bycatch Reallocation: Uncaught halibut bycatch mortality ITQ can be reallocated, subject to rules stated above. Halibut bycatch ITQ is not considered part of the groundfish trawl vessel's groundfish ITQ holdings for holdings cap calculations/limits.
e) Halibut Bycatch Quota Overage: Halibut catch in excess of a vessels individual halibut bycatch cap will result in the vessel being restricted to mid-water species coast-wide for the remainder of the year, or until additional halibut bycatch cap is reallocated on the license.
    a. Halibut overages in the current year will be deducted from the groundfish trawl licences halibut bycatch mortality cap allocation the following year.
f) Halibut Bycatch Underage: A trawl license can carry forward up to 15% of their halibut bycatch mortality holdings that are uncaught into the next season.

Monitoring Practices Implemented to Reduce Halibut Bycatch

Timely and accurate information on harvesting practices, catch composition and location is essential to assess the status of fish stocks and ensure the conservation and long-term sustainability of fish resources. While the previous dockside monitoring program (DMP) allowed for all landed catch to be verified, at-sea monitoring is also essential for incidental catch -- catch which may not be landed and for which DFO would

otherwise have little or no fishery data. As such, in 2006 with the CGIP DFO commenced a new standard for all commercial groundfish fisheries of 100% at-sea monitoring. This was in addition to the already existing 100% DMP requirement.

Monitoring Program within the Hook and Line/ Trap Fisheries

Although a limited monitoring program existed for the hook and line fisheries since 1991, in 2006 additional monitoring practices to reduce bycatch and the associated mortality were introduced. The current comprehensive hook and line monitoring program include:

a) Hail-out and hail-in
b) 100% at-sea monitoring; either through an onboard observer or electronic monitoring (EM) system
c) Logbooks
d) Dockside Monitoring Program (DMP)
e) Audit process

Prior to leaving port, vessels must hail-out to a service provider and state which fishery the vessel will participate in. Vessels must have quota for their target species prior to hailing out. Once a fishing trip has commenced, vessels are required to have 100% at-sea monitoring, which is comprised of either an onboard observer or an EM system. Both the observer and the EM system record information on latitude and longitude, date, haul start and end times, fishing depths, retained and release species. If a vessel is equipped with an electronic monitoring system there are requirements that must be met; the system must be fully operational for the entire duration of the trip, the system must remain on at all times, and the cameras must have a clear view of the fishing area at all times. If these requirements are not met, the vessel may be required to carry an onboard observer on subsequent fishing trips. While fishing, all releases must take place within view of the camera equipment. While releasing any sub-legal sized halibut, a measurement grid may be used to provide proof that the fish is indeed sub-legal. If the grid is not used during the release, the halibut will be considered legal size and the corresponding mortality rate will be applied. The licence holder is responsible for acquiring quota to cover all mortality. All halibut that are caught, whether retained or released, must be accurately recorded by piece and estimated weight in the fishing log. Fishing logs must also record the date, time, and location that the fishing event took place.

Before completion of the trip, the vessel must hail-in. A dockside observer will meet the vessel at the dock; landing cannot begin until the observer is present. The observer will separate, count by piece and weigh all retained species of fish using the dockside weight verification system. All fish landed are verified and recorded in the Groundfish Validation Log, and halibut are converted to a net dressed, head-off weight. Retained halibut are tagged and recorded by the observer. Once the validation is complete, the observer will compare the weight of all validated fish to the licence's remaining ITQ. If the vessel is deemed not to be in excess overage of any species of fish, the observer will provide the vessel with a Quota Status Verification Number (QSVN), which will be required during the vessels next hail-out. If the vessel is in excess overage, it will not be permitted to fish again (no QSVN issued) until sufficient quota is reallocated to cover the overage.

The catch monitoring program requires all vessels fishing within the hook and line and trap fisheries to have at-sea monitoring either via onboard observers or EM. EM technology incorporates a system of onboard cameras integrated with GPS and other onboard electronic sensors. Harvesters are required to record all retained and released catch by piece and by location within their logbooks. Ten percent of the camera footage is viewed to check the accuracy of the harvesters' logbook. The data collected at the DMP, which verifies only catch that is retained and landed, is also used to audit the logbook. If a logbook is found not to

accurately represent actual catch seen on the video footage or the DMP, 100% of the camera footage is reviewed at the individual harvester's expense. If it is found that a vessel's logbook consistently does not match with the camera footage, the vessel will be required to take an onboard observer on future trips.

An audit is performed after each fishing trip has been completed and validated. The purpose of the audit is to verify the accuracy of the logbook; the observed catches and releases from the electronic footage are compared to the logbook records, and a trip score is assigned based on the accuracy of the logbook. The service provider for groundfish monitoring, randomly selects and reviews electronic video footage for 10% of the sets from each trip. If the score is below an acceptable threshold it may result in further action been taken, e.g. being required to take an at-sea observer or 100% video footage review, both at the expense of the harvester. If the logbook matches the video footage within an acceptable range, the logbook becomes the official record of all species caught, both retained and released, for the trip.

Monitoring Program within the Groundfish Trawl Fisheries

Some monitoring practices in the trawl sector had already been established prior to the CGIP. The 100% Dockside Monitoring Program was made mandatory in 1994, and 100% at-sea observer coverage was implemented in 1996. The monitoring practices employed by the trawl industry include:

a) Hail-in and hail-out
b) Log books
c) 100% at-sea monitoring; either through an onboard observer or EM, depending on the licence category
d) Dockside Monitoring Program
e) Audit process

Prior to the beginning of a trip, a trawl vessel must hail-out and inform the service provider of its intentions. During the trip, all vessels are required to have 100% at-sea monitoring. Within the trawl fishery there are two different categories of trawl license, classified as either Option A or Option B. Option A and B differ slightly in regards to at-sea monitoring as seen below:

a) Option A: Option A vessels are permitted to mid-water trawl coastwide, and bottom trawl in all waters excluding the Strait of Georgia. These vessels are subject to 100% at-sea observer coverage.
b) Option B: Option B vessels are permitted to fish by bottom trawl only within the Strait of Georgia. These vessels employ 100% electronic monitoring, which was implemented in 2007.

If a halibut is caught while trawling, the observer will assess the condition of the halibut before it is released back into the water. The observer will examine several features of the halibut, such as operculum movement, colour of the gills, and liveliness. The observer will then assign a corresponding mortality rate that has been established by the IPHC, and will record the mortality in the observer logbook. The observer logbook also records information on latitude and longitude, haul start and finish time, date, start and end depths, area, target species, catch, and other important features. The vessel master must also maintain a logbook. For those vessels that use EM (Option B vessels), the same conditions for EM apply as in the hook and line industry; the camera equipment must be fully functional for the entire duration of the trip, the system must remain on at all times, and it must have a clear view of the fishing area at all times.

Prior to landing, a vessel must hail-in and inform the service provider of its intentions to dock. A dockside observer will meet the vessel at the dock; landing cannot begin until the observer is present. The observer will piece count and weigh all retained fish, confirming that no halibut have been retained. After

validation by the DMP has occurred, the groundfish monitoring service provider finalizes the catch record. At-sea observer data undergoes a complex audit process, with a series of checks, to ensure that the data is valid. DMP data is then correlated with the observer data, and catch is then assigned to the appropriate management area and vessel. The finalized information is then forwarded to the vessel master as a Quota Status Report (QSR) with 48 hours of offload completion. Option B vessels also undergo an audit process. The groundfish monitoring service provider reviews 100% of the video footage to identify any at-sea releases. If any halibut is retained by a trawl vessel, a compliance report will be filled out and will be followed up by Conservation and Protection (C&P). If necessary, certain enforcement measures can be taken depending on the severity of the infraction. These can range from sending a letter to the fisher to imposing fines or pursuing legal action.

Alaska

Management Practices Implemented to Reduce Halibut Bycatch

The North Pacific Fishery Management Council (Council) manages commercial fisheries for groundfish, crab, scallop, and salmon under separate FMPs under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (MSA). Council recommendations are approved, partially approved, or rejected by the National Marine Fisheries Service (NMFS), acting on behalf of the Secretary of Commerce, under the authority of the MSA.

The GOA Groundfish FMP became effective on December 11, 1978, and the BSAI Groundfish FMP became effective on January 1, 1982. The initial GOA FMP contained halibut bycatch limits for the fully domestic fishery, whereas the BSAI FMP did not. Generally, the GOA groundfish regulatory areas overlap IPHC regulatory areas 2C, 3A, and 3B; the BSAI groundfish regulatory areas overlap IPHC regulatory Area 4. The Council manages Pacific halibut allocations in federal regulations under separate authority of the North Pacific Halibut Act.

The Council is guided by ten national standards[1]. The Council often must balance competing standards in developing its fishery management policies. In managing North Pacific groundfish fisheries to achieve their optimal yields, the Council also strives to minimize bycatch, and the mortality associated with such bycatch. The Council designated several fully utilized species, including Pacific halibut, as prohibited species upon implementation of its two groundfish FMPs over 30 years ago. Each groundfish FMP has been amended several times since implementation, with several of the amendments containing provisions regarding halibut bycatch limits. This section provides an overview of these bycatch reduction measures.

> ***National Standard 1.*** *Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.*
>
> ***National Standard 9.*** *Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.*

[1] http://www.nmfs.noaa.gov/fishwatch/management.htm

Halibut Longline Fishery

The Council allocates Pacific halibut in areas 2C, 3A - B, and 4A – E based on catch limits set by the IPHC. The Pacific halibut longline fishery was one of the first fully domestic fisheries to become established off Alaska. By 1990, the halibut and sablefish longline fisheries were exhibiting significant problems created by open access derby-style fisheries. With the constant influx of new entrants into the fishery, the fishing seasons had been reduced to several short seasons each year, with halibut seasons lasting only a day or two in some areas. The short seasons created a number of problems, including allocation conflicts, gear conflicts, dead loss from lost gear, increased bycatch and discard mortality, excess harvesting capacity, decrease in product wholesomeness, safety concerns, and economic instability in the fisheries and fishing communities.

The Council adopted individual fishing quota (IFQ) programs in 1992 for the Pacific halibut and sablefish fixed gear fisheries, which were implemented in 1995. The programs assign the privilege of harvesting a percentage of the sablefish and halibut quotas to specific individuals with a history of harvest in the fisheries. The 'rights' given to each person are proportional to their fixed gear halibut and sablefish landings during the qualifying period and are represented as quota shares (QS). Only persons holding QS are allowed to make fixed gear landings of halibut and sablefish in the regulatory areas identified on the permits.

The effect of the two IFQ programs was an immediate reduction in halibut bycatch allowances of 400 mt, or 882,000 lb, each year. Instead of being caught and potentially discarded, these catches are retained using IFQs.

Commercial Groundfish Fisheries

As domestic groundfish fisheries developed and foreign fishing was phased out in the 1980s, federal regulations were implemented to limit bycatch of halibut so as to minimize impacts on the domestic halibut fisheries. Interception of juvenile halibut (~30 cm and greater) often occurs in trawl fisheries targeting other groundfish species (such as rock sole, pollock, yellowfin sole, and Pacific cod). Incidental catch of halibut also occurs in groundfish hook and line and pot fisheries. Regulations require that all halibut caught incidentally must be discarded, regardless of whether the fish is living or dead.

The Council recommends annual catch limits and allocations for commercial groundfish fisheries for 133 species managed under 22 management categories in the BSAI and 121 species and 25 categories in the Gulf of Alaska (GOA). Commercial groundfish quotas in the BSAI are capped at a 2 million mt, or 4.4 billion lb, optimal yield (OY) by the US Congress. Commercial groundfish quotas in the GOA are set at about 300,000 mt, or 660 million lb, each year. Flatfish quotas are set well below the acceptable biological levels (ABCs) due to the BSAI OY cap and halibut bycatch constraints in both areas.

Control of domestic bycatch of halibut

Regulations to control halibut bycatch in domestic groundfish fisheries were implemented initially as part of the GOA groundfish fishery management plan (FMP) in 1978 and the BSAI groundfish FMP in 1982. These regulations reflected some of the time-area closures in effect for foreign trawl operations. The GOA fisheries were also monitored under halibut bycatch limits. Restrictions on domestic operations were relaxed and revised as the domestic groundfish fishery developed, consistent with the desire to enhance development of this fishery. Beginning in 1985, annual halibut prohibited species catch (PSC) limits were implemented for the groundfish trawl fisheries, attainment of which triggered closures to bottom trawl gear. In 1990, regulatory authority was also implemented to limit halibut bycatch in GOA fixed-gear fisheries. Seasonal allocations of halibut PSC limits also are authorized. Their attainment will close the GOA to further fishing with the applicable gear type for the remainder of the season.

Other measures that have reduced halibut bycatch include seasonal and area allocations of groundfish quotas for selected target species, seasonal and year round area closures, gear restrictions, careful release requirements, public reporting of individual bycatch rates, and gear modifications. Examples of the latter include biodegradable panels and halibut excluder devices that are required on all groundfish pots. While the groundfish FMPs allow the Council to set the season start dates to accommodate fishery interests, it has relied on the seasonal apportionments of halibut PSC limits to take advantage of seasonal differences in halibut and some groundfish fishery species distributions. Gear restrictions are specified to reduce bycatch or bycatch mortality of halibut. Restrictions include (a) requiring biodegradable panels on groundfish pots, (b) requiring halibut exclusion devices on groundfish pots, and (c) revised specifications for pelagic trawl gear that constrain the pelagic trawl fisheries for groundfish to a trawl gear configuration designed to enhance escapement of halibut.

Prohibited Species Catch Limits

Fisheries off Alaska targeting groundfish incidentally catch non-groundfish species. Some of these non-groundfish species are themselves the objects of valuable targeted fisheries. These species include Pacific halibut, Chinook and "other" salmon, several crab species, and herring. Provisions to prohibit the retention of these species by foreign fleets were incorporated in early FMPs for GOA and BSAI groundfish (hence the expression "prohibited species"). The Council has adopted numerous management measures to reduce halibut bycatch in groundfish fisheries.

Bycatch limits, referred to in the FMPs and federal regulations as prohibited species catch (PSC) limits, have been used to control the bycatch of halibut in the groundfish fisheries off Alaska since the initial groundfish FMPs were developed. These PSC limits are intended to optimize total groundfish harvest under established PSC limits, taking into consideration the anticipated amounts of incidental halibut catch in each directed fishery. They are apportioned by target fishery, gear type, and season. Essentially, these bycatch limits direct fisheries, by area or time, to regions where the highest volume or highest value target species may be harvested with minimal halibut bycatch. When any fishery exceeds its seasonal limit, directed fishing for that species must stop, and the species may not be retained incidentally in other directed fisheries. All other users and gear remain unaffected. Reaching a PSC limit results in closure of an area or a groundfish directed fishery, even if some of the groundfish (particularly flatfish) TAC for that fishery remains unharvested.

Federal regulations also establish allocations of the BSAI halibut PSC limit between the community development quota (CDQ) and non-CDQ fisheries and a process for apportioning PSC among non-CDQ fisheries. The BSAI halibut PSC limit is set in regulation and the GOA halibut PSC limit is set annually through the groundfish harvest specifications process; neither is tied to halibut abundance.

Halibut PSC limits in the GOA are specified at 2,300 mt. The total is allocated: a) 2,000 mt (or 3.3 million lb net wgt.) to trawl gear (implemented in 1985) and b) 300 mt (or 500,000 lb net wgt) to fixed gear (implemented in 1990). The FMP originally allocated 750 mt (or 1.2 million lb net wgt.) for fixed gear but this was reduced as a result of implementation of the halibut and sablefish IFQ programs in 1995. Halibut PSC limits in the BSAI are set in regulations at 4,526 mt. The total is allocated: a) 3,626 mt (6 million lb net wgt.) to trawl gear and 900 mt (1.5 million lb net wgt) to fixed gear. The Bering Sea trawl halibut PSC limit was reduced by 100 mt (165,000 lb net wgt) in 1999 when the Council adopted a requirement that only pelagic trawls can be used in the BSAI pollock fishery. While the total has not been reduced, allocations to the trawl sector will be reduced to 3,475 mt by 2012 for a net savings in halibut mortality in excess of 300,000 lb net wgt.

Groundfish pot gear is exempted from halibut bycatch restrictions because (l) halibut discard mortality rate and total mortality associated with this gear type is relatively low; and (2) existing pot gear restrictions are intended to further reduce halibut bycatch mortality. Halibut PSC limits are for dead fish only. Most halibut taken as bycatch are juveniles, so the loss is viewed not just as immediate tonnage, but also as fish that would have grown larger and recruited into the directed halibut fisheries.

A PSC limit in a fishery is essentially a common property quota[2]. Although the purpose is to limit PSC, the effect of the cap is to create a quota that accommodates unavoidable incidental catches, but strictly forbids the retention of PSC by the participants in the target fishery. Access to a PSC limit is highly competitive. The PSC limit for a fishery can become an effective limit on the target fishery, preventing the TAC from being completely harvested. This situation sets up "perverse" economic incentives that encourage individual vessels to "race" to catch their intended target species before the fishery's collective PSC limit is taken and the fishery closed. This race results in excessively rapid catch of PSC and the early closure that participants fear. PSC limits quickly led to numerous and expensive groundfish fishing closures. These closures have significant economic impacts on joint venture and domestic flatfish fisheries in the BSAI, domestic pollock and Pacific cod fisheries in the BSAI, and domestic hook-and-line and non-pelagic trawl fisheries in the GOA. Closure of these fisheries has resulted in an economic loss estimated to be in the tens of millions of dollars in groundfish fishing revenues, based on the amount of groundfish TAC that remained unutilized.

The "race for the fish," and attendant high PSC rates, occur because the competition created by PSC limits do not encourage individual fishing operations to take full account of their actions when they make fishing decisions (a "common property externality"). An operation that fishes with high rates of associated PSC ("dirty" fishing), seeking only to maximize its target catch rate, obtains a benefit that accrued to it alone: a larger share of the total groundfish catch (i.e., increased catch per unit effort, lower cost per unit catch). But, the operation does so by hastening the closure of the groundfish fishery. If the closure came before the target groundfish TAC was fully caught, society incurs a cost associated with the value of the foregone groundfish (unharvested TAC). The operation that was fishing dirty would bear some small share of this cost, but much of it would be distributed across other operations in the fishery. However, the dirty operation realizes a direct economic benefit from its actions and offsets its share of this cost through its higher catch per unit of effort (CPUE) as compared to clean fishermen in the fleet. By shifting a large part of its "net" bycatch costs to other operations, a dirty operation has no incentive to control PSC rates.

If all the operations in a targeted groundfish fishery controlled their PSC, the fishery could operate longer and produce larger volumes of fish for the participants. However, an operator that chose not to control PSC while all others did, would be able to "free ride" on the efforts of those fishermen that incurred the cost of PSC controls. This creates a perverse incentive structure that effectively subverts PSC reduction efforts by any single operation. Without appropriate incentives for an individual operation, a group of fishermen will fail to take actions that would have positive net benefits for them as a group.

To directly limit the bycatch of prohibited species, the Council and NMFS have supported numerous actions to establish PSC protection areas, encourage bycatch reduction, and improve the selectivity of fishing gear:

- Amendments 12a and 18 (54 *FR* 19199) introduced PSC limits into groundfish management in the BSAI and GOA Groundfish FMPs, respectively. PSC limits were established and apportioned among fisheries based on gear or target species. Once a fishery had taken its PSC limit for a given species,

[2] This section was adapted from NMFS (2008).

directed fishing for the target species was closed. The program was introduced for part of 1989 and all of 1990.

- Amendments and 16 and 21 to the BSAI and GOA Groundfish FMPs, respectively, (56 *FR* 2700) would have created incentives for individual fishing operations to control their PSC rates. The incentive program was referred to as the "penalty box" program; it would have required operations in a fishery to "maintain a four-week average bycatch rate less than two times the concurrent fleet average in each of the fisheries and for each of three bycatch species. Failure of a vessel to meet such bycatch rate standards would result in a suspension of the vessel from the Alaskan groundfish fishery (placement in the penalty box) for a period ranging from five days to six weeks." The Secretary did not approve the penalty box program because of legal considerations; however, he did approve other measures, including a trawl prohibition at all times within the Pribilof Island Habitat Conservation Area to eliminate trawl activities in areas of importance to blue king crab and Korean hair crab stocks, so that the stocks could rebuild, and to reduce bycatch of juvenile halibut and crab, and mitigate and unobserved mortality or habitat modification that occurred due to trawling.

- Regulatory amendments (56 *FR* 21619) implemented a vessel incentive program (VIP) in the BSAI and GOA to replace its rejected penalty box program.

- Amendments 19/24 to the BSAI and GOA Groundfish FMPs (57 *FR* 43926) reduced the 1992 halibut PSC limit established for BSAI trawl gear from 5,333 metric tons (mt) to 5,033 mt, but retained the primary halibut PSC limit at 4,400 mt; 2) established a 750 mt PSC limit for BSAI fixed gear in 1992; and 3) established FMP authority to develop and implement regulatory amendments that allow for time/area closures to reduce prohibited species bycatch rates (revised "hotspot authority"). A number of regulatory amendments were adopted: 1) revised BSAI fishery definitions for purposes of monitoring fishery specific bycatch allowances and assigning vessels to fisheries for purposes of the VIP; 2) revised management of BSAI trawl fishery categories for PSC accounting; 3) expanded VIP to address halibut bycatch rates in all trawl fisheries; 4) delayed the season opening date of the BSAI and GOA groundfish trawl fisheries to January 20 of each fishing year to reduce salmon and halibut bycatch rates; 5) further delayed the season opening date of the GOA trawl rockfish fishery to the Monday closest to July 1 to reduce halibut and Chinook salmon bycatch rates; and 6) changed directed fishing standards to further limit halibut bycatch associated with bottom trawl fisheries.

- BSAI Groundfish FMP Amendment 50 (63 *FR* 32144; 66 *FR* 53122): Donation program of incidentally caught halibut to food banks was implemented in 1998. Since then approximately 614,500 portions have been provided.

- GOA Groundfish FMP Amendment 59 (65 *FR* 30559; 65 *FR* 67305; 66 *FR* 8372): Prohibited fishing in important fish habitat areas.

- GOA Groundfish FMP Amendment 60 (67 *FR* 34424; 67 *FR* 70859): Prohibited the use of trawl gear in Cook Inlet.

- GOA Groundfish FMP Amendment 68 (71 *FR* 27984; 71 *FR* 67210): Central GOA Rockfish pilot program implemented a 5-year catch share program (CSP) in 2007 for several rockfish species, sablefish, and Pacific cod to mid-sized trawl and fixed gear vessels with shore-based and at-sea fleets that form cooperatives; it further divided allocations to catcher vessel (CV) and catcher/processor (CP) sectors. Catcher vessel incidental catch and discards of halibut has been reduced substantially.

- BSAI Groundfish FMP Amendment 79 (71 *FR* 17362): Established a minimum groundfish retention standard and required all non-American Fisheries Act (AFA) trawl vessels greater than or equal to 125 ft LOA to use flow scales and carry two observers.

- BSAI Groundfish FMP Amendment 80 (72 *FR* 21198; 72 *FR* 30052): Allocated specified target species and PSC catch limits to non-AFA catcher trawl processors and facilitated the formation of fishery cooperatives.

- GOA Groundfish FMP Amendment 88 (pending Secretarial review) would allocate permanent catch shares to Amendment 68 cooperatives. It would reduce the GOA halibut PSC limit by 27.4 mt, or 60,000 lb. To create an incentive for further halibut mortality reductions, 55 percent of any cooperative's unused halibut allowance would be available for use in the 5th season trawl fisheries. The remaining halibut allowance would remain unused for that fishing year.

- Issuance of an exempted fishing permit to test a new device designed to reduce halibut PSC bycatch in trawl gear.

- Use and research of halibut excluder devices in the trawl fishery.

- Installation of vessel monitoring systems to assist enforcement of numerous regulatory measures.

- Voluntary industry bycatch control measures (e.g., Sea State, Inc.).

Failed Management Attempts to Control Halibut Bycatch in the late 1980s and 1990s

After the Council had approved the penalty box program (FMP Amendments 16/21) NMFS determined that there were substantial revisions to observer information after observers from sea and were debriefed, their data edited and finalized. At the time, the final data might not have been available for up to six months after a fishing week. Because enforcement of the penalty box program could only be based upon corrected data, in-season action against vessels that failed to meet acceptable bycatch rate standards could not be taken (NMFS 1990). The penalty box program also failed to conform to requirements of other applicable law, including the Administrative Procedure Act (APA). The APA requires that regulations be reasonable and effective. The observer data were insufficient to determine whether variability of PSC rates allowed the use of four-week fleet averages as a basis for legally acceptable standards (NMFS 1990).

Following the Secretary's rejection of the penalty box program, the Council adopted the VIP in November 1990. The Secretary issued an interim final rule implementing the VIP on May 10, 1991 (56 *FR* 21619). The VIP bycatch rate standards applied only to the non-pelagic pollock fishery because halibut PSC rates were low in the pelagic pollock fishery. To avoid excessive PSC rates, non-pelagic pollock trawl fishermen reconfigured their nets as pelagic gear, but continued to fish the gear on the bottom. In June 1992 the Council and NMFS addressed this problem through an emergency rule that applied VIP requirements to the pelagic pollock fishery. The final rule became effective in 1993 and extended the VIP to all trawl fisheries in the GOA and BSAI. The Council viewed the extension of the VIP "as a means of decreasing the inequities between vessels in different fisheries which contributed to the same halibut bycatch allowances." It also tightened the regulation to prevent vessels from manipulating fishing targets in order to be excluded from the VIP.

NMFS was required to publish fishery-specific bycatch rate standards for halibut in the GOA and BSAI two times a year. Observer data on the catch composition of harvests in subject fisheries was

statistically analyzed. Vessels that exceeded the published standards were subject to prosecution. As a practical matter, only groundfish trawl vessels carrying observers were subject to the VIP. The trawl fisheries that were subject to the VIP requirement included two GOA fisheries (midwater pollock and other trawl) and four BSAI fisheries (midwater pollock, yellowfin sole, bottom pollock, and other trawl).

Enforcement actions could be taken if a vessel's bycatch rate for a fishing month exceeded the standard established for that fishery. The VIP imposed potential costs on fishermen with high observed prohibited species bycatch rates. This created an incentive for fishermen to reduce these observed rates by changing the patterns of their fishing behavior or by manipulating the observer reported rates. The incidence of these illegal actions was unknown, but may have been serious.

Effective enforcement of the VIP imposed significant costs on NMFS. Furthermore, the establishment of fishery cooperatives and the stringent catch monitoring provisions implemented by NMFS to monitor cooperative-specific allocations of groundfish and prohibited species, including halibut and red king crab, are other means to reduce bycatch. Cooperative members receive a joint allocation of PSC, and this creates incentives and capabilities for cooperatives to control individual operation PSC bycatch rates to maximize the value of the cooperative's PSC allocation better than occurred under the VIP.

Prior to 2003, publication of the bi-annual bycatch rate standards was expedited to the final rule by using the "good cause" exemption in the APA. The good cause waiver allows an agency to forgo publication in the *Federal Register* for a 30-day public comment period before a rule is promulgated. This waiver can only be used if notification and public comment "are impracticable, unnecessary, or contrary to the public interest." In spring 2003 NMFS concurred with NOAA General Counsel that the rationale on which a good cause waiver of prior notice and opportunity to comment had been based did not constitute adequate justification for such a waiver. Without use of the waiver, NMFS could not publish bycatch rate standards for the second half of 2003, because of the time and resources needed for notice, public comment, and analysis. VIP bycatch rate standards have not been published since the first half of 2003.

With this record, the Council initiated an amendment in 2003 to repeal the VIP given concerns about its effectiveness, its potential to absorb resources that could be utilized by other, more important management and enforcement functions, the incentive created for pre-sorting of bycatch, and developments in other bycatch reduction programs that have occurred since 1991. The Council approved withdrawal of VIP in 2006. The VIP was withdrawn from federal regulations in 2008 (73*FR* 12898).

Table 4. VIP Chronology

1990	Jan	Implementation of required Observer Program
1991	May	Interim final rule published in *Federal Register* on May 10, effective on May 6 First violation that will be prosecuted occurs
	Jun-Jul	Second and third violations that will be prosecuted occur
	Sep	Fourth violation that will be prosecuted occurs
1992	Sept	Final rule published that expands VIP to include halibut PSC in all trawl fisheries
1993	May	Fifth and last violation that will be prosecuted occurs
1999		Last warning letter sent out in Fall
2003	June	VIP bycatch rate standards for second half of 2003 are not published Council votes to consider repeal of the VIP during its October meeting
	Oct	Council approves alternatives outlined in the NMFS discussion paper about VIP

	Dec	Council reiterates its approval of the alternatives outlined in the NMFS VIP discussion paper
2006	Oct	Council performs initial review of the EA/RIR/IRFA and releases it for public review.
	Dec	Council takes final action, adopting Alternative 3, Option 2.

Other Programs Considered (but not adopted) by the Council

Halibut Mortality Avoidance Program (HMAP)

Between 1998 and 2002 the Council considered a system to reduce halibut bycatch mortality by allowing deck sorting of halibut under a controlled and verifiable protocol. Trawlers would limit the length of their tows and carefully remove halibut from the catch as soon as the net is on board. Observers would count and measure halibut before releasing them. Deck sorting was proposed to lower halibut mortality but also produce more accurate estimates of halibut taken in a fishery. Several studies were conducted by NMFS and industry partners under experimental fishing permits. In 2002 the SSC concluded based on a contracted Council analysis that the HMAP proposal is not feasible under existing levels of observer coverage. The HMAP proposal requires that observers monitor the on–deck sorting of halibut bycatch for each haul. This would have greatly increased the complexity and amount of the observer's workload, placing halibut mortality assessment as the highest priority for observer activity, requiring that observers work in a potentially unsafe environment, and increasing the potential for conflict between observers and vessel crew. The HMAP proposal could not be implemented without increasing the number of observers on participating vessels.

Vessel Bycatch Accountability (VBA)

In the late 1990s the Council tasked a committee with developing a pilot program for Vessel Bycatch Accountability, along with a HMAP pilot program and developing options for setting PSC caps for cooperatives in non-pollock fisheries, as part of the American Fisheries Act amendment measures. Ultimately, the VBA initiative was subsumed in the development of several CSPs (as noted below).

Individual Vessel Checklist Program (IVCP)

In the late 1990s the Council also tasked its bycatch committee with investigating vessel based bycatch reduction programs, along with HMAP, VBA, and other PSC limit reduction programs. Ultimately elements of IVCP were examined for incorporation into CSPs, where applicable to improve monitoring and reduce bycatch.

Voluntary Industry Efforts

Several fishery participants have voluntarily modified their gear or fishing behavior to reduce halibut bycatch in order to increase their target fishery catches. Evaluations of these efforts are summarized for the Pacific cod longline and the flatfish trawl fisheries.

Hot-spot analysis

The Bering Sea flatfish and cod fisheries have reduced halibut bycatch rates through the use of a data-sharing program called Sea State since 1995. Under this system, fishermen share bycatch rate information

depicted on charts detailing vessel-specific bycatch rates and "hotspots" on a daily basis. The small number of participants (~25) and the transparency of vessel-specific bycatch performance allow it to function reasonably well with only informal agreements between fishermen determining when they should leave a given area based on relative or absolute bycatch rates. The program works best with a limited number of entrants. Bycatch avoidance is reduced when peer pressure becomes more difficult as participants begin to doubt that the savings in terms of additional fishing opportunity from bycatch savings will accrue to the ones who incurred the sacrifices. This is a classic case where the lack of assigned rights to catch and bycatch tends to allow individual profit maximization incentives to prevail even when such behavior decreases total yields and overall revenue.

A critical factor in the success of bycatch management in the Bering Sea flatfish fishery is the relatively predictable and consistent spatial patterns in bycatch locations that emerge within seasons and annually that does not exist in the GOA. The system works overall, however, because there are generally reasonable alternative areas for fishermen to relocate fishing effort to reduce bycatch while achieving acceptable target catch rates. So peer pressure works because fishermen are rarely faced with "no win" situations wherein to achieve lower bycatch rates they must necessarily accept lower target catch rates.

Pacific cod longline fishery

The Freezer Longline Coalition has implemented a voluntary cooperative in the GOA since 2006. The Freezer Longline Coalition Cooperative (FLCC) negotiated which vessels could fish and what share of the halibut PSC limit each boat would be allocated to harvest. The suballocation of the PSC limit was determined by subtracting the estimated halibut needs of the shoreside hook-and-line sector from the remaining hook and line cap amount prior to the fishery.

The FLCC contracted with Fisheries Information Service (FIS) and now SeaState, Inc. to monitoring trends in real-time target catch (usually cod) and halibut bycatch in the hook-and-line sector. An ancillary function is to collect and analyze halibut viability data. All federally permitted freezer-longliners participate in the monitoring program. SeaState downloads observer information on daily catch and bycatch rates from NMFS. Detailed information about vessel-specific totals (and halibut cap remainders) to-date, bycatch rates (ratio of halibut to cod), estimates of end-date based on recent catches, and a graphic showing progression of halibut catch toward the boat cap is sent to boat and/or boat manager on a daily basis. Information is provided weekly to the entire fleet and NMFS in-season managers.

The efforts of the FLCC to assign direct responsibility for halibut bycatch reduction to individual vessels resulted in a reduced halibut discard mortality rate (DMR) from 13 percent to 11 percent for 2010-2012 for the Pacific cod longline fishery. The DMR is calculated by the IPHC using observer information and adopted by the Council every three years (and based on a ten-year moving average). Figure 1 shows the difference in assumed rates vs. actual rates achieved by the FLC cooperative. Additional background on bycatch avoidance practices by the freezer longline fleet can be found in Smoker (1996).

	2006	2007	2008
assumed DMR	13.00%	14.00%	14.00%
Coop actual* DMR	12.30%	4.56%	6.94%
NMFS halibut mort. (metric tons)	113.95	49.99	72.73
Halibut mort. with actual DMR	107.79	16.28	36.07
Difference	6.16	33.71	36.66

*based on inseason observer data on sampled halibut condition

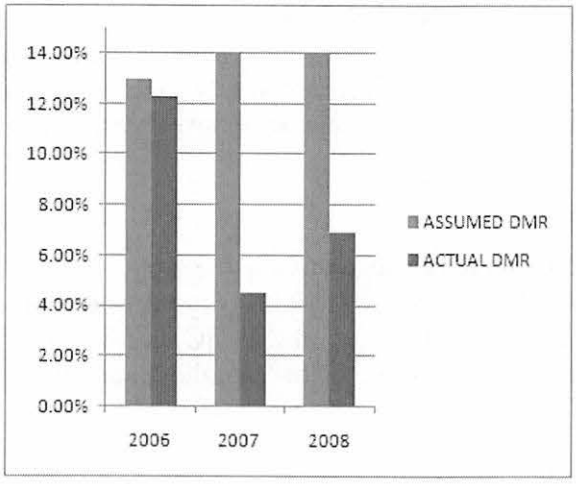

Figure 1. Halibut mortality data for GOA hook-and-line cooperative fisheries. (Source: FLCC)

Halibut Excluders

The reduction of halibut PSC allocations has created incentives for industry to investigate the use of halibut excluders and methods to reduce halibut mortality rates through improved handling procedures. Commercial trawl industry representatives have worked to develop bycatch excluders for use in trawl fisheries for flatfish and Pacific cod trawl fisheries in the BSAI and GOA. The potential for halibut excluders is particularly important in the Pacific cod fishery since, according to fishermen, Steller sea lion regulations have forced more cod fishing towards summer and early when halibut bycatch rates are high in the cod fishery (Gauvin 2008).

Several halibut excluder devices have been developed for trawl fisheries for flatfish and Pacific cod trawl fisheries in the BSAI and GOA. Rose and Gauvin (2000) and Gauvin and Rose (2000) reported on a rigid grate system and escape panel, which are installed ahead of the trawl codend to avoid catching halibut. In test trials in the GOA deepwater flatfish fishery because halibut and deep water flatfish are concentrated in the same areas and exclusion of halibut could dramatically increase harvest of the target species. Also the halibut caught in this fishery tended to be large, resulting in more halibut exclusion. The test gear excluded 94 percent of the halibut while releasing 38 percent of the target flatfish. Results of simulations of its use in the flatfish fishery estimated that fleet-wide use of the grate would result in a 171 percent increase in the duration of the fishery, a 61 percent increase in target flatfish catch, and a 71 percent reduction in overall halibut bycatch. Other simulations, demonstrated a high incentive for individual non-compliance without a rationalized fishery.

Gauvin (2004) studied the tradeoffs of target catch rates (flatfish) and halibut bycatch in Central GOA trawl fisheries. He examined the potential for gear modifications to reduce halibut bycatch rates while increasing utilization of GOA flatfish resources within the available halibut PSC allowance. Results from the study concluded that there are differences in the usage ratios of target catch to halibut for different GOA fishing areas and within different target fisheries. These differences were seasonal, with the relative strength and repeatability of between-area and within-season patterns being an unresolved question for improving the efficiency of flatfish yields against PSC usage. He drew some general observations from experience with the BSAI flatfish trawl fleet.

- The GOA flatfish fishery faces greater challenges in terms of finding areas where tradeoffs between target and bycatch rates can be achieved. This observation is based primarily on the relative degree of consistency and predictability of target catch and halibut bycatch rates by area for the flatfish fisheries of the Bering Sea relative to the Central GOA.

- Catch and bycatch trends the Bering Sea flatfish fishery appear less-variable both in terms of the range of catch rates for target species and the range in halibut bycatch rates from season-to-season and year-to-year at the core fishing locations.

- The cod fishery in the GOA and Bering Sea are similar in several respects. For instance, the GOA and Bering Sea cod fisheries appear to have relatively similar catch and bycatch rates in terms of the range from high to low. Additionally, they both have a few core areas that tend to offer clearly better tradeoffs in terms catch rates and halibut bycatch usage. However, the GOA cod fishery, had fishing areas with a variety of rates for catch and halibut bycatch spread over a larger number of relatively small and discrete locations. This is not the case for the Bering Sea where cod fishing tends to occur in three basic locations: Unimak Pass, the Slime Bank, and south and west of the Pribilof Islands. The differences in the catch rates and halibut bycatch rates between these areas are relatively small and generally predictable from year-to-year and within seasons.

Gauvin (2004) also reviewed the halibut excluder devices tested in the BS and GOA for the flatfish and cod fisheries. He concluded that the use of "soft" halibut excluders on shoreside trawlers could increase utilization under a CSP, with potential for increases in flatfish yields as halibut bycatch rates declined. Remaining selectivity and usage issues could be ameliorated with additional field testing for some species; however, fisheries for arrowtooth flounder and flathead sole continue to appear problematic for halibut bycatch reduction due to similar average size of arrowtooth flounder, flathead sole and halibut. He reported limited success with the use of spreading bars has provided some success for achieving the proper surface for sorting panels made of square mesh webbing. More recent work re-considering some of the previous HMAP type approaches demonstrated that mortality could be reduced, but there was a high labor cost.

Dr. Craig Rose with the NMFS Alaska Fishery Science Center also worked with industry to design a halibut excluder for the Pacific cod trawl fishery, based on the excluder designed for the flatfish fishery. The square openings were replaced with circular openings. This configuration was effective for large halibut, but it was necessary to add new components to exclude small halibut and skates. The main challenge in applying the flatfish excluder device to cod fisheries was that cod are much more similar in size and swimming ability to halibut than are sole. Thus, a square hole or mesh large enough to allow all cod to pass would only exclude the very largest halibut. The different body shapes of these fish were considered a characteristic that could be exploited for separation. Excluders were constructed with rigid circular holes in the selection panels because rigid circular holes, sized for the largest cod, had the best chance of excluding smaller halibut (Rose undated). Gulf of Alaska tests released 80 percent of the halibut while retaining an average of 85 percent of the cod.

Monitoring Practices Implemented to Reduce Halibut Bycatch

Alaska Regional Catch Accounting System

Halibut PSC estimation methods used in the Alaska Region Catch Accounting System (CAS) were designed to provide in-season point estimates of catch that enable managers to monitor and manage fisheries within prescribed limits. For example, in-season managers need to estimate and monitor PSC in multiple management scenarios, including PSC quotas that are part of CSPs (e.g., Amendment 80 and CDQ cooperatives; industry-formed cooperatives) and halibut PSC that is allocated to an open access fishery that is specific to species, gear, and processing modes. Estimation methods were developed to balance the near-real time requirements of in-season management while being specific to fishery attributes associated PSC allocations. The CAS database is designed such that PSC estimates are summed to an account that reflects groundfish fisheries with in-season monitoring of halibut PSC limits. These accounts are often specific to attributes such as target species, season, management program, gear, and reporting area. The CAS uses complex algorithms with associated data assumptions that cannot be captured in a brief overview. Readers are directed to Cahalan et al. (2010) for a comprehensive description of PSC estimation methods and reporting tools used in CAS.

Halibut mortality rates are applied to the total estimated halibut discard for a gear type, FMP area (GOA or BSAI), fishery, and year. Mortality rates are derived from the estimated condition of halibut sampled by observers (Williams 2010a). The halibut mortality rates are determined periodically by the IPHC and are specific to the condition of the halibut. The pre-determined mortality rates are applied to the subsequent fishery regardless of actual fleet performance. Improved performance would lower future rates.

As described above, groundfish catch information used for halibut PSC estimation is often based on industry-based reporting. Vessels in Federal or State fisheries report groundfish landing and production through a web-based interface known as eLandings. In 2005, NMFS, ADF&G, and the IPHC implemented eLandings to reduce reporting redundancy and consolidate industry-reported fishery landing information. There is also a stand-alone application available for the vessels fishing and processing catch at sea (the at-sea fleet). The at-sea fleet submits eLandings files via email. Each industry report submitted via eLandings undergoes error checking by NMFS. Data are then stored in a database and made available to the three collaborating agencies.

There are two basic eLandings report types used for catch estimation: production reports and landing reports.

- At-sea production reports are mandatory for CPs and motherships that are issued a Federal Fishing Permit (FFP). At-sea production reports include information about the gear type used, area fished, and product weights (post-processed) by species. As of 2009, the at-sea fishing fleet has submitted these reports daily. Prior to 2009, these reports were submitted weekly. Shore-based plants also complete production reports, but these are not discussed since they are not used for halibut PSC estimation.

- Landing reports are required when a CV makes a delivery to a shoreside plant or a mothership. Upon making a landing, a representative of the shoreside plant or mothership submits the landing report into eLandings and a paper "fish ticket" is printed for both the processor and the CV representative to sign. The collection period for a landing report is a trip for shoreside processors and a day for each CV that delivers to a mothership. A trip for CVs delivering to a shoreside processor is defined as the time period between when fishing gear is first deployed and the day the vessel offloads groundfish

(50 CFR 679.2). Landing reports are mandatory for all processors required to have a Federal processing permit, including motherships who receive groundfish from federally permitted CVs.

Observer Program

The Fisheries Monitoring Division of the Alaska Science Center operates the North Pacific Groundfish Observer Program (Observer Program). The current Observer Program generally covers groundfish vessels greater than 60 feet in length over-all (LOA) and governed under a FFP. The amount of observer coverage described in regulation is broadly divided into three categories: Vessels less than 60' are not required to carry observers; vessels between 60' and 125' LOA are required to carry observers 30 percent of their fishing days; and vessels greater than 125' must have all fishing days observed. Vessels between 60' and 125' make up the majority of vessels fishing groundfish in the GOA and out of ports other than Dutch Harbor and Akutan in the BSAI. Regardless of length, vessels that are associated with CSPs, such as Amendment 80, AFA, and RPP, are required to carry an observer whenever the vessel is fishing. Many of the larger processing vessels now carry 2 observers at all time to ensure round the clock observation.

Observer information represents the only at-sea discard information available to estimate mortality of halibut in Alaska groundfish fisheries and is central to understanding catch activity in waters off Alaska. Observer data from observed vessels are assumed to be representative of the activity of all vessels (observed and unobserved), and are used to estimate total incidental catch of prohibited species (halibut) for the entire fishery. In addition, observers collect lengths and sample halibut viability and injury, which are used to assess halibut mortality estimates for groundfish fisheries. Further, observer information is used extensively in management analysis, halibut stock assessment, and in-season forecasting of PSC limits.

In 2010 the Council recommended restructuring the observer program for vessels and processors that are determined to need less than 100% observer coverage in federal fisheries, including previously uncovered sectors such as the commercial halibut sector and <60' groundfish sector. NMFS would contract directly with observer companies to deploy observers according to a scientifically valid sampling and deployment plan, and industry would pay a fee equal to 1.25% of the ex-vessel value of the landings included under the program. NMFS will have the flexibility to deploy observers in response to fishery management needs and to reduce the bias inherent in the existing program. The industry sectors that are determined to need ≥100% coverage would be included in the 'full coverage' category and continue to meet observer coverage requirements by contracting directly with observer companies under the status quo service delivery model. These vessels and processors include: CPs and motherships; CVs while fishing under a management system that uses PSC limits in conjunction with a catch share program; and shoreside and floating processors when taking deliveries of AFA and CDQ pollock.

The Council would not require 100% coverage on CPs <60' with a history of CP and CV activity in the same year or any CP with an average daily production of less than 5,000 lb in the most recent full calendar year of operation prior to January 1, 2010. These vessels would make a one-time election as to whether they will be in the <100% coverage category and pay an ex-vessel value based fee, or in the ≥100% coverage category and pay a daily rate directly to observer providers for coverage. This will provide some flexibility for the smallest class of catcher processors, and those vessels that currently operate as both a CP and CV during the year.

All other CV sectors, including those participating in the halibut and sablefish IFQ program, would be included in the partial coverage category (<100% coverage) and pay the 1.25% ex-vessel fee. No observer coverage is planned for vessels <40' length overall in the first year(s) of the program. The new program would not be implemented earlier than 2013.

Logbook Program

While not used for PSC estimation, the NMFS logbook program has been in place since 1991 and has largely been used for enforcement purposes. Paper logbooks are required to be completed and submitted for federally permitted vessels over 60' in length that are fishing for groundfish and for vessels that are 25' and over in length fishing for IFQ halibut. Catcher vessels and CPs that participate in both the groundfish fishery and sablefish or halibut IFQ fishery during the same fishing year are allowed to submit a single combined NMFS/IPHC logbook. Haul-specific information, including date and time, location, vessel estimates of total catch and species-specific catch, fishing gear, fishing depth, and at-sea discard are recorded in the logbook. These data are not available electronically and are not used in catch estimation.

A small number of vessels are currently participating in an electronic logbook program. This program was implemented in 2003 and involves 12 voluntary participants. Expansion of electronic logbooks would provide haul-specific effort information on unobserved vessels and the information could be useful for halibut discard estimation or observer deployment processes in the future.

Electronic Monitoring

NMFS and industry having been working together to evaluate the potential for video monitoring to augment observer information (Cahalan et al. 2010b, Kingsolving 2006, Bonney and McGauley 2008, Bonney et al. 2009). In 2008, NMFS, NPRB and the NPFMC conducted a workshop to assess the state of EM technology across the nation and internationally (AFSC, 2008). One session discussed past pilot studies conducted in the US and Canada. Other sessions included industry perspectives, legal, management, and enforcement concerns, and research and development advancements. The workshop concluded with a synthesis of the discussions of the workshop. The major outcomes of the workshop were that EM may have potential in the North Pacific but the applicability depends on the specific objectives of the program that must be monitored and potential directions for further investigation of EM.

Most EM work in Alaska to date has been focused on the compliance monitoring, with some tests of EM efficacy for fisheries management. Currently, EM has limited potential as a biological data collection tool. EM will likely not be able to collect age or sex information, but as the technology advances may be able to provide species and length information. Video has been implemented through regulations in two programs: as a tool to monitor pre-sorting in the Amendment 80 program and to monitor Chinook salmon bycatch under Amendment 91.

Summary of Evaluations of Current Management Practices, Accuracy of Data Collected from Monitoring Programs and Areas of Improvement

West Coast

The Pacific Council completes a biennial management process every even-numbered year for the following two years (e.g., measures adopted in 2010 will apply to 2011 and 2012). Through this comprehensive process, new stock assessments are completed and independently reviewed and management practices, monitoring and sampling programs, and bycatch modeling techniques are evaluated by the Council's Groundfish Management Team. In addition, the Pacific Council's receives annual reports from the National Marine Fisheries Service, Northwest Fisheries Science Center, on the halibut bycatch estimates in the trawl and fixed gear fisheries. These reports are reviewed by the Council's Scientific and Statistical Committee (SSC) in September of each year. The Final Environmental Impact Statements for the biennial

management process, annual halibut bycatch estimate reports, and the SSC's comments are posted on the Pacific Council's website.

Additional reports produced by the Pacific Council and others to evaluate current management practices and/or data collected through monitoring programs are listed below in chronological order:

Sampson, D. B., P. R. Crone. (Eds.) 1997. Commercial fisheries data collection procedures for U.S. Pacific coast groundfish. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-NWFSC-31, 189 p.

Pacific Fishery Management Council. 2000. Groundfish Fishery Strategic Plan, "Transition to Sustainability." Pacific Fishery Management Council, Portland, OR. October 2000.

Harms, J., G. Sylvia. 2001. A Comparison of Conservation Perspectives Between Scientists, Managers, and Industry in the West Coast Groundfish Fishery. Fisheries, 26:6-15.

National Marine Fisheries Service. 2003. West Coast Groundfish Observer Program Initial Data Report and Summary Analyses. Northwest Fisheries Science Center, Seattle, WA.

National Marine Fisheries Service. 2004. West Coast Groundfish Observer Program Data Report and Summary Analyses for Sablefish-endorsed Fixed Gear Permits. Northwest Fisheries Science Center, Seattle, WA. February 2004.

National Marine Fisheries Service. 2004. West Coast Groundfish Observer Program Data Report and Summary Analyses. Northwest Fisheries Science Center, Seattle, WA. January 2004.

Pacific Fishery Management Council and National Marine Fisheries Service. 2005. Amendment 18 to the Pacific Coast Groundfish Fishery Management Plan, Bycatch Mitigation Program. Pacific Fishery Management Council, Portland, OR. November 2005.

Punt, A. E., M. W. Dorn, M. A. Haltuch. 2008. Simulation Evaluation of Threshold Management Strategies for Groundfish off the U.S. West Coast. Fisheries Research.

Pacific Fishery Management Council and National Marine Fisheries Service. 2010. Rationalization of the Pacific Coast Groundfish Limited Entry Trawl Fishery; Final Environmental Impact Statement Including Regulatory Impact Review and Initial Regulatory Flexibility Analysis. Pacific Fishery Management Council, Portland, OR. June 2010.

Heery, E., M. A. Bellman, J. Majewski. 2010. Pacific Halibut Bycatch in the U.S. West Coast Groundfish Fishery from 2002 through 2009. National Marine Fisheries Service, West Coast Groundfish Observer Program, Seattle, WA. August 2010.

Areas for Improvement

One major area of concern is with respect to management of bycatch, particularly for overfished species, as the Pacific Council's efforts have focused on drafting and implementing rebuilding plans for overfished rockfish and minimizing bycatch through the use of trip limits and time and area restrictions. Total catch accounting for target species and bycatch has been difficult to achieve with the limited amount of monitoring at-sea (20-30%). However, the Council's trawl individual quota program with 100% at-sea observer coverage is expected to provide individual accountability for catch, including impacts to overfished species and halibut.

British Columbia

Summary of Evaluations of Current Management Practices

Prior to the introduction of ITQs, TACs in the groundfish fishery were often exceeded. For example, in the 1980's TACs in the British Columbia halibut fishery were exceeded in 8 out of 10 years (Casey et al. 1995). Following the implementation of ITQs in the halibut fishery in 1991, the TAC has never been exceeded in the commercial fishery. In addition, since the CGIP began in 2006, all rockfish catches have been below the set TAC (DFO 2009). The same can also be seen for other groundfish species; DFO year-end summary reports show that the total quota for any groundfish species has not been exceeded since the CGIP was implemented (Mawani 2009). Table 5 below shows that for the 2008/09 and 2009/10 fishing seasons, the total halibut catch did not exceed the total amount of quota. This also includes the mortality associated with released legal size fish.

Table 5. Halibut quota and catch in pounds for the hook & line sector in 2008/09 to 2009/10

	Sector	Halibut	Sablefish	Rockfish Inside	Rockfish Outside	Lingcod	Spiny Dogfish	Total
2008	Total Quota	7,744,715	41,211	655	152,051	15,567	225,992	8,180,191
	YTD Catch	7,253,422	45,017	651	118,484	12,427	219,791	7,649,792
Percent of Total Quota								**93.52**
2009	Total Quota	6,318,373	48,103	427	143,665	11,528	207,800	6,729,896
	YTD Catch	6,121,372	72,164	483	138,975	10,890	203,487	6,547,371
Percent of Total Quota								**97.29**

Since the implementation of ITQs, there has been a marked difference in the levels of catch and bycatch. Prior to ITQs, the "derby" style fishery resulted in "...excessive fishing capacity, very short seasons, unsafe fishing operations, large quantities of bycatch being wasted..." (E.B. Economics 1992). When ITQs were introduced into the halibut fishery in 1991, the fishing season was extended from 10 days in 1989 (the TAC was exceeded by 95 tonnes that year) to 250 days (Mawani 2009). The benefits of ITQs extend across both the hook and line fishery and the trawl fishery. In regards to the trawl fishery, Grafton et al. (2005) states that "... changed fishing practices in response to economic incentives have also reduced the annual bycatch mortality for halibut to about 15% of its previous level, dropping from around 900 tonnes to a little over 100 tonnes since the introduction of ITQs." Figure 2 seen below shows the estimates of halibut bycatch mortality from all sources throughout British Columbia. It can be seen that bycatch mortality rates were generally increasing through the late 80's, with a peak occurring in 1991. After 1991, there is a decrease in halibut bycatch mortality, with the most dramatic decrease occurring from 1995 (1,522,000 pounds) to1996 (299,000 pounds). The bycatch mortality rate has remained fairly consistent since 1995. These numbers correlate well with the introduction of ITQs within the fisheries. In 1991 ITQs were introduced into the halibut fishery, and in 1996 individual vessel bycatch limits for trawl vessels were implemented, which then became halibut bycatch ITQs.

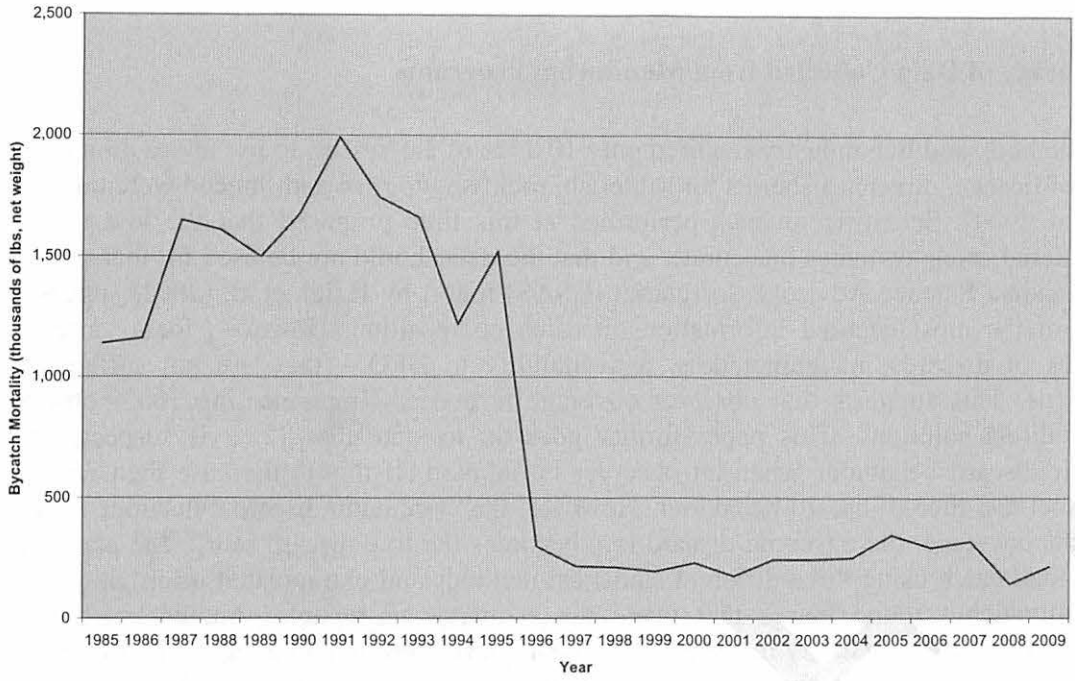

Figure 2. Estimates (thousands of pounds, net weight) of bycatch mortality of Pacific halibut from all sources in British Columbia (Area 2B) for 1985 through 2009. (Source: Williams 2010b)

The introduction of halibut bycatch limits within the Trawl fleet that required individual harvesters to account for their bycatch and as such significant reductions in catch were realized. This is illustrated in Figure 3. Prior to the implementation of this bycatch limit the groundfish trawl catch of halibut was in excess of 2 million pounds as seen in Figure 3.

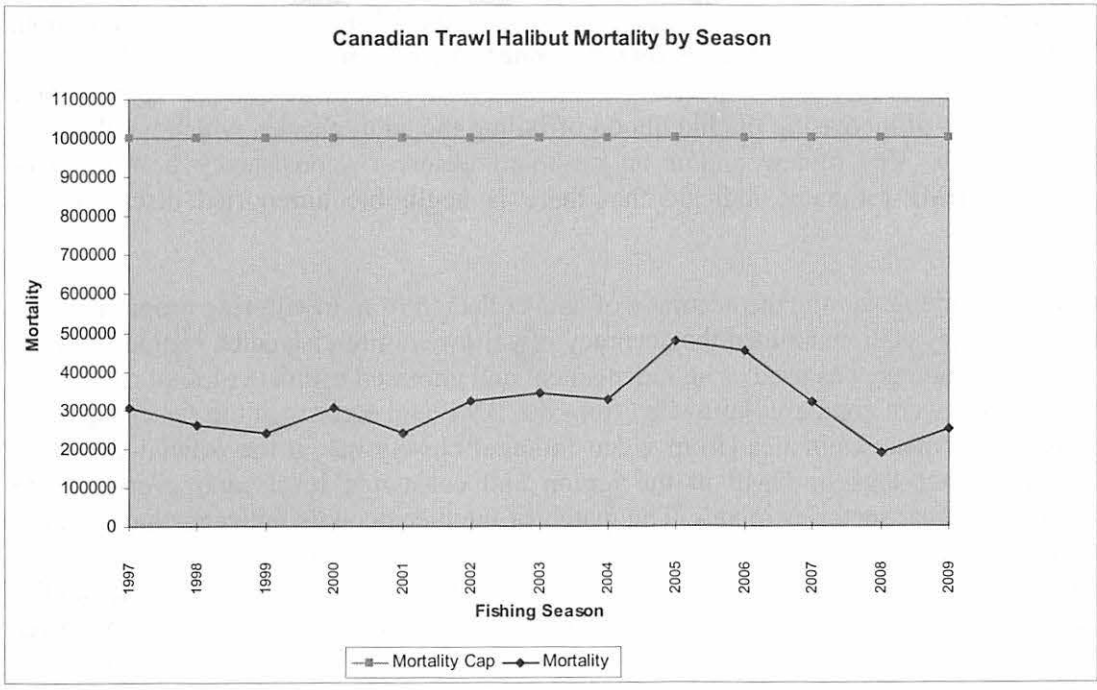

Figure 3. Trawl bycatch mortality (pounds) from 1997 to 2009.

Summary of the Accuracy of Data Collected from Monitoring Programs

Before 2006, the hook and line industry required only 10-15% of the vessels to use at-sea monitoring. Under the conditions of licence, directed fisheries for sablefish, rockfish, dogfish and lingcod were unable to retain halibut (Mawani 2009). Scientific reviews performed at this time proposed that the low level of observer coverage rendered catch estimates inaccurate, and that the data should not be used for management (Mawani 2009). A Canadian Science Advisory Secretariat (CSAS) report by Haigh et al. (2002) suggested, "... [fisher logs] record the most detailed information on catch composition. However, for a variety of reasons – no estimates of discards, incompleteness, unavailability to DFO – they are not sufficient to determine total removals. This suggests that observer coverage is needed. Implementing 100% observer coverage is the most direct solution". This paper further goes on to state that, "...it is suspected that fishermen change their discard behaviour when an observer is onboard. If this is the case then observer records accurately reflect the altered discard behaviour. However, the systematic discard behaviour remains unknown. Under 100% coverage, the observed discard rate becomes the true discard rate". The paper also attempted to estimate total catch using three different statistical methods and extrapolated information from partial at-sea observations, but found biases that made the estimates un-reliable. Another such study concludes that improved catch accountability in fisheries can be achieved through an integrated observer and EM monitoring program, by providing higher fleet coverage and more randomly distributed fleet sampling (McElderry et al. 2003).

Electronic monitoring has shown to be an effective method of observation, but without any enforcement, i.e. an audit process, it would not be able to provide accurate catch numbers. The electronic footage captures any discarding that occurs while fishing, but there is still a possibility that fishers may discard before unloading at the dock. When combined, the Dockside Monitoring Program and the video audit are effective tools to ensure that no illegal discarding has occurred. A study performed by Stanley et al. (2009) shows that the DMP results and reviewed EM footage generally match the total fisher log counts for yelloweye rockfish. Furthermore, most fishers receive a passing score in the DMP and fishing log validation. An evaluation of the CGIP done by DFO in 2009 states that: "...concerns [regarding cheating] can be abated by measures within the monitoring program. It is perceived that harvesters would be unlikely to bias their logbooks or DMP records for fear of increasing the likelihood of failing the audit checks, which would incur the cost of 100% video footage (VF) review and/or an on-board observer...consistency between VF-estimates, the fisher log and DMP-estimates indicate that there is negligible unreported discarding or dumping."

Studies have been completed to examine the accuracy of data collected from monitoring programs. One study conducted in 2009 by Stanley et al. examined the accuracy of yelloweye rockfish catch estimates in the CGIPP. In this study, EM video footage was used as an independent and unbiased estimate of total catch. The catch estimates from this footage were compared to results from the DMP and records in the fisher log. One point noted by Stanley is "...the mean estimates [from video footage] closely match the official estimates provided as the sum of the fisher logs or DMP at the region and coastwide levels and even provide reasonable matches for the individual sector estimates. The match of the piece counts indicates that the total weights reported in the DMP accurately reflect the actual total catch of yelloweye rockfish in the regions for these sectors." The results of this comparison can be seen below in table 6. In some cases, such as within the halibut and spiny dogfish sectors, the video footage estimates for yelloweye rockfish were found to be lower than the DMP totals; however, since the official estimates were higher, there was no risk posed to conservation. It is also noted that, "All of the official yelloweye rockfish estimates fall well within the 95% confidence limits of the VF estimates" (Stanley et al. 2009). Stanley goes on to conclude that the CGIP catch monitoring program provides accurate total catch estimates of yelloweye rockfish in British Columbia.

Table 6. Comparison of yelloweye rockfish piece counts from video footage (VF) review, fisher logs, and the Dockside Monitoring Program (DMP) for each groundfish licence sector along the coast of British Columbia, fishing year 2008/09. (Source: Stanley et al. 2009)

	Total Piece Count Source		
Sector and Region	VF	Fisher Logs	DMP
Pacific halibut (outside)	34,547	39,880	39,988
Pacific halibut/sablefish (outside)	11,144	10,411	10,128
Lingcod (outside)	2,310	2,008	2,056
Rockfish (inside)	536	554	519
Rockfish (outside)	16,991	14,159	14,063
Sablefish (outside)	359	292	304
Spiny dogfish (inside)	1,282	1,581	1,563
Spiny dogfish (outside)	4,496	3,499	3,531
Outside total	69,847	70,249	70,070
Inside total	1,819	2,135	2,082
Coastwide	71,666	72,384	72,152

The reliability of at-sea observer release reports with the groundfish trawl fishery has also been examined by Grinnell (2010). Grinnell compared releases reported by at-sea observers to calculated predicted releases of sablefish and halibut. The predicted releases incorporated three different factors; social, economic and environmental predictors. The study examined many different factors that influence observer reports, and the reliability of the information. One of the variables measured was "observer-skipper familiarity" (obsSkipTows); a social predictor that measured the number of events that a skipper and observer have in common. The study noted that observers will report higher halibut mortality as the number of fishing events with a particular skipper (obsSkipTows) increases. The mean proportion of dead released halibut was 0.312 (±0.001) for events with 1 obsSkipTows, which decreased to a minimum of 0.298 (±0.001) for events with 25 obsSkipTows. From there, the value gradually increased to 0.337 (±0.010) for events with 390 obsSkipTows. From this data, it can be seen that observers do not show preferential treatment to those skippers they are more familiar with. Grinnell also notes that, "Observer experience has an important effect on release rates, and indicates that experienced observers report less released fish than new observers." In general, it was seen that new observers reported a higher proportion of dead released halibut then those with more experience; however, Grinnell's calculations show that for halibut from 1997 to 2006, the 90th percentile range for misreported weight overlaps zero, indicating that yearly misreported weights are not statistically different from zero. The study concludes that misreported weights are negligible, and that there are no strong reasons to suspect release data reported by observers is unreliable.

Alaska

Summary of Evaluations of Current Management Practices

Catch Share Programs

A number of CSPs that include bycatch reduction elements have been implemented in Alaska federal fisheries. CSPs allow vessel operators to make operational choices to reduce discards of fish due to longer fishing periods and economically efficient use of vessel capacity. The harvest privileges afforded by a catch

share program allow vessel operators to slow the pace of fishing and to fish in less wasteful manner. For example, catch shares have encouraged operators to use modified gear to reduce bycatch, coordinate with other vessel operators to avoid areas of high bycatch, and investigate handling methods to reduce discard mortality.

Individual Fishing Quota Program (Amendments 15/20 to the BSAI/GOA FMPs)

An Individual Fishing Quota Program was implemented for the Pacific halibut (via regulatory amendment) and sablefish fixed gear fisheries in the federal waters of the BSAI and GOA in1995. Bycatch reduction was inherent in the program, due to the close interaction between sablefish and halibut fisheries. Much of the longline bycatch of halibut occurred in the sablefish fisheries, and many fishermen fish for both (and received IFQ for both). To the extent sablefish fishermen hold halibut IFQ, this halibut is now retained and counted against the target quotas, as opposed to being caught as bycatch and discarded (regulations previously required it to be discarded). Implementation of the IFQ Program resulted in an immediate reduction of the GOA halibut PSC limit apportionment to the longline sector from 750 mt to 300 mt in the annual specifications process for 1995 and thereafter (Pautzke and Oliver 1997).

Central GOA Rockfish Program (Amendments 68 and 88 to the GOA FMP)

The Central GOA Rockfish Pilot Program (RPP) was implemented in 2007 and is currently being reauthorized as the Central GOA Rockfish Program (Amendment 88 to the GOA FMP). The program enhances resource conservation and improves economic efficiency for participating harvesters and processors. Allocations of the primary rockfish species (Pacific Ocean perch, northern rockfish, and pelagic shelf rockfish) and important incidental catch species (sablefish, Pacific cod, shortraker, rougheye, and thornyhead rockfishes) are divided between the catcher vessel sector and the catcher processor sector. Each sector is also allocated halibut PSC based on historic catch of halibut in the target rockfish fisheries. Participants in each sector can either fish as part of a cooperative or in a competitive, limited access fishery.

The annual halibut catch and mortality in the CGOA rockfish fishery has declined since the implementation of the pilot program (Table 7). This reduction in halibut mortality (particularly in the CV sector) likely arises from several factors. First, vessels have exclusive allocations, allowing them to move from areas of high halibut catch without risking loss of catch of the primary rockfish. Second, exclusive allocations also increase the incentive for participants to communicate with each other concerning catch rates, improving information concerning areas of high halibut incidental catch in the fleet, and preventing repeated high halibut mortality among vessels exploring fishing grounds. Third, several vessels have begun employing new pelagic gear that limits bottom contact and halibut incidental catch. These gear changes are apparent when comparing the percentage of catch using pelagic trawl gear and non-pelagic gear in the first two years of the program with catch by those gear types in the preceding years. In the second year of the program over 40 percent of primary rockfish catch was with pelagic trawl, in comparison to less than 25 percent in 2006 and 6 percent or less in the preceding years. In the second year of the program, nearly 85 percent of the catcher vessel fleet used pelagic gear for some of its catch, in comparison to slightly more than half of that fleet in 2006 and less than 20 percent in the preceding years. Participants in the program report that a primary motivation for these changes in gear types is constraining halibut allocations, which could jeopardize cooperative catches in the event that halibut bycatch exceeds allocations.

Previously, attainment of the halibut PSC limit prior to catch of the rockfish TAC resulted in early closures of the rockfish season, until the September apportionment of catch was newly available. Since implementation, cooperatives receive exclusive allocations of halibut PSC limits from the third quarter deep water complex apportionment that constrain their fishing activity. Participants in the limited access fishery (who elected not to join a cooperative) are subject to the same limitation as participants in the rockfish

fisheries prior to the pilot program. In other words, if the third season halibut PSC limit apportionment is fully used prior to harvest of the applicable limited access rockfish TAC, that fishery will be closed until the next season's apportionment comes available in September.

Table 7. Halibut mortality of vessels in the Central Gulf rockfish pilot program (2007 and 2008)

Year	Fishery	Vessels	Halibut PSC mortality (pounds)**	Catch of primary rockfish (tons)	Pounds of halibut PSC mortality per ton of primary rockfish catch	Allocation including transfer of halibut PSC mortality (pounds)	Unused allocation (pounds)
2007	Catcher processor limited access	3	26,312.8	2,063.3	12.8	NA	NA
	Catcher processor cooperative*	1	16,623.3	1,933.1	8.6	77,760.7	61,137.3
	Catcher vessel cooperative	25	32,710.1	7,746.0	4.2	309,816.8	277,106.7
	Total	29	75,646.3	11,742.4	6.4	387,577***	338,244+
2008	Catcher processor limited access	4	47,624.4	2,892.1	16.5	NA	NA
	Catcher processor cooperative*	2	19,332.0	1,836.4	10.5	44,092.0	24,760.0
	Catcher vessel cooperative	23	60,622.0	7,446.7	8.1	331,906.9	271,284.9
	Total	29	127,578.4	12,175.2	10.5	375,998.9***	296,044.9+

Source: NMFS Catch Accounting Data

*Data are not confidential because of disclosure in cooperative reports.

** Includes all halibut mortality under the primary program (i.e., excludes entry level fishery).

*** Includes allocation to catcher processor cooperative that did not fish. No allocation is made to the limited access fishery.

+ Includes all allocations and only catches by vessels subject to those allocations.

The incentive for halibut mortality reductions is increased by the rollover of saved halibut mortality to other fisheries late in the year, allowing the trawl sector as a whole (including vessels that did not qualify for the RPP) to benefit from these halibut mortality reductions. As seen in the three years of the pilot program, any unused halibut PSC that has been allocated to the cooperatives that has not been used by a cooperative before November 15 or after a declaration to terminate fishing by the cooperative, will be added to the last seasonal apportionment for trawl gear during the current fishing year. On November 13, 2007, 128 metric tons of unused rockfish cooperative halibut PSC was reallocated to trawl gear, on November 13, 2008, 135 metric tons was reallocated, and on November 15, 2009, 139 metric tons was reallocated. In all three years, the reallocation of halibut PSC from the rockfish pilot program to the GOA trawl fisheries allowed the trawl GOA groundfish fisheries to remain open until December 31. The GOA trawl fisheries used 97 percent, 98 percent, and 91 percent of its halibut allocation in 2007, 2008, and 2009, respectively. In the five years previous to implementation of the RPP, the trawl GOA groundfish fisheries were closed to directed fishing prior to the end of the season so as not to exceed the halibut PSC limit. In two of those years, 2004 and 2005, the trawl GOA groundfish fishery was closed to direct fishing on October 1.

Under pending revisions to the renewed program, halibut PSC limits will be reduced to 87.5 percent of the annual average usage of halibut in the target fishery during the qualifying period by both sectors. The remaining 12.5 percent would remain unavailable for use in any fishery, a reduction of 27.4 mt (45,000 lb net wgt). In addition, 55 percent of any cooperative's unused halibut allowance would be available for use in the 5th season trawl fisheries, as an added incentive in target groundfish fisheries, with the remainder unallocated.

Amendment 80 to the BSAI Groundfish FMP

Amendment 80 established a limited access privilege program (LAPP) in 2008 for the BSAI trawl catcher/processor sector that are not included in the American Fisheries Act (non-AFA). Previously, halibut PSC limits were allocated by target fishery and shared among all trawl vessels, resulting in a race to harvest target species before a PSC limit allocation was reached. This resulted in trawl fisheries being prematurely closed due to halibut PSC limit constraints. Vessels participating in the Amendment 80 cooperative have successfully harvested target species quotas and maintained halibut catch below halibut PSC allocation.

Amendment 80 provides specific groundfish and PSC allocations to the non-American Fisheries Act (AFA) trawl catcher processor sector and allows the formation of cooperatives. A key feature of the Program was to reduce the amount of halibut bycatch (PSC) that may be taken while non-AFA trawl catcher processors are harvesting groundfish in the BSAI. Because vessel operators in cooperatives are better able to target catch and can engage in voluntary agreements to avoid areas with higher PSC, the Council recommended an overall reduction in the amount of halibut and crab PSC that may be used by the non-AFA trawl catcher/processor sector. In addition, the amount of halibut allocated to the Amendment 80 cooperative sector is ratcheted down by 200 mt yearly from a high of 2,535 mt in 2008 to 2,325 mt in 2012 and subsequent years. The halibut PSC allocation for the trawl limited access group is fixed at 875 mt. Further, Amendment 80 vessels are limited in the amount of halibut PSC they may catch in the GOA, but it is not an allocation. Abbot et al. (2010) provides an assessment of the Sea State program for fishing that occurred prior to Amendment 80, suggesting efforts to reduce bycatch failed due to incentives that have since been removed with the implementation of Amendment 80.

Bering Sea/Aleutian Islands Pacific Cod Allocations (Amendment 85 to the BSAI FMP)

Federal regulations established a 3,400 mt halibut PSC limit in the non-CDQ BSAI trawl fisheries. In the annual harvest specifications process, NMFS apportioned this amount to different trawl fishery categories (e.g., yellowfin sole, Pacific cod, rock sole/other flats/flathead sole). In some fisheries, the allocation was further apportioned by season. At the beginning of the fishing year, the Pacific cod fishery was allocated more halibut PSC allowance than was needed for directed fishing, then NOAA Fisheries transferred small amounts of halibut allowance in the Pacific cod fishery to the flatfish fisheries throughout the season as needed. Despite this apportionment, some fisheries trawl vessels raced to harvest as much of the TAC as possible before the PSC allowance to the overall trawl sector was fully utilized. Once the PSC allowance or TAC was taken the directed fishery would be closed to avoid exceeding the limits. NOAA Fisheries worked with industry to ensure that other fisheries were not constrained by PSC limits (while keeping total halibut mortality under the trawl PSC limit) by moving PSC among fisheries in-season to cover potential shortfalls. This flexibility to move PSC allowances between fisheries and general consent from industry is critical since no formal regulation defined this management practice.

The halibut PSC limit for trawl gear in the non-CDQ fisheries is apportioned in the annual harvest specifications process among the four following fisheries: (1) Pacific cod, (2) yellowfin sole, (3) rock sole/other flatfish/flathead sole, and (4) pollock/Atka mackerel/other fisheries. Beginning in 2008 under Amendment 85, BSAI Pacific cod allocations to all gear sectors and seasonal apportionments were revised: hook-and-line (CP & CV); pot (CP & CV); jig; <60' longline/pot; trawl CV; non-AFA trawl CP; AFA trawl CP; and CDQ sector. The objective was to change allocations to better reflect actual historical use of the resource (i.e., account for roll-overs), with consideration for social and community factors.

Amendment 85 further apportioned the Pacific cod trawl fishery halibut PSC limits among the trawl sectors and between two hook-and-line sectors. Pot and jig sectors currently are exempt from halibut PSC limits due to very low bycatch rates in these sectors. Generally, about 1,400 mt of halibut PSC mortality is apportioned to the BSAI Pacific cod trawl fishery, but this amount and actual use can vary annually. The annual halibut PSC limit specified for this fishery category is divided among the trawl sectors as follows: 70.7 percent for trawl CVs; 4.4 percent for AFA trawl CPs; and 24.9 percent for non-AFA trawl CPs. Because the AFA and non-AFA trawl CVs would share a Pacific cod allocation, this sector receives combined halibut PSC limits. Halibut PSC mortality is attributed to a fishery based upon the target fishery. A significant amount of Pacific cod is taken incidentally in trawl fisheries for species other than Pacific cod. However, the halibut PSC mortality associated with that incidental Pacific cod harvest is attributed to a fishery other than the Pacific cod trawl fishery.

Gulf of Alaska Pacific Cod Allocations

From 1999 to 2006, the Council developed several approaches to rationalize the derby style GOA groundfish fisheries to address concerns regarding social and economic impacts of regulations on harvesters, processors, crew, and communities that depend on these fisheries. In December 2006, however, the Council instead developed a more discrete approach to allocate the Pacific cod resource to the various gear sectors and limit future entry to the groundfish fisheries by extinguishing latent (unused) Limited License Program (LLP) licenses.

The competition among sectors in the Pacific cod fishery may have contributed to higher rates of halibut bycatch and discards, and out-of-season incidental catch of Pacific cod. Participants in the fisheries who have made long-term investments and are dependent on the fisheries faced uncertainty as a result of the competition for catch share history as the Council developed alternatives to rationalize the fishery.

In December 2009, the Council apportioned the GOA hook-and-line halibut PSC to the CP and CV sectors in proportion to the total Western GOA and Central GOA Pacific cod allocations to each sector. No later than November 1, any remaining halibut PSC not projected by NMFS to be used by one of the hook-and-line sectors during the remainder of the year would be made available to the other sector. The apportionment of halibut will be proportional to the Pacific cod area apportionment determined during the TAC setting process. But the Council did not reduce the PSC limit to this fishery.

Summary of the Accuracy of Data Collected from Monitoring Programs

The current catch estimation methodology employed by NMFS in the CAS and Observer Program constitutes the best available science for data collection. Observers are currently the only reliable method through which PSC data can be collected in the North Pacific groundfish fisheries.

Past analytical examinations of the Observer Program have discussed sampling protocols, bias, estimate expansion, and the statistical properties of estimates (e.g., Jensen et al. 2000; Miller 2005; Miller and Skalski 2006a, 2006b; Miller et al. 2007; MRAG Americas 2000, 2002; Volstad et al. 2006; Volstad et al. 1997, Pennington 1996; Pennington and Volstad 1994). These recommendations are considered when adjustments are made to the methods used by observers to collect catch and biological data. Redesigned data collections were implemented by the Observer Program in 2008 and include recording sample-specific in lieu of pooled information, increased use of systematic sampling over simple random and opportunistic sampling, and decreased reliance on observer computations. In addition, studies suggest the risk of bias in the data is reduced by changing from the current system, in which 30 percent coverage vessels can choose when and where to take observers, to a restructured observer deployment program in which NMFS is responsible for distributing observers among vessels using statistically robust methods.

At its October 2010 meeting, the Council recommended restructuring the Observer Program such that NMFS could address issues of bias among other issues in the current deployment model (NPFMC 2010a). This flexibility would enable NMFS to explore and develop alternative observer sampling designs (including sample size analyses and optimization) and estimators of catch. The proposed new methods that incorporate random selection would also likely reduce bias introduced through an observer deployment effect as has been shown elsewhere (Benoit and Allard, 2009). Further, randomization of trip selection in the portion of the groundfish fleet that is not subject to full coverage will increase the statistical credibility of the catch estimates used to regulate the fisheries, and may decrease the bias that arises from non-representative spatial and temporal distribution of observed catch (relative to total catch; NMFS 2010).

The ability for NMFS to assess the statistical reliability of CAS is hampered by the current non-random placement of observers on vessels less than 125 feet, unknown consequences of post-stratification of observer information in CAS, unknown bias associated with imputation methods (Cahalan et al. 2010). The restructured Observer Program will greatly enhance NMFS's ability to assess uncertainty associated with halibut bycatch estimates. In addition, NMFS and the Pacific State Marine Fisheries Commission are currently working to evaluate procedures used to estimate total catch and discard from Alaska's groundfish fisheries. Recently, an evaluation of the imputation methodology (Mondragon et al. 2010) and spatial analysis (Gasper et al. 2010) were prepared. The continued evaluation is expected to assess alternative estimators of total catch and bycatch as well as develop and incorporate statistically valid variance estimates.

Finally, evaluations of sampling methods used by the Observer Program to estimate catch have been conducted. These studies range from evaluations of sampling tools used such as motion compensated flow scales (Dorn et al. 1999), evaluation of haul weight estimation (e.g., Dorn et al. 1997, Dorn et al. 1995), and evaluation of observer coverage levels (e.g., NPFMC 2010a). These studies, as well as those mentioned in preceding paragraphs, informed the development of current and future sampling protocols and provide information on the reliability of historic sampling methodology used by the Observer Program.

Areas for Improvement

Estimation and management have improved greatly since halibut PSC limits were initially established. These improvements have built upon support from the Council and industry in reducing halibut bycatch mortality. Work continues on the part of Council, industry, and NMFS to improve estimation and reduce bycatch in the groundfish fisheries. Areas of focus include:

1) Providing statistically robust estimates of halibut PSC through a new observer deployment model that allows NMFS to deploy observers. The regulations and detailed deployment are currently in development.

2) The NMFS Alaska Regional Office continues work on evaluating and improving estimation methods, evaluating the quality of data, and ensuring data is available to managers and researchers.

3) Assessing the feasibility of electronic monitoring (EM) to augment observer information is an important area of research. The 2006 reauthorization of the MSA included changes to Section 313(b)(2), allowing for fees collected under this section to be used for electronic monitoring (EM) systems. This language appears to anticipate the future potential of electronic monitoring technologies as part of a comprehensive monitoring plan in the North Pacific.

4) Continued work by NMFS, NPFMC, and industry to develop innovative methods to reduce bycatch through gear modification and careful handling of halibut. Through the use of Exempted Fishing Permits, the trawl industry in particular has been active with the development and testing of trawl modifications and evaluating handling mortality of Pacific halibut.

Summary of Best Management and Monitoring Practices

West Coast

As mentioned above, the Pacific Council's strategy relative to bycatch management is to gather data through a standardized total catch reporting methodology, use federal/state/tribal agency partners to assess these data through bycatch models, and develop and implement management measures that minimize bycatch, such as catch limits for target species and time and area closures. These management and monitoring practices have largely been successful; however, the Council recognizes and supports the improved management and monitoring practices associated with its planned trawl individual quota program, which will include bycatch limits and 100% observer coverage.

British Columbia

Individual Accountability—A Key Ingredient

A key premise of the CGIP is the requirement for individual accountability for all catch. This guiding principle was the precursor to each of the management techniques that followed. The complexities of multi-species fisheries require a holistic approach to fisheries management. To achieve individual accountability in multi-species fisheries, accurate and defensible catch information must be obtained and a mechanism for harvesters to "account" for this catch must be provided. As such, a management system in a multi-species fishery such as the B.C. groundfish fishery, which requires individual accountability for all catch, benefits from the implementation of ITQs, transferability amongst and between licence categories, and comprehensive at-sea and dockside monitoring. Each of these management techniques work in combination to achieve the principle of individual accountability. Individual accountability is a key ingredient for sustainable fisheries. Scott Wallace, a sustainable fisheries analyst for the David Suzuki Foundation, believes "the principles of full catch accountability and defensible catch limits are a prerequisite for any sustainable multi-species fishery" (S. Wallace, personal communication, February 2009). *As such, multi-species fisheries aspiring to achieve "sustainability" status should consider including individual catch accountability as a founding principle.*

Ecosystem-Based Approach to Management—Two Pronged

An ecosystem approach requires fisheries management to take into consideration impacts on incidental catches, benthic habitat, and the larger ecosystem in which species reside. This ecosystem-based approach requires significant changes to the more traditional fisheries management techniques, which in turn requires active stakeholder participation in the development of an effective and efficient management regime.

The objectives put forward by DFO in 2003 could not have been achieved without impacting industry participants and therefore require the active involvement of industry in a meaningful manner. *Fisheries wishing to move in the direction of an ecosystem-based approach to management must acknowledge that the approach extends beyond merely management changes to also include a strong co-management arrangement.*

In 2003, DFO gave clear directions to industry regarding conservation concerns and what the minimal requirements were for the future. DFO then empowered stakeholders with the ability to develop their own solutions for consideration by the Minister. The Minister still has the ultimate decision-making authority, but industry also has a meaningful role in the decision-making process. Of equal significance is that the Minister

accepted industry's solutions in 2006 and continues to consider industry solutions on an ongoing basis as the program is modified in-season and over the longer term.

Despite the fact that prior to the CGIP there was a long history of industry groups not cooperating with each other and trying to convince DFO that their ideas were of greater merit than those of competing industry groups, it was in the best interest of industry participants to collaborate and develop a plan that met their needs while meeting the requirements of DFO. Moreover, the consensus process that was used by the advisory board now requires industry groups to convince each other or compromise if they want to affect change. With a significant stake in the design of the plan, industry had a greater incentive to collaborate to make it work. This process also helped to gain industry acceptance of the management changes. *The development of co-management arrangements should include clear objectives, expectations, and true empowerment of the body to develop initial as well as ongoing recommendations for consideration.*

Catch Monitoring

Without adequate catch monitoring, an effective fisheries management plan to reduce incidental harvest of species is impossible. Individual accountability must be accompanied by 100% at-sea monitoring, otherwise the incentive to "cheat" the system will always exist and the individual incentive to report accurately is diminished. Knowing that each harvester is equally monitored and the ability to "cheat" the system is eliminated, harvesters are provided with incentive to fish more responsibly and are better able to take ownership of their fishing practices. In the monitoring section of this paper, evidence has been provided that data derived from management programs with at-sea monitoring below 100% should not be used to make management decisions. The data does not accurately reflect true removals and as such, does not allow a government agency to confidently state that current harvest levels are within sustainable limits. *The only effective catch monitoring program is one that requires 100% at-sea monitoring either using electronic monitoring and an accompanying audit program or on-board observers.*

Alaska

Catch Accounting and Monitoring

Accurate and timely estimates of bycatch in the groundfish fisheries has required implementation of a combination of robust monitoring tools including high levels of observer coverage; technology (e.g., flow scales, VMS); regulations designed to improve estimates (e.g., observer station requirements and prohibition on pre-sorting of catch); and electronically reported industry data.

Catch Share Programs

Catch share programs have been used in U.S. federal fisheries since 1990 and now include 14 different programs managed by six different Councils from Alaska to Florida (NOAA 2010). Catch share is a general term for fishery management strategies that allocate a specific portion of the total allowable fishery catch to individuals, cooperatives, communities, or other entities. Catch share programs are an important component of NOAAs comprehensive national ocean policy (NOAA 2010). This policy encourages well-designed CSPs to help maintain fisheries, while recognizing they may not be the best management option for every fishery or sector. Care must be exercised in the design and monitoring phases to insure discards are adequately monitored and the program components are appropriate for the fishery.

The BSAI Amendment 80 and GOA Amendments 68 and 88 rockfish CSPs have both demonstrated a reduction in halibut discards since their inception. Cooperatives formed under these programs have

experienced decreased discards as fishermen are able to become more selective and redirect their effort away from areas of bycatch to avoid prohibited and non-target species. Further, these programs both resulted in increased monitoring requirements to facilitate accurate and timely accounting for enforcement and quota monitoring. Catch and bycatch monitoring issues have been addressed through high levels of observer coverage (all trips observed), technology (e.g., flow scales), sampling protocol, and regulations designed to improve estimates (e.g., observer station requirements and prohibition on pre-sorting of catch).

Gear modifications

The Council and NMFS, through industry partnerships, have pursued methods of reducing halibut bycatch using gear modifications. These efforts are consistent with NMFS policy directive (January 11, 2008) that established the Bycatch Reduction Engineering Program (BREP). The mission of the BREP is to develop technological solutions and investigate changes in fishing practices designed to minimize bycatch and mortality (including post-release injury and mortality).

In 2009, BREP funded research through the Alaska Fishery Science Center to work with the Bering Sea bottom trawl fleet to develop and improve devices for trawl selectivity. This funding builds on previous partnerships between industry, NPFMC, and NMFS to develop gear that excluders Pacific halibut (Gauvin 2008). The project's primary fieldwork, aboard the F/V *Cape Horn* in June 2008, tested flexible grid excluders just ahead of trawl codends in the Bering Sea flathead sole fishery. The most effective of these designs excluded approximately 65 percent of the halibut with a loss of 20 percent of the target flatfish (NOAA 2009).

Ongoing research activity continues to develop and improve bycatch reduction devices (BRDs), which improves the selectivity of trawls in Alaska's groundfish fisheries and facilitates BRD application in the fishery. The long-term goal is to create a diverse and flexible toolbox of devices and make the fleet familiar with their applicability to a range of bycatch situations. The greatest advance in 2008 was a greatly increased routine use of these BRDs, motivated by management changes and fleet cooperation (NOAA 2009).

Careful handling of halibut

Crucifiers, or hook strippers, speed up the process of removing hooks by stopping the fish while allowing the longline gear to proceed; thereby tearing the hook out of the fish's mouth. Crucifiers are mounted near the roller on longliners and consist of a pair of parallel bars spaced just far enough apart to allow gangions and hooks to pass, but not hooked fish. This technique increases mortality of undersized fish compared with careful release techniques. Increasing the mortality has the effect of decreasing the commercial catch limits. Circle hooks have greatly increased the efficiency of longlining and shift the selectivity towards legal sized fish (Crutchfield and Zellner 2003).

Hook strippers were illegal aboard halibut longliners prior to the implementation of the IFQ program in 1995. Their use was reinstated after the Council adopted the IFQ program for halibut. At that time, the focus of the regulations shifted from prohibiting the gear to prohibiting the effects of the gear, *i.e.*, damaging jaws. The use of hook strippers started on the bigger vessels fishing sablefish, as they were very handy for the close-spaced gear commonly used in that fishery. In the preparatory work for implementing the IFQ program, a multiagency group that worked on 'harmonizing' the regulations for halibut and sablefish resolved the inconsistency by recommending that IPHC drop the prohibition and instead prohibit the injuries caused by hook strippers. Currently, the North Pacific hook-and line fisheries have specific careful release handling techniques for Pacific halibut that are defined in regulation (CFR 679.7):

(1) All halibut that are caught and are not retained shall be immediately released outboard of the roller and returned to the sea with a minimum of injury by

(a) hook straightening;

(b) cutting the gangion near the hook; or

(c) carefully removing the hook by twisting it from the halibut with a gaff.

(2) Except that paragraph (1) shall not prohibit the possession of halibut on board a vessel that has been brought aboard to be measured to determine if the minimum size limit of the halibut is met and, if sublegal-sized, is promptly returned to the sea with a minimum of injury.

Summary of Planned Changes to Management and Monitoring Practices

West Coast

Trawl Individual Quota Program

The Pacific Council adopted Amendments 20 and 21, which establish a trawl individual quota (TIQ) program and set allocations for most target species and some overfished rockfish species between the trawl and non-trawl fishing sectors. The TIQ program is scheduled to be implemented beginning in 2011, and includes individual bycatch quotas for halibut.

The trawl sector would be held to an overall quota, which would be established through the Pacific Council's biennial management process. A portion of the trawl quota would be set aside to cover catches occurring in the at-sea midwater trawl whiting (hake) fishery, and the bottom trawl fishery occurring south of Cape Mendocino, California (40°10' N. latitude). The remaining trawl quota would be allocated to individuals. The fishery would have 100% at-sea observer coverage, and 100% dockside monitoring. Observers would record number and length of halibut, and note disposition of released halibut to determine discard mortality. The mortality of all halibut, regardless of size, would count against the individual's bycatch quota.

British Columbia

Given the comprehensive nature of the CGIP, including the monitoring programs in the groundfish trawl and hook and line fisheries, additional significant management and monitoring changes are not anticipated. The program continues to be improved upon following input from stakeholders to improve the accuracy and efficiency of the program while adhering to the founding principles of the program. The CGIP is the first step in a more ecosystem-based approach to groundfish fisheries management with respect to the impact on incidental catches, but more work is required to address the other aspects of ecosystem-based management.. Government and industry will continue to collaborate to meet DFO's objectives for ecosystem-based management.

Alaska

Restructuring of the North Pacific Observer Program

The current federal groundfish observer program in Alaska is structured by vessel size. As such, groundfish vessels less than 60' are not required to carry observers; vessels 60' – 125' length overall (LOA)

are required to carry and pay for their own observers 30 percent of their fishing days, regardless of gear type or target fishery; and vessels greater than 125' LOA are required to carry observers 100 percent of the time. Vessels in the 30 percent coverage category select when to carry observers and are constrained in this self-selection by regulatory requirements for quarterly coverage levels. The two size categories with less than 100 percent observer coverage comprise the majority of vessels fishing in the Gulf of Alaska (GOA) and out of ports other than Dutch Harbor and Akutan in the Bering Sea and Aleutian Islands (BSAI).

Observers estimate total catch for a portion of hauls or sets, and sample hauls or sets for species composition, including PSC. These data are extrapolated in the Alaska Region Catch Accounting System (CAS) to make estimates of total PSC halibut catch on both observed and unobserved vessels. Observer data are assumed to be representative of the activity of all vessels and are used to estimate total halibut PSC. The ratio estimator is derived from a set of covariates that match both observer and groundfish landing/production information. A detailed description of this process is presented in Cahalan et al. (2010).

Regulations governing observer deployment (i.e., observer coverage requirements) introduce the potential for bias in observer data by using a non-random deployment model that may facilitate non-representative fishing. Given the use of observer data in CAS, and the subsequent use of CAS estimation in stock assessments and quota management, this issue can undermine the data used to manage halibut PSC (among other species) in the North Pacific groundfish fisheries. In response to these issues, the Council took action at its October 2010 meeting to recommend that NMFS restructure the observer program to address multiple issues, including bias (NPFM 2010). The preferred alternative provides NMFS with flexibility to place observers onboard vessel using accepted statistical practices so that coverage gaps and vessel-trip selection bias is addressed.

The preferred alternative is likely to influence estimation most in sectors currently with 30 percent or less coverage. Past analytical examinations of the North Pacific Groundfish Observer Program have dealt with such issues as sampling protocols, reducing bias, estimate expansion, and the statistical properties of estimates (e.g. Jensen et al. 2000, Volstad et al. 1997, Pennington 1996, and Pennington and Volstad 1994). These and other studies suggest bias is likely reduced by changing from the current system, in which 30 percent coverage vessels can choose when and where to take observers, to a new system in which NMFS is responsible for distributing observers among vessels using statistically robust methods. Restructuring will also allow NMFS to place observers on halibut IFQ vessels, which were previously unobserved. This will provide information on bycatch that can be used to augment the current IFQ logbook program.

Possible revisions to GOA and BSAI Groundfish Halibut PSC limits

In December 2009 the Council requested a discussion paper on the process for changing the halibut PSC limits in the GOA and the BSAI (NPFMC 2010b). In February 2010 the Council reviewed a NMFS discussion paper that described how halibut PSC limits are established and may be revised in both areas. The Council requested separate discussion papers for each area, and set a discussion paper for GOA halibut PSC limits as its first priority.

In June 2010 the Council briefly reviewed a preliminary discussion paper that provided 1) information identified in the GOA Groundfish FMP as necessary to change the halibut PSC limits and 2) preliminary data summaries. The Council directed that a December 2010 discussion paper bifurcate potential Council action for determining whether and how to take potential action to revise GOA halibut PSC limits:

1) simple measures to reduce halibut bycatch in near term and
2) an action list of industry approaches to reduce halibut bycatch in the long term.

In December 2010 the Council requested additional information for review in April 2011 before it determines the process for revising halibut PSC limits and selecting alternative limits it wishes to consider. The Council believes that an evaluation of the current halibut PSC limits is warranted and additional information about the condition of halibut stocks, the effects of bycatch reduction, and other fishery factors is necessary to determine potential action. Therefore, the Council requested assistance by IPHC staff to provide information on the following topics for its review in April 2011. At that time, the Council is scheduled to adopt a management process and proposed alternatives for analysis to revise GOA halibut PSC limits for implementation in 2012. The Council has not set a timeline for action to consider revising BSAI halibut PSC limits.

1. The effect of reducing bycatch limits in the GOA on the exploitable biomass available to the directed fisheries, over an appropriate time period; this includes the effects of migration on downstream users (i.e., what is the effect of a 100mt reduction in bycatch over a 5 year period?).
2. The recent changes in IPHC stock assessment methods, harvest policies, and catch limit setting on directed halibut fisheries.
3. Possible causes of low growth rates and the effects on future exploitable biomass and spawning biomass.

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Appendix 1: Summary Table of Monitoring Programs for 2009

Area	Fishery	Vessel length class	Halibut bycatch estimate (lbs)[1]	Source of bycatch estimate	Total number of trips	Number of trips observed	Total number of tows	Number of tows observed
2A	Bottom Trawl Groundfish	N/A	553,355	At-sea observer, Logbook	N/A	692	85,047 (tow hrs)	19,542 tow hrs (23%)
2A	LE Fixed Gear Sablefish Primary	N/A	109,490	At-sea observer	N/A	74	N/A	354 sets (8.7% of LE primary sablefish landed observed)
2A	LE Sablefish Non-Primary Longline	N/A	83	At-sea observer	N/A	138	N/A	271 sets
2A	Open Access Fixed Gear	N/A	14,115	At-sea observer	N/A	98	N/A	146 sets
2A	Nearshore Fixed Gear	N/A	2,862	At-sea observer	N/A	N/A	N/A	219 sets (6.2% of target species landed) in OR 122 sets (2.6% of target species landed) in CA
2A	Pink Shrimp Trawl	N/A	0	At-sea observer	N/A	N/A	N/A	695 (6% of pink shrimp landings)
2A	CA Halibut Trawl	N/A	0	At-sea observer	N/A	N/A	N/A	29 (6%) LE 30 (0.7% of CA halibut landings) OA

Area	Fishery	Vessel length class	Halibut bycatch estimate (lbs)[1]	Source of bycatch estimate	Total number of trips[5]	Number of trips observed[5]	Total number of tows[5]	Number of fishing events observed
2B	Halibut	N/A	Directed catch: 6,121,372 ± 0	At-sea observer/EM, DMP, Logbook	496	496	7,977	100% are observed w/ EM or observer, 10% are audited if EM used
2B	Sablefish	N/A	72,164 ± 0	At-sea observer/EM, DMP, Logbook	52	52	6,106	100% are observed w/ EM or observer, 10% are audited if EM used
2B	Halibut & Sablefish	N/A	Reported in "Halibut" and "Sablefish" fisheries	At-sea observer/EM, DMP, Logbook	80	80	2,065	100% are observed w/ EM or observer, 10% are audited if EM used
2B	Rockfish Inside	N/A	483 ± 0	At-sea observer/EM, DMP, Logbook	60	60	782	100% are observed w/ EM or observer, 10% are audited if EM used
2B	Rockfish Outside	N/A	138,975 ± 0	At-sea observer/EM, DMP, Logbook	246	246	3,838	100% are observed w/ EM or observer, 10% are audited if EM used
2B	Lingcod	N/A	10,890 ± 0	At-sea observer/EM, DMP, Logbook	190	190	2,353	100% are observed w/ EM or observer, 10% are audited if EM used
2B	Dogfish	N/A	203,487 ± 0	At-sea observer/EM, DMP, Logbook	212	212	3,346	100% are observed w/ EM or observer, 10% are audited if EM used
2B	Trawl	N/A	278,069 ± 0	At-sea observer/EM, DMP, Logbook	1,586	1,586	15,827	100% are observed

Area	Fishery[2]	Vessel length class	Halibut bycatch estimate (lb)[1]	Source of bycatch estimate	Total number of trips[3]	Number of trips observed	Total number of tows	Number of tows observed
3	Trawl CP Pacific cod	NA	56,960	CAS	7	7	NA	NA
3	Trawl CP Rockfish	NA	135,658	CAS	41	41	NA	NA
3	Trawl CP other	NA	849,396	CAS	70	59	NA	NA
3	Trawl CV Pollock	NA	82,967	CAS	450	254	NA	NA
3	Trawl CV Pacific cod	NA	579,762	CAS	267	100	NA	NA
3	Trawl CV Rockfish	NA	24,395	CAS	113	101	NA	NA
3	Trawl CV other	NA	2,301,846	CAS	509	342	NA	NA
3	GOA pot and jig[4]	NA	15,048	CAS	1,472	29	NA	NA
2C and 3	GOA non-IFQ hook-and-line	NA	626,447	CAS	789	163	NA	NA

Area	Fishery[2]	Vessel length class	Halibut bycatch estimate (lb)[1]	Source of bycatch estimate	Total number of trips[3]	Number of trips observed	Total number of tows	Number of tows observed
4	Trawl CP/M pollock	NA	727,292	CAS	312	312	NA	NA
4	Trawl CP/M Pacific cod	NA	180,426	CAS	33	32	NA	NA
4	Trawl CP/M Atka mackerel	NA	158,565	CAS	112	112	NA	NA
4	Trawl CP other	NA	4,620,129	CAS	582	582	NA	NA
4	Trawl CV pollock	NA	284,553	CAS	1,450	1,430	NA	NA
4	Trawl CV Pacific cod	NA	389,081	CAS	361	323	NA	NA
4	Trawl CV other	NA	4,344	CAS	9	9	NA	NA
4	BSAI Pot and jig gear[4]	NA	3,603	CAS	1,034	114	NA	NA
4	BSAI non-IFQ hook-and-line	NA	1,533,904	CAS	1,090	871	NA	NA

[1] Bycatch estimates include both the total caught and released mortality.
[2] Fishery definitions can be ambiguous due to difficulty in determining a target species in multi-species fisheries. For example, Pacific cod maybe retained in the "other trawl target", which in the GOA is primarily composed of deep and shallow water flatfish "fisheries." Estimates were made based on the predominant species in the catch.
[3] A trip is defined for catcher processors (CPs) as a week (Sunday-Saturday) and for catcher vessels (CVs) as the time period between when fishing started and landing.
[4] Trip total is the sum of jig and pot gear trips. Halibut bycatch is not estimated for jig gear due to lack of observer coverage.
[5] For 2009/10 fishing season, from February 21, 2009 to February 20, 2010.

AGENDA D-1(b)
DECEMBER 2010

MEMORANDUM

TO: Council, SSC and AP Members

FROM: Chris Oliver for
Executive Director

DATE: November 26, 2010

SUBJECT: Groundfish Management

ESTIMATED TIME
8 HOURS
ALL D-1 ITEMS

ACTION REQUIRED

Review discussion paper on GOA Halibut PSC Limits.

BACKGROUND

At its December 2009 meeting, the Council requested a discussion paper on the process for changing the halibut Prohibited Species Catch (PSC) limits in the Gulf of Alaska (GOA) and the BSAI. In February 2010, the Council reviewed a NMFS discussion paper that described how halibut PSC limits are established and may be revised in both areas. The Council requested separate discussion papers for each area, and set a discussion paper for GOA halibut PSC limits as its first priority; it has not set a timeline for a BSAI halibut PSC limit discussion paper.

In June 2010, the Council briefly reviewed a preliminary discussion paper that provided 1) information identified in the GOA Groundfish FMP as necessary to change the halibut PSC limits and 2) preliminary data summaries. The Council identified additional issues to clarify. All of these referenced reports, including an expanded data summary, were mailed out to you on November 19. The December addendum to the discussion paper is attached as Item D-1(b)(1). Two errata tables for the discussion paper are attached as Item D-1(b)(2).

The Council identified its intent to bifurcate potential Council action for determining whether and how to revise GOA halibut PSC limit(s). These actions include: 1) simple measures to reduce halibut bycatch in near term and; 2) an action list of industry approaches to reduce halibut bycatch in the long term.

The Council may choose to 1) take no action; 2) initiate an amendment (EA) to the GOA Groundfish FMP to revise the PSC setting process to mirror the regulatory process as in the BSAI, as needed and include alternatives to the status quo halibut PSC limits in the analysis (RIR/IRFA); 3) initiate a separate analysis of halibut PSC limits to support the harvest specifications EA for 2012/2013; or 4) include an analysis of halibut PSC limits in the next harvest specifications EA. The earliest that GOA halibut PSC limits could be revised is for the 2012 fishing year, if so desired.

Should the Council wish to move ahead with this issue, it should identify: 1) a problem in the fishery, 2) goals and objectives for addressing the problem, and 3) a reasonable range of management alternatives for analysis. If the Council chooses to take no action to initiate a separate analysis, it always has the option to incorporate halibut PSC limit reductions in other proposed actions, as it did with BSAI Amendment 80

(150 mt) and the GOA rockfish program (24 mt). Even under no action, more widespread (mandatory or voluntary) use of halibut excluder devices could result in fewer halibut taken as bycatch in groundfish fisheries, thus leading to 1) potential increases in halibut abundance if not reallocated and commercial longline fishery catch limits and/or 2) increased GOA groundfish target harvests.

Gulf of Alaska Halibut Prohibited Species Catch Limit Discussion Paper

Addendum to June 2010 Draft
December 2010

PART 1. Near Term and Long Term Management Approaches

The Council identified a two-prong approach for determining whether and how to take potential action to revise Gulf of Alaska (GOA) halibut Prohibited Species Catch (PSC) limit(s) during its review of a June 2010 Draft Halibut PSC Limit discussion paper (Attachment 1):

1) **simple measures to reduce halibut bycatch in near term and**
2) **an action list of industry approaches to reduce halibut bycatch in the long term.**

Near term approaches

In terms of process, a February 2010 NMFS discussion paper described the different management processes the Council could pursue to revise halibut PSC limits (Attachment 2). The Council could choose the status quo approach to modify PSC limits as part of the annual harvest specifications process based on specified criteria in regulations and the FMP, or amend the GOA Groundfish FMP to place the PSC limits in regulation. Information identified under existing FMP criteria to determine whether a change the PSC limits is warranted was presented for Council consideration in the June 2010 discussion paper.

Step 1. Decide on the process

Step 1a. Status quo approach (continue halibut PSC limits under the groundfish specifications process)

As the status quo is described therein, the GOA Groundfish FMP and implementing regulations authorize the Council to recommend, and NMFS to approve, annual halibut mortality PSC limits as a component of the proposed and final groundfish harvest specifications. The final harvest specifications summarize the Council and NMFS's findings with respect to each of these FMP considerations. Section 679.21(d) already authorizes the apportionment of annual halibut PSC limits to GOA trawl and hook-and line gear fisheries and allows the establishment of apportionments for pot gear.

The current 2,000 mt halibut PSC limit for the GOA trawl groundfish fisheries has remained unchanged since 1986. The 300 mt halibut PSC limit for the non-trawl groundfish fisheries has remained unchanged since 1995, when the IFQ sablefish fishery was exempted from the PSC limit and the PSC limit was reduced by 450 mt. Halibut PSC limits for GOA trawl and non-trawl fisheries and associated catch mortality since 1995 are listed in Attachment 2, Table 1.

Separate but related criteria are set forth in the GOA Groundfish FMP for the seasonal distribution of the halibut PSC limits (Attachment 2, Appendix 1), as well as in regulations at §679.21(d)(5). The paper describes the schedule for an analysis that would need to coincide with the annual harvest specifications process so that harvest specifications are not delayed (see Figure 1 in Attachment 2). In summary, under the status quo (i.e., GOA Groundfish FMP) the timing of periodic changes in halibut PSC limits may not dovetail simultaneously with periodic environmental assessments prepared for the harvest specifications process. This year is a case in point, during which the information required by the FMP has been presented for Council review but not analyzed *per se* (either in the previous harvest specifications EA or any other type of formal analysis).

Step 1b. Amend the GOA Groundfish FMP (set halibut PSC limits in regulations)

While the harvest specifications EIS/FRFA does contain a summary of social and economic effects of the alternative harvest strategies for GOA groundfish considered by the Council. It does not contain an assessment of alternative PSC limits and the types of socio-economic analyses contained in the regulatory impact review or regulatory flexibility analysis that would be required to accomplish a change in PSC limits that typically are required to implement regulatory amendments. Changing the GOA halibut PSC limits as a component of the annual harvest specifications would require that this analysis be prepared.

Therefore, the Council would have the greatest (future) flexibility by first amending the GOA Groundfish FMP to remove the FMP authority to set halibut PSC limits annually as part of the annual harvest specifications process and amend the FMP to authorize the establishment of halibut PSC limits in federal regulations; this first step would require an EA/RIR/IRFA to remove halibut PSC limits from the FMP. The effect of such an action is to have the two groundfish FMPs operationally similar.

The Council could adopt a *problem statement* that addressed the need for increased flexibility (i.e., timing not dependent upon that for the harvest specifications EA/EIS) and additional analytical requirements (RIR/IRFA) for setting the halibut PSC limits in regulations, which better inform the public.

To mirror the BSAI Groundfish FMP, *plan amendment language* could be revised to reflect the BSAI FMP text in the box (right).

BSAI FMP Pacific Halibut PSC Limit Specifications

Annual BSAI-wide Pacific halibut bycatch mortality limits for trawl and non-trawl gear fisheries will be established in regulations and may be amended by regulatory amendment. When initiating a regulatory amendment to change a halibut bycatch mortality limit, the Secretary, after consultation with the Council, will consider information that includes:

1. estimated change in halibut biomass and stock condition;
2. potential impacts on halibut stocks and fisheries;
3. potential impacts on groundfish fisheries;
4. estimated bycatch mortality during prior years;
5. expected halibut bycatch mortality;
6. methods available to reduce halibut bycatch mortality;
7. the cost of reducing halibut bycatch mortality; and
8. other biological and socioeconomic factors that affect the appropriateness of a specific bycatch mortality limit in terms of FMP objectives.

Step 2. Decide on appropriate halibut PSC limits

Step 2a. Status quo (no change(s) to halibut PSC limits in the GOA)

A second, coincident step would be to decide whether to set the status quo (rollover) halibut PSC limits (or alternative limits) in regulation; this step would require an EA/RIR/IRFA. Under this proposed scenario, the total PSC limits and sector allocations (trawl and non-trawl sectors) would be set in regulation.

Step 2b. Revise the halibut PSC limits

At this point the Council has yet to decide if there is a problem in its management of groundfish or halibut fisheries regarding halibut PSC limits. Should the Council identify a problem, it must identify both potential management alternatives to address the problem AND the process for implementing the change(s) to the fisheries (i.e., under the GOA Groundfish FMP or regulations).

A contract report by Northern Economics, Inc. provides additional information on GOA halibut mortality in the groundfish fisheries for the years 2000 – 2009 (Attachment 3). This report can be used by the Council to identify alternative halibut PSC limits (in total or by fishery, target, and/or regulatory area), if so desired, for potential action.

Long term approaches

The Council identified an interest in halibut bycatch avoidance techniques that could reduce incidental harvests in groundfish fisheries. Long term approaches would be the subject of future, separate regulatory action(s) or voluntary industry efforts.

PART 2. Response to Issues Identified in June 2010 for Additional Clarification

The Council requested additional information on the following topics during its review of the June 2010 Halibut PSC Limit discussion paper. Staffs of the Council, NMFS AKRO, IPHC, and ADF&G responded to the requests for additional information.

1. The amount of halibut bycatch reduction projected from the June 2010 preferred alternative for the GOA Rockfish Program.

Halibut prohibited species catch allowances will be made to the program in an amount equal to 87.5 percent of the annual average usage of halibut in the target fishery during the qualifying period (2000-2006) by both sectors. The remaining 12.5 percent would remain unavailable for use in any fishery. This program allowance is then divided between and within the sectors based on qualifying primary rockfish species histories. The resulting calculation results in a 74.1 mt limit for catcher processors, 117.3 mt limit for the catcher vessels, and 27.4 mt remaining unavailable for use in any fishery. In addition, to create an incentive for further halibut mortality reductions, 55 percent of any cooperative's unused halibut allowance would be available for use in the 5th season trawl fisheries. The remaining halibut allowance would remain unused for that fishing year.

The Council may wish to revise total GOA halibut PSC limits to document the reduced allocation of PSC limits to component fisheries[1].

2. Basis for original PSC limits

Beginning in 1985, annual halibut bycatch limits were implemented for the GOA groundfish trawl fisheries, attainment of which triggered closure of the GOA to bottom trawl gear. In 1990, regulatory authority was also implemented to limit GOA halibut bycatch in fixed-gear fisheries. Seasonal allocations of halibut PSC limits also are authorized.

In order to provide opportunity for development of a fully domestic fishery and protection for the halibut resource, the FMP specified halibut bycatch limits for a domestic fishery. The limits applied to domestic trawling conducted between December 1 and May 31 and were specified at 29 mt (48,000 pounds) for the Western area and 52 mt (86,000 pounds) for the Central area. The limits were based on the assumption of a one percent bycatch rate, or roughly equal to one percent of the domestic harvest of Pacific cod expected in 1979 or soon thereafter. When the limits were reached, further domestic trawling during the December-May period in that area was prohibited. Fishing conducted outside this period was

[1] The Council also may wish to revise total BSAI halibut PSC limits to better document reduced PSC limit allocations to BSAI groundfish fishery sectors (e.g., Amendment 80 halibut PSC limit reductions), in a separate action.

unencumbered by limits. These limits were in addition to various halibut bycatch restrictions in place for foreign and joint venture fisheries.

The domestic groundfish fishery grew more quickly than anticipated and by the mid-1980s, the bycatch limits began to seriously restrict the fishery. For the 1984 and 1985 fisheries, the Council requested NMFS to enact Emergency Rules increasing the bycatch limits to 270 mt (0.45 million pounds) in the Western area and 768 mt (1.27 million pounds) in the Central area to prevent domestic on-bottom trawling from being excessively restricted. Also, additional Emergency Rules were implemented for the 1984 and 1985 fisheries to exempt midwater trawls from any fishery closure because of the inherently low halibut bycatches. This was done in recognition of the valuable pollock fishery in Shelikof Strait, which was conducted with midwater trawls.

3. Whether the Council can set PSC limits by area.

Yes. The Council has the authority to recommend that NMFS allocate PSC limits by area, but inseason management may have difficulty insuring area PSC limits are not exceeded if these limits are in areas where open access fisheries occur and the areas are of small size. The primary reason for difficulty is that PSC rates change as information collected by observers enters the catch accounting system and more landing information is obtained. Thus, inseason managers make closure decisions that require forecasting when a PSC limit will be reached based on PSC estimates that can change. This issue is exacerbated when the PSC limits are small given that each vessel's PSC is proportionally a larger part of the total PSC limit.

A PSC limit specific to an area smaller than a federal reporting area requires consideration as to whether the PSC information needs to be area specific. If so, then observer coverage must be available to provide an area-specific estimate. For smaller areas this usually requires 100 percent observer coverage on vessels. In addition, regardless of whether a PSC rate is area-specific, a trip-specific method is required to determine the total amount of groundfish caught in the special PSC area. For example, vessels could be prohibited from fishing both inside and outside a special area on a single trip, or required to carry 100 percent observer coverage on a trip that occurs in the special area.

In designing the new deployment model for the observer program, consideration of PSC limits will be required, such that observer coverage is able to complement management needs. Matching observer coverage to management needs likely becomes more difficult with small PSC limits.

4. In-depth historical discussion of halibut discard mortality rates and all ongoing studies.

A summary of historical rates and ongoing studies was provided in the June 2010 paper. Additional descriptions may be provided in future analyses, pending Council action. Additional information on halibut bycatch avoidance may be requested of the industry. An in-depth summary of halibut bycatch mortality in groundfish fisheries is presented under Attachment 3.

5. Description of general management and regulatory requirements that affect mortality rates and amounts

Access to unsorted catch is critical for observers to collect unbiased samples from which robust estimates of catch can be made and biological information used. Federal regulations support this need by stipulating that observers must have access to unsorted catch. For example, specific regulation referencing the ability for observers to obtain unsorted catch is found in general prohibitions (679.7[g][2]), equipment and operational requirements (679.28), IRIU (679.27), Groundfish and CDQ catch monitoring (679.32), Groundfish Observer Program (679.50), Rockfish Pilot Program (679.84), and Amendment 80 program (679.93).

Within a sampled haul or set, observers weigh and count all halibut within a species composition sample, take length measurements and record halibut viability. Length measurements and estimates of viability may come from inside or outside of the random species composition samples. Obtaining representative viability estimates requires observers to assess viability at the point of discard and account for the time on deck for non-sampled halibut. Halibut sampled for viability do not have a higher mortality than unsampled halibut discarded by crew. http://www.afsc.noaa.gov/FMA/Manual_pages/MANUAL_pdfs/manual2010.pdf.

6. **Description of use of hook strippers (i.e., crucifiers) by fishery over time; is there a direct correlation to mortality (e.g., P cod)**

Hook strippers, also called crucifiers, speed up the process of removing hooks by stopping the fish but allowing the longline gear to proceed thereby tearing the hook out of the fish's mouth. Crucifiers are mounted near the roller on longliners and consist of a pair of parallel bars spaced just far enough apart to allow gangions and hooks to pass, but not hooked fish. This technique increases mortality on fish which are to be discarded, compared with careful release techniques. Increasing the mortality of discards has the effect of decreasing the fishery catch limits.

A review of mortality associated with fishery sectors (www.fao.org/docrep/008/y6981e/y6981e07.htm) reported that all major fishing gear types involve some degree of injury to fish through internal and external wounding, crushing, scale loss and hydrostatic effects, with the severity of the injury depending on the gear type and its operation. Susceptibility to injury varies with species and type of stressor. There have been several investigations on the survival of fish released from the hook in various longline fisheries. Generally, it appears that hook penetration depth, hooking location and the technique used to remove fish from the hook have major impacts on subsequent survival. A swallowed hook may induce a substantially greater injury than a hooked mouth (e.g., through the jaw, lips or operculum). Fish removed from hooks automatically (e.g., by a crucifier or gaff) experience a significantly higher mortality than fish removed manually. Both manual and automatic release methods have the potential to inflict severe injuries to the mouth parts of the fish. Fish that were released by a gaff suffered also from punctures to the body wall and damage to the abdomen and intestines. It is worth noting that a gaff can be used to remove the hook without handling the fish, and this is likely to result in minimal injury.

Several IPHC papers and studies address the careful release of halibut in the IFQ and Pacific cod fisheries (Kaimmer 1994, Kaimmer and Trumble 1998, and Trumble, Kaimmer, and Williams 2000). Kaimmer (1994) reported that setline vessels in the North Pacific began using automated gear retrieval systems incorporating hook strippers to remove unused bait and caught fish from the hooks during gear retrieval. Pacific halibut removed by these automated systems suffer a handling mortality which is as much as nine times that experienced by fish removed carefully by the more traditional manual method of rolling the hook out of the mouth using a gaff. This increased mortality results from more severe injuries in the mouth area associated with the automated removal. Fish receiving sublethal injuries as a result of automated removal experience a significantly reduced growth rate in subsequent years.

Kaimmer and Trumble (1998) reported that Pacific halibut caught as bycatch or intended for discard by longline vessels in U.S. and Canadian waters of the north Pacific must be removed from the hook using careful release techniques required by regulation. In many fisheries, trained observers subsample the released halibut for fish condition. These condition codes are used to track cumulative bycatch mortality in these fisheries. Tag return rates of halibut released from longline gear near Kodiak Island, Alaska, were used to estimate relative and absolute mortalities of fish by release method, hook removal injury, and condition code. Generally, the proper application of the careful release techniques result in only minor hook removal injuries. Mortality rates of moderately and severely injured halibut are 1.5–2 times higher than previously assumed. One result of our study is the finding that not all fish judged at tagging as likely

to die, actually die. They recommended a reworking of the condition code methodology, which subsequently occurred in 2000

Trumble et al. (2000) noted that mandatory release of halibut incidental catches in groundfish fisheries has the potential to close fisheries managed with PSC limits, when those PSC limits are reached. His study demonstrated that halibut with similar types of injuries experienced lower mortality following release from small circle or autoline hooks than from larger circle hooks and led to revised criteria to determine viability (reducing discard mortality rates in longline fisheries by 20 percent).

Trumble et al. (2000) summarized the earlier IPHC studies that suggested that Pacific halibut are very hardy fish that have high survival rates, when handled appropriately, following capture and discard to sea from longline vessels. He reported that most longline fishermen use circle or semi-circle autoline hooks which hook the fish in the mouth and cause little damage. Almost all halibut are hooked with the bend of the hook circling the jaw and the point protruding through a hole in the cheek. Removal of the hook requires either backing the hook out around the jaw (generally with low mortality) or tearing the hook out through the jaw (generally with increased mortality. A later study found that survival by injury type with the smaller hooks was much greater than than with larger hooks.

Adlerstein and Trumble (1998) reported on mortality of discarded Pacific halibut bycatch from Pacific cod fisheries in the Bering Sea leads to significant losses in the halibut setline and in the Pacific cod fisheries. The commercial halibut fishery loses yield because of fishery catch limit reductions to compensate the resource for lost spawning potential and because halibut killed as bycatch will not be available for subsequent harvest, and the cod fisheries may lose harvest if they reach a bycatch mortality limit before reaching allowed catch. In this study, significant differences in Pacific halibut bycatch rates and associated yield losses were found among months and areas of the Bering Sea in the longline and trawl fisheries for Pacific cod in 1990–1992. Bycatch rates were usually highest in late spring and early summer and in areas close to the Unimak Pass. With the exception of 1992, yield loss in the longline fishery was around 1 kg per kg of bycatch mortality, irrespective of where or when bycatch occurred. In the trawl fishery, loss of halibut yield varied from 1 to 4 kg per kg of bycatch mortality. Highest halibut net yield losses per ton of groundfish harvest usually coincided with highest bycatch rates. When both fisheries operated in one area, trawl bycatch often imposed higher yield losses than longline bycatch, despite lower bycatch rates. Bycatch was affected by the strong 1987 halibut year class. Highest bycatch and yield loss rates occurred in the trawl fishery in 1990 and 1991 when the population was dominated by halibut age-3 and age-4, and in the longline fishery in 1992 as fish reached age-5.

Heery and Bellman (2009) reported that when Pacific halibut are caught by trawl vessels fishing off the US west coast, they are always brought on-board the vessel, ensuring the observer can randomly select a subsample for length and viability sampling. On hook-and-line vessels, crew members have the ability to "shake" or use other means (cutting of gangions, straightening of hooks) to discard the halibut without having to bring it onboard. This type of crew behavior normally occurs before or as the Pacific halibut reaches the "roller", which prevents the fish from hitting the "crucifier" (being torn from the hook) and lying on deck for any period of time. This is generally considered good handling practice that reduces potential mortality. However, at this time west coast groundfish fishery regulations do not have 'careful release' requirements.

Hooking mortality is variable and is affected by many factors, for example, the size and shape of the hook. Trumble et al., (2000) conducted a large-scale tagging experiment on Pacific halibut released from longline gear; halibut experienced lower mortality following release from small circle or autoline hooks than from large circle hooks.

Crucifiers were prohibited by IPHC regulation beginning in 1987 (Hoag et al. 1993), so their use was illegal aboard halibut longliners prior to the implementation of the IFQ program in 1995. Their use was reinstated by IPHC after the Council adopted the IFQ program for halibut. At that time the focus of the regulations shifted from prohibiting the gear to prohibiting the effects of the gear, i.e., damaging jaws. The use of hook strippers started on the bigger vessels fishing sablefish, as they were very handy for the close-spaced gear commonly used in that fishery. In the preparatory work for implementing the IFQ program, a multiagency group that worked on 'harmonizing' the regulations for halibut and sablefish resolved the inconsistency by recommending that IPHC drop the prohibition and instead prohibit the injuries caused by hook strippers. Currently, the North Pacific hook-and line and halibut fisheries have specific careful release handling techniques for Pacific halibut that are defined in regulation (CFR 679.7):

(1) All halibut that are caught and are not retained shall be immediately released outboard of the roller and returned to the sea with a minimum of injury by

(a) hook straightening;

(b) cutting the gangion near the hook; or

(c) carefully removing the hook by twisting it from the halibut with a gaff.

(2) Except that paragraph (1) shall not prohibit the possession of halibut on board a vessel that has been brought aboard to be measured to determine if the minimum size limit of the halibut is met and, if sublegal-sized, is promptly returned to the sea with a minimum of injury.

A 2009 proposal to the IPHC by the U.S. sport charter sector called for a renewed ban on the use of crucifiers on commercial halibut vessels, unless the vessel was equipped with an EM system. The proposal was ultimately withdrawn, as IPHC had no authority to require vessels to use EM. Consequently, the IPHC took no action..

The impact of hook strippers on released halibut may also be tracked through information on Prior Hook Injuries (PHI) collected by IPHC on its annual halibut setline assessment survey (Kaimmer and Leickly 2010). The survey consists of approximately 1,250 stations laid out on a systematic grid on the continental shelf, from 20-275 fathoms, and employs chartered commercial longline vessels. One of the duties of on-board samplers is to record the presence of PHI in the halibut brought on board for sampling. Data collection follows a set of prescribed criteria in which severity of prior injury is noted. While the precise cause of the PHI cannot be determined, IPHC has noted that the occurrence of PHI tends to be concentrated in areas which groundfish longline fisheries target Pacific cod.

7. Description of Canadian IBQ trawl fishery

A PowerPoint presentation by the DFO Pacific Region Groundfish Management staff provided to the IPHC and halibut industry at the January 2010 IPHC Annual Meeting is provided under Attachment 4. Canada DFO staff may be invited by the Council to provide additional information at a future meeting depending on Council interest, possibly February 2011. The (DFO) Pacific Region Integrated Fisheries Management Plan for 2010/2011 is available at:

http://www.scribd.com/doc/34285199/Integrated-Fisheries-Management-Plan-for-Southern-B-C.

8. Effects of restructured observer program

The current federal groundfish observer program in Alaska is structured by vessel size. As such, groundfish vessels less than 60' are not required to carry observers; vessels 60' – 125' length overall (LOA) are required to carry and pay for their own observers 30 percent of their fishing days, regardless of gear type or target fishery; vessels greater than 125' LOA are required to carry observers 100 percent of the time. Vessels in the 30 percent coverage category select when to carry observers and are constrained in this self-selection by regulatory requirements for quarterly coverage levels. The two size categories with less than 100 percent observer coverage comprise the majority of vessels fishing in the Gulf of Alaska (GOA) and out of ports other than Dutch Harbor and Akutan in the Bering Sea and Aleutian Islands (BSAI).

Observers estimate total catch for a portion of hauls or sets, and sample hauls or sets for species composition, including PSC. These data are extrapolated in the Alaska Region Catch Accounting System (CAS) to make estimates of total PSC halibut catch on both observed and unobserved vessels. Observer data are assumed to be representative of the activity of all vessels and are used to estimate total halibut PSC. The ratio estimator is derived from a set of covariates that match both observer and groundfish landing/production information. A detailed description of this process is presented in Cahalan et al. (2010).

Regulations governing observer deployment (i.e., observer coverage requirements) introduces the potential of bias in observer data by using a non-random deployment model which may facilitate non-representative fishing. Given the use of observer data in CAS, and the subsequent use of CAS estimation in stock assessments and quota management, this issue can undermine the data used to manage halibut PSC (among other species) in the North Pacific groundfish fisheries. In response to these issues, the Council took action at its October 2010 meeting to recommend that NMFS restructure the observer program to address multiple issues with the current program, including bias (NPFM 2010). The recommended restructuring preferred alternative provides NMFS with flexibility to place observers onboard vessel using accepted statistical practices so that coverage gaps and vessel-trip selection bias is addressed (http://www.alaskafisheries.noaa.gov/npfmc/current_issues/observer/ObserverMotion1010.pdf).

The preferred alternative is likely to influence estimation most in sectors currently with 30 percent or less coverage. Past analytical examinations of the North Pacific Groundfish Observer Program have dealt with such issues as sampling protocols, reducing bias, estimate expansion, and the statistical properties of estimates (e.g. Jensen et al. 2000, Volstad et al. 1997, Pennington 1996, and Pennington and Volstad 1994). These and other studies suggest bias is likely reduced by changing from the current system, in which 30 percent coverage vessels can choose when and where to take observers, to a new system in which NMFS is responsible for distributing observers among vessels using statistically robust methods.

The extent to which random deployment influences PSC halibut estimates is related to current efforts by the fleet to manipulate PSC rates as well as the magnitude of bias caused by quarterly deployment regulations and timing of observer coverage. Work presented in the restructuring analysis (NPFMC 2010) suggests evidence of a deployment effect, but the magnitude of this bias on PSC estimates is not known. Improvements in the statistical properties of observer samples and estimates will result in many data improvements, including improved spatial coverage as smaller vessels that fish in inshore areas receive coverage; a reduction in the ability for vessels to "game" coverage by not taking an observer to certain areas of known high bycatch or attempting to manipulate PSC rates; CAS estimates may better reflect sector-specific PSC halibut catch due to a consistent amount of observer data available throughout the year; and finally a more representative sample of halibut viability may be obtained.

The potential changes in PSC halibut estimation described in the preceding paragraph will most influence groundfish fisheries that currently have a large amount of effort from 30 percent or unobserved vessels. Fisheries currently with a 100 percent or more of coverage will continue to receive vessel specific rates, which is the most accurate and precise estimate available. Fisheries currently with a mixture of 100 percent and 30 percent vessels receive PSC estimates that are vessel-specific for observed vessels and PSC halibut rates derived from observer information collected onboard a mixture of 100 percent and 30 percent vessels. PSC estimates in a fishery may change depending on the direction of deployment bias and the amount of 30 percent coverage relative to 100 percent coverage under the current observer deployment model. Fisheries with both levels of coverage, but historically operated under high levels of 30 percent coverage, may experience a larger reduction in bias (and subsequent change in PSC) than those with a large amount of 100 percent coverage. Further, the amount of variation associated with PSC rates and estimates may also change due to a representative sample better reflecting true variation of halibut catch in the fishery, as well as additional vessels (those 40-60' LOA) being sampled by observers.

9. Information on (exempted) jig fisheries (P cod and rockfish), with ramp up levels

NMFS uses the Catch Accounting System to estimate the amount of halibut PSC in the parallel fisheries, which occur in State waters. Because the system is set up to make the estimates in State waters, PSC in the GHL fisheries is estimated as well. In the GOA, halibut PSC started accruing in 2009 when the State allowed longline gear to fish its Prince William Sound (PWS) fishery. Before 2009, no halibut mortality accrued to the federal PSC limits from the GOA State GHL fishery since the allowed gears, pot and jig, are exempt from halibut mortality limits. The method of estimating PSC is the same in State waters fisheries as in federal fisheries. PSC is estimated on unobserved trips by matching observer-based rates with the groundfish catch based on year, week ending date, trip target, gear, and FMP area. In 2009 and 2010, the halibut mortality rates were derived from observer data on hook-and-line catcher/processors in the Western and Central Pacific cod fisheries, since no observer coverage is required in the State's PWS fishery. In 2009 and 2010, the estimate of halibut PSC was 3 mt (per year) out of the 290 mt annual limit. In the Aleutian Islands, halibut PSC has accrued since 2006 from hook-and-line and trawl gear effort in the State waters GHL fishery. The halibut PSC from the State's Aleutian Islands Pacific cod fishery are: 20 mt in 2006, 46 mt in 2007, 10 mt in 2008, 2 mt in 2009, and 10 mt in 2010 (through September 25, 2010).

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Table 3. Halibut Mortality in the Deep Water Complex Fisheries by Target and Gear for the GOA, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Arrowtooth Trawl										
Mortality (MT)	369.5	157.0	323.1	429.3	313.2	500.5	613.0	442.3	532.0	285.6
Target Catch (MT)	16,210.7	5,579.9	13,429.5	20,134.4	8,541.3	15,031.8	21,331.0	20,822.7	24,931.3	15,812.3
Mortality Rate (%)	2.28%	2.81%	2.41%	2.13%	3.67%	3.33%	2.87%	2.12%	2.13%	1.81%
Deep Water Flatfish Trawl										
Mortality (MT)	42.6	43.4	24.1	20.5	72.0	--	--	0.3	--	--
Target Catch (MT)	1,007.0	1,176.8	551.2	814.4	1,196.0	--	--	22.1	--	--
Mortality Rate (%)	4.23%	3.69%	4.37%	2.52%	6.02%	--	--	1.42%	--	--
Rex Sole Trawl										
Mortality (MT)	255.4	249.4	310.4	236.6	189.6	85.6	129.2	132.2	108.3	274.1
Target Catch (MT)	8,898.7	7,741.2	7,943.1	10,310.6	3,521.1	3,244.0	7,466.3	5,926.7	4,740.4	13,207.9
Mortality Rate (%)	2.87%	3.22%	3.91%	2.29%	5.38%	2.64%	1.80%	2.23%	2.28%	2.08%
Rockfish Trawl										
Mortality (MT)	200.9	329.4	242.9	256.4	300.1	247.3	170.5	96.0	111.7	74.9
Target Catch (MT)	23,026.7	21,858.6	23,989.7	25,537.1	26,421.1	22,942.3	25,354.7	24,331.4	24,870.1	25,878.7
Mortality Rate (%)	0.87%	1.51%	1.01%	1.00%	1.14%	1.08%	0.67%	0.39%	0.45%	0.29%
Deep Water H&L (Misc)										
Mortality (MT)	12.0	8.2	3.5	1.9	6.3	4.7	4.6	--	--	0.1
Target Catch (MT)	591.8	640.7	301.5	2.8	229.0	163.3	30.5	--	--	13.5
Mortality Rate (%)	2.03%	1.27%	1.17%	0.00%	2.73%	2.86%	0.00%	0.00%	0.00%	0.00%
Deep Water ComplexTotal										
Mortality (MT)	880.4	787.3	904.1	944.6	881.1	838.0	917.2	670.9	752.0	634.6
Target Catch (MT)	49,735.0	36,995.2	46,215.0	56,799.2	39,908.5	41,381.4	53,882.5	51,102.9	54,541.8	54,912.4
Mortality Rate (%)	1.77%	2.13%	1.96%	1.66%	2.21%	2.03%	1.70%	1.31%	1.38%	1.16%

Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).
Note: Deep Water H&L comprised target fisheries for rockfish (92 percent), arrowtooth flounder (7 percent), and deep water flatfish (<0.5 percent).

Table 4. Halibut Mortality in the Shallow Water Complex Fisheries by Target for the GOA, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pollock - Bottom Trawl										
Mortality (MT)	39.2	69.8	3.0	9.5	12.8	1.9	67.9	79.3	70.2	36.0
Target Catch (MT)	9,851.2	30,373.1	10,325.7	3,576.1	11,057.2	18,544.4	35,096.6	14,791.7	16,890.3	10,692.0
Mortality Rate (%)	0.40%	0.23%	0.03%	0.27%	0.12%	0.01%	0.19%	0.54%	0.42%	0.34%
Pollock -- Midwater Trawl										
Mortality (MT)	11.7	10.7	0.5	0.4	1.0	0.5	0.4	0.6	1.9	1.1
Target Catch (MT)	57,404.3	39,549.6	27,565.4	45,894.2	49,918.6	63,113.9	37,134.7	36,944.9	33,102.1	26,526.3
Mortality Rate (%)	0.02%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%
Shallow Water Flatfish Trawl										
Mortality (MT)	576.3	483.6	841.8	530.0	526.4	564.5	634.6	707.5	495.9	796.1
Target Catch (MT)	9,783.7	8,280.5	13,992.3	8,448.1	4,115.7	8,260.2	14,213.5	14,393.5	15,074.5	19,774.3
Mortality Rate (%)	5.89%	5.84%	6.02%	6.27%	12.79%	6.83%	5.66%	4.92%	3.29%	4.03%
Flathead Sole Trawl										
Mortality (MT)	4.5	62.5	56.1	120.1	65.0	43.1	22.6	16.5	58.1	59.6
Target Catch (MT)	140.1	1,535.4	2,724.5	4,023.6	3,075.5	3,058.6	1,461.1	1,591.0	1,779.7	2,785.6
Mortality Rate (%)	3.18%	4.07%	2.06%	2.98%	2.11%	1.41%	1.55%	1.04%	3.26%	2.14%
Other Species/Atka Mackerel Trawl										
Mortality (MT)	1.8	0.7	0.1	2.8	25.2	0.1	--	--	0.0	1.2
Target Catch (MT)	121.7	71.1	6.7	2,365.8	572.9	480.6	--	88.3	3.1	39.4
Mortality Rate (%)	1.50%	0.94%	0.00%	0.88%	4.40%	0.03%	0.00%	0.00%	0.00%	0.00%
Pacific Cod Trawl										
Mortality (MT)	385.6	790.1	193.3	461.9	938.5	664.1	346.0	473.0	577.3	289.3
Target Catch (MT)	25,557.5	29,474.5	15,250.8	15,967.4	16,856.7	12,481.8	11,419.8	14,048.4	22,880.8	8,774.7
Mortality Rate (%)	1.51%	2.68%	1.27%	2.89%	5.57%	5.32%	3.03%	3.37%	2.52%	3.30%
Pacific Cod Pot										
Mortality (MT)	6.9	4.5	2.5	9.2	16.1	33.0	18.6	18.9	31.2	6.8
Target Catch (MT)	17,647.8	7,371.6	7,136.9	21,154.9	26,087.2	24,706.7	23,826.8	24,669.3	20,798.5	22,125.7
Mortality Rate (%)	0.04%	0.06%	0.03%	0.04%	0.06%	0.13%	0.08%	0.08%	0.15%	0.03%
Pacific Cod H&L										
Mortality (MT)	255.8	266.6	238.3	185.2	292.8	202.8	324.2	290.2	495.9	270.9
Target Catch (MT)	13,957.3	11,049.6	15,355.9	9,846.4	11,049.1	6,127.9	11,824.8	12,853.9	14,395.7	14,559.0
Mortality Rate (%)	1.83%	2.41%	1.55%	1.88%	2.65%	3.31%	2.74%	2.26%	3.44%	1.86%
Shallow Water H&L (Misc)										
Mortality (MT)	0.6	8.9	1.8	102.8	--	0.1	5.2	0.0	--	--
Target Catch (MT)	6.2	82.7	21.4	1,506.3	--	1.8	51.8	2.0	--	--
Mortality Rate (%)	0.00%	10.74%	0.00%	6.83%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Shallow Water Complex Total										
Mortality (MT)	1,282.4	1,697.3	1,337.2	1,439.8	1,877.7	1,510.1	1,419.4	1,586.1	1,730.4	1,461.0
Target Catch (MT)	134,469.7	127,788.0	92,378.8	112,782.9	122,732.8	136,486.0	132,029.1	119,383.1	124,924.8	105,277.0
Mortality Rate (%)	0.95%	1.33%	1.45%	1.28%	1.53%	1.11%	1.08%	1.33%	1.39%	1.39%

Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).
Note: Shallow water H&L comprised target fisheries for "other species" (99 percent), flathead sole (1 percent), and bottom pollock (>0.5 percent).

Agenda Item D-1(b) GOA Halibut PSC Limits

Council Motion

In recent years, the directed halibut catch limits in the GOA regulatory areas 2C, 3A and 3B have declined steadily, and the recommended catch limits for 2011 are almost 30% lower than in 2010. Growth rates of halibut remain very low and size at age has been declining; much of the total biomass is made up of smaller fish that are more vulnerable than larger fish to trawl gear. In addition, evidence of west to east migration of halibut within a coast wide stock may have implications for the impacts of halibut bycatch on stock assessment, and directed fishing opportunities. These factors raise concerns about the current halibut PSC limits in the GOA, and the effect this bycatch has on the directed fishing opportunities, as well as the productivity of the stock.

At this time the Council has not selected a specific process for considering changes to the GOA halibut PSC limits. Although the Council believes that an evaluation of the current halibut PSC limits is warranted, additional information about the condition of halibut stocks, the effects of bycatch reduction, and other fishery factors is necessary. Therefore, the Council directs staff to provide information on the following topics:

1. The effect of reducing bycatch limits in the GOA on the exploitable biomass available to the directed fisheries, over an appropriate time period; this includes the effects of migration on downstream users. (i.e. what is the effect of a 100mt reduction in bycatch over a 5 year period?).

2. The recent changes in IPHC stock assessment methods, harvest policies, and catch limit setting on directed halibut fisheries.

3. Changes to Federal fishery management programs and halibut PSC apportionments that begin in 2012 that are relevant to the use of halibut PSC.

4. Possible causes of low growth rates and the effects on future exploitable biomass and spawning biomass.

The Council further requests the IPHC to provide the appropriate scientific expertise and information to assist the Council.

Talking Points

The Council has received a discussion paper that focuses on alternative procedures for changing current halibut PSC limits in the Gulf of Alaska, and provides background information on halibut bycatch policy, halibut stocks, and bycatch in the groundfish fisheries. The discussion paper notes that the halibut PSC limit of 2,000 mt for the trawl groundfish fisheries has remained unchanged since 1986, and the 300 mt limit for the non-trawl groundfish fisheries has not changed since 1995.

These limits were set as a way of promoting the development of U.S. groundfish fisheries while also removing the incentive that groundfish participants might have to otherwise target halibut.

Since 1986 there have been significant changes in groundfish and halibut management programs and fishing patterns, environmental conditions, fishing technology, and our knowledge of halibut and groundfish stocks. Halibut is fully utilized in the directed sport, subsistence and commercial fisheries and is of significant social,cultural and economic importance to communities throughout the geographical range of the resource. Halibut PSC allowances are also critical to the prosecution of many groundfish trawl and non-trawl fisheries operating in the GOA.

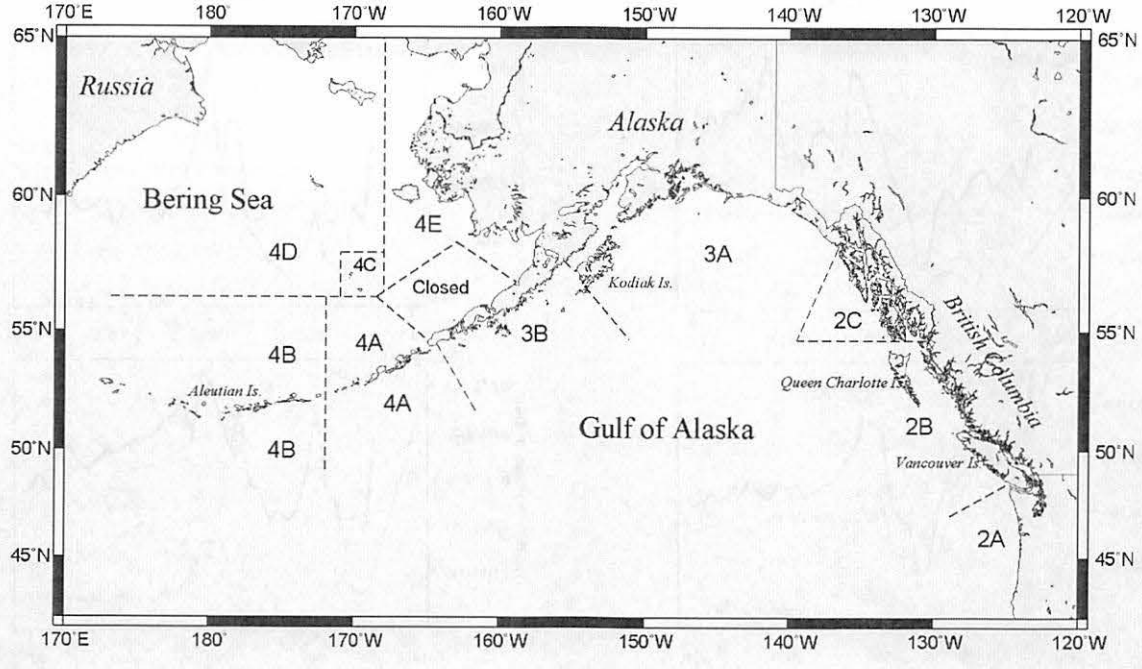
The intent of the motion is that this information would be available prior to the April meeting, which is the timeline staff has identified as necessary if the Council wishes to consider changes during the 2012 TAC setting process.

HALIBUT BYCATCH ISSUES

IPHC Staff

This presentation is intended to be complemented by a verbal interpretation. As such, it is offered here solely for informational purposes, and to allow some familiarity with the material prior to its formal presentation.

IPHC Regulatory Areas

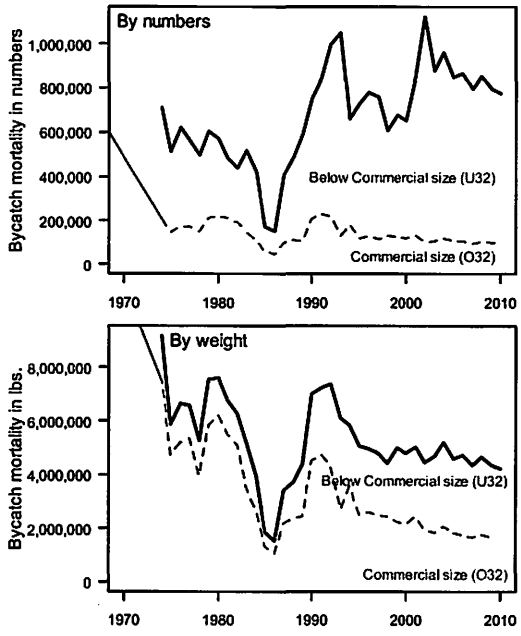


IPHC jargon

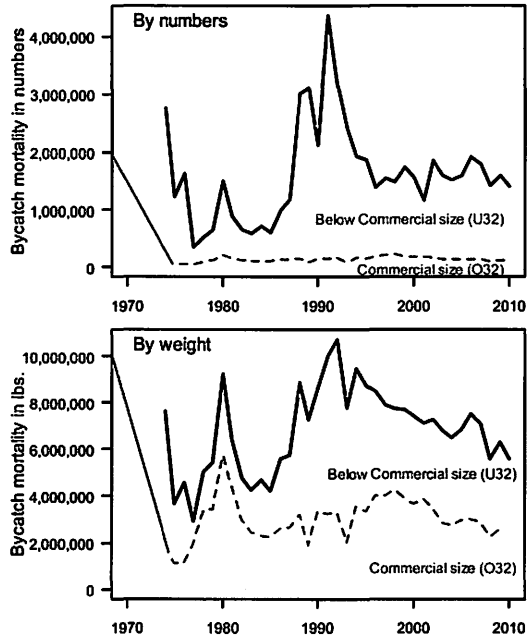
- Catch Limits (CL) – equivalent to TAC
- EBio – exploitable biomass, defined by length-specific selectivity of longline gear
- SBio – female spawning biomass
- O32 – over 32 inches in length (comm. size limit)
- U32 – under 32 inches in length
- WPUE – Weight per unit effort, the weight of O32 halibut caught per skate in standard IPHC survey

Halibut bycatch mortality

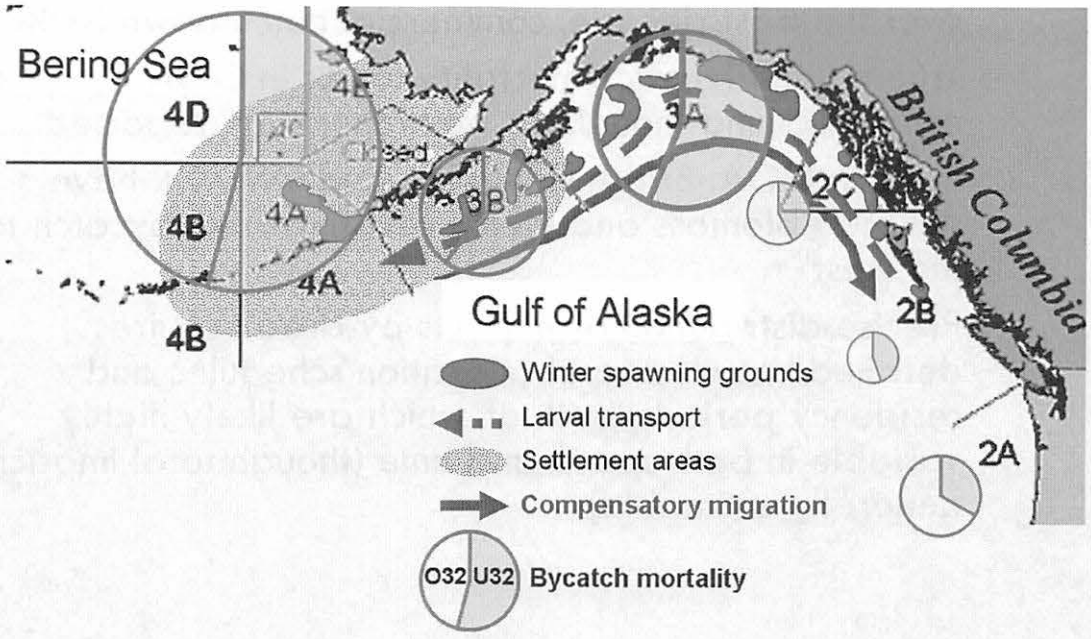
Gulf of Alaska



Bering Sea



Pacific halibut life history – role in bycatch impacts



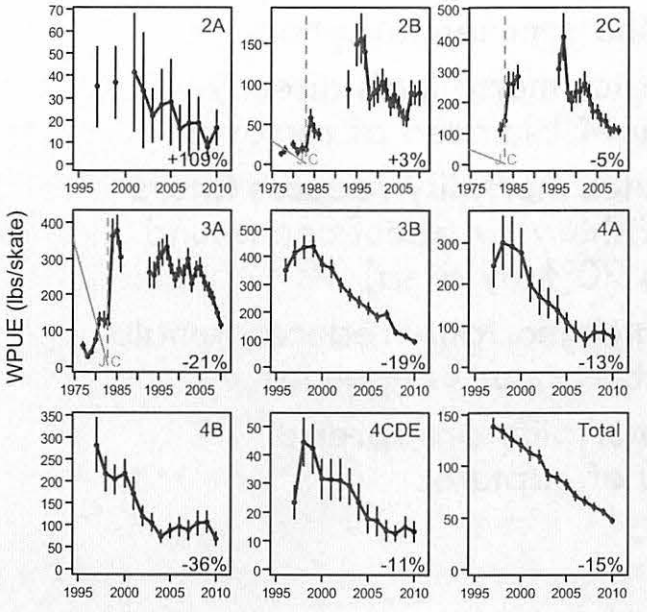
Halibut bycatch mortality facts

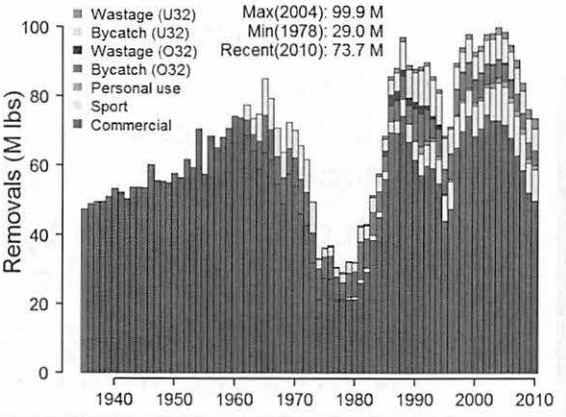
- Approximately the same number of halibut are killed as bycatch as are taken in the commercial fishery
- Each pound of O32 bycatch mortality is directly deducted from commercial CL in area of removal
- Each pound of U32 bycatch mortality reduces future yield to the commercial fishery by about one pound (actual ratio varies up to 20% by area)
- Each pound of U32 bycatch mortality reduces female spawning stock biomass by about 1.6 pounds
- The impacts of bycatch mortality are spread "downstream" from area of capture

Importance of bycatch mortality

- Coastwide halibut exploitable biomass is down 50% over the past decade, commercial catch down 34%
- True halibut bycatch mortality levels in GOA are poorly estimated and thought to be higher than reported
- Eastern GOA, British Columbia and WA/OR have reduced biomass and yields resulting from bycatch to the west
- Precise distribution of impacts by area requires detailed knowledge of migration schedules and residency periods, both of which are likely highly variable in both space and time (though total impact is generally estimable)

Halibut population and catch trends

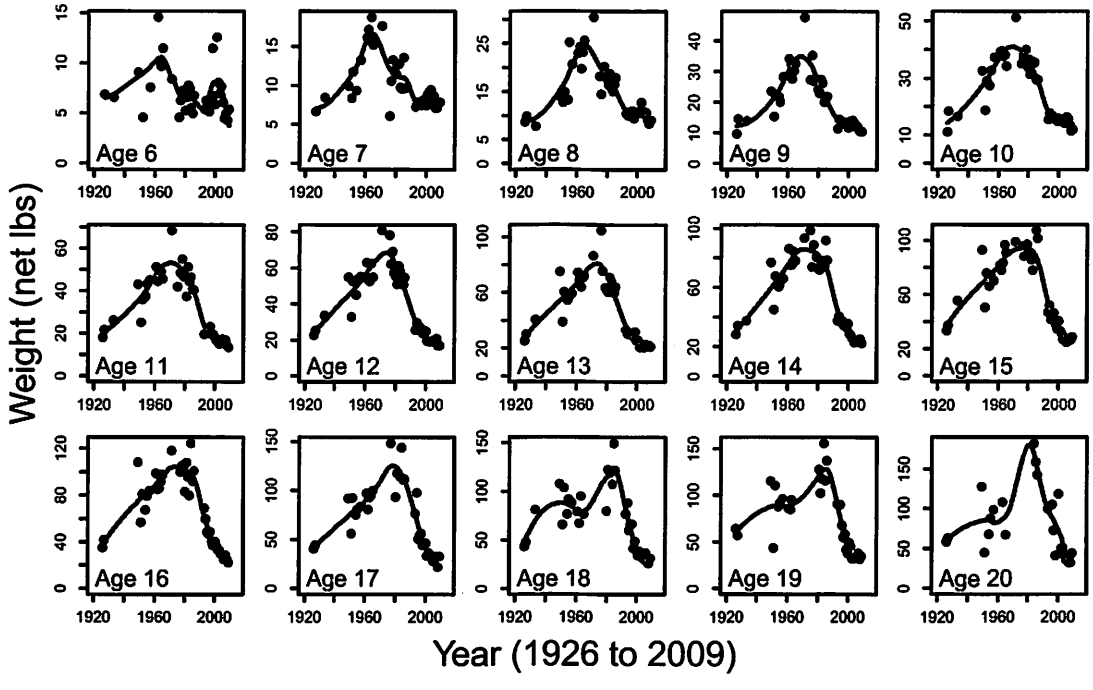




Recent changes in the IPHC assessment

- Coastwide assessment with biomass partitioning using halibut survey (since 2007)
  - Adjustments to survey indices for catchability and timing
  - Survey WPUE weighted 75:20:5, most recent year receives highest weight (began in 2011)
- Constant harvest rate policy with reduced harvest rates in the western areas
- Changes in annual CLs moderated by "Slow Up Full Down" adjustment (was "Slow Up Fast Down")
- Bycatch between 26 and 32 inches first deducted directly from CL in 2011.

Halibut size-at-age



Why are halibut so much smaller now?

- One or more of following
  - Density dependence (competition with halibut and other flatfish, especially arrowtooth flounder)
  - Environmental changes – food, temperature
  - Effects of size-selective fishing
    - Annual cropping of faster growing fish leaves smaller ones behind
    - Fishery induced evolution – genetic truncation
  - Other unidentified processes
  - Any/all of these may be working together
- What can we do about this?
  - Ensure we have a robust harvest policy (protect the SBio!)
  - Consider a change in the size limit – unpredictable results!
  - We can't selectively remove arrowtooth flounder
  - Very difficult to design a study that can answer this over a short duration since change occurs on a decadal scale

D-2(b) GOA Halibut PSC limits, motion

Purpose and need statement

The GOA Groundfish FMP and NMFS rule making establish a 2,000mt halibut PSC limit for trawl gear and a 300mt halibut PSC limit for hook and line gear. The FMP authorizes the Council to recommend, and NMFS to approve, annual halibut mortality limits as a component of the proposed and final groundfish harvest specifications. Halibut PSC limits are set separately for trawl and fixed gear, which may be further apportioned by season, regulatory area, and/or target fishery.

Since the existing GOA halibut PSC caps were established, the total biomass and abundance of Pacific halibut has varied and in recent years the stock has experienced an ongoing decline in size at age for all ages in all areas. Exploitable biomass has decreased 50% over the past decade. In recent years, the directed halibut catch limits in the GOA regulatory areas 2C, 3A and 3B have declined steadily. From 2002 to 2011 the catch limit for the combined areas 2C, 3A, and 3B declined by almost 50%. While total biomass is high, much of this biomass is made up of smaller fish that are more vulnerable than larger fish to trawl gear.

With the exception of bycatch reductions in the IFQ sablefish fishery, and the Rockfish Pilot Program, the current bycatch limits have not been revised since 1989 (Amendment 18). Since that time there have been significant changes in groundfish and halibut management programs and fishing patterns, environmental conditions, fishing technology, and our knowledge of halibut and groundfish stocks. Halibut is fully utilized in the directed sport, subsistence and commercial fisheries and is of significant social, cultural and economic importance to communities throughout the geographical range of the resource. Halibut PSC allowances are also critical to the prosecution of many groundfish fisheries operating in the GOA.

The GHL for the charter sector in 2C has declined from 1,432,000 to 788,000 net pounds in the last 5 years, and progressively restrictive management measures have been implemented to keep this sector within its GHL.

Recognizing the significant decline in exploitable biomass, the uncertainties about current halibut stock dynamics and the effect of current bycatch levels, the Council acknowledges a need to evaluate existing halibut PSC limits and consider reductions.

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Alternatives for analysis

The Council directs staff to prepare the necessary analytical document to consider a reduction in GOA halibut PSC limits, through the 2012/2013 specifications process. The reductions in halibut PSC limits that were set in the Rockfish Program, but not removed from the 2,000mt PSC cap will be taken off the top, and there will be no further reductions in the Rockfish Program through this action. This action also assumes that a pro-rata adjustment will be made to seasonal apportionments for the trawl PSC limit (except under the suboption for Alternative 2, Option 2).

Alternative 1: Status quo

Alternative 2: PSC limit reduction

Option 1: Reduce the halibut PSC limit for hook-and-line gear by

a) 5%.

b) 10%.
c) 15%.

Option 2: Reduce the halibut PSC limit for trawl gear by

a) 5%.
b) 10%.
c) 15%.

Suboption: Apply the full trawl PSC limit reduction to the 5th season.

A draft analysis should be available for review by the GOA Plan Team at its August meeting and provided to the Council for initial review at the Council's October 2011 meeting to ensure that any PSC reductions can be considered as part of the Council's 2012 annual specification process. This analysis should examine the effects of modifying halibut PSC as detailed in Section 3.6.2.1.1 of the GOA Groundfish FMP. In addition this analysis should examine the effect of changing GOA PSC limits on the applicable allocations and sideboard limits under the AFA, Amendment 80, and the proposed Rockfish Program. The analysis should also examine the implications of Pacific cod sector splits on halibut PSC. This action should be prepared as an analysis that will be incorporated into the existing harvest specifications process. However, the Council may determine at Initial Review that it is more appropriate to proceed with this action as a separate amendment to the annual harvest specifications process that would modify the 2012 GOA halibut PSC limits.

In the future the Council intends to seek longer term solutions that incorporate halibut bycatch reduction by all gear types and fisheries in the GOA groundfish fisheries through Groundfish FMP and regulatory amendment. It is expected that the analysis to reduce halibut PSC limits through the harvest specifications process will inform Council direction for proceeding with longer term solutions. The Council's intent is to work with stakeholders to explore different approaches to halibut bycatch reduction, including individual accountability and incentive based approaches, that balance the interests of stakeholders and that provide the tools necessary to meet management and conservation objectives in the halibut and groundfish fisheries.