INITIAL REVIEW DRAFT

Environmental Assessment/ Regulatory Impact Review/
Initial Regulatory Flexibility Analysis
for Proposed Amendment
to the Fishery Management Plan for Groundfish of the
Bering Sea/Aleutian Islands Management Area

Revise Bering Sea/Aleutian Islands Halibut Prohibited Species Catch Limits

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Abstract: This document analyzes proposed management measures to reduce Pacific halibut prohibited species catch (PSC) mortality limits in the Bering Sea/Aleutian Islands (BSAI) groundfish fisheries. PSC limit reductions are considered for various sectors, including the BSAI trawl limited access sector, the Amendment 80 sector, longline catcher vessels, longline catcher processors, and the Community Development Quota sector (i.e., a reduction to the CDQ's allocated prohibited species quota reserve). The objective of reducing PSC limits would be to minimize bycatch to the extent practicable, potentially provide additional harvest opportunities in the directed halibut fishery, and help improve halibut stock conditions. The North Pacific Fishery Management Council (Council) has also asked for additional information on other issues, which are not currently part of the action, except that they may inform the Council with respect to other options that could be considered for inclusion.

List of Acronyms and Abbreviations

A80	Amendment 80
ABC	acceptable biological catch
ADFG	Alaska Department of Fish and Game
AFA	American Fisheries Act
AFSC	Alaska Fisheries Science Center
AKFIN	Alaska Fisheries Information Network
AKSC	Alaska Seafood Cooperative
BBEDC	Bristol Bay Economic Development Corporation
BPD	Bycatch Projection Delta
BSAI	Bering Sea and Aleutian Islands
BSAI TLA	Bering Sea and Aleutian Islands Trawl Limited Access sector
CAS	Catch Accounting System
CEQ	Council on Environmental Quality
CFEC	State of Alaska Commercial Fisheries Entry Commission
CFR	Code of Federal Regulations
COAR	Commercial Operator's Annual Report
Convention	Convention between the U.S. and Canada for the Preservation of the Halibut Fishery of the North Pacific Ocean and Bering Sea
Council	North Pacific Fishery Management Council
CP	catcher processor
CSP	Catch Sharing Plan
CV	catcher vessel
CVRF	Coastal Village Region Fund
DMR	Discard mortality rate
DPS	distinct population segment
E	East
E.O.	Executive Order
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EFP	Exempted Fishing Permit
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FCEY	fishery constant exploitation yield
FLCC	Freezer Longline Conservation Cooperative
FMP	fishery management plan
FR	*Federal Register*
FRFA	Final Regulatory Flexibility Analysis
ft	foot or feet
GHL	guideline harvest level
GOA	Gulf of Alaska
HMT	Halibut PSC mortality
IFQ	
IMS Model	Iterative Multi-year Simulation Model; model that is the basis of this analysis
IRFA	Initial Regulatory Flexibility Analysis
IPHC	International Pacific Halibut Commission
lb	pound(s)
LLP	license limitation program

m	meter or meters
M	million
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MMPA	Marine Mammal Protection Act
MSST	minimum stock size threshold
mt / MT	metric ton
NEI	Northern Economics, Inc.
NEPA	National Environmental Policy Act
NMFS	National Marine Fishery Service
NOAA	National Oceanographic and Atmospheric Administration
NPFMC	North Pacific Fishery Management Council
NPV	Net present value
NSEDC	Norton Sound Economic Development Corporation
O26	Halibut that are over 26 inches in length
O32	Halibut that are over 32 inches in length
Observer Program	North Pacific Groundfish and Halibut Observer Program
OMB	Office of Management and Budget
OT AK	Other Alaska
PBR	potential biological removal
PSC	prohibited species catch
PSQ	Prohibited species quota
PRA	Paperwork Reduction Act
PSEIS	Programmatic Supplemental Environmental Impact Statement
QS	Quota share
RFA	Regulatory Flexibility Act
RFFA	reasonably foreseeable future action
RIR	Regulatory Impact Review
SAFE	Stock Assessment and Fishery Evaluation
SAR	stock assessment report
SBA	Small Business Act
Secretary	Secretary of Commerce
SHARC	Subsistence Halibut Registration Certificate
SPLASH	Structure of Populations, Levels of Abundance, and Status of Humpbacks
SPR	Spawning Potential Ratio
SW	southwest
SWHS	ADFG Statewide Harvest Survey
TAC	total allowable catch
TCEY	total constant exploitation yield
U26	Halibut that are under 26 inches in length
U32	Halibut that are under 32 inches in length
U.S.	United States
USFWS	United States Fish and Wildlife Service
W	West

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Executive Summary

This document analyzes proposed management measures to reduce Pacific halibut prohibited species catch (PSC) mortality limits in the Bering Sea/Aleutian Islands (BSAI) groundfish fisheries. PSC limit reductions are considered for various sectors, including the BSAI trawl limited access sector, the Amendment 80 sector, longline catcher vessels, longline catcher processors, and the Community Development Quota (CDQ) sector (i.e., a reduction to the CDQ's allocated prohibited species quota reserve). The objective of reducing PSC limits would be to minimize bycatch to the extent practicable, potentially provide additional harvest opportunities in the directed halibut fishery, and help improve halibut stock conditions. The North Pacific Fishery Management Council (Council) has also asked for additional information on other issues, which are not currently part of the action, except that they may inform the Council with respect to other options that could be considered for inclusion.

Bycatch and PSC terminology

The Council manages the groundfish fisheries of the BSAI under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1802(2)), and through a Fishery Management Plan for the BSAI Management Area (BSAI FMP). Bycatch, as defined by the MSA, "means fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards[1] and regulatory discards." The term "regulatory discards" means "fish harvested in a fishery which fishermen are required by regulation to discard whenever caught, or are required by regulation to retain, but not sell." In the case of the BSAI FMP, the Council has designated Pacific halibut, along with several other fully utilized species such as salmon, herring, and crab species, as "prohibited species" in the groundfish fisheries, which fishermen are required by regulation to discard. These species are identified in law; their capture is required to be minimized; and their retention is prohibited. Unintended removals of prohibited species are separately monitored and controlled under the groundfish fishery management plans. In the context of the BSAI FMP, "halibut PSC" refers to the bycatch of halibut in the groundfish fisheries. This analysis primarily addresses halibut PSC mortality, i.e., the subset of halibut PSC that is assumed to be dead as a consequence of interactions with the groundfish fisheries. Mortality calculations are made for all halibut PSC in the groundfish fisheries, using discard mortality rates adopted triennially by the Council as part of the harvest specifications process. Halibut PSC limits, and removals of halibut PSC in the groundfish fisheries, are specified in terms of metric tons, round weight, of halibut PSC mortality.

The International Pacific Halibut Commission (IPHC) is responsible for the overall biologic assessment and conservation of Pacific halibut off the coasts of Alaska, British Columbia, and the western United States. In the parlance of the IPHC, "bycatch" refers to the mortality of Pacific halibut occurring in commercial fisheries that target other species, including halibut PSC mortality in the groundfish fisheries. This analysis refers to halibut PSC mortality in the context of the proposed action, except where appropriate to describe the IPHC catch limit process, or their research or stock assessment information. The IPHC manages and reports on halibut removals in pounds, net weight, of halibut mortality, and assumes that net weights are 75 percent of round weights.

Purpose and Need

Consistent with the MSA's National Standard 1 and National Standard 9, the Council and NMFS use halibut PSC mortality limits to minimize halibut bycatch in the groundfish fisheries to the extent practicable, while achieving, on a continuing basis, the optimum yield from the groundfish fisheries. The

[1] "Economic discards" are defined as "fish which are the target of a fishery, but which are not retained because of an undesirable size, sex, or quality, or other economic reason."

Council has designated Pacific halibut as "prohibited species" in groundfish fisheries, which fishermen are required by regulation to discard.

The IPHC accounts for incidental halibut removals in the groundfish fisheries, recreational and subsistence catches, and other sources of halibut mortality before setting commercial halibut catch limits each year. Declines in the exploitable biomass of halibut since the late 1990s, and decreases in the Pacific halibut catch limits set by the IPHC for the directed BSAI halibut fisheries, have raised concerns about the levels of halibut PSC mortality by the commercial groundfish trawl and hook-and-line sectors. Reductions in halibut PSC mortality have not been proportional to the reductions in directed halibut harvest limits over this time period, although Council recognizes industry efforts to reduce halibut PSC mortality. Under National Standard 8, the Council must also provide for the sustained participation of and minimize adverse economic impacts on fishing communities, and BSAI coastal communities are affected by reduced catch limits for the directed halibut fishery, especially in IPHC Area 4CDE.

The proposed action would reduce the halibut PSC limits in the BSAI, which are established for the BSAI trawl and fixed gear sectors in Federal regulation, and in some cases, in the BSAI Groundfish FMP. Minimizing halibut PSC mortality while achieving optimum yield is necessary to maintain a healthy marine ecosystem, ensure long-term conservation and abundance of halibut, provide maximum benefit to fishermen and communities that depend on halibut and groundfish resources, as well as U.S. consumers, and comply with the Magnuson-Stevens Act and other applicable Federal law. Halibut "savings" that would occur from reducing halibut PSC mortality below current usage, would accrue to the directed halibut fisheries in both the near term and long term.

Alternatives

The Council adopted the alternatives listed below for analysis in June 2014. More than one alternative or option listed below may be selected simultaneously. **Staff have proposed some minor modifications to Alternative 2 options, which are consistent with Council intent.** The proposed modifications are indicated in <u>underline</u> or ~~strikeout~~, and all of the alternatives and options, including the proposed modifications, are explained in more detail in the subsections that follow.

With respect to Alternative 3, the Council received a report on progress with developing deck sorting procedures and technologies that could reduce halibut mortalities in October 2014. In compliance with the Council's request, industry and NMFS are working together to develop deck sorting procedures, and have determined that these need to be further tested through an Experimental Fishing Permit. As a result, the Council acknowledged that there is not yet sufficient information to analyze halibut mortality reductions as a result of this alternative in time for initial review in February 2015. **Staff recommends that this alternative be removed from the analysis at this time.**

Alternative 1 No action.

Alternative 2 Amend the BSAI Groundfish FMP to revise halibut PSC limits as follows *(more than one option can be selected)*.

~~**Option 1** Establish seasonal apportionment of halibut PSC in the BSAI trawl limited access sector.~~

Option 2 Reduce halibut PSC limit for the BSAI Trawl Limited Access Sector by:
a) 10 percent b) 20 percent c) 30 percent or d) 35 percent

Option 3 Reduce halibut PSC limit for the Amendment 80 Sector by:
a) 10 percent b) 20 percent c) 30 percent or d) 35 percent

Option 4 Reduce halibut PSC limit for <u>Pacific cod</u> hook and line catcher vessel sector by:

a) 10 percent b) 20 percent c) 30 percent or d) 35 percent

Option 5 Reduce halibut PSC limit for Pacific cod hook and line catcher processor sector by:
a) 10 percent b) 20 percent c) 30 percent or d) 35 percent

Option 6 Reduce the CDQ halibut PSQ limit by:
a) 10 percent b) 20 percent c) 30 percent or d) 35 percent

Option 7 Reduce halibut PSC limit for other non-trawl (i.e., hook and line catcher vessels and catcher processors targeting anything except Pacific cod or sablefish) by:
a) 10 percent b) 20 percent c) 30 percent or d) 35 percent

~~**Alternative 3.** Implement measures in the Amendment 80 sector to provide opportunities for deck sorting of halibut, or other handling practices that may provide an opportunity to reduce mortality of halibut that cannot be avoided.~~

The Council also requested several additional items to be included in the analytical package for addressing BSAI halibut PSC mortality. Staff has also added two additional items to this list of discussion items, to correspond with proposed modifications to the alternatives. Also, the Council's June 2014 motion included three items to be addressed on a related timeline to the halibut analysis. These are included at the bottom of the list, and an update is included in the analysis.

- Maps/tables of catch/bycatch in IPHC closed area: The levels of groundfish catch and halibut PSC by groundfish sectors, and the size and age distribution of that halibut PSC, in the existing IPHC area (Closed Area) that is closed to the directed halibut fishery in the Bering Sea.
- PSC limit for IFQ sablefish: Whether a halibut PSC limit would be appropriate to limit halibut PSC mortality in the directed sablefish IFQ fishery.
- Effects on salmon bycatch: Potential impacts of efforts to reduce halibut PSC mortality on existing and anticipated Chinook and chum salmon PSC management measures (i.e., incentive plan agreements).
- Biomass-based PSC limits: The range of potential approaches to establishing a halibut PSC limit based on projections of total biomass, projected spawning biomass, or other appropriate indices of abundance and productivity.
- Halibut PSC rollovers: Current protocols for rolling unused halibut between sectors, and the effect of those protocols on the achievement of OY and/or reductions in overall halibut PSC mortality
- 4CDE subsistence info: Overview of available subsistence information for Areas 4CDE
- Directed halibut fishery: Fishing practices that reduce halibut bycatch in the directed halibut fishery
- Amendment 80 measures: Evaluate the potential for the Amendment 80 flatfish flexibility program to reduce halibut PSC mortality; evaluate the potential of a change to the Amendment 80 trawl season opening date from Jan 20 to Jan 1 to reduce halibut PSC mortality; evaluate the potential of changes to the current Amendment 80 area closures to reduce halibut PSC mortality
- Seasonal apportionment: Evaluate whether seasonal apportionment in the BSAI trawl limited access fishery could reduce halibut PSC mortality
- Halibut deck sorting: Provide a progress report on the design and implementation of the deck sorting EFP, and how it relates to the overall reduction of halibut PSC mortality for Amendment 80

- Request for voluntary 10% halibut PSC mortality and discard reduction efforts by the groundfish and halibut industry in 2014 and 2015
- Report on voluntary efforts by industry sectors (American Fisheries Act (AFA) CPs, AFA CVs, Amendment 80, Freezer Longline Conservation Cooperative, CDQ) at time of initial review
- Work with IPHC to incorporate bycatch (halibut PSC mortality) and discard data from observer program into halibut stock assessments

Environmental Assessment

Under Alternative 1, there would be no changes to the regulated BSAI PSC limits. Since 2008, halibut PSC mortality in the BSAI groundfish fisheries has been 70 to 84 percent of the regulated PSC limits. In June 2014, industry sectors were asked by the Council to voluntarily reduce halibut PSC mortality over the 2014 and 2015 fishing seasons, and have been reporting to the Council on measures they are undertaking to reduce halibut PSC mortality.

Alternative 2 could reduce the amount of halibut PSC mortality in the trawl and longline groundfish fisheries. The alternative includes several options to apply PSC limit reductions to different sectors of the BSAI trawl and longline groundfish fleet. Some of the options under Alternative 2 would result in no change to the status quo, while others would result in constraining PSC limits under which industry may change fishing patterns in order to to optimize their groundfish harvest with a minimum of halibut PSC mortality, in order to avoid fishery closures[2]. This could result in a response of reducing fishing effort, as the industry chooses not to pursue less valuable fisheries in order to conserve halibut PSC mortality, or it could result in greater fishing effort at lower catch per unit effort, as vessels change fisheries patterns or seasonal changes in the timing of the fishing, to increase halibut avoidance. Shifts in the location or timing of fishing may occur as a result of Alternative 2. However, there is already considerable interannual variability in the patterns of fishing across the BSAI groundfish sectors, as environmental conditions and avoidance of PSC species have caused vessels to adjust their fishing patterns. Any shift in fishing is likely to occur within the existing footprint of the groundfish fishery in the BSAI.

Pacific halibut

Alternative 1 would result in no change to the amount of halibut PSC mortality in the trawl and longline groundfish fisheries, and it is unlikely that groundfish fishing under the status quo, or Alternative 1, has direct or indirect impacts on Pacific halibut sustainability. While the halibut biomass has declined from peaks in the late 1990s, the estimated female spawning biomass appears to have stabilized or be slightly increasing. Halibut mortality in the groundfish fisheries is taken into account when the commercial halibut quotas are set, to prevent significantly adverse impacts on the halibut stocks.

Halibut PSC removals in the groundfish fisheries are constrained by PSC limits, which provide an upper limit annually on halibut PSC mortality. The level of halibut removals in the trawl and longline groundfish fisheries under the status quo could result in reduced allocations to the directed halibut fisheries in Area 4 through reduced yield, as halibut removals are deducted from the total constant exploitation yield (TCEY) for the halibut stock before a directed fishery allocation is calculated. Any reductions in the directed fishery allocations affect the economic state of commercial halibut fishermen or the communities they impact. At the same time, hook-and-line and trawl industry efforts to reduce halibut PSC mortality in the prosecution of the groundfish fisheries may lower the amount of future removals the IPHC deducts from the TCEY. It is unlikely that halibut harvests in unguided sport and subsistence fisheries are impacted by Alternative 1 because these fisheries do not have caps on removals in Area 4, and harvests in the halibut subsistence and unguided sport fisheries are also deducted from the TCEY

[2] Note that the BSAI pollock fishery is not constrained by the current cap, nor are there options in the analysis to introduce such constaints. As a result, reduced PSC limits would not affect them directly.

prior to the commercial fishery limits being set. Since subsistence and recreational removals are not restricted by catch limits, it is assumed that those sectors are not affected by the status quo or options that reduce the PSC limits.

Alternative 2 includes several options to apply PSC limit reductions to different sectors of the BSAI trawl and longline groundfish fleet, although not all of them result in a change to the status quo, given that the sectors regularly harvest less than the regulated PSC limit. An important component of PSC mortality is the proportion that is over and under 26 inches. Halibut that are over 26 inches (O26) that are killed as PSC would have been a part of the halibut fishery commercial catch limit (FCEY) had they not been killed. Halibut killed as PSC mortality that are under 26 inches (U26), will become a factor for the commercial fishery in later years. Reductions in O26 halibut mortality resulting from PSC will be directly reallocated to increased halibut yields available to harvesters in the directed halibut IFQ fisheries in Area 4, at an approximately 1:1 relationship between halibut PSC mortality "savings" and directed fishery yield. The O26 component is estimated to be 64 percent of the overall BSAI halibut PSC mortality in 2013 (the last full year of data). Because they roll completely into the directed halibut fishery, reductions in O26 halibut PSC mortality will have no effect on the halibut stock condition.

Reductions in halibut PSC mortality of U26 fish will also contribute to increased halibut yields for directed halibut IFQ fisheries, at the same pound for pound relationship, but these yields are in increases to the exploitable biomass, and will be distributed across all regulatory areas, as the fish grow to commercial size. Based on the setline survey, Area 4 represents 22 percent of the exploitable biomass (halibut over 32 inches) for the coastwide halibut stock, therefore approximately 22 percent of the U26 halibut PSC mortality reductions would, at some future time, accrue back to the Area 4 directed fisheries as halibut yield. The remainder of the U26 halibut "savings" would accrue to directed halibut users in other IPHC regions, in proportion to their share of the coastwide biomass. With respect to whether removals of U26 halibut have an effect on the condition of the halibut stock, mortality of juvenile halibut will have an effect on the distribution of the surviving fish, and therefore the subsequent spawning biomass. It is not currently known how important the spatial distribution of the spawning stock may be to short or long-term stock productivity, but greater mortality at younger ages is likely to change this distribution more than older removals. Reductions in U26 halibut PSC mortality could make more halibut of various sizes available in the BSAI. The extent to which this may affect the halibut spawning biomass coastwide depends on the importance of spatial distribution of the spawning stock, but any effect of the PSC limit reductions in the BSAI will be tempered by the proportion of the reduction that affects U26 halibut (currently 34 percent of halibut PSC mortality), and the BSAI's overall proportion of total coastwide biomass (currently 22 percent). It is notable that while the majority of coastwide U26 halibut PSC mortality occurs in Area 4CDE, the proportion of the coastwide biomass in this area has been stable with a slight increase over the last fifteen years.

For the most part, the options in Alternative 2 which would result in a change from status quo, in terms of halibut PSC mortality, are unlikely to have a different effect on halibut, as catch will largely be reallocated from halibut PSC mortality to directed fishery catch, although there may be some conservation benefit to the stock with respect to reducing the mortality of U26 halibut. Alternative 2 is not anticipated to have a significant effect on the Pacific halibut biomass.

<u>Other resource components</u>

Under the status quo, the BSAI groundfish stocks are neither overfished nor subject to overfishing, and levels of fishing on ecosystem component species (including forage fish and prohibited species) are constrained by bycatch and PSC limits. Under the more constraining options of Alternative 2, reduced PSC limits may result in some groundfish fisheries closing before the total allowable catch (TAC) is reached, which will result in less impact on the stock, or fishing occurring in areas of lower catch per unit effort. While this may result in higher interception of incidental species, the groundfish stocks, forage fish and prohibited species are also managed under catch, bycatch and PSC limits, which mitigate risk to these stocks. For groundfish stocks, the biological effects are expected to be correctly incorporated in stock assessments and the harvest specifications system.

Marine mammal and seabird disturbance and incidental take are at low levels and are mitigated by groundfish fishery area closures. Under Alternative 2, there may be changes in fishing patterns that result in more fishing effort (at lower catch per unit effort), in response to potentially constraining PSC limits. This is most likely to occur in trawl fisheries, where limits are more constraining. Neither disturbance, incidental take, changes in prey availability or benthic habitat alteration, however, is anticipated to increase to a level that would result in population level effects on marine mammals or seabirds.

Previous analyses have found no substantial effects to habitat in the BSAI from fishing activities (NMFS 2005b). Under Alternative 2, any increase in fishing effort would still occur within the existing footprint of fishing and existing habitat and conservation measures, and is unlikely to be significant.

Regulatory Impact Review

The RIR describes the status quo with respect to participants in each of the affected sectors, catch and revenue, regional impacts, PSC limits and associated mortality in target fisheries, reliance on BSAI groundfish and diversification into other fisheries. A description of catch and revenue in the commercial halibut fishery is also included, along with a summary of its regional impact. To analyze the effects of Alternative 2, the analysis uses an iterated multi-year simulation model, which uses the basis years of 2008 to 2013 to forecast future impacts of the PSC limit reductions. There are two aspects to the modeling of impacts of PSC limit reductions: how to account for fishermen’s response to constraining limits by optimizing their groundfish fishing to the extent possible (noting that their ability to respond effectively is more difficult when PSC limit reductions, or other management measures affecting them, are more constraining), and how “savings” of halibut PSC mortality in the groundfish fisheries affect other sectors, in this case, the commercial halibut fishery. The model uses two scenarios to mimic how industry would respond to a lower PSC limit. The scenarios employ different methods of dropping groundfish harvest records to meet the new PSC limit, and are intended to represent reasonable lower and upper bounds of the impact of the PSC limit reduction. For the impact on the halibut fishery, the model uses algorithms that mimic the IPHC process to generate recommendations for the coming year’s Fishery Constant Exploitation Yield (FCEY), or catch limit for the directed halibut fishery, including taking into account the O26/U26 proportion of halibut PSC mortality.

Table ES-1 summarizes the Alternative 2 PSC limit reduction options in terms of their halibut PSC mortality reductions in the groundfish fishery and the foregone net present value associated with those reductions. The table also shows how halibut PSC reductions would translate into reallocations to the directed halibut fishery yield in terms of O26 fish, and the associated gain in net present value, as well as Area 4’s proportionate share of a potential future U26 yield.

Only some of the options would result in a change to the status quo, given that the sectors regularly harvest less than the regulated PSC limit.

- For the Bering Sea trawl limited access sector (Option 2), all of the PSC limit reduction options would have been constraining in some years from 2008 to 2013, and all of the options are likely to be constraining in future years.
- For the Amendment 80 sector (Option 3), all of the PSC limit reduction options would have been constraining in some of the years 2008 to 2013, and all of the options are likely to be constraining in future years.

- For Pacific cod longline catcher processors (Option 5), only reductions of 30 or 35 percent would be likely to constrain this sector in the future. Reductions of 10 or 20 percent would not have constrained the fishery in any of the years from 2008 to 2013, and unless the Pacific cod TACs grow considerably larger in future, these options are unlikely to be constraining.
- For CDQ groups (Option 6), only a reduction of 35 percent would be likely to constrain this fishery in the future, unless the fishery continues its current rate of growth. Reductions from 10 to 30 percent would not have constrained the CDQ groundfish activities in any of the years from 2008 to 2013.
- There would not have been an effect of any of the reduction options on Pacific cod longline catcher vessels (Option 4), or the PSC limit that is apportioned to other non-trawl fisheries (i.e., targeting species other than Pacific cod or sablefish) (Option 7), during the years 2008 to 2013. Given the current lack of growth in either of these fisheries, it is unlikely that any of the proposed options would be constraining in the future.

Table ES-1 Comparison of alternatives and major impacts

	BSAI Groundfish Fisheries					Commercial Halibut Fishery in Area 4				
	Current PSC Limit	Mean PSC Used[1]	New PSC Limit	Average PSC Reductions[2]	Foregone Net Present Value	Reallocated Yield to Commercial Halibut Fishery from O26 Fish: 4A	4B	4CDE	Potential Yield in Area 4 from U26	Gain of Net Present Value from O26 Fish
	Halibut PSC Mortality (round mt)				2013$ Million	net weight pounds (1,000s)				2013$ Million
Option 2, Affecting BSAI Trawl Limited Access Sector										
a) -10%	**875**	**700**	788	12 – 17	$10 – $16	4.0 – 6.4	0.4 – 0.5	5.3 – 6.3	1.6 – 2.1	$1.0 – $1.4
b) -20%			700	27 – 39	$30 – $50	8.9 – 11.9	1.6 – 2.4	11.1 – 16.7	3.5 – 5.0	$2 – $3
c) -30%			613	44 – 70	$62 – $92	15.0 – 24.8	3.4 – 4.0	17.0 – 25.6	5.7 – 8.8	$4 – $6
d) -35%			569	55 – 99	$78 – $145	17.4 – 37.2	4.2 – 5.2	22.0 – 35.9	7.1 – 12.7	$5 – $8
Option 3, Affecting Amendment 80 Catcher Processors										
a) -10%	**2,325**	**2,037**	2093	40 – 57	$10 – $19	3.0 – 1.6	0.1 – 0.0	36.2 – 54.3	5.0 – 7.1	$4 – $6
b) -20%			1860	191 – 212	$52 – $115	25.7 – 23.9	0.1 – 0.0	162.6 – 184.6	23.8 – 26.3	$20 – $22
c) -30%			1628	414 – 441	$161 – $285	59.3 – 66.6	18.7 – 11.6	327.5 – 352.8	51.2 – 54.4	$44 – $46
d) -35%			1511	531 – 555	$224 – $368	79.6 – 87.9	32.4 – 14.2	406.5 – 439.6	65.5 – 68.5	$56 – $58
Option 4, Affecting Pacific Cod Hook and Line Catcher Processors										
All options	**15**	**3**	10–14	There are no material impacts under any of the options						
Option 5, Affecting Pacific Cod Hook and Line Catcher Vessels										
a) -10%	**760**	**521**	684	There are no material impacts under option (a)						
b) -20%			608	There are no material impacts under option (b)						
c) -30%			532	13 – 30	$10 – $24	2.0 – 5.4	0.7 – 4.1	11.5 – 22.9	1.8 – 4.1	$1.5 – $3.5
d) -35%			494	34 – 51	$27 – $50	3.3 – 8.5	5.9 – 6.5	26.8 – 40.2	4.6 – 7.0	$4 – $6
Option 6, Affecting CDQ										
a) -10%	**393**	**210**	354	There are no material impacts under option (a)						
b) -20%			314	There are no material impacts under option (b)						
c) -30%			275	There are no material impacts under option (c)						
d) -35%			255	2 – 2	$0.5 – $2	0.5 – 1.2	0.0 – 0.0	1.7 – 0.3	0.3 – 0.2	$0.23 – $0.16
Option 7, Affecting Hook and Line for Other Targets										
All options	**58**	**5**	38–52	There are no material impacts under any of the options						

Note, when numbers are shown as a range, they represent estimates from two Scenarios—Scenario A is a relatively “low impact” scenario and Scenario B is a relatively “high impact” scenario.

[1] 2008 to 2013

[2] With the exception of columns showing current and proposed PSC limits, all of the numbers in the table are estimated using the simulation model developed to assess the impacts of the proposed reductions in PSC limits. The model assumes that historical fishing years from 2008 to 2013 repeat themselves randomly out into the future. If one of those years was a “high bycatch” year then that year would have been affected by the reduced PSC limit when other “low bycatch” years would not have been affected. This explains why there are projected impacts to vessels participating in BSAI Trawl Limited Access fisheries under Option 2(a) and Option 2(b), even though the “mean PSC used”, which is an output of the model, is less than or equal to the “New” PSC Limit.

1 Introduction

This document analyzes proposed management measures to reduce Pacific halibut prohibited species catch (PSC) mortality limits in the Bering Sea and Aleutian Islands (BSAI) groundfish fisheries. PSC limit reductions are considered for various sectors, including the BSAI trawl limited access sector, the Amendment 80 sector, longline catcher vessels, longline catcher processors, and the Community Development Quota sector (i.e., a reduction to the CDQ's allocated prohibited species quota reserve). The objective of reducing PSC limits would be to minimize bycatch to the extent practicable, potentially provide additional harvest opportunities in the directed halibut fishery, and help improve halibut stock conditions. The North Pacific Fishery Management Council (Council) has also asked for additional information on other issues, which are not currently part of the action, except that they may inform the Council with respect to other options that could be considered for inclusion.

This document is an Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis (EA/RIR/IRFA). An EA/RIR/IRFA provides assessments of the environmental impacts of an action and its reasonable alternatives (the EA), the economic benefits and costs of the action alternatives, as well as their distribution (the RIR), and the impacts of the action on directly regulated small entities (the IRFA). This EA/RIR/IRFA addresses the statutory requirements of the Magnuson Stevens Fishery Conservation and Management Act (MSA), the National Environmental Policy Act, Presidential Executive Order 12866, and the Regulatory Flexibility Act. An EA/RIR/IRFA is a standard document produced by the Council and the National Marine Fisheries Service (NMFS) Alaska Region to provide the analytical background for decision-making.

1.1 Bycatch and PSC terminology

The Council manages the groundfish fisheries of the Bering Sea and Aleutian Islands under the authority of the MSA (16 U.S.C. 1802(2)), and through a Fishery Management Plan for the BSAI Management Area (BSAI FMP). The Council is guided in the management of groundfish by ten national standards (see Section 7.1) set forth in the MSA. In developing its fishery management policies, the Council often has to balance competing standards. In managing groundfish fisheries to achieve their optimal yields (National Standard 1), the Council uses the best available scientific information (National Standard 4) and also strives to provide for the sustained participation and to minimize adverse economic impacts on fishing communities (National Standard 8) and to minimize bycatch, and the mortality associated with such bycatch (National Standard 9).

Bycatch, as defined by the MSA, "means fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards[3] and regulatory discards." The term "regulatory discards" means "fish harvested in a fishery which fishermen are required by regulation to discard whenever caught, or are required by regulation to retain, but not sell." In the case of the BSAI FMP (and also the Fishery Management Plan for Gulf of Alaska Groundfish), the Council has designated Pacific halibut, along with several other fully utilized species such as salmon, herring, and crab species, as "prohibited species" in groundfish fisheries, which fishermen are required by regulation to discard. These species are identified in law; their capture is required to be minimized; and their retention is prohibited. Unintended removals of prohibited species are separately monitored and controlled under the groundfish fishery management plans. In the context of the BSAI FMP, "halibut PSC" refers to the bycatch of halibut in the groundfish fisheries. This analysis primarily addresses halibut PSC mortality, i.e., the subset of halibut PSC that is assumed to be dead as a consequence of interactions with the groundfish fisheries.

[3] "Economic discards" are defined as "fish which are the target of a fishery, but which are not retained because of an undesirable size, sex, or quality, or other economic reason."

Mortality calculations are made for all halibut PSC in the groundfish fisheries, using discard mortality rates adopted triennially by the Council as part of the harvest specifications process. Halibut PSC limits, and removals of halibut PSC in the groundfish fisheries, are specified in terms of metric tons, round weight, of halibut PSC mortality.

The International Pacific Halibut Commission (IPHC), which was established in 1923 by the Convention between the United States and Canada for the Preservation of the Halibut Fishery of the North Pacific Ocean and Bering Sea, is responsible for the overall biologic assessment and conservation of Pacific halibut off the coasts of Alaska, British Columbia, and the western United States (the Council, in constrast, makes allocative decisions with respect to Pacific halibut targeted off Alaska, under the authority of the Northern Pacific Halibut Act of 1982). In the parlance of the IPHC, “bycatch” refers to the mortality of Pacific halibut occurring in commercial fisheries that target other species, including the groundfish fisheries. The IPHC uses the term “wastage” to refer to halibut killed, but not landed in the commercial halibut Individual Fishing Quota (IFQ) fishery (e.g., due to lost gear, capture of undersized fish). This analysis refers to halibut PSC mortality in the context of the proposed action, except where appropriate to describe the IPHC catch limit process, or their research or stock assessment information. The IPHC manages and reports on halibut removals in pounds, net weight, of halibut mortality, and assumes that net weights are 75 percent of round weights.

1.2 Purpose and Need

Consistent with the MSA’s National Standard 1 and National Standard 9, the Council and NMFS use halibut PSC mortality limits to minimize halibut bycatch (halibut PSC) in the groundfish fisheries to the extent practicable, while achieving, on a continuing basis, the optimum yield from the groundfish fisheries. Although fishermen are required by regulation to avoid the capture of any prohibited species in groundfish fisheries, the use of halibut PSC limits in the groundfish fisheries provide an additional constraint on halibut PSC mortality, and promote conservation of the halibut resource. Halibut PSC limits provide a regulated upper limit to mortality resulting from halibut interceptions, as continued groundfish fishing is prohibited once a halibut PSC limit has been reached for a particular sector and/or season. This provides the maximum benefit to fishermen and communities that depend on both halibut and groundfish resources, as well as U.S. consumers.

The halibut resource is fully allocated. The IPHC accounts for incidental halibut removals in the groundfish fisheries, recreational and subsistence catches, and other sources of halibut mortality before setting commercial halibut catch limits each year. Declines in the exploitable biomass of halibut since the late 1990s, and decreases in the Pacific halibut catch limits set by the IPHC for the directed BSAI halibut fisheries, have raised concerns about the levels of halibut PSC mortality by the commercial groundfish trawl and hook-and-line sectors. Reductions in halibut PSC mortality have not been proportional to the reductions in directed halibut harvest limits over this time period, although Council recognizes industry efforts to reduce halibut PSC mortality. Under National Standard 8, the Council must also provide for the sustained participation of and minimize adverse economic impacts on fishing communities, and BSAI coastal communities are affected by reduced catch limits for the directed halibut fishery, especially in IPHC Area 4CDE.

The proposed action would reduce the halibut PSC limits in the BSAI, which are established for the BSAI trawl and fixed gear sectors in Federal regulation, and in some cases, in the BSAI Groundfish FMP. Overall halibut PSC limits can be modified only through an amendment to the regulations and the FMP, although seasonal and some fishery apportionments of those PSC limits would continue to be set annually through the BSAI groundfish harvest specifications process.

The purpose of the proposed action is to minimize halibut PSC mortality in the commercial groundfish fisheries to the extent practicable, while preserving the potential for the full harvest of the groundfish total allowable catches (TACs) assigned to the trawl and hook-and-line sectors. The proposed action minimizes halibut PSC mortality to the extent practicable in consideration of the management measures currently available to the groundfish fleet, the uncertainty about the extent to which halibut PSC mortality in the groundfish fishery has adverse effects on the halibut resource, and the need to ensure that catch in the trawl and hook-and-line fisheries contributes to the achievement of optimum yield in the groundfish fisheries. Minimizing halibut PSC mortality while achieving optimum yield is necessary to maintain a healthy marine ecosystem, ensure long-term conservation and abundance of halibut, provide maximum benefit to fishermen and communities that depend on halibut and groundfish resources, as well as U.S. consumers, and comply with the Magnuson-Stevens Act and other applicable Federal law.

Halibut savings that would occur from reducing halibut PSC mortality below current levels would accrue to the directed halibut fisheries in both the near term and long term. Near term benefits would result from the PSC mortality reductions of halibut that are over 26 inches in length (O26). These halibut would be available to the commercial halibut fishery in the year that the PSC mortality is foregone, or when the fish reach the legal size limit for the commercial halibut fishery (greater than or equal to 32 inches in total length). Longer term benefits in the directed fisheries would accrue from a reduction of halibut PSC mortality from fish that are less than 26 inches (U26). Benefits from these smaller halibut would occur as they recruit into the directed halibut fisheries.

1.2.1 Council statement

The Council articulated the following purpose and need statement to originate this action in June 2014:

> *Halibut is an important resource in the Bering Sea and Aleutian Islands that supports commercial and subsistence fisheries. Halibut is also incidentally taken in commercial groundfish fisheries managed by the Council, and in the directed halibut fishery.*
>
> *Declines in halibut exploitable biomass since the late 1990s have raised concerns about levels of halibut PSC in the BSAI groundfish fisheries. This decline is particularly pronounced in Areas 4A, 4B, and 4CDE. These areas have incurred major reductions in halibut harvest limits since 2003. BSAI halibut Prohibited Species Catch (PSC) in non-directed fisheries have not declined at a rate proportional to harvest reductions in the directed fishery, and the effect of bycatch on the directed fisheries in Area 4CDE is the most pronounced. The IPHC uses the previous year's actual bycatch amount to set the following year's halibut harvest limits; thus, short-term reductions in BSAI halibut PSC could have immediate implications for directed halibut users. Under National Standard 8, the Council must consider the sustained participation of communities when making fisheries management decisions.*
>
> *The Council recognizes that efforts by various sectors of the industry in recent years have reduced halibut PSC; however, the current low status and continued declines in the halibut resource require immediate action by the Council and industry. Additional regulatory measures to avoid halibut, and further minimize halibut PSC mortality would help to improve halibut stock conditions, could provide additional harvest opportunities in the directed halibut fishery, and be consistent with objectives under National Standard 9.*
>
> *A range of management options are available to reduce halibut bycatch in the BSAI groundfish fisheries. These include reducing existing halibut PSC limits in the trawl and hook and line fisheries and changes in vessel operations that allow halibut to be returned to the sea sooner, thereby reducing halibut mortality.*

1.3 History of this Action

Halibut removals often occur in trawl fisheries targeting groundfish species (such as pollock, Pacific cod, and flathead sole). Interceptions of halibut also occur in groundfish hook-and-line and pot fisheries. Pacific halibut are designated as “prohibited” in the BSAI FMP, and regulations require that all halibut caught incidentally must be discarded, regardless of whether the fish is living or dead. The BSAI Groundfish FMP has been amended several times since implementation over thirty years ago, to expressly address halibut PSC limits.

Under PSC limits, the Council’s intent is to control the bycatch of halibut intercepted in groundfish fisheries. These PSC limits are intended to optimize total groundfish harvest, while taking into consideration the anticipated amounts of halibut PSC mortality in each directed groundfish fishery. The halibut PSC allowances are apportioned by target fishery, gear type, and season. Essentially, these PSC limits direct fisheries, by area or time, to regions where the highest volume or highest value target species may be harvested with reduced halibut PSC mortality. Reaching a seasonal or sector halibut PSC limit results in closure of a directed groundfish fishery, even if some of the groundfish TAC for that fishery remains unharvested.

Halibut PSC limits in the BSAI Groundfish FMP and Federal regulations are specified at 3,675 mt of halibut mortality for trawl gear, and 900 mt of halibut mortality for non-trawl fisheries. A proportion of each of these overall limits is allocated to the CDQ program as a prohibited species quota (PSQ) reserve, which is not apportioned by gear or fishery. A proportion of the trawl PSC limit is specifically allocated to Amendment 80 (including an unallocated amount representing a phased-in reduction in that fleet’s halibut usage following implementation of the Amendment 80 program). The remaining trawl and non-trawl PSC limits are then annually allocated in the harvest specifications process to the fishery categories specified in regulations, for annual or seasonal durations. Groundfish pot gear is exempted from halibut PSC limits because (l) halibut discard mortality rate and total mortality associated with this gear type is relatively low, and (2) existing gear restrictions for pots (e.g., halibut excluders) are intended to further reduce halibut PSC mortality. Groundfish jig gear is also exempted, because of their low overall catch of groundfish in the BSAI.

The Council has reviewed several discussion papers, beginning in 2012, evaluating halibut PSC mortality in the BSAI groundfish fisheries, and impacts on the halibut stock. The Council initiated this analysis in June 2014.

1.4 FMP requirements

Section 3.6.2.1.4 of the BSAI Groundfish FMP requires that annual BSAI-wide Pacific halibut PSC mortality limits for trawl and non-trawl gear fisheries be established in regulations, and may be amended by regulatory amendment. The Secretary, after consultation with the Council, is to consider specific information when initiating a regulatory amendment to change a halibut PSC mortality limit, listed below. This analysis contains the information required by the BSAI Groundfish FMP; the relevant section is noted in brackets adjacent to each item below.

1. estimated change in halibut biomass and stock condition; [Sections 3.1.1]
2. potential impact on halibut stocks and fisheries; [Section 3.1.5]
3. potential impacts on groundfish fisheries; [Section 0]
4. estimated bycatch mortality during prior years; [Section 3.1.3]
5. estimated halibut PSC mortality; [Section3.1.3]
6. methods available to reduce halibut PSC mortality; [Section 4.8]
7. the cost of reducing halibut PSC mortality; and [Section 0]

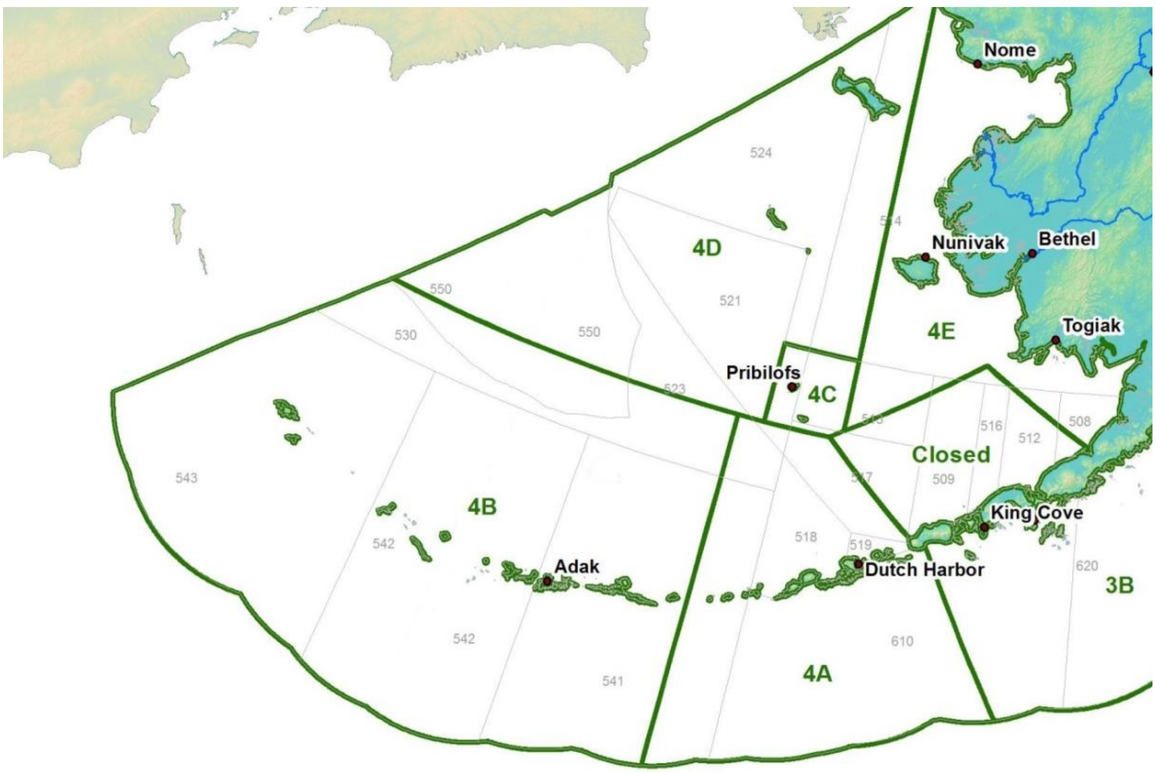
8. other biological and socioeconomic factors that affect the appropriateness of a specific bycatch mortality limit in terms of FMP objectives. [Sections 3.2 to 3.7, 4, 0]

Halibut PSC limits are established in the BSAI FMP for the trawl Amendment 80 and BSAI trawl limited access sectors (Section 3.7.5.2.1 of the FMP), as well as the total allocation of halibut PSC limit (from trawl and non-trawl) to the CDQ Program (Section 3.7.4.6 of the FMP). Halibut PSC limits for non-trawl fisheries are specified only in regulation.

1.5 Description of Action Area

The proposed action would be implemented in the BSAI groundfish management areas, which overlap IPHC regulatory areas 4A, 4B, 4C, 4D, and 4E (Figure 1-1).

Figure 1-1 Alaska groundfish reporting areas and IPHC regulatory areas for Pacific halibut.



Source: Adapted from NMFS Alaska Region map by Northern Economics Inc.

NMFS management areas do not match exactly to IPHC regulatory areas (Figure 1-1). For the purposes of this analysis, the groundfish BSAI reporting areas are equated with IPHC areas as shown in Table 1-1.

Table 1-1 NMFS management area reassignments used to aggregate groundfish and halibut statistics to IPHC regulatory areas

NMFS Areas	IPHC Area	Region
517, 518, 519	4A	BSAI
541, 542, 543	4B	
508*, 509*, 512*, 513, 514, 516*, 521, 523, 524	4CDE and Closed area*	

2 Description of Alternatives

NEPA requires that an EA analyze a reasonable range of alternatives consistent with the purpose and need for the proposed action. The alternatives in this chapter were designed to accomplish the stated purpose and need for the action. All of the alternatives were designed to reduce PSC limits, with the objective of minimizing bycatch to the extent practicable, potentially providing additional harvest opportunities in the directed halibut fishery, and helping improve halibut stock conditions.

The Council adopted the alternatives listed below for analysis in June 2014. More than one alternative or option listed below may be selected simultaneously. **Staff have proposed some minor modifications to the alternatives, which are consistent with Council intent.** The proposed modifications are indicated in underline or ~~strikeout~~, and all of the alternatives and options, including the proposed modifications, are explained in more detail in the subsections that follow. In June, the Council noted that further development of these alternatives and options could occur at initial review. The Council also requested several additional items to be included in the analytical package for addressing BSAI halibut PSC mortality, and some other related requests; these are discussed in Sections 2.4 and 2.5, respectively.

Alternative 1 No action.

Alternative 2 Amend the BSAI Groundfish FMP to revise halibut PSC limits as follows *(more than one option can be selected)*.

~~**Option 1** Establish seasonal apportionment of halibut PSC in the BSAI trawl limited access sector.~~

Option 2 Reduce halibut PSC limit for the BSAI Trawl Limited Access Sector by:
a) 10 percent b) 20 percent c) 30 percent or d) 35 percent

Option 3 Reduce halibut PSC limit for the Amendment 80 Sector by:
a) 10 percent b) 20 percent c) 30 percent or d) 35 percent

Option 4 Reduce halibut PSC limit for Pacific cod hook and line catcher vessel sector by:
a) 10 percent b) 20 percent c) 30 percent or d) 35 percent

Option 5 Reduce halibut PSC limit for Pacific cod hook and line catcher processor sector by:
a) 10 percent b) 20 percent c) 30 percent or d) 35 percent

Option 6 Reduce the CDQ halibut PSQ limit by:
a) 10 percent b) 20 percent c) 30 percent or d) 35 percent

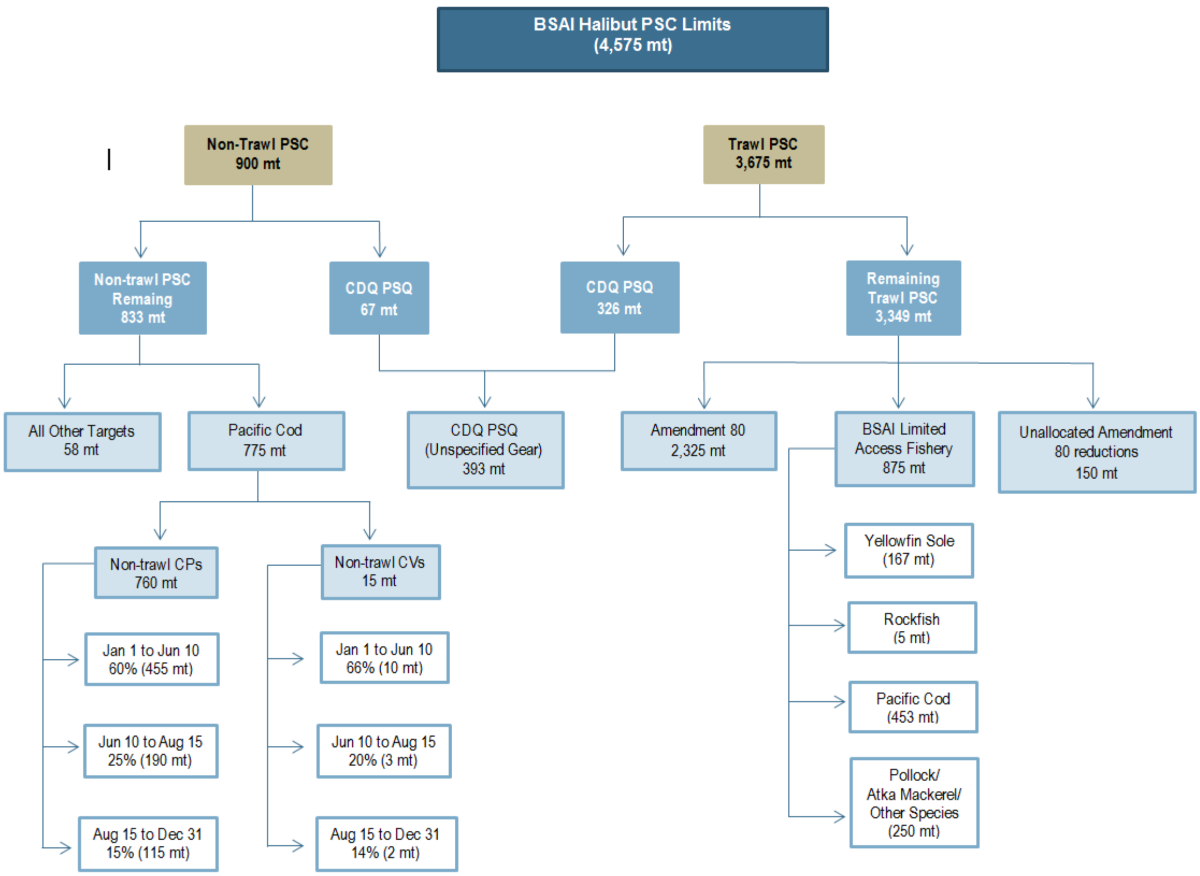
Option 7 Reduce halibut PSC limit for other non-trawl (i.e., hook and line catcher vessels and catcher processors targeting anything except Pacific cod or sablefish) by:
a) 10 percent b) 20 percent c) 30 percent or d) 35 percent

~~**Alternative 3.** Implement measures in the Amendment 80 sector to provide opportunities for deck sorting of halibut, or other handling practices that may provide an opportunity to reduce mortality of halibut that cannot be avoided.~~

2.1 Alternative 1, No Action

Under the status quo, the BSAI trawl and non-trawl halibut PSC limits are set in regulation as an amount of halibut equivalent to 3,675 mt of halibut mortality for trawl gear, and 900 mt of halibut mortality for non-trawl fisheries. A proportion of each of these overall limits is allocated to the CDQ program as a prohibited species quota (PSQ) reserve, which is not apportioned by gear or fishery. A proportion of the trawl PSC limit is specifically allocated to Amendment 80 (including an unallocated amount representing a phased-in reduction in that fleet's halibut usage following implementation). The remaining trawl and non-trawl PSC limits can then be annually allocated in the harvest specifications process to the fishery categories specified in the regulations, on an annual or seasonal basis. Figure 2-1 illustrates how the PSC limits are currently apportioned. When an annual or seasonal PSC limit is reached, all vessels fishing in that fishery category must stop fishing for the remainder of the year or season. The exception is for the PSC limit applying to the pollock/Atka mackerel/"other species" fishery category, where reaching the PSC limit only closes directed fishing for pollock using nonpelagic trawl gear, but directed fishing for pollock with pelagic gear is still permitted.

Figure 2-1 Flow Chart of BSAI Halibut PSC Limits for 2014



Source: Developed by Northern Economics based on NMFS AKR Groundfish Harvest Specification Tables.

With respect to the non-trawl PSC limit, there are six possible fishery categories to which the limit can be allocated. In practice, the PSC limit is only allocated to three of these (Pacific cod hook and line catcher vessels (CVs), Pacific cod hook and line catcher processors (CPs), and other nontrawl fisheries). The other three categories are for vessels using pot gear, jig gear, or fishing in the sablefish individual fishing quota (IFQ) fishery. In practice, vessels fishing in these fishery categories are exempt from halibut PSC limits. As described in the proposed rule for implementing harvest specifications for 2014-2015 (78 FR 74063), the pot gear fisheries have low halibut PSC mortality (2 mt in 2013), and halibut mortality in the jig gear fleet is negligible because of the small size of the fishery (the fleet harvested 11 mt of groundfish in 2013), and the selectivity of the gear. The proposed rule also explains that the sablefish and halibut IFQ fisheries have low halibut PSC mortality because the IFQ program requires legal-size halibut to be retained by vessels using hook and line gear if a halibut permit holder is aboard and is holding unused halibut IFQ. In 2013, NMFS estimated halibut PSC mortality in the sablefish fishery to be 1 mt, and 8 mt in 2014. The Council has requested a discussion of establishing a PSC limit for sablefish (Section 4.7).

2.2 Alternative 2, Revise Halibut PSC Limits

Options 2 through 7 under Alternative 2 propose reducing the halibut PSC limit for various BSAI sectors. The same four suboptions are considered for each of the sectors, ranging from a 10 to a 35 percent reduction. Table 2-1 identifies what the proposed PSC limits would be under each reduction option, for each sector.

Table 2-1 Proposed PSC Limits under Alternative 2 (in mt)

	Status quo	a) -10%	b) -20%	c) -30%	d) -35%
Option 2: BS trawl limited access	875	788	700	613	569
Option 3: Amendment 80	2,325	2,093	1,860	1,628	1,511
Option 4: Hook and line Pcod – CV	15	14	12	11	10
Option 5: Hook and line Pcod – CP	760	684	608	532	494
Option 6: CDQ PSQ	393	354	314	275	255
Option 7: Hook and line CV and CP – targets other than Pcod or sablefish	58	52	46	41	38

The halibut PSC limits for the trawl Amendment 80 and BSAI trawl limited access sectors are established in the BSAI FMP, along with the total allocation of halibut PSC limit (from trawl and non-trawl) to the CDQ Program. Changing these PSC limits, under Options 2, 3, and 6 would require an FMP (and regulatory) amendment. The halibut PSC limits for non-trawl fisheries are only specified in regulation, and will require only a regulatory amendment to change.

2.2.1 Option 1: Seasonal apportionment

Option 1 proposes to establish a seasonal apportionment of the halibut PSC limit for the BSAI trawl limited access sector. As decribed under Alternative 1 (Section 2.1), the FMP and regulatory authority for this option already exists, and the Council has the option to apportion the halibut PSC limit seasonally during the harvest specifications process. **Staff recommends removing this option from the analysis**, and no specific analysis has been provided for a regulatory change under this option**.**

It is assumed, however, that the Council's intent was to evaluate whether there would be an effect on PSC mortality in the BSAI trawl limited access fisheries from seasonally apportioning the halibut PSC limit during the harvest specifications process . As a result, this has been added to the list of additional elements for discussion requested by the Council in June 2014 (Section 2.4). It is discussed in Section 4.7.

2.2.2 Option 2: BSAI Trawl Limited Access Sector PSC limit reduction

Under Option 2, the PSC limit for the BSAI trawl limited access sector (BSAI TLA) would be reduced from 875 mt, to between 569 mt and 788 mt, depending on the suboption chosen. As in the status quo, the Council recommends, on an annual basis, how to apportion the sector's limit by fishery category, and whether to apportion it seasonally. In practice, the Council apportions this PSC limit among the yellowfin sole, rockfish, Pacific cod, and pollock/Atka mackerel/"other species categories. Under the regulations, the Council also has the option to apportion the PSC limit to the Greenland turbot/arrowtooth flounder/Kamchatka flounder/sablefish category as well (but as there is no PSC limit apportioned in practice, no directed fishing is allowed for these species by this sector).

2.2.3 Option 3: Amendment 80 PSC limit reduction

Under Option 3, the PSC limit for the Amendment 80 sector would be reduced from 2,325 mt, to between 1,511 mt and 2,093 mt, depending on the suboption chosen. As in the status quo, the halibut PSC limit will be apportioned among Amendment 80 cooperatives[4], according to prescribed formulas defined under the implementing regulations for Amendment 80. For each of the Amendment 80 cooperatives, the halibut PSC limit is an annual hard cap, and it is not constrained by fishery category.

2.2.4 Options 4, 5, and 7: Longline PSC limit reductions

Options 4, 5, and 7 reduce the PSC limits for longline fisheries. In June 2014, the Council motion referenced reducing existing halibut PSC limits in the hook and line fisheries, but only included options to reduce limits for longline catcher vessels and catcher processors. As described under the status quo (Section 2.1), there are currently three different PSC limits established for the hook and line fisheries. Only the Pacific cod fishery categories are split out by operational type (catcher vessel or catcher processor). In order to establish PSC limits by operational type for longline vessels fishing for groundfish other than Pacific cod, a regulatory amendment would be required to create corresponding fishery categories. Instead, it is staff's determination that the Council intended for the options to reflect the existing halibut PSC limit categories for hook and line fisheries, and consequently, **staff recommends the following revised Options 4 and 5, and the inclusion of a new Option 7 in the analysis**:

Option 4: Reduce halibut PSC limit for Pacific cod hook and line catcher vessel sector by:
a) 10 percent b) 20 percent c) 30 percent or d) 35 percent

Option 5: Reduce halibut PSC limit for Pacific cod hook and line catcher processor sector by:
a) 10 percent b) 20 percent c) 30 percent or d) 35 percent

Option 7: Reduce halibut PSC limit for other nontrawl (i.e., hook and line catcher vessels and catcher processors targeting anything except Pacific cod or sablefish) by:
a) 10 percent b) 20 percent c) 30 percent or d) 35 percent

Under Option 4, the PSC limit for Pacific cod hook and line catcher vessels (CVs) would be reduced from 15 mt to between 10 and 14 mt. Under Option 5, the PSC limit for Pacific cod hook and line catcher processors (CPs) would be reduced from 760 mt to between 494 and 684 mt. Under Option 7, the nontrawl fishery PSC limit would be reduced from 58 mt to between 38 and 52 mt. Technically, this PSC limit constrains both hook and line CVs and CPs, but since 2008 there have been no NMFS catch records that document participation by hook and line CVs in target fisheries for groundfish species other than Pacific cod or sablefish (which is currently exempt from the limit). Therefore, in practice this option focuses on hook and line CPs that participated in target fisheries for groundfish species other than Pacific cod or sablefish.

It is assumed that vessels fishing with pot or jig gear, and vessels fishing in the sablefish IFQ fishery would continue to be exempt from halibut PSC limits (although on an annual basis, the Council could consider allocating the non-trawl halibut PSC limit to those fishery categories). Section 4.7 provides a discussion of setting a sablefish IFQ PSC limit for longline vessels.

2.2.5 Option 6: CDQ prohibited species quota reduction

Under Option 6, the current allocation of 393 mt of halibut mortality prohibited species quota (PSQ) to the CDQ Program would be reduced to between 255 and 354 mt. Under the current regulations, 7.5 percent of the nontrawl gear halibut PSC limit is allocated to the CDQ Program, and the remainder of the

[4] or the Amendment 80 limited access sector, if Amendment 80 vessels choose to fish in limited access

current allocation, as specified in the FMP, is allocated from the trawl halibut PSC limit. Depending on the Council's final combination of options for a preferred alternative, NMFS would have to determine what process to use to allocate a reduced halibut PSC limit to the CDQ program under this option. As the CDQ allocation is specified in the FMP, changing the allocation will require an FMP amendment.

2.3 Alternative 3, Halibut Deck Sorting on Amendment 80 Catcher Processors

Alternative 3 would implement measures in the Amendment 80 sector to provide opportunities for deck sorting of halibut, or other handling practices that may provide an opportunity to reduce mortality of halibut that cannot be avoided. Handling practices that measurably reduce the discard mortality rate in a groundfish fishery will have the same effect as a reduction in actual bycatch of the same percentage.

The Council received a report on progress with developing deck sorting procedures and technologies that could reduce halibut mortalities in October 2014. In compliance with the Council's request, industry and NMFS are working together to develop deck sorting procedures, and have determined that these need to be further tested through an Experimental Fishing Permit. As a result, the Council acknowledged that there is not yet sufficient information to analyze halibut mortality reductions as a result of this alternative in time for initial review in February 2015. The Council consequently noted that they did not expect to see analysis of this alternative in the initial review draft. **Staff recommends that this alternative be removed from the analysis at this time.**

The Council did ask that a progress report on the design and implementation of a deck sorting EFP, as well as how it relates to the overall reduction of halibut PSC mortality for Amendment 80, to be included in the document for Council review, however. This progress report has been included with the other discussion items requested (Section 2.4), and is discussed in Section 4.

2.4 Additional discussion items for the analytical package

In the Council's June 2014 motion, there were several additional items that the Council requested be included in the analytical package for addressing BSAI halibut PSC mortality. These are described below, and for the most part, they have been addressed as individual discussion items in Section 4. In some cases, where indicated, the requested information has been folded in to the analysis of the PSC limit reduction options. Staff has also added the final two items to the list of discussion items, to correspond with proposed modifications to the alternatives discussed in Sections 2.2.1 and 2.3.

- <u>Maps/tables of catch/bycatch in IPHC closed area:</u> The levels of groundfish catch and halibut bycatch by groundfish sectors, and the size and age distribution of that bycatch, in the existing IPHC area (Closed Area) that is closed to the directed halibut fishery in the Bering Sea.
  - Section 4.1
- <u>PSC limit for IFQ sablefish:</u> Whether a halibut PSC limit would be appropriate to limit halibut bycatch in the directed sablefish IFQ fishery.
  - Section 0
- <u>Effects on salmon bycatch:</u> Potential impacts of efforts to reduce halibut PSC mortality on existing and anticipated Chinook and chum salmon PSC management measures (i.e., incentive plan agreements).
  - Addressed in the EA, Section 3.2

- Biomass-based PSC limits: The range of potential approaches to establishing a halibut PSC limit based on projections of total biomass, projected spawning biomass, or other appropriate indices of abundance and productivity.
    - Section 4.3
- Halibut PSC rollovers: Current protocols for rolling unused halibut between sectors, and the effect of those protocols on the achievement of OY and/or reductions in overall halibut PSC mortality
    - Section 4.4
- 4CDE subsistence info: Overview of available subsistence information for Areas 4CDE
    - Addressed in the EA, Section 3.1.4.3
- Directed halibut fishery: Fishing practices that reduce halibut bycatch in the directed halibut fishery
    - Section 4.5
- Amendment 80 measures: Evaluate the potential for the Amendment 80 flatfish flexibility program to reduce halibut PSC mortality; evaluate the potential of a change to the Amendment 80 trawl season opening date from Jan 20 to Jan 1 to reduce halibut PSC mortality; evaluate the potential of changes to the current Amendment 80 area closures to reduce halibut PSC mortality
    - Section 4.6
- Seasonal apportionment: Evaluate whether seasonal apportionment in the BSAI trawl limited access fishery could reduce halibut PSC mortality
    - Section 4.7
- Halibut deck sorting: Provide a progress report on the design and implementation of the deck sorting EFP, and how it relates to the overall reduction of PSC mortality for Amendment 80
    - Section 4.8

2.5 Related actions included in June 2014 Council motion

Voluntary halibut PSC mortality and discard reduction efforts in 2014

The Council included the following requests in the June 2014 motion initiating the halibut PSC reduction analysis:

- Request for voluntary 10% halibut PSC and discard reduction efforts by the groundfish and halibut industry in 2014 and 2015:
    - *The Council requests all industry sectors (American Fisheries Act Catcher Processor, American Fisheries Act Catcher Vessel, Amendment 80, Freezer Longline Cooperative, and Community Development Quota) undertake voluntary efforts to reduce halibut mortalities in the BSAI resulting from halibut PSC use, as well as discards in the directed halibut fishery, by 10% from the current 5-year average levels, through the 2014-15 fishing seasons.*
- Report on voluntary efforts by industry sectors (American Fisheries Act (AFA) CPs, AFA CVs, Amendment 80, Freezer Longline Conservation Cooperative, CDQ) at time of initial review:
    - *To evaluate progress in these efforts, the Council also requests industry to report back to the Council on measures that are being implemented and developed and, to the extent possible, the effectiveness of those measures in terms of absolute reductions in halibut mortalities.*

As originally put forward, the Council's motion requested all industry sectors, including the directed halibut fishery, to undertake voluntary efforts to reduce halibut PSC mortality and discards (Amendment 80, Trawl Limited Access, CDQ, hook and line CV and CP). As part of clarifications on the motion, the Council discussed that it would be difficult to identify a spokesperson for the hook and line catcher vessel sector in the BSAI, and instead the motion was clarified to request that the same five sectors who reported in June 2014 would be asked to report again on their halibut PSC mortality reduction efforts, at the meeting for which initial review of the PSC limit reduction analysis was scheduled. A short discussion of halibut discards ("wastage", in IPHC terminology) is, however, included in Section 3.1.4.2.

Note, a Council request of a report, even a verbal report, from industry requires an information collection request under the Paperwork Reduction Act. For the February 2015 voluntary reports, this has been addressed as an extension of the previous Paperwork Reduction Act request filed for the Council's June 2014 request for information from industry.

Improvements to IPHC assessment of bycatch and discard data

The Council also included a request for NMFS to work with IPHC with respect to halibut PSC mortality data from the Observer Program:

- *The Council requests NMFS work together with the IPHC to provide halibut bycatch and discard size data from the Observer Program in a form that can be better incorporated into IPHC stock assessments.*

The agency met with the IPHC in December 2014, to discuss how the IPHC currently accesses NMFS' bycatch data from the Alaska fisheries, and opportunities for improvements. In 2014, the IPHC used observed length distribution from bycatch in the groundfish fisheries as an element of the stock assessment, for the first time. There was also agreement that in future, IPHC staff should pull bycatch data directly from AKFIN, rather than using the NMFS website, in order to access the most up-to-date data. One of the difficulties with incorporating annual bycatch estimates into the stock assessment is that the IPHC assessment will always need to project bycatch through the end of the current year, because the assessment needs to be prepared for the interim meeting (in late November or early December). It was suggested that there may be a way for IPHC staff to interface with NMFS inseason managers, who are likely to have the most accurate information on the basis of which to project bycatch trajectories for the remainder of the year. Another area for improvement that is a longer-term project is to evaluate whether there is a better way to map groundfish bycatch, which is reported by NMFs reporting areas, to the IPHC management areas. The agencies are scheduling a workshop in the spring to further evaluate this issue.

2.6 Comparison of Alternatives

Under Alternative 1, there would be no changes to the regulated BSAI PSC limits. Since 2008, halibut PSC mortality in the BSAI groundfish fisheries has been 70 to 84 percent of the regulated PSC limits (Table 3-9). In June 2014, industry sectors were asked by the Council to voluntarily reduce halibut PSC mortality over the 2014 and 2015 fishing seasons, and have been reporting to the Council on measures they are undertaking to reduce halibut PSC mortality.

Alternative 2 could reduce the amount of halibut PSC mortality in the trawl and longline groundfish fisheries. The alternative includes several options to apply PSC limit reductions to different sectors of the BSAI trawl and longline groundfish fleet. Table 2-2 summarizes the options in terms of halibut PSC mortality "savings" under the PSC limit reductions, and associated reallocations to the directed halibut fishery in terms of halibut that are over 26 inches in length (O26) and those that are under 26 inches (U26).

Table 2-2 Comparison of alternatives and major impacts

	BSAI Groundfish Fisheries					Commercial Halibut Fishery in Area 4				
	Current PSC Limit	Mean PSC Used[1]	New PSC Limit	Average PSC Reductions[2]	Foregone Net Present Value	Reallocated Yield to Commercial Halibut Fishery from O26 fish: 4A	4B	4CDE	Potential Yield in Area 4 from U26	Gain of Net Present Value from O26 fish
	Halibut PSC Mortality (round mt)				2013$ Million	net weight pounds (1,000s)				2013$ Million
Option 2, Affecting BSAI Trawl Limited Access Sector										
a) -10%			788	12 – 17	$10 – $16	4.0 – 6.4	0.4 – 0.5	5.3 – 6.3	1.6 – 2.1	$1.0 – $1.4
b) -20%	**875**	**700**	700	27 – 39	$30 – $50	8.9 – 11.9	1.6 – 2.4	11.1 – 16.7	3.5 – 5.0	$2 – $3
c) -30%			613	44 – 70	$62 – $92	15.0 – 24.8	3.4 – 4.0	17.0 – 25.6	5.7 – 8.8	$4 – $6
d) -35%			569	55 – 99	$78 – $145	17.4 – 37.2	4.2 – 5.2	22.0 – 35.9	7.1 – 12.7	$5 – $8
Option 3, Affecting Amendment 80 Catcher Processors										
a) -10%			2093	40 – 57	$10 – $19	3.0 – 1.6	0.1 – 0.0	36.2 – 54.3	5.0 – 7.1	$4 – $6
b) -20%	**2,325**	**2,037**	1860	191 – 212	$52 – $115	25.7 – 23.9	0.1 – 0.0	162.6 – 184.6	23.8 – 26.3	$20 – $22
c) -30%			1628	414 – 441	$161 – $285	59.3 – 66.6	18.7 – 11.6	327.5 – 352.8	51.2 – 54.4	$44 – $46
d) -35%			1511	531 – 555	$224 – $368	79.6 – 87.9	32.4 – 14.2	406.5 – 439.6	65.5 – 68.5	$56 – $58
Option 4, Affecting Pacific Cod Hook and Line Catcher Processors										
All options	**15**	**3**	10–14	There are no material impacts under any of the options						
Option 5, Affecting Pacific Cod Hook and Line Catcher Vessels										
a) -10%			684	There are no material impacts under option (a)						
b) -20%	**760**	**521**	608	There are no material impacts under option (b)						
c) -30%			532	13 – 30	$10 – $24	2.0 – 5.4	0.7 – 4.1	11.5 – 22.9	1.8 – 4.1	$1.5 – $3.5
d) -35%			494	34 – 51	$27 – $50	3.3 – 8.5	5.9 – 6.5	26.8 – 40.2	4.6 – 7.0	$4 – $6
Option 6, Affecting CDQ										
a) -10%			354	There are no material impacts under option (a)						
b) -20%	**393**	**210**	314	There are no material impacts under option (b)						
c) -30%			275	There are no material impacts under option (c)						
d) -35%			255	2 – 2	$0.5 – $2	0.5 – 1.2	0.0 – 0.0	1.7 – 0.3	0.3 – 0.2	$0.23 – $0.16
Option 7, Affecting Hook and Line for Other Targets										
All options	**58**	**5**	38–52	There are no material impacts under any of the options						

Note, when numbers are shown as a range, they represent estimates from two Scenarios—Scenario A is a relatively “low impact” scenario and Scenario B is a relatively “high impact” scenario.

[1] 2008 to 2013

[2] With the exception of columns showing current and proposed PSC limits, all of the numbers in the table are estimated using the simulation model developed to assess the impacts of the proposed reductions in PSC limits. The model assumes that historical fishing years from 2008 to 2013 repeat themselves randomly out into the future. If one of those years was a “high bycatch” year then that year would have been affected by the reduced PSC limit when other “low bycatch” years would not have been affected. This explains why there are projected impacts to vessels participating in BSAI Trawl Limited Access fisheries under Option 2.1 and Option 2.2, even though the “mean PSC used”, which is an output of the model, is less than or equal to the “New” PSC Limit.

Given that the sectors habitually harvest less than the regulated PSC limit, some of the options under Alternative 2 would result in no change to the status quo, while others would result in constraining PSC limits. For the Bering Sea trawl limited access sector and the Amendment 80 sector, any of the PSC limit reduction options would be constraining in some years, based on the multi-years simulation model described in Section 5.4, which uses the basis years of 2008 to 2013 to forecast how PSC limit reductions would affect the groundfish fisheries. For Pacific cod longline catcher processors, only reductions of 30 or 35 percent would constrain this sector, and for CDQ groups, only a reduction of 35 percent would be constraining. There is no effect of any of the reduction options on Pacific cod longline catcher vessels, or the PSC limit that is apportioned to other non-trawl fisheries (i.e., targeting species other than Pacific cod or sablefish).

Specific options under Alternative 2 may result in no change to the status quo, or may result in constraining PSC limits under which industry may change fishing patterns in order to to optimize their groundfish harvest with a minimum of halibut PSC mortality, in order to avoid fishery closures[5]. This could result in a response of reducing fishing effort, as the industry chooses not to pursue less valuable fisheries in order to conserve halibut PSC mortality, or it could result in greater fishing effort at lower catch per unit effort, as vessels change fisheries patterns or seasonal changes in the timing of the fishing, to increase halibut avoidance. Shifts in the location or timing of fishing may occur as a result of Alternative 2. However, there is already considerable interannual variability in the patterns of fishing across the BSAI groundfish sectors, as environmental conditions and avoidance of PSC species have caused vessels to adjust their fishing patterns. Any shift in fishing is likely to occur within the existing footprint of the groundfish fishery in the BSAI.

2.7 Alternatives Considered but not Analyzed Further

In June 2014, when this analysis was initiated, the Council considered an option to apportion the BSAI trawl limited access sector halibut PSC limits between AFA vessels and non-AFA trawl catcher vessel sectors. The motion proposed that the halibut PSC limit be apportioned based on historic use by these vessel categories from 2009 to 2013. Effectively, this would change apportionment of the halibut PSC limit for BSAI TLA from an apportionment by fishery category (Pacific cod, yellowfin sole, and pollock) to one based on on whether a non-Amendment 80 vessel participates in the AFA sector or not. The implementation of this option would have resulted in a halibut PSC hard cap to the AFA sector, which would then be internally allocated among CPs and CVs, and individual cooperatives or vessels.

The Council chose to remove this option from consideration as part of this analysis. The rationale that was given was that analysis of this option would result in significant allocative implications, which would require considerable analysis that would likely eclipse the discussions of halibut reduction that are the object of this analysis. In addition, the Council noted that including this option would not necessarily impact halibut bycatch performance, which can be achieved in the more straightforward options included in this analysis.

[5] Note that the BSAI pollock fishery is not constrained by the current cap, nor are there options in the analysis to introduce such constaints. As a result, reduced PSC limits would not affect them directly.

3 Environmental Assessment

There are four required components for an environmental assessment. The need for the proposal is described in Section 1, and the alternatives in Section 2. This section addresses the probable environmental impacts of the proposed action and alternatives. A list of agencies and persons consulted is included in Section 8.

This section evaluates the impacts of the alternatives and options on the various environmental components. The socio-economic impacts of this action are described in detail in the Regulatory Impact Review (RIR) and Initial Regulatory Flexibility Analysis portions of this analysis (Sections 5 and 6).

Recent and relevant information, necessary to understand the affected environment for each resource component, is summarized in the relevant subsection. For each resource component, the analysis identifies the potential impacts of each alternative, and uses criteria to evaluate the significance of these impacts. If significant impacts are likely to occur, preparation of an EIS is required. Although an EIS should evaluate economic and socioeconomic impacts that are interrelated with natural and physical environmental effects, economic and social impacts by themselves are not sufficient to require the preparation of an EIS (see 40 CFR 1508.14).

The National Environmental Protection Act (NEPA) also requires an analysis of the potential cumulative effects of a proposed action and its alternatives. An environmental assessment or environmental impact statement must consider cumulative effects when determining whether an action significantly affects environmental quality. The Council on Environmental Quality (CEQ) regulations for implementing NEPA define cumulative effects as:

> *"the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7*).

The discussion of past and present cumulative effects is addressed with the analysis of direct and indirect impacts for each resource component below. The cumulative impact of reasonably foreseeable future actions is addressed in Section 3.7.

Documents incorporated by reference in this analysis

This EA relies heavily on the information and evaluation contained in previous environmental analyses, and these documents are incorporated by reference. The documents listed below contain information about the fishery management areas, fisheries, marine resources, ecosystem, social, and economic elements of the groundfish fisheries. They also include comprehensive analysis of the effects of the fisheries on the human environment, and are referenced in the analysis of impacts throughout this chapter.

Alaska Groundfish Harvest Specifications Final Environmental Impact Statement (NMFS 2007).

This EIS provides decision makers and the public an evaluation of the environmental, social, and economic effects of alternative harvest strategies for the federally managed groundfish fisheries in the GOA and the Bering Sea and Aleutian Islands management areas and is referenced here for an understanding of the groundfish fishery.[6] The EIS examines alternative harvest strategies that comply with Federal regulations, the Fishery Management Plan (FMP) for Groundfish of the GOA, the Fishery

[6] The alternatives considered in this EA will not cause any of the potentially significant impacts addressed in the Alaska Groundfish Harvest Specifications Final EIS to recur.

Management Plan (FMP) for Groundfish of the BSAI Management Area, and the Magnuson-Stevens Fishery Conservation and Management Act. These strategies are applied using the best available scientific information to derive the total allowable catch (TAC) estimates for the groundfish fisheries. The EIS evaluates the effects of different alternatives on target species, non-specified species, forage species, prohibited species, marine mammals, seabirds, essential fish habitat, ecosystem relationships, and economic aspects of the groundfish fisheries. This document is available from: http://alaskafisheries.noaa.gov/analyses/specs/eis/default.htm.

Stock Assessment and Fishery Evaluation (SAFE) Report for the Groundfish Resources of the BSAI (NPFMC 2014).

Annual SAFE reports review recent research and provide estimates of the biomass of each species and other biological parameters. The SAFE report includes the acceptable biological catch (ABC) specifications used by NMFS in the annual harvest specifications. The SAFE report also summarizes available information on the ecosystems and the economic condition of the groundfish fisheries off Alaska. This document is available from: http://www.afsc.noaa.gov/refm/stocks/assessments.htm.

Final Programmatic Supplemental Environmental Impact Statement (PSEIS) on the Alaska Groundfish Fisheries (NMFS 2004).

The PSEIS evaluates the Alaska groundfish fisheries management program as a whole, and includes analysis of alternative management strategies for the GOA and Bering Sea/Aleutian Islands (BSAI) groundfish fisheries. The EIS is a comprehensive evaluation of the status of the environmental components and the effects of these components on target species, non-specified species, forage species, prohibited species, marine mammals, seabirds, essential fish habitat, ecosystem relationships, and economic aspects of the groundfish fisheries. This document is available from: http://alaskafisheries.noaa.gov/sustainablefisheries/seis/intro.htm.

Analytical method

For each of the resource categories described in this chapter, a brief history of the state of the resource is included, along with reference to other documents, followed by an evaluation of the effects of the alternatives.

3.1 Pacific halibut

3.1.1 Life history, biomass, and distribution

Pacific halibut (*Hippoglossus stenolepsis*) is one of the largest species of fish in the world, with individuals growing up to eight feet in length and over 500 lb. The range of Pacific halibut that the International Pacific Halibut Commission (IPHC) manages covers the continental shelf from northern California to the Aleutian Islands and throughout the Bering Sea (Figure 1-1). Pacific halibut are also found along the western north Pacific continental shelf of Russia, Japan, and Korea.

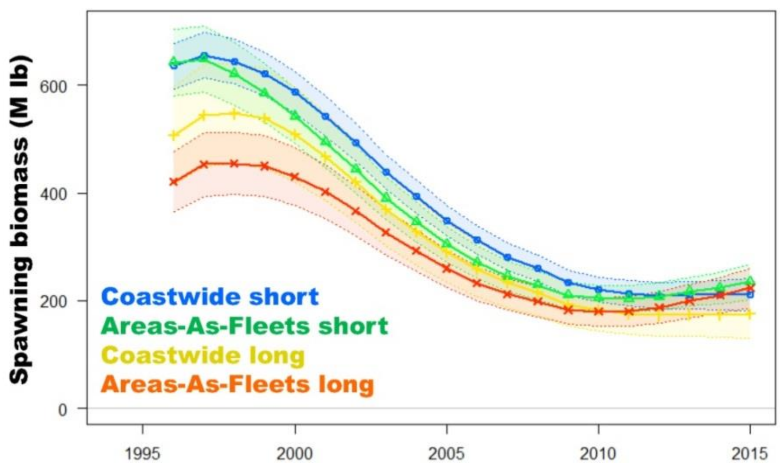
The depth range for halibut is up to 250 fathoms (457 m) for most of the year and up to 500 fathoms (914 m) during the winter spawning months. During the winter (November through March), the eggs are released, move up in the water column, and are caught by ocean currents. Female halibut release a few thousand eggs to several million eggs, depending on the size of the fish. Eggs are fertilized externally by the males. Prevailing currents carry the eggs north and west. By the age of 6 months, young halibut settle to the bottom in shallow nearshore areas such as bays and inlets. Research has shown that the halibut then begin what can be called a journey back. This movement runs counter to the currents that carried them away from the spawning grounds and has been documented at over 1,000 miles for some fish. Most male halibut are sexually mature by about 8 years of age, while half of the females are mature by about age 11.6 (Stewart 2015). At this age, they are generally large enough to meet the minimum size limit for the commercial fishery of 32 inches.

Halibut feed on plankton during their first year of life. Young halibut (1 to 3 years old) feed on euphausiids (small shrimp-like crustaceans) and small fish. As halibut grow, fish make up a larger part of their diet. Larger halibut eat other fish, such as herring, sand lance, capelin, smelt, pollock, sablefish, cod, and rockfish. They also consume octopus, crabs, and clams.

The results of the 2014 stock assessment indicate that the Pacific halibut stock declined continuously from the late 1990s to around 2010. That trend is estimated to have been a result of decreasing size-at-age, as well as recent recruitment strengths that are much smaller than those observed through the 1980s and 1990s. Since that time period, the estimated female spawning biomass appears to have stablized near 200 million pounds, with flatter trajectories estaimted in coastwide models and slightly increasing trends in areas-as-fleets models (Figure 3-1; Stewart and Martell 2015).

Measures of halibut stock biomass in BSAI areas indicate similar declines since the late 1990s, consistent with the entire stock. Cohorts born in 2004 to 2006 and observed in large numbers in the trawl survey data appear to have declined rapidly in abundance in the Bering Sea, and are not evident in the fishery, setline survey, or NMFS GOA trawl surveys. The strength of these year classes could remain uncertain for several more years (Stewart et al. 2014a).

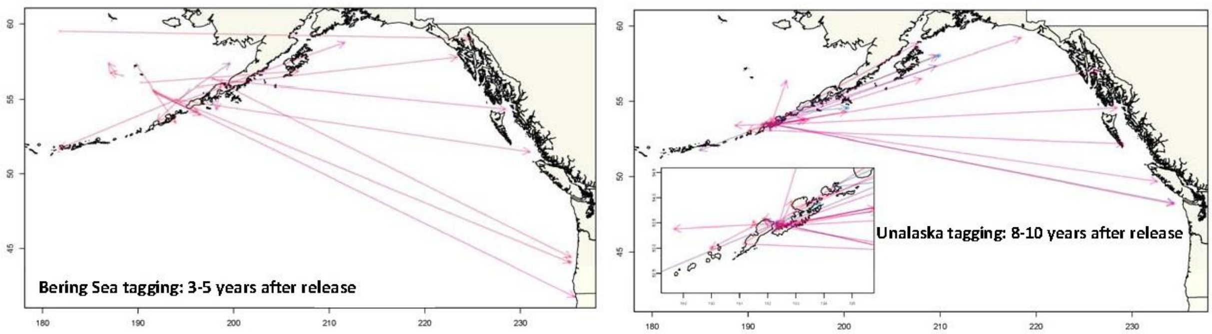
Figure 3-1 Trend in spawning biomass estimated from each of the four models included in the 2014 stock assessment ensemble.
Series indicate the maximum likekihood estimates, shaded intervals indicate approximate 95% confidence intervals.



Source: IPHC 2014b

Stewart et al. (2014a) provides a general understanding of Pacific halibut distribution, indicating that the bulk of the pelagic juvenile halibut occurs in the western GOA, Aleutian Islands and southwestern Bering Sea. Densities of one to four year old halibut (not frequently encountered in setline surveys or the directed fishery) are typically also very high in these areas; this has been observed in trawl surveys, directed IPHC trawl investigations, and in the length-frequencies of halibut captured as bycatch in various trawl fisheries operating in these areas. The aggregate result of historical IPHC tagging programs indicates that the Bering Sea is a net exporter of halibut of all sizes to all other regulatory areas. New analysis of historical tagging projects conducted by the IPHC in the BSAI has recently been undertaken (Webster 2015). Results of this analysis indicate that juvenile halibut tagged in the BSAI and near Unalaska tend to remain near the area of tagging for the first year at large, but then distribute broadly to the Aleutian Islands, Gulf of Alaska (70-90%), and Area 2 (Figure 3-2). This would imply that by the time they enter the directed fishery (and are fully selected by the setline survey) halibut spending their first few years of life in the Bering Sea could be in virtually any regulatory area. At present it is not possible to correct for the spatial distribution of fishing effort in these data, which may lead to an overestimate of movement rates to areas (like the Gulf of Alaska) with more fishing activity. Halibut also move seasonally between shallow waters and deep waters. Mature fish move to deeper offshore areas in the fall to spawn, and return to nearshore feeding areas in early summer. It is not yet clear if fish return to the same areas to spawn or feed year after year.

Figure 3-2 Release and recovery locations for juvenile halibut tagged in the Bering Sea, and near Unalaska

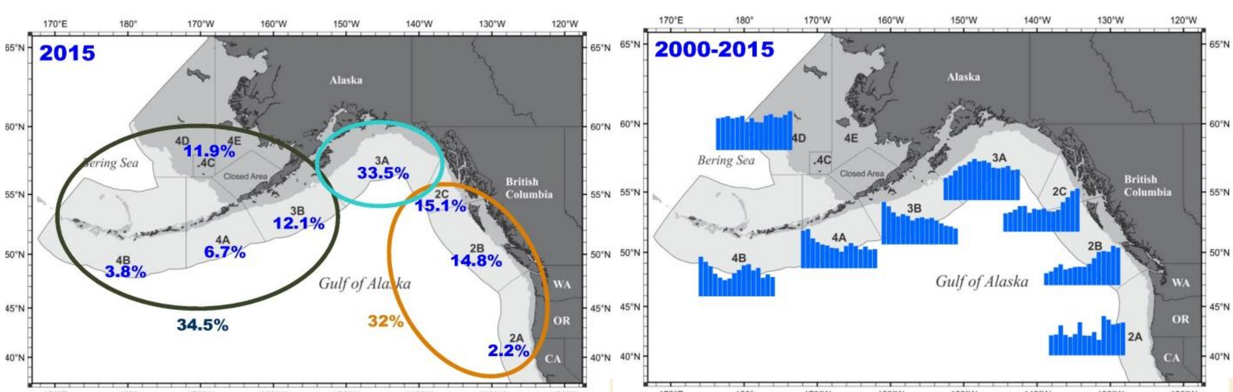


Source: Stewart et al. 2014a

Larger halibut are also estimated to move from 4D to 4A at a rate of 6% per year, and to the Gulf of Alaska and Area 2 at a rate of 1.4% per year (Valero and Webster 2012; Table 14). No adult fish from areas outside the Bering Sea are estimated to move into 4CDE, save 0.2% of fish tagged in Area 4B. Additionally, there are seasonal movements within Area 4CDE associated with changes in ice cover (fish forced out of shallow water areas in winter months), summer feeding migrations (fish moving into shallower waters), and fall/winter spawning migrations (fish moving into deeper water for spawning). The net result of these movements is widespread mixing within the eastern Bering Sea (Stewart et al. 2014a).

Figure 3-3 illustrates the estimated distribution of the halibut stock greater than 32 inches in length (O32) across the IPHC regulatory areas. In 2015, Area 4 represents about 22 percent of the O32 halibut biomass. In the last sixteen years, the trend in the apportionment of the O32 biomass in Area 4CDE (including the Closed Area) has generally been stable, with a slight increase in the last two years. The apportionment estimate for both Area 4A and 4B has decreased over that time period, with a corresponding increase in the proportion of the stock occurring in Area 2.

Figure 3-3 Estimated distribution of the halibut stock for fish over 32 inches in length, by regulatory area for 2015, based on the IPHC setline survey weight per unit effort, and trends for 2000 to 2015



Source: IPHC 2014b.

3.1.2 Halibut fishery management in the BSAI

The Council and NMFS manage Pacific halibut allocations in Alaska in Federal regulations, under the authority of the Northern Pacific Halibut Act of 1982, while the International Pacific Halibut Commission is responsible for halibut stock assessment and catch recommendations. The IPHC was established in 1923 by the Convention between the United States and Canada for the Preservation of the Halibut Fishery of the North Pacific Ocean and Bering Sea (Convention). Its mandate is research on and management of the stocks of Pacific halibut within the Convention waters of both nations. The IPHC consists of three government-appointed commissioners for each country, and a director and staff. Annually, the IPHC meets to discuss and approve budgets, research plans, biomass estimates, catch recommendations, and regulatory proposals, which are then forwarded to the respective governments for implementation.

3.1.2.1 Bycatch and PSC terminology

The IPHC refers to halibut "bycatch" to describe the mortality of all sizes of halibut caught in the commercial groundfish fisheries (hook-and-line sablefish and Pacific cod; trawl Pacific cod, pollock, flatfish, and rockfish, and pot Pacific cod), and minor amounts in commercial shrimp trawl and crab pot fisheries. In the groundfish fisheries, Pacific halibut is a prohibited species, and bycatch mortality of halibut is referred to as halibut PSC mortality.

In IPHC terms, "wastage" describes halibut killed, but not landed by the directed (hook-and-line) halibut fisheries, due to lost and abandoned gear, and mortality of released fish. Wastage is not included in IPHC estimates of "bycatch."

3.1.2.2 How are halibut catch limits determined?

Halibut fishery catch limits are the result of a multi-step process by the IPHC, with allocative input from U.S. and Canadian fishery management organizations, with the objective of determining how much can be harvested by the directed commercial fishery, given the IPHC's goals for stock conservation. The process starts with IPHC staff determining the scale or size of the coastwide exploitable biomass (generally, halibut greater than 32 inches in length (O32)) and then estimating its distribution or apportionment among each of eight major Regulatory Areas: 2A, 2B, 2C, 3A, 3B, 4A, 4B, and 4CDE (Figure 1-1) using the setline survey weight per unit effort.

Next, the exploitable biomass estimate by area is multiplied by the IPHC's target harvest rates, to come up with a target distribution of the total amount of coastwide yield available for harvest, referred to as the Total Constant Exploitation Yield, or TCEY.The target harvest rates are area-specific: 21.5% in Areas 2 and 3A, and 16.125% in Areas 3B and 4. U26 mortality is accounted for implicitly in the harvest rate policy, and assumes a static level of U26 mortality consistent with the period over which the rates were developed (Hare 2011). The target harvest rates are lower than they would be in the absence of U26 mortality, but do not respond to changes in that level, or the ratio of U26 to O26 removals. The targets were developed based on average age-6 recruitment levels under both positive and negative phases of the Pacific Decadal Oscillation (PDO), where U26 fish were assumed to be less than age-6. In addition, the harvest policy includes a harvest control rule that reduces target harvest rates linearly if the stock is estimated to have fallen below given reference points. Application of these calculations produces area-specific TCEY values, and "blue line" harvest policy targets.

Table 3-1 Example of IPHC TCEY calculation, using 2015 values

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
Apportionment	2.2%	14.8%	15.1%	33.5%	12.1%	6.7%	3.8%	11.9%	100.0%
Target harvest rate	21.5%	21.5%	21.5%	21.5%	16.1%	16.1%	16.1%	16.1%	19.6%
Target TCEY Distribution	2.4%	16.2%	16.5%	36.6%	9.9%	5.5%	3.1%	9.8%	100.0%

Source: Stewart 2015.

The third step is to subtract all other removals of halibut over 26 inches (O26) from the TCEY, in order to determine the Fishery Constant Exploitation Yield or FCEY. The FCEY is calculated such that all O26 removals sum to the TCEY target within each regulatory area, and at the coastwide level. The FCEY includes commercial fishery limits in all areas, and other sectors in any area subject to Catch Share Plans for allocation of the halibut harvest. Note, Catch Share Plans are developed by the responsible fishery management organizations in each IPHC regulatory area. Non-FCEY removals include catches which either have no explicit limits on the amount of harvest (unguided sport harvest in Alaska, subsistence/personal use harvest in Canada and Alaska, and wastage from the commercial halibut fishery), or catches which the IPHC has no authority to manage (bycatch mortality, such as halibut PSC mortality in Alaska). Non-FCEY values are assumed to remain constant at the previous year's level. Bycatch (including halibut PSC mortality) and wastage of halibut that is less than 26 inches (U26) is accounted for in the stock assessment with respect to total mortality on the halibut stock, but is not part of the TCEY.

Table 3-2 Example of IPHC catch table, using 2015 blue line values

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
O26 Non-FCEY									
Comm. wastage	0.02	0.17	NA	NA	0.24	0.05	0.03	0.01	0.52
Bycatch	0.07	0.22	0.02	1.14	0.78	0.52	0.35	3.07	6.16
Sport (+ wastage)	NA	NA	1.14	1.49	0.02	0.02	0.00	0.00	2.67
Pers./Subs.	NA	0.41	0.40	0.25	0.02	0.01	0.00	0.03	1.11
Total Non-FCEY	0.08	0.80	1.55	2.88	1.06	0.60	0.38	3.11	10.46
O26 FCEY									
Comm. wastage	NA	NA	0.11	0.42	NA	NA	NA	NA	0.53
CSP Sport (+wastage)	0.31	0.69	0.79	1.89	NA	NA	NA	NA	3.68
Pers./Subs.	0.03	NA	NA	NA	NA	NA	NA	NA	0.03
Comm. Landings	0.41	4.27	3.40	7.81	2.46	1.35	0.72	0.37	20.78
Total FCEY	0.75	4.96	4.30	10.12	2.46	1.35	0.72	0.37	25.02
TCEY	0.84	5.75	5.85	13.00	3.51	1.95	1.10	3.48	35.48
U26									
Comm. wastage	0.00	0.01	0.01	0.02	0.04	0.00	0.00	0.00	0.08
Bycatch	0.00	0.02	0.00	0.47	0.46	0.39	0.05	1.75	3.15
Total U26	0.00	0.03	0.01	0.50	0.50	0.40	0.06	1.75	3.24
Total Mortality	0.84	5.78	5.85	13.49	4.01	2.35	1.16	5.23	38.72

Source: Stewart 2015.

The IPHC staff provides harvest advice based on catch limit calculations, which is distributed in advance of the IPHC Annual Meeting in January, allowing the halibut industry to discuss and provide comment back to the IPHC. Once the Annual Meeting commences, the IPHC considers all of the input—public comment, recommendations from its advisory bodies, and staff advice—and then adopts fishery catch limits and other measures which seek to balance the advice it has received, with stock conservation being the primary consideration.

3.1.2.3 Area 4 allocations

The Bering Sea and Aleutian Islands management area equates approximately to the IPHC's Area 4 regulatory areas. Area 4CDE and the IPHC Closed Area are considered to be a single unit in all IPHC apportionment and harvest policy analyses. Halibut allocations to sectors within each of the Area 4 regulatory ares (Area 4A, 4B, and 4CDE) are under the jurisdiction of the Council and NMFS, rather than the IPHC.

The 4C, 4D, and 4E subareas were created to serve the needs of the Council's Area 4CDE Catch Sharing Plan (CSP). Annually, the IPHC adopts the Council's CSP to determine the specific catch limits for these subareas. The percentage share to these areas, as determined by the Council, are: Areas 4C and 4D each receive 46.43% of the IPHC's adopted catch limit for Area 4CDE, and Area 4E receives 7.14%. If the total catch limit for Area 4CDE exceeds 1.6576 Mlb, Area 4E receives 0.08 Mlb off the top of the total catch limit before the percentages are applied.

Within Area 4CDE, the annual available halibut yield is further allocated among CDQ and IFQ fishing within subareas. The amounts allocated to CDQ by area are: Area 4C 50%, Area 4D 30% and Area 4E 100%. There are also provisions within the CSP allowing Area 4C CDQ and IFQ to be harvested in Area 4D, and for allowing Area 4D CDQ fish to be harvested in Area 4E. The CDQ allocations are apportioned among the six CDQ organizations.

3.1.2.4 Process for obtaining halibut PSC mortality data

The IPHC relies upon the monitoring programs of the Council and NMFS for estimates of halibut bycatch (or halibut PSC mortality) in the Alaska groundfish fisheries. NMFS operates an observer program on federal groundfish and halibut fisheries, which collects information on catches, and this data is used to estimate bycatch by federal management area, gear, and target fishery.

The information provided by NMFS does not match exactly to the IPHC's needs, so the data undergo subsequent processing and recoding. First, groundfish fishery management is conducted according to NMFS management areas, which are not exactly the same as IPHC regulatory areas (Figure 1-1). NMFS areas are assigned to IPHC areas as shown in Table 3-3.

Table 3-3 NMFS management area reassignments used to aggregate groundfish and halibut statistics to IPHC regulatory areas

NMFS Areas	IPHC Area	Region
650, 659	2C	GOA
630, 640, 649	3A	
610, 620	3B	
517, 518, 519	4A	BSAI
541, 542, 543	4B	
508*, 509*, 512*, 513, 514, 516*, 521, 523, 524	4CDE and Closed area*	

Also, the IPHC convert weight units from metric tons, round weight, to pounds, net weight, to be consistent with standard IPHC weight accounting, according to the following:

$$W_{\text{lbs net}} = (W_{mt} \text{ x } 2205) \text{ x } 0.75$$

where $W_{\text{lbs net}}$ = weight in pounds, net weight,
W_{mt} = weight in metric tons, round weight,
2205 is the number of pounds per metric ton, and
0.75 is the conversion from round weight to net weight for Pacific halibut

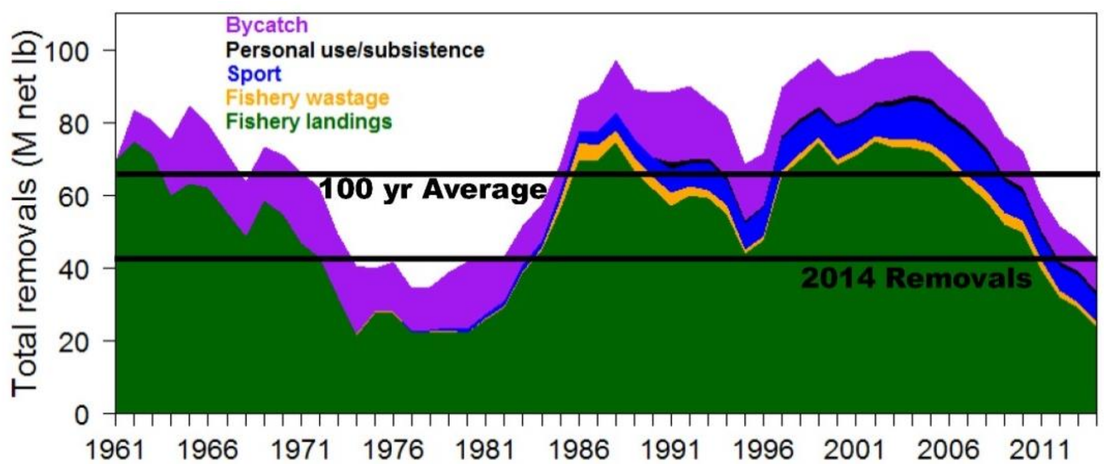
Because data inputs are due to the halibut stock assessment team prior to the completion of the groundfish fishing year, IPHC staff also make projections of year-end bycatch, usually for November-December, in order to ensure a full accounting. The long-standing practice is to make projections by applying the average proportion taken by a similar date during the preceding 3-year period to the current partial year data, i.e., January-October, data. The projections are made by IPHC regulatory area and gear (IPHC 2014a).

The IPHC also applies an estimate of the proportion of the halibut PSC mortality, by regulatory area, over and under 26 inches. In 2014, for the first time, the assessment used the most recent observer data to estimate the relative proportion of halibut PSC mortality that was O26. After the fishing year is finished, IPHC also applies that year's discard mortality rates (DMRs), calculated from NMFS observer data, to determine actual mortality incurred from fishing for IPHC databases.

3.1.3 Halibut PSC mortality in the BSAI groundfish fisheries

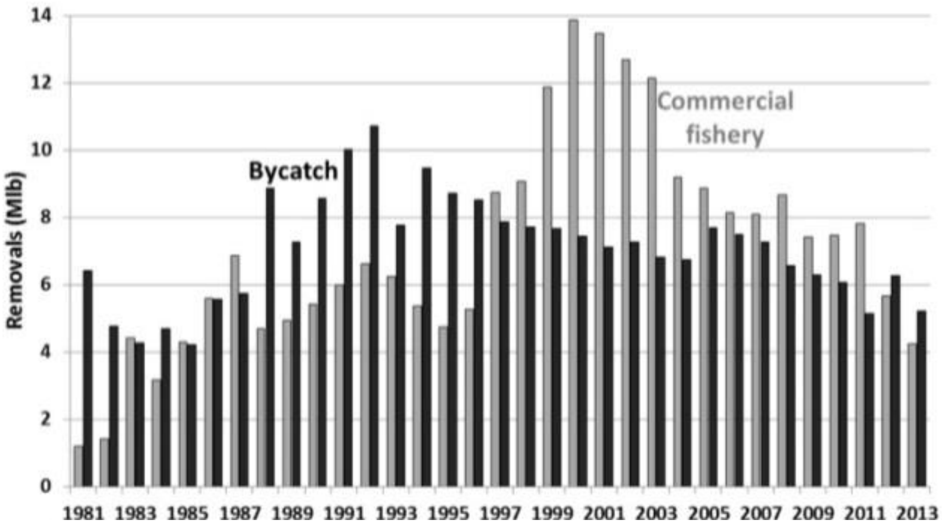
Although the commercial halibut longline fishery accounts for the majority of halibut removals coastwide (Figure 3-4), halibut PSC mortality (halibut bycatch in the groundfish fisheries) is an important proportion of halibut removals in the BSAI (Area 4, including the Closed Area) (Figure 3-5). Approximately two-thirds of bycatch removals of the halibut stock coastwide occur in Area 4. On a coastwide basis, total removals are at their lowest level since the early 1980s.

Figure 3-4 Total removals coastwide for the period 1961 to 2014.



Source: Stewart 2015.

Figure 3-5 Halibut fishery landings and bycatch (halibut PSC mortality) in IPHC regulatory Areas 4A, 4B, and 4CDE, in millions of pounds, net weight.



Source: Stewart et al. 2014a.

3.1.3.1 Management of halibut PSC in the groundfish fisheries

Pacific halibut is a prohibited species in the groundfish fisheries, which fishermen are required to return immediately to the sea with a minimum of injury, if caught incidentally in the groundfish fisheries[7]. These species are identified in law; their capture is required to be minimized; and their retention is prohibited. The mortality of halibut that is incidentally caught in the groundfish fisheries is separately monitored and controlled under the groundfish fishery management plans, and referred to as halibut PSC. Halibut PSC is managed in metric tons, round weight, of halibut mortality.

Regulations to control halibut PSC have been included in the BSAI FMP since its implementation over thirty years ago. Measures that have reduced halibut bycatch include halibut PSC limits, 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. Gear modifications to reduce halibut PSC mortality include (a) requiring biodegradable panels and halibut exclusion devices on groundfish pots and (b) requiring pelagic trawl gear specifications that enhance escapement of halibut.

Annual halibut PSC mortality limits have long been used to control halibut removals in the groundfish fisheries off Alaska, where the attainment of a limit triggers fishery closures to a sector or gear type. Seasonal allocations of halibut PSC limits are also authorized, which can take advantage of seasonal differences in halibut and some groundfish fishery species distributions. PSC limits are intended to optimize total groundfish harvest, 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 limits provide an incentive for specific fisheries to operate in times and areas where the highest volume or highest value target species may be harvested with minimal halibut bycatch. Reaching a PSC limit results in closure of an area or a groundfish directed fishery, even if some of the groundfish total allowable catch (TAC) for that fishery remains unharvested.

[7] Except where their retention is authorized by other applicable law for biological sampling or for programs such as the Prohibtied Species Donation Program.

The overall BSAI halibut PSC limits for trawl and non-trawl gear are set in regulation, and are not tied to halibut abundance. Halibut PSC limits are set at 3,675 mt for trawl gear, and 900 mt to fixed gear (Table 3-4; Figure 2-1). Regulations also establish allocations of the BSAI trawl and non-trawl halibut PSC limits to the community development quota (CDQ) program, and allocate the trawl PSC limit between the BSAI trawl limited access sector (BSAI TLA) and the Amendment 80 sector (non-AFA trawl catcher processors). While the total trawl limit has not been reduced in regulation, allocations to the trawl sector were reduced by 150 mt, over five years, with the adoption of the Amendment 80 program in 2008. The limits are annually apportioned to specific fishery categories, for fisheries other than CDQ and Amendment 80, and may also be apportioned seasonally, through the groundfish harvest specifications process (guidelines are published in regulation). When an annual or seasonal PSC limit is reached, all vessels fishing in that fishery category must stop fishing for the remainder of the year or season. The exception is for the PSC limit applying to the pollock/Atka mackerel/“other species” fishery category, where reaching the PSC limit only closes directed fishing for pollock using nonpelagic trawl gear, but directed fishing for pollock with pelagic gear is still permitted.

Table 3-4 BSAI halibut PSC limits, in metric tons and net pounds of halibut mortality

Defined in regulations / FMP				Annually apportioned – example from 2014			
Overall PSC limits		**By sector**		**By fishery category**		**By operational type**	
Trawl	3,675 mt (6,077,531 lbs)	CDQ	326 mt (539,123 lbs)				
		Amendment 80	2,325 mt (3,844,969 lbs)				
		BSAI TLA	875 mt (1,447,031 lbs)	Yellowfin sole	167 mt (276,176 lbs)		
				Rockfish	5 mt (8,269 lbs)		
				Pacific cod	453 mt (749,149 lbs)		
				Pollock/ Atka mackerel/ ”other species”	250 mt (413,438 lbs)		
Non-trawl	900 mt (1,488,375 lbs)	CDQ	67 mt (110,801 lbs)				
		Remaining non-trawl fisheries	833 mt (1,377,574 lbs)	Pacific cod	775 mt (1,281,656 lbs)	Catcher processors	760 mt (1,256,850 lbs)
						Catcher vessels	15 mt (24,806 lbs)
				Other non-trawl fisheries	58 mt (95,918 lbs)		
CDQ	*(sum of CDQ allocations above)*	unspecified gear	393 mt (649,924 lbs)				

Although by regulation, the non-trawl PSC limit could also be apportioned to vessels using pot gear, jig gear, or fishing in the sablefish individual fishing quota (IFQ) fishery, in practice, the Council has chosen to exempt vessels fishing in these categories from halibut PSC limits. As described in the proposed rule for implementing harvest specifications for 2014-2015 (78 FR 74063), the pot gear fisheries have low halibut PSC mortality (2 mt in 2013), and halibut PSC mortality in the jig gear fleet is negligible because of the small size of the fishery (the fleet harvested 11 mt of groundfish in 2013), and the selectivity of the gear. Existing gear restrictions for vessels using pot gear are also intended to further reduce mortality of halibut. The proposed rule also explains that the sablefish IFQ fishery has low halibut PSC mortality because the IFQ program requires legal-size halibut to be retained by vessels using hook and line gear if a halibut permit holder is aboard and is holding unused halibut IFQ. NMFS estimated halibut PSC mortality in the sablefish fishery to be 1 mt in 2013, and 8 mt in 2014. The IPHC does include estimates of halibut mortality from pot and jig gear, although not from the sablefish IFQ fishery, as a source of total mortality for the stock assessment.

3.1.3.2 Discard mortality rates

As described above, BSAI halibut PSC limits are described in terms of halibut mortality. To track halibut mortality, and progress towards PSC limits, inseason, discard mortality rates (DMRs) are established for each BSAI groundfish fishery category (including CDQ target fisheries), and applied to the total halibut catch to calculate halibut PSC mortality. Handling practices that measurably reduce the discard mortality rate in a groundfish fishery will have the same effect as a reduction in actual bycatch of the same percentage. IPHC staff evaluates groundfish observer data to calculate fishery-specific DMRs, using a consistent methodology that considers the length and viability/injury assessment of sampled halibut.

In 2000, the Council adopted a plan in which the DMRs used to monitor halibut PSC mortality are an average of data from the most recent 10-year period. These 10-year mean DMRs for each fishery are used by NMFS for a 3-year period, with the justification being: 1) interannual variability of fishery DMRs is relatively small, and 2) a three-year period provides stability for the industry to better plan their operations. In 2015, the Council is in the third year of applying DMRs to the BSAI, based on the 2002 to 2011 period (Table 3-5). The DMR for trawl fisheries is higher, mostly between 71 and 88 percent for non-CDQ fisheries, and much lower (4 to 13 percent) for pot and hook and line fisheries. For comparison, the IPHC assigns a 16 percent mortality rate to halibut discarded in the commercial halibut IFQ fishery. Table 3-6 illustrates the annual assessment of discard mortality for each fishery, as evaluated by IPHC staff, for trawl and longline sectors.

Table 3-5 2013 to 2015 Pacific Halibut Discard Mortality Rates for the BSAI

<table>
<tr><th colspan="3">Non-CDQ</th><th colspan="3">CDQ</th></tr>
<tr><th>Gear</th><th>Fishery</th><th>DMR (%)</th><th>Gear</th><th>Fishery</th><th>DMR (%)</th></tr>
<tr><td rowspan="14">Trawl</td><td>Alaska plaice</td><td>71</td><td rowspan="14">Trawl</td><td></td><td></td></tr>
<tr><td>Arrowtooth flounder[2]</td><td>76</td><td></td><td></td></tr>
<tr><td>Atka mackerel</td><td>77</td><td>Atka mackerel</td><td>86</td></tr>
<tr><td>Flathead sole</td><td>73</td><td>Flathead sole</td><td>79</td></tr>
<tr><td>Greenland turbot</td><td>64</td><td>Greenland turbot</td><td>89</td></tr>
<tr><td>Non-pelagic pollock</td><td>77</td><td>Non-pelagic pollock</td><td>83</td></tr>
<tr><td>Pelagic pollock</td><td>88</td><td>Pelagic pollock</td><td>90</td></tr>
<tr><td>Other flatfish[3]</td><td>71</td><td></td><td></td></tr>
<tr><td>Other species[1]</td><td>71</td><td></td><td></td></tr>
<tr><td>Pacific cod</td><td>71</td><td>Pacific cod</td><td>90</td></tr>
<tr><td>Rockfish</td><td>79</td><td>Rockfish</td><td>80</td></tr>
<tr><td>Rock sole</td><td>85</td><td>Rock sole</td><td>88</td></tr>
<tr><td>Sablefish</td><td>75</td><td></td><td></td></tr>
<tr><td>Yellowfin sole</td><td>83</td><td>Yellowfin sole</td><td>86</td></tr>
<tr><td rowspan="4">Hook and line</td><td>Greenland turbot</td><td>13</td><td rowspan="4">Hook and line</td><td>Greenland turbot</td><td>4</td></tr>
<tr><td>Other species[1]</td><td>9</td><td></td><td></td></tr>
<tr><td>Pacific cod</td><td>9</td><td>Pacific cod</td><td>10</td></tr>
<tr><td>Rockfish</td><td>4</td><td></td><td></td></tr>
<tr><td rowspan="3">Pot</td><td>Other species[1]</td><td>8</td><td rowspan="3">Pot</td><td>Pacific cod</td><td>8</td></tr>
<tr><td>Pacific cod</td><td>8</td><td></td><td></td></tr>
<tr><td></td><td></td><td>Sablefish</td><td>34</td></tr>
</table>

Table 3-6 Summary of halibut discard mortality rates in the BSAI non-CDQ groundfish fisheries, from 1990 to 2011

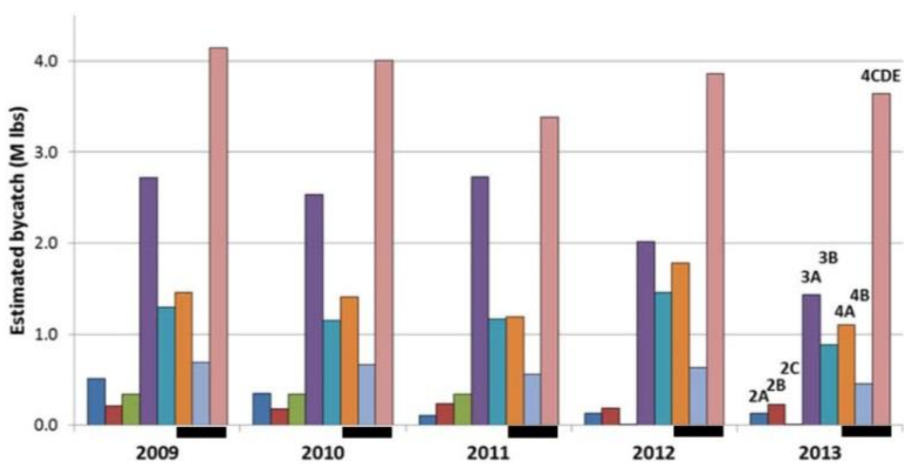
	Trawl												Hook and line			
	Midwater pollock	Bottom pollock	Pacific cod	Sablefish	Yellowfin sole	Flathead sole	Rock sole	Arrowth flounder	Other Flatfish	Greenland Turbot	Atka mackerel	Rockfish	Pacific cod	Rockfish	Sablefish	Greenland Turbot
1990	85	68	68	46	83	-	64	-	80	69	66	65	19	17	14	15
1991	82	74	64	66	88	-	79	-	75	55	77	67	23	55	32	30
1992	85	78	69	-	83	-	78	-	76	-	71	69	21	-	14	11
1993	85	78	67	26	80	-	76	-	69	-	69	69	17	6	13	10
1994	80	80	64	20	81	67	76	-	61	58	73	75	15	23	38	14
1995	79	73	71	-	77	62	73	-	68	75	73	68	14	-	-	9
1996	83	79	70	-	76	66	74	-	67	70	83	72	12	20	-	15
1997	87	72	67	-	80	57	77	-	71	75	85	71	11	4	-	22
1998	86	80	66	-	82	70	79	-	78	86	77	56	11	52	-	18
1999	87	74	69	90	78	79	81	-	63	70	81	81	12	-	-	17
2000	88	67	69	60	77	74	75	-	76	74	77	89	12	12	-	14
2001	89	74	69	-	74	69	77	-	81	68	73	85	12	10	-	6
2002	90	78	69	-	77	60	83	-	77	75	85	73	10	4	-	23
2003	89	65	67	-	81	69	82	67	79	67	67	84	8	-	-	7
2004	88	73	70	-	86	70	85	67	80	31	63	68	10	-	-	4
2005	90	79	81	-	85	83	84	90	65	82	67	79	8	-	-	6
2006	90	74	77	-	87	75	83	-	82	-	64	90	10	-	-	8
2007	90	69	78	-	77	80	83	-	-	-	89	87	9	-	-	-
2008	85	79	61	-	87	79	86	78	41	-	90	73	8	-	-	17
2009	84	88	76	-	87	75	88	-	-	-	90	83	8	-	-	35
2010	87	78	63	-	85	82	88	-	-	-	87	67	9	-	-	6
2011	86	85	65	-	79	55	84	-	-	-	67	87	9	-	-	9

Source: Williams 2012.

3.1.3.3 Halibut PSC mortality estimates for groundfish fisheries

As described above, halibut PSC mortality in Area 4 represents a majority of the coastwide mortality from fisheries other than the directed halibut fishery (Figure 3-6). According to the IPHC (2014a), trends observed in 2011 to 2013 are that the regional PSC mortality has been modestly increasing in the BSAI. Trawl fishery PSC has been increasing in Area 4CDE and in the Closed Area (which is part of Area 4CDE), while declining in Areas 4A and 4B.

Figure 3-6 Bycatch estimates by IPHC area



Note: 2013 values based on projected bycatch at the time of the stock assessment; 2013 halibut PSC mortality for Area 4CDE was underestimated.
Source: Stewart et al. 2014a

The IPHC's 2014 projection for bycatch (halibut PSC mortality), as released for the December 2014 IPHC interim meeting, showed a sizeable jump from 2013 because of the way the IPHC projects year-end halibut PSC mortality in the groundfish fisheries in order to complete the halibut stock assessment for the interim meeting. The 2013 halibut PSC mortality value for Area 4CDE underestimated actual 2013 halibut PSC mortality, resulting in an adjustment in the 2014 stock assessment. Additionally, the projection of the 2014 halibut PSC mortality estimate took into account that halibut PSC mortality in 4CDE, through October 25, was higher than it had been in the last two years, and in the past three years there has been a significant amount of fishing in that area in November and December, so the expansion to account for the remaining fishing year increased the overall BSAI estimate to 6,070,630 net lbs, or 3,671 mt. Actual 2014 bycatch as of 2014 year-end has shown that this projection was an overestimate of halibut PSC mortality by about 325,000 net lbs. NMFS' halibut PSC mortality data by regulatory area for 2011 through 2014 is provided in Table 3-7.

Table 3-7 BSAI halibut PSC mortality estimates, 2011 to 2014, by IPHC regulatory area, in metric tons and net pounds (in thousands).

Area	Gear	2011		2012		2013		2014[1]	
		mt	net lbs	mt	net lbs	mt	net lbs	mt	net lbs
4A	Hook and line	125	206.5	121	199.3	174	287.5	122	202.0
	Pot	4	6.6	2	3.5	1	1.4	2	3.0
	Trawl	533	880.7	936	1,547.8	582	961.6	384	634.5
	Total	662	1,093.8	1,059	1,750.6	756	1,250.4	508	839.6
4B	Hook and line	19	31.0	18	30.4	4	6.5	3	4.7
	Pot	0	90	1	926	0	296	0	40
	Trawl	254	420.2	337	556.9	246	406.9	207	342.2
	Total	273	451.4	356	588.3	250	413.8	210	347.0
4CDE	*Hook and line*	*277*	*458.6*	*296*	*489.3*	*198*	*327.2*	*251*	*414.9*
	Pot	*0*	*219*	*0*	*1*	*0*		*0*	*76*
	Trawl	*885*	*1.463.2*	*983*	*1,625.3*	*1,008*	*1,667.1*	*1,349*	*2,230.9*
Closed Area	*Hook and line*	*129*	*212.9*	*177*	*292.9*	*143*	*236.9*	*66*	*108.9*
	Pot	*1*	*1.9*	*2*	*3.3*	*1*	*1.9*	*1*	*2.2*
	Trawl	*940*	*1.554.4*	*863*	*1,426.5*	*1,244*	*2,057.1*	*1,089*	*1,801.2*
4CDE + Closed Area	Hook and line	406	671.5	473	782.2	341	564.2	317	523.8
	Pot	1	2.2	2	3.3	1	1.8	1	2.2
	Trawl	1,825	3,017.6	1,846	3,051.8	2,252	3,724.1	2,439	4,032.1
	Total	2,232	3,691.2	2,321	3,837.3	2,595	4,290.2	2,757	4,558.1
BSAI TOTAL		**3,167**	**5,236.3**	**3,735**	**6,176.1**	**3,601**	**5,954.5**	**3,474**	**5,744.7**

[1] Estimate as of 1/8/15

Table 3-8 provides NMFS data on levels of halibut PSC mortality accruing to BSAI halibut PSC sector limits, from 2008 to 2014. Table 3-9 provides the PSC limits over the same time period, for comparison, and identifies the percent of the limit taken in each year. Overall, the BSAI groundfish fisheries have taken 65% to 70% of the regulatory halibut PSC limits on an annual basis, in recent years. The trawl sectors have taken a higher proportion of their PSC limits than other sectors. Longline catcher vessels have very little halibut PSC mortality. Figure 3-7 provides a slightly longer historical context for halibut PSC mortality in the groundfish fisheries, capturing the decline in halibut PSC mortality for the Amendment 80 sector that was associated with the implementation of that program in 2008.

Table 3-8 Halibut PSC mortality in BSAI groundfish target fisheries, by sector, 2008 to 2014, in metric tons and net pounds (in thousands)

Sector	2008		2009		2010		2011		2012		2013		2014	
	mt	lbs	mt	lbs	mt	lbs	mt	lbs	mt	lbs	mt	lbs	mt	lbs
Trawl limited access sector	739	1,222	727	1,202	484	801	637	1,054	960	1,588	707	1,169	717	1,186
Amendment 80	1,969	3,256	2,074	3,429	2,254	3,727	1,810	2,994	1,945	3,217	2,168	3,585	2,106	3,483
Longline Pcod CVs	5	9	3	5	2	3	1	2	2	3	3	6	7	12
Longline Pcod CPs	564	933	554	916	489	809	477	788	550	909	458	758	412*	681*
CDQ	214	354	151	250	159	262	223	369	252	416	265	438	244	404
Other non-trawl	1	2	6	11	10	17	5	7	6	9	1	2	*	*
All BSAI halibut PSC mortality accruing to limits	**3,493**	5,776	**3,515**	5,812	**3,398**	5,619	**3,153**	5,214	**3,714**	6,142	**3,603**	5,958	**3,486**	5,765

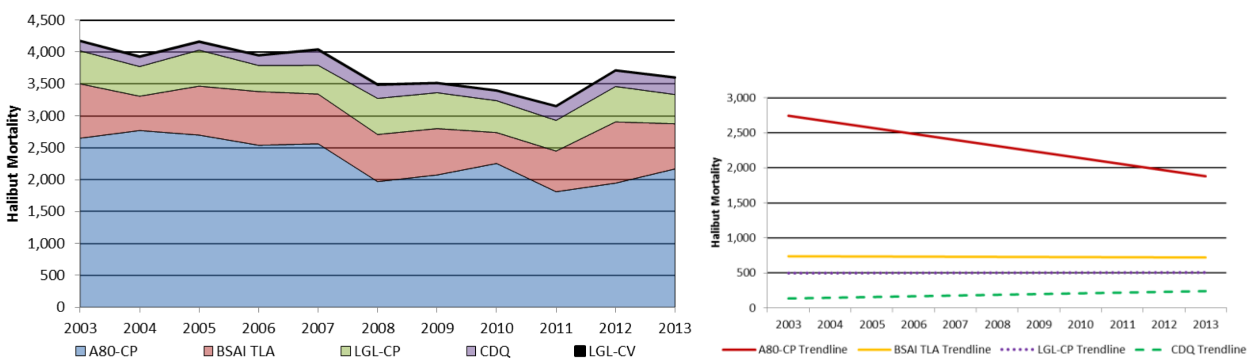
* All 2014 halibut PSC mortality accruing to the other non-trawl PSC limit was intercepted by longline CPs, and is included with the longline Pacific cod CP amount.
Source: AKFIN.

Table 3-9 Percent of BSAI halibut PSC limit taken, by sector, 2008 to 2014

Sector	2008	2009	2010	2011	2012	2013	2014
Trawl limited access sector	84%	83%	55%	73%	110%	81%	82%
Amendment 80	78%	84%	93%	76%	84%	93%	91%
Longline catcher vessels	33%	20%	13%	7%	13%	20%	47%
Longline catcher processors	69%	68%	61%	59%	68%	56%	50%
CDQ	62%	44%	40%	57%	64%	67%	62%
All BSAI Halibut PSC Limits	**76%**	**78%**	**75%**	**70%**	**84%**	**81%**	**79%**

[1] PSC limit for Pacific cod longline catcher processor combined with other non-trawl.
Source: AKFIN.

Figure 3-7 Halibut PSC mortality in BSAI groundfish target fisheries, by sector, 2003 to 2013, and linear trends



Source: AKFIN

In June 2014, the Council asked all industry sectors to voluntarily reduce halibut PSC mortality, and discards in the directed halibut fishery, by 10% (from the recent five-year average) during the 2014-2015 fishing years. Table 3-10 summarizes the 2014 halibut PSC mortality by sector in the context of this request, looking both at the overall halibut PSC mortality amounts, as well as the rate of halibut PSC mortality per groundfish catch amount. Discards in the directed halibut fishery are discussed in Section 3.1.4.2. Overall, the BSAI groundfish fisheries were unsuccessful in reducing 2014 halibut PSC mortality by the target goal of 10%. The hook and line catcher processor fisheries were able to achieve this reduction, but both the Amendment 80 sector and the trawl limited access sector increased their halibut PSC mortality over the five-year average, although only by a small percentage.

Table 3-10 2014 halibut PSC mortality compared to 2009 to 2013 average, in mt and rate of halibut per mt groundfish

Sector	Average PSC mortality 2009-2013	2014 PSC mortality	% change	2009-2013 rate	2014 rate
				(kg halibut PSC / mt groundfish)	
Amendment 80	2,050	2,106	+ 3%	6.27	6.79
Trawl limited access sector	703	717	+ 2%	0.69	0.58
AFA CPs – pollock	*172*	*88*	*- 49%*	*0.45*	*0.19*
AFA CVs – pollock	*113*	*57*	*- 50%*	*0.20*	*0.08*
AFA CPs – non-pelagic	*104*	*268*	*+ 158%*	*3.41*	*4.66*
Non-pelagic CVs	*315*	*304*	*- 3%*	*6.54*	*5.17*
Longline CPs	511	412	- 19%	4.31	2.88
Longline CVs	2	7	+ 250%	3.34	2.76
CDQ	210	244	+ 16%	1.39	3.54
All BSAI Halibut PSC mortality accruing to limits	**3,482**	**3,486**	**0 %**	**2.14**	**2.0**

Source: AKFIN.

3.1.3.4 Spatial distribution of halibut PSC

The following series of maps depict the average groundfish catch and corresponding average halibut PSC rate in the BSAI, by fishery sector, from 2008 through 2013.

For both the BSAI trawl limited access sector (Figure 3-8) and Amendment 80 sector (Figure 3-9), groundfish catches were highest within the IPHC Closed Area and just north on the border of reporting areas 513 and 514 (Area 4E), with a hotspot to the northwest on the eastern edge of 521 (on the border of Area 4C and Area 4D). Halibut PSC rates were highest outside of these areas, generally corresponding with areas of low groundfish catch. The hook-and-line sector (combined catcher vessel and catcher processors) had a very broad distribution of groundfish catch and halibut PSC rates along the Bering Sea shelf, corresponding with Areas 4C and 4D, and along the northeastern boundaries of Area 4A (Figure 3-10).

For the hook-and-line Community Development Quota (CDQ) sector, most groundfish catch was along the Bering Sea shelf break (Figure 3-11). Areas of high halibut PSC mortality rates within the closed area correspond with relatively low groundfish catch within the closed area. Nearly all fishing by the non-pelagic trawl CDQ sector occurs within the IPHC closed area, and this sector has low overall halibut PSC rates (Figure 3-12).

Figure 3-8 Average groundfish catch in metric tons (top panel) and average halibut PSC rates (bottom panel) in the BSAI from 2008 through 2013 by the BSAI trawl limited access sector

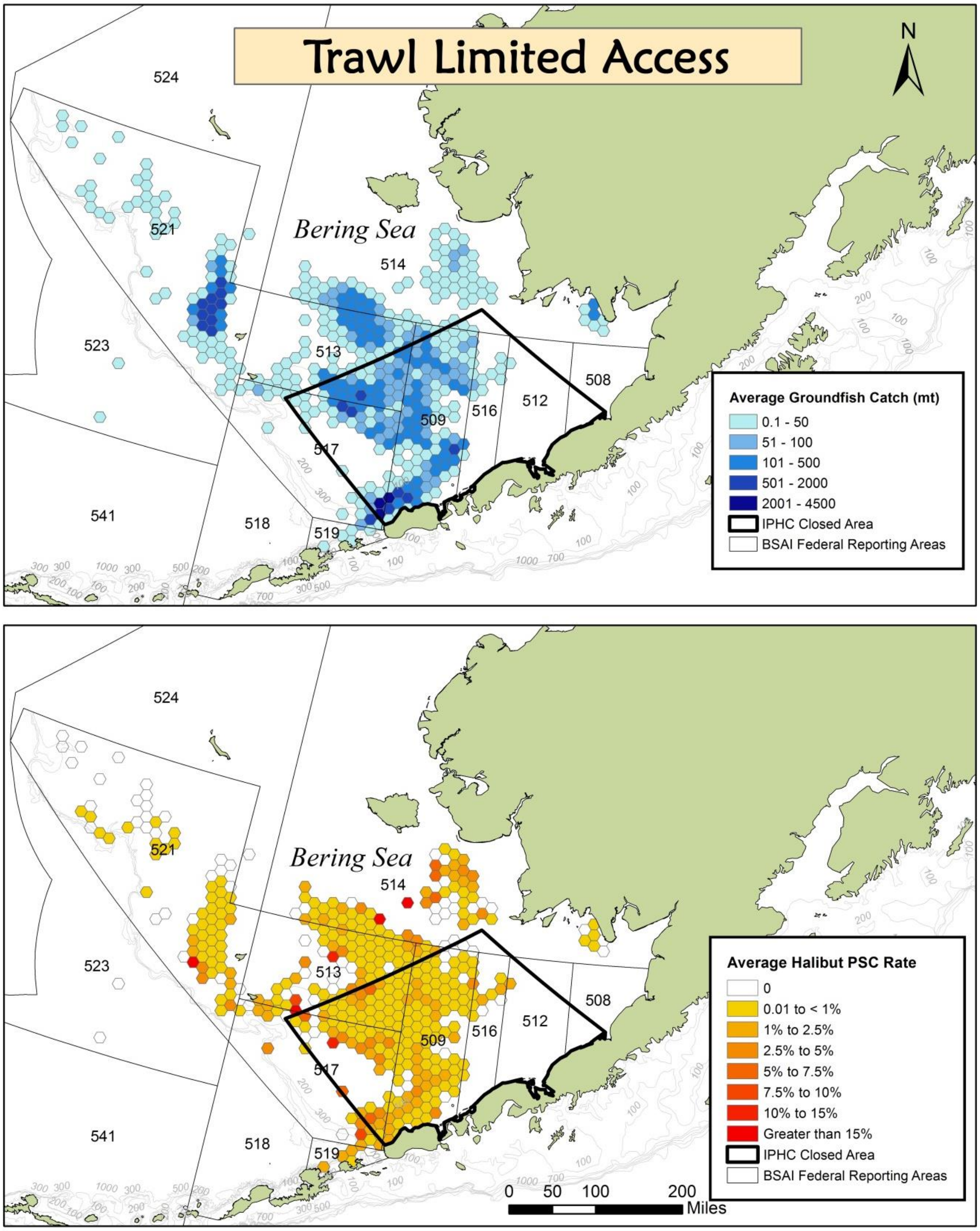


Figure 3-9 Average groundfish catch in metric tons (top panel) and average halibut PSC rates (bottom panel) in the BSAI from 2008 through 2013 by the Amendment 80 sector

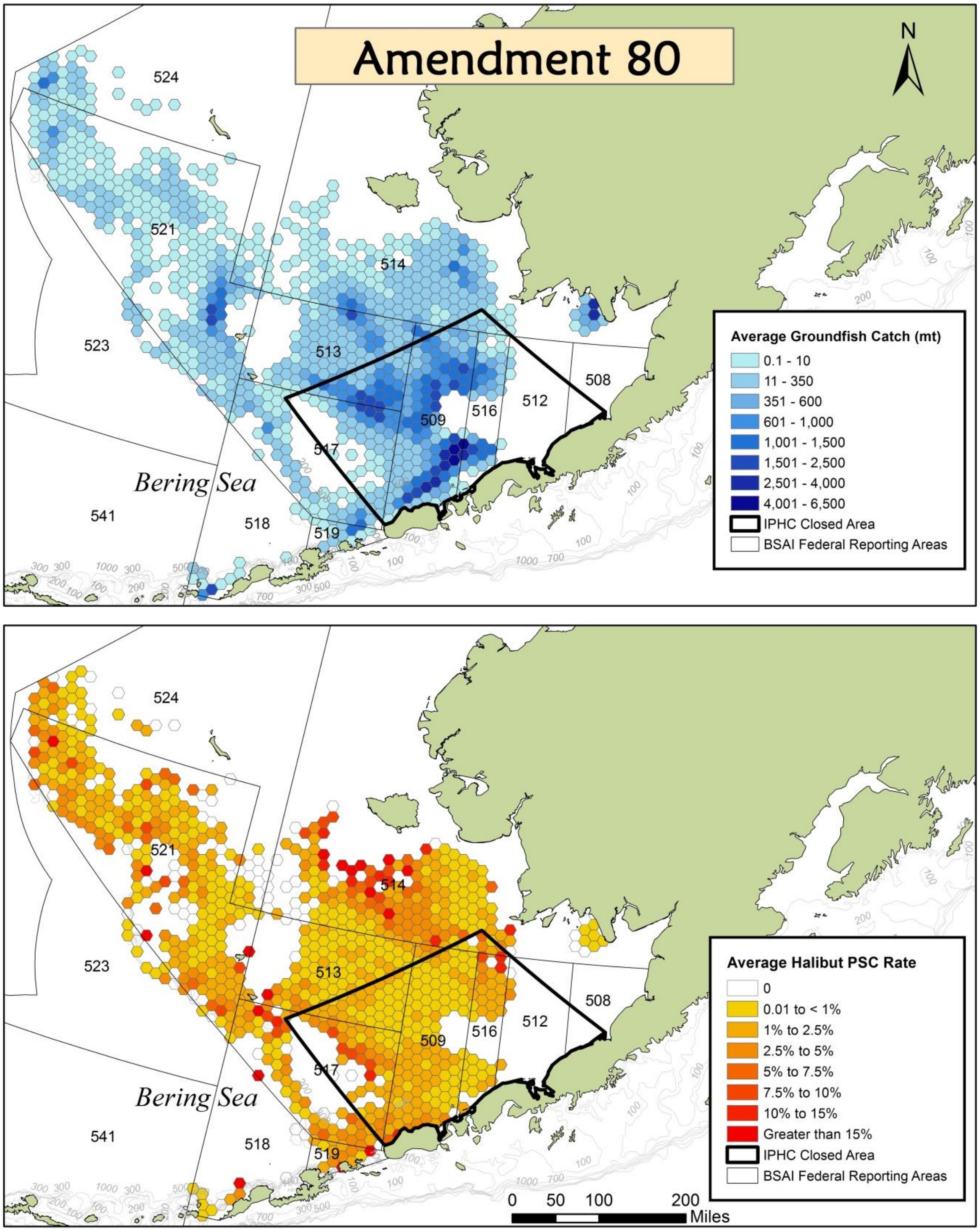


Figure 3-10 Average groundfish catch in metric tons (top panel) and average halibut PSC rates (bottom panel) in the BSAI from 2008 through 2013 by the hook-and-line catcher vessel and catcher-processor vessel sectors combined

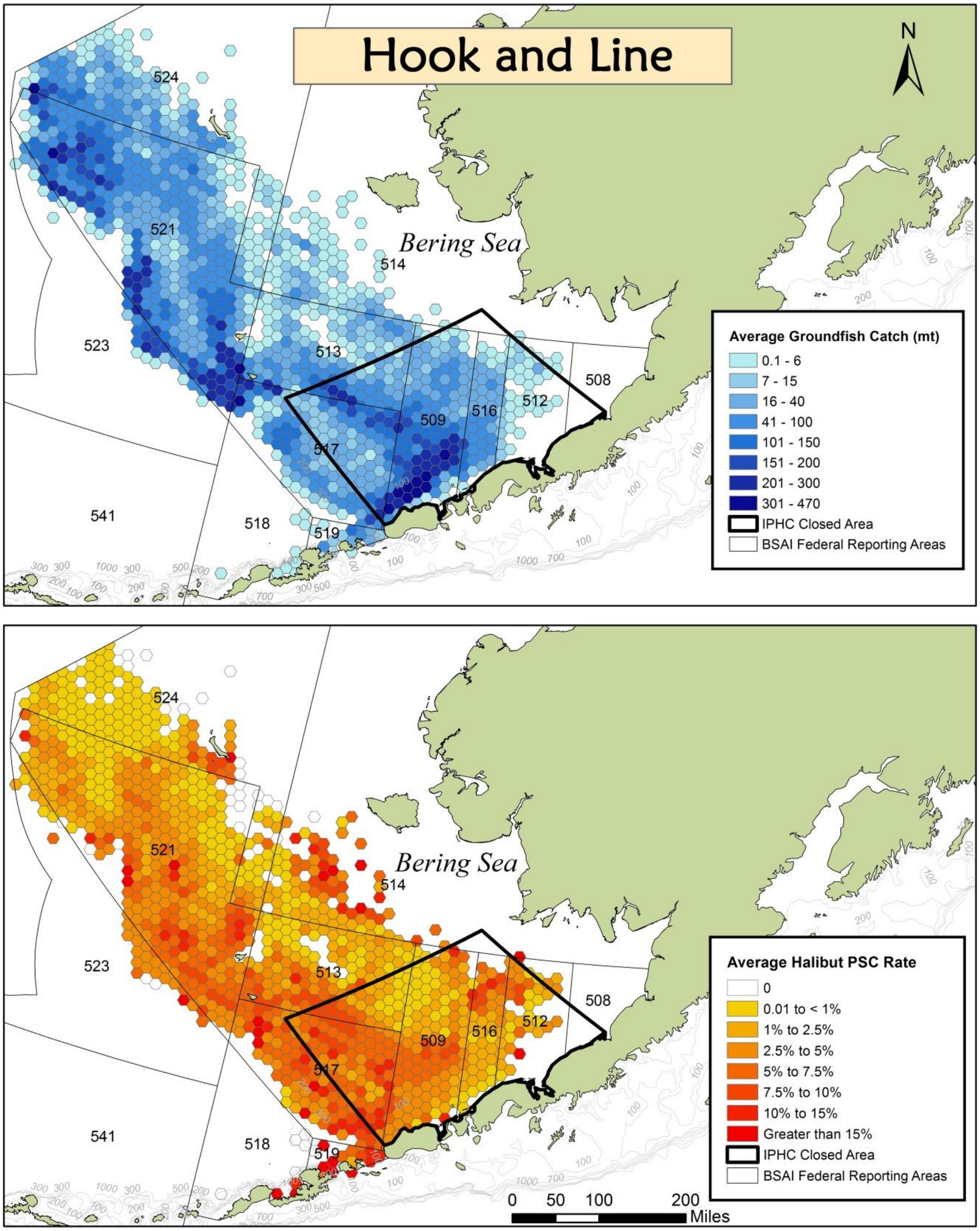


Figure 3-11 Average groundfish catch in metric tons (top panel) and average halibut PSC rates (bottom panel) in the BSAI and IPHC Closed Area from 2008 through 2013 by the hook-and-line Community Development Quota (CDQ) sector.

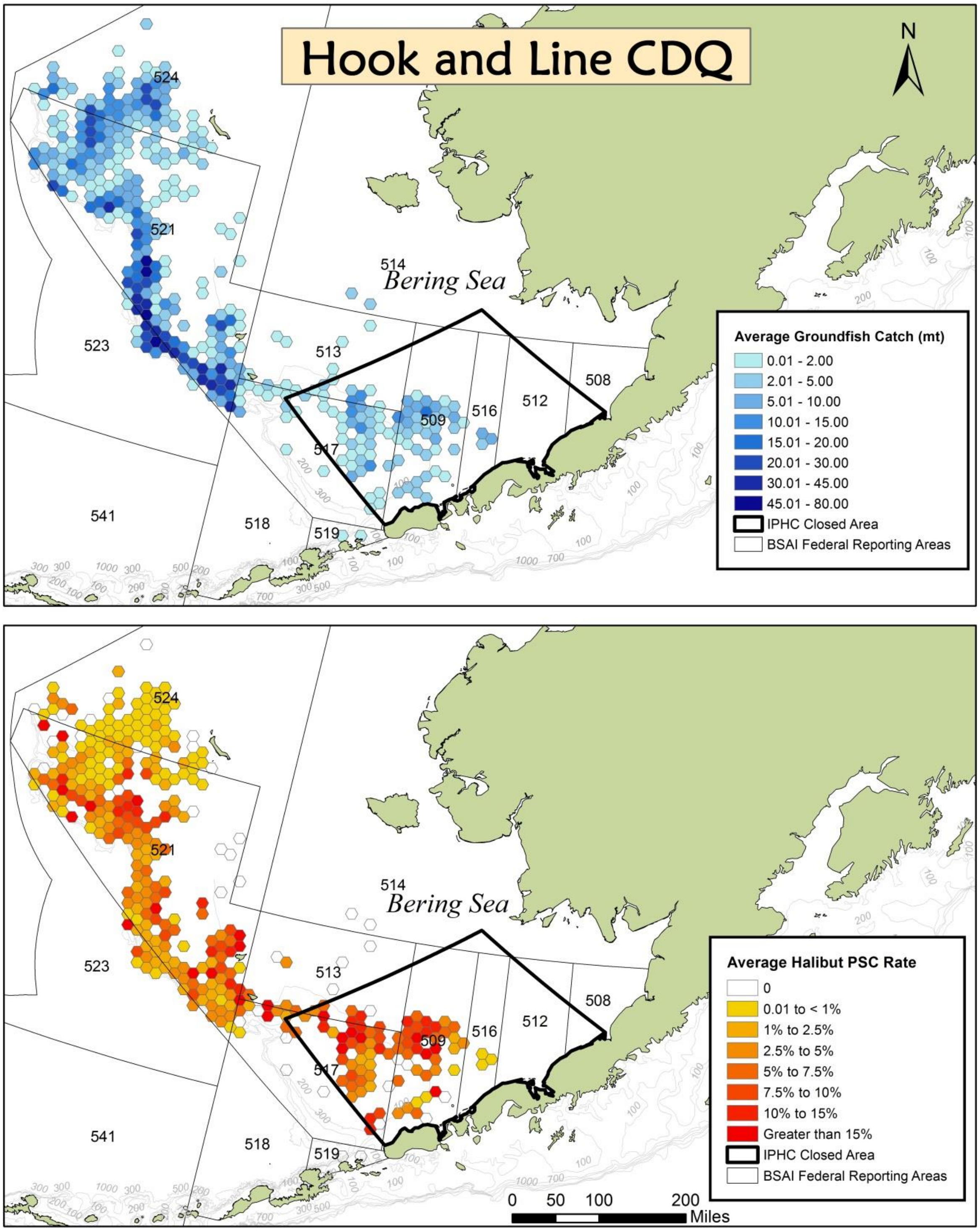
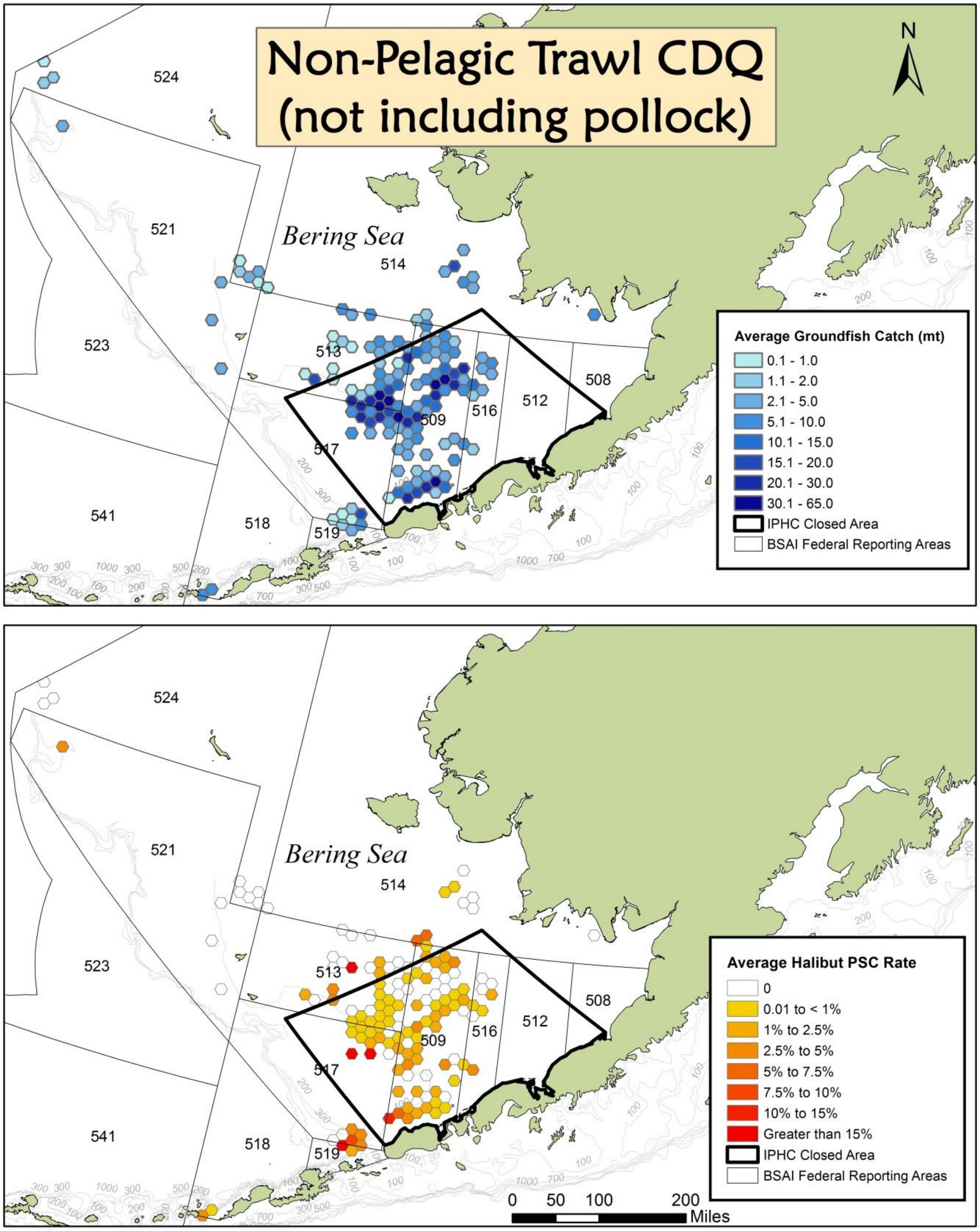
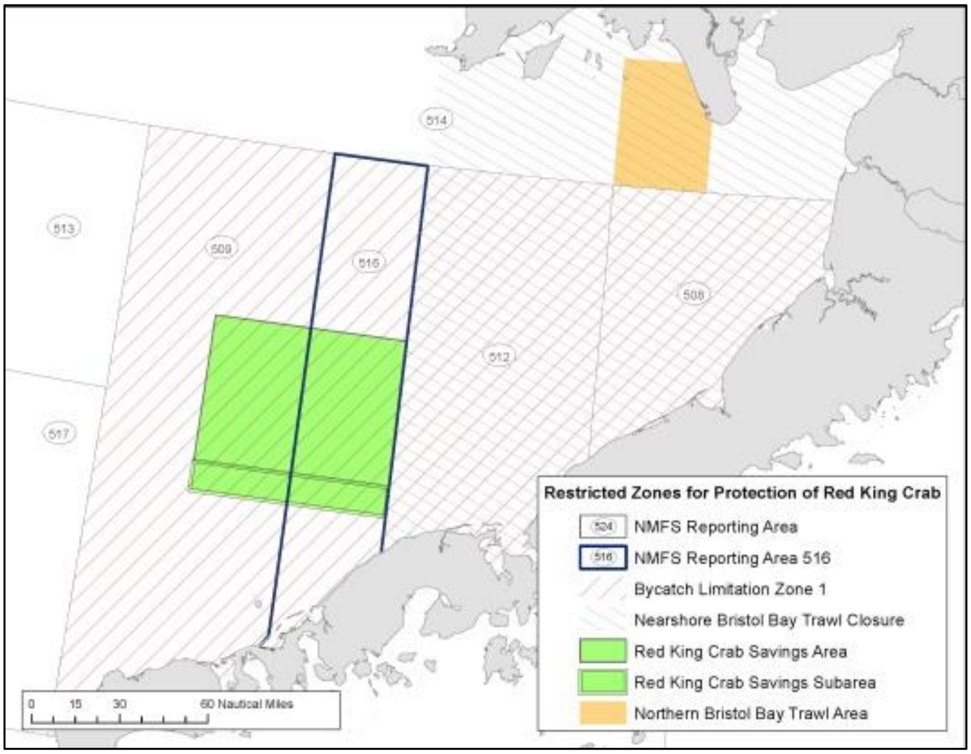


Figure 3-12 Average groundfish catch in metric tons (top panel) and average halibut PSC rates (bottom panel) in the BSAI from 2008 through 2013 by the non-pelagic trawl Community Development Quota (CDQ) sector.
Average groundfish harvests shown exclude CDQ catches of walleye pollock.



For trawl gear, there are also several closure areas in place which may afford protection to halibut spawning and nursery grounds. These include the nearshore Bristol Bay Trawl Closure Area, where no trawl fishing with trawl gear is allowed at any time, and several annual and seasonal red king crab closures in reporting areas 509, 516, and 512 (Figure 3-13).

Figure 3-13 Bering Sea fishery closures for the protection of red king crab



3.1.3.5 Size distribution of halibut PSC

Halibut PSC in the Alaska groundfish fisheries occurs for a range of halibut ages and sizes. Given the life history and population dynamics of the halibut stock, there are different ramifications to the stock and directed fisheries for different size categories of mortality. There are two size categories that are important for halibut:

- over 26 inches in size (O26); and
- under 26 inches in size (U26).

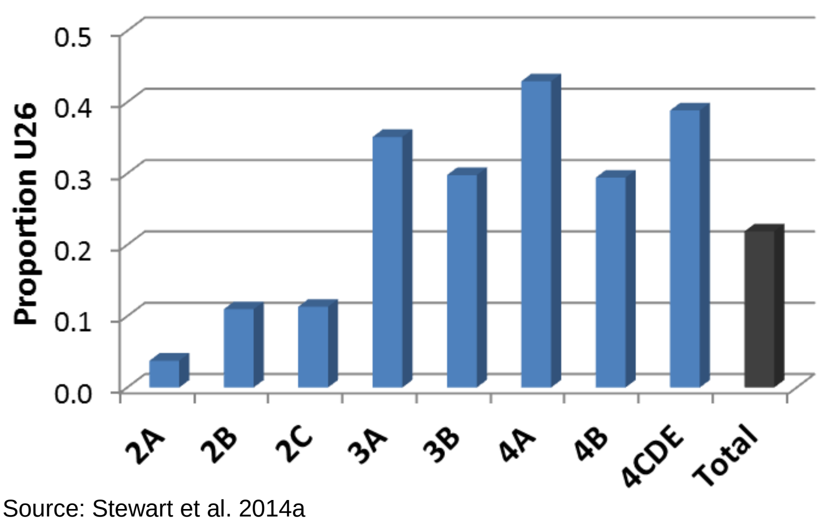
Within the O26 category, there are also two considerations: fish that are over 32 inches, and those from 26 to 32 inches. The 32 inch and over portion is relevant to the directed commercial IFQ fishery, which has a 32 inch size limit. Fish that are 26 to 32 inches are caught in directed sport and subsistence catch, which is not constrained by a size limit. A sizable fraction of halibut PSC is also over 26 inches but under 32 inches. The U26 category contains almost exclusively halibut PSC, as there is virtually no sport or subsistence catch smaller than 26 inches in length. In addition to the directed (commercial, sport, subsistence) fisheries, there is also the loss of halibut from prosecution of the directed commercial fishery, termed “wastage.” Virtually all wastage is above 26 inches in length and is deducted in whole from the TCEY.

Distinguishing between the O26 and U26 components is important. The O26 inch component taken as PSC has approximately the same effect on the halibut stock as O26 directed catch, and is treated the same: it is directly deducted from the TCEY. Thus any reduction in O26 halibut PSC mortality will accrue directly to the directed halibut fisheries. Based on IPHC's evaluation of observer-collected length frequency samples, approximately 64 percent of halibut PSC mortality in the BSAI (Area 4) is O26. As halibut PSC mortality is reduced and the "savings" taken up by the directed fisheries, the impact on directed yield is a gain of 0.64 pounds per pound of halibut PSC mortality reduction.

Removals of U26 halibut are included in the stock assessment, and therefore in the estimated productivity and current status of the stock. Because the stock assessment is conducted at the coastwide level, this means that U26 mortality is implicitly assumed to have an equal effect on the productivity of all regulatory areas. The U26 component of PSC mortality due to the groundfish fisheries, which is 36 percent of halibut PSC mortality in Area 4, is not immediately transferred to the directed halibut fisheries. The reason for this has to do with the small size and future potential of these fish. Nonetheless, the reduction in future yield to the directed fisheries from U26 PSC mortality cumulatively totals about a pound of directed yield per pound of halibut PSC mortality in groundfish fisheries. This yield is distributed coastwide among all regulatory areas.

IPHC staff estimated the proportion of the halibut PSC mortality that is comprised of U26 halibut in 4A and 4CDE as the highest among all regulatory areas over the last five years (Figure 3-14); in 4CDE this corresponded to estimates of 2.23 Mlb of O26 halibut and 1.42 Mlb of U26 halibut mortality in 2013 (or approximately 61% of the bycatch as O26 halibut) (Stewart et al. 2014a). For the 2015 stock assessment, IPHC used NMFS observer data from 2013 (the most recent complete year) to calculate the proportion of O26/U26 fish in halibut PSC mortality. The length frequency observations for each gear type (hook and line, trawl, and pot) were collected for each regulatory area, expanded to an aggregated weight to account for different sampling rates within fisheries, and divided by the aggregate weight for that gear type. The overall estimate of O26 fish in the BSAI halibut was 64%, based on 2013 data. This value is driven largely by the proportion of O26 fish in Area 4CDE and the Closed Area, where the majority of BSAI bycatch occurs, and where the proportion was similarly 64%. In Area 4B, the rate was much higher (88% O26 fish), and in Area 4A, a little lower (57% O26 fish).

Figure 3-14 Estimated proportion of U26 halibut PSC mortality by regulatory area, averaged over 2009 to 2013.



Source: Stewart et al. 2014a

In Section 5.4.2, the overall proportion of O26/U26 fish was evaluated for each major fishery sector (Amendment 80, Bering Sea trawl limited access sector, and longline catcher processors), using a similar methodology[8]. Table 3-11 illustrates the O26/U26 proportions for 2008 to 2013, by sector, that result from these calculations.

Table 3-11 Estimated proportion of halibut over and under 26 inches (O26/U26), by sector, 2008 to 2013

	Amendment 80 CPs		BSAI Trawl Limited Access Sector		Longline CPs	
	O26	U26	O26	U26	O26	U26
Year	Percent of Halibut Mortality by Year					
2008	61.8%	38.2%	68.6%	31.4%	75.2%	24.8%
2009	61.2%	38.8%	57.9%	42.1%	68.3%	31.7%
2010	56.4%	43.6%	59.0%	41.0%	69.8%	30.2%
2011	65.6%	34.4%	51.5%	48.5%	63.4%	36.6%
2012	64.7%	35.3%	43.9%	56.1%	61.5%	38.5%
2013	64.1%	35.9%	52.8%	47.2%	63.5%	36.5%
Weighted Average	61.6%	38.4%	56.2%	43.8%	66.6%	33.4%

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

3.1.4 Other halibut removals

Commercial halibut landings and groundfish halibut PSC mortality comprise the majority of Pacific halibut removals in Area 4. Recreational removals, personal use, and fishery wastage are relatively minor in BSAI areas, contributing only 0.03, 0.04 and 0.17 million pounds of removals, respectively, in 2013 (Stewart et al. 2014a) (Figure 3-15). On a coastwide basis, annual removals were above the 100-year average from 1985 through 2010, peaking in 2004 (Figure 3-4). Commercial removals are the lowest since 1980. Table 3-12 lists total removals coastwide for the last five years.

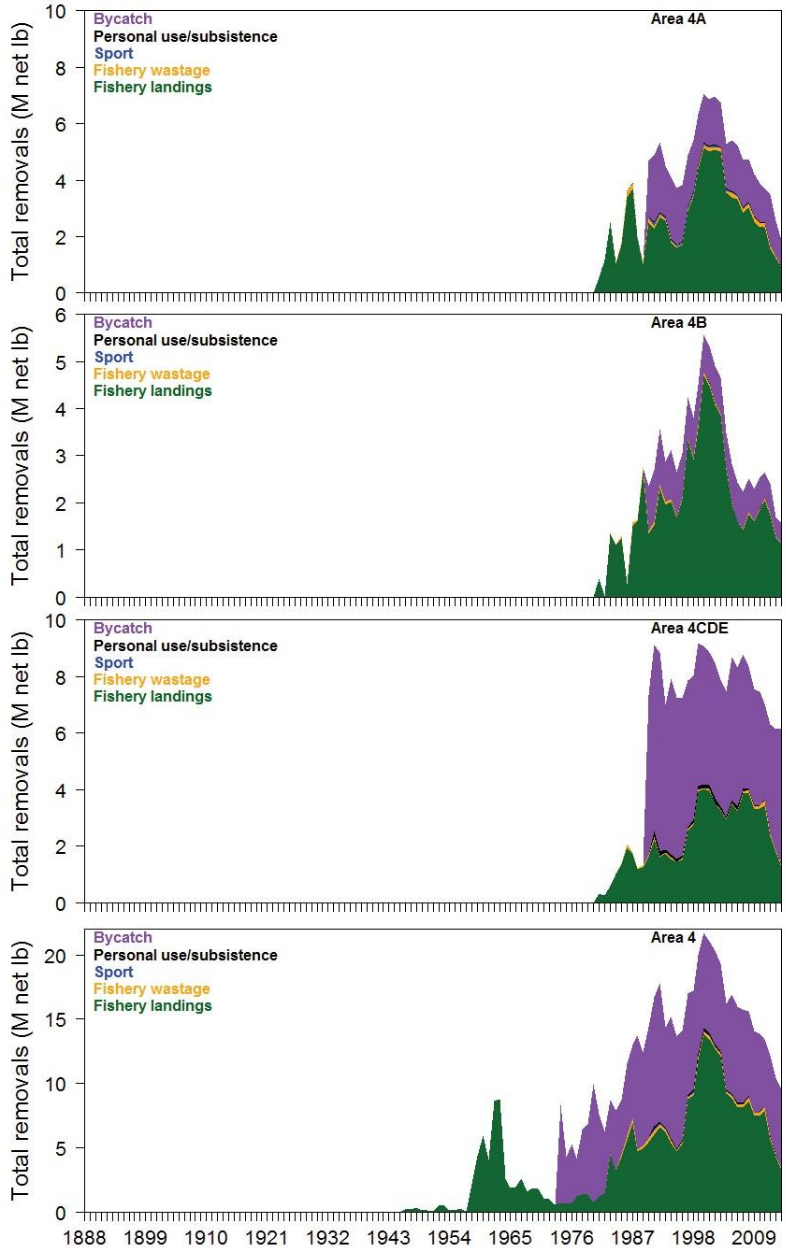
Table 3-12 Total removals coastwide, 2010 through 2014, in millions of pounds

Year	Commercial Landings	Wastage	Sport	Personal use/ Subsistence	Bycatch	Total
2010	49.72	3.21	7.85	1.24	10.30	72.36
2011	39.51	2.46	7.10	1.14	9.42	59.64
2012	31.99	1.67	6.77	1.14	10.10	51.67
2013	29.04	1.43	7.59	1.14	8.84	48.04
2014*	23.69	1.29	7.08	1.14	9.32	42.51

*Preliminary, based on data as of November 11, 2014. Bycatch totals through the end of 2014 were projected.
Source: IPHC 2014b.

[8] IPHC staff is working with NMFS in 2015 to improve the process of using NMFS observer data and the catch accounting system to assess halibut PSC mortality, which will include consideration of whether O26/U26 estimates can be expanded and weighted to fishery sectors.

Figure 3-15 Total estimated removals by source in Areas 4A, 4B, 4CDE, and all of Area 4 combined, since 1888. Note that the y-axes differ in scale.



Source: Stewart 2015.

3.1.4.1 Commercial Halibut Hook and Line Fishery

The Council allocates Pacific halibut in Area 4 based on catch limits set by the IPHC. The Council adopted Individual Fishing Quota (IFQ) programs in 1992 for the Pacific halibut fixed gear fisheries, which were implemented in 1995. The IFQ system was put into place to end the "race for fish" caused by too many boats fishing during restricted seasons of a few days. The IFQ system has resulted in longer seasons, improved vessel safety, and fresh halibut being available about 8 months per year (the season is open from mid-March through mid-November). The IFQ 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 fishing privileges assigned 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. Those who do not hold QS are generally excluded from the fisheries, although the program contains several very limited provisions for "leasing" IFQ. Administrative actions provide for some limited adjustments to annual IFQ permit amounts resulting from underages or overages of IFQ the prior year; however, significant fishing in excess of an IFQ permit is a violation.

The program includes strict limits on how much QS can be held by any person, and caps on vessel use ensure continued participation by at least a minimum number of vessels. To meet the goal of an owner-operated fleet, catcher vessel QS may be transferred only to individuals who must be aboard the vessel when the fish are harvested and landed. Quota share and the annual IFQ that it yields are classified by species, regulatory area, vessel category, and whether it may be fished on a vessel in another size category ("fish up" or "fish down"). A variety of restrictions regarding harvesting, processing IFQ and non-IFQ species, landing, and reporting IFQ fish are also in place.

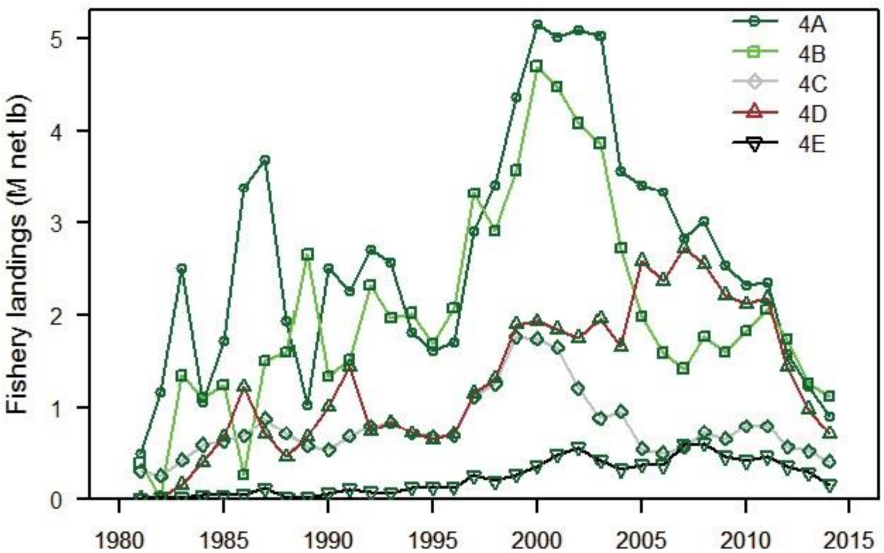
Commercial halibut fishery removals are delineated within Area 4 beginning in 1981 (Figure 3-16). From 1981 to 1984 the fishery in Area 4CDE removed from 0.3 to 1.0 million pounds (Figure 3-5). Fisheries in Areas 4A and 4B were of a similar magnitude during this period, and all three grew rapidly as the stock increased through the 1990s (Stewart and Martell 2014), peaking at 5.2 (4A), 4.5 (4B), and 4.0 million pounds (4CDE) in 2000 to 2001 (Table 3-13). Directed fisheries in the BSAI, as in all other regulatory areas, have since dropped to 2013 values of 1.2 (4A and 4B) and 1.8 million pounds (4CDE). These reductions are roughly consistent with proportional declines in fishery and survey catch rates (Figure 3-3). Over the last 3-5 years, the setline survey weight-per-unit-effort has exhibited a relatively flat trend, and in contrast to the coastwide level, individual size-at-age has been more stable throughout the recent period.

Table 3-13 Summary of halibut fishery landings in the BSAI – IPHC regulatory Areas 4A, 4B, and 4 CDE, in thousands of pounds, net weight.

Commercial Halibut Landings								
Year	**4A**	**4B**	**4CDE**		**Year**	**4A**	**4B**	**4CDE**
1995	1,620	1,680	1,440		2005	3,400	1,980	3,480
1996	1,700	2,070	1,510		2006	3,330	1,590	3,230
1997	2,910	3,320	2,520		2007	2,830	1,420	3,850
1998	3,420	2,900	2,750		2008	3,020	1,760	3,880
1999	4,370	3,570	3,920		2009	2,530	1,590	3,310
2000	5,160	4,690	4,020		2010	2,330	1,830	3,320
2001	5,020	4,470	3,970		2011	2,350	2,050	3,430
2002	5,090	4,080	3,520		2012	1,580	1,740	2,340
2003	5,020	3,860	3,260		2013	1,230	1,240	1,780
2004	3,560	2,720	2,920		2014*	900	1,120	1,260

* preliminary
Source: Stewart et al. 2014a; Stewart 2015

Figure 3-16 Recent landings of halibut by the directed commercial fishery, by Area 4 subarea



Source: Stewart 2015

Table 3-14 lists commercial catch limits of Pacific halibut from 2005 to 2014. The final adopted catch limits for 2014 resulted in FCEYs of 0.85 (4A), 1.14 (4B), and 1.29 million pounds (4CDE). These limits correspond to estimated harvest rates (based on apportionment of the coastwide exploitable biomass; Webster and Stewart 2014) of 16.125 percent in 4A, 20.7 percent in 4B, and 19.8 percent in 4CDE; the latter two were in excess of the current harvest policy targets (the blue line) for those areas (16.125 percent). Table 3-15 identifies the proportion of the catch limit achieved for each area, in 2005 to 2014. Area 4A is fully harvested in most years; Area 4B varies interannually, between 85 and 98 percent; and Area 4CDE has ranged between 92 and 98 percent harvested in the last five years.

Table 3-14 Commercial catch limits of Pacific halibut, 2005 to 2014, in thousands of pounds, net weight.

Area	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014*
4A	3,440	3,350	2,890	3,100	2,550	2,330	2,410	1,567	1,330	850
4B	2,260	1,670	1,440	1,860	1,870	2,160	2,180	1,869	1,450	1,140
4C	1,815	1,610	1,866.5	1,769	1,569	1,625	1,690	1,107	859	596
4D	1,815	1,610	1,866.5	1,769	1,569	1,625	1,690	1,107	859	596
4E	359	330	367	352	322	330	340	250	212	92

Note: Additional carryover from the underage/overage plans is not included.
* Preliminary
Source: Gilroy et al. 2015.

Table 3-15 Proportion of commercial Pacific halibut catch limit landed (including IPHC research catch), 2005 to 2014.

Area	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014[1]
4A	99%	99%	98%	97%	99%	100%	98%	101%	93%	106%
4B	87%	95%	98%	95%	85%	85%	94%	93%	86%	98%
4CDE	87%	91%	94%	100%	96%	93%	92%	95%	92%	98%

[1] Preliminary
Source: Gilroy et al. 2015, based on landings from NMFS Restricted Access Management Division.

A total of 362 unique halibut IFQ QS holders (as defined by unique combinations of species, areas, and vessel categories) held some Area 4 QS, as of early January 2015. Table 3-16 illustrates the distribution of QS holdings within Area 4 subareas, noting that there will be some duplication in the table as some persons hold QS for multiple areas. IFQ QS holders reported 342 vessel landings of IFQ halibut in Area 4 in 2014. Table 3-17 displays landings by regulatory area, and IFQ pounds as reported by Registered Buyers.

Table 3-16 Halibut QS holdings as of January 2015

Area	Alaskan		Non-Alaskan	
	Number of persons	QS Units	Number of persons	QS units
4A	125	7,520,428	75	7,037,941
4B	46	4,475,795	41	4,808,979
4C	30	1,702,440	22	2,082,183
4D	15	1,552,965	30	3,281,686
4E	84	117,285	12	22,307

Source: NMFS RAM, http://alaskafisheries.noaa.gov/ram/ifq/14ifqunitf.csv, accessed 1/9/15.

Table 3-17 2014 IFQ and CDQ halibut allocations and fixed-gear landings, net pounds (in thousands)

Fishery	Area	Vessel Landings	Total Catch Pounds	Allocation Pounds	Remaining Pounds	Percent Landed
IFQ	4A	145	827	850	23	97%
	4B	93	864	912	48	95%
	4C/4D	104	688	716	28	96%
CDQ	4B	*	*	228	*	*
	4C	*	*	298	*	*
	4D	176	120	179	59	67%
	4E[1]	240	152	92	-60	166%

* confidential

[1] 4D allocation may be fished in 4D or 4E. Harvest is debited from the account for the reported harvest area. This may cause 4E landings to appear overharvested and 4D underharvested.

Source: NMFS RAM, http://alaskafisheries.noaa.gov/ram/ifq/14ifqland.pdf

Table 3-18 shows the seasonality of the commercial fishery in the BSAI for 2014. In Area 4A, there was a moderate amount of fishing in April and May, a pulse in July, tapering off into the fall. 4B and 4CDE experienced higher levels of catch from April through August, with a pulse in June, and relatively less effort in the fall.

Table 3-18 Seasonal catch of commercial Pacific halibut landings in 2014 (not including research catch), for Area 4 subareas, by month, in total pounds net weight (preliminary).

Area	April	May	June	July	Aug.	Sept.-Oct.	Total
4A	148	153	91	246	131	58	827
4B	162*	200	290	222	150	65	1089
4CDE	211	228	410	232	139	25	1245
Area 4 total	521	581	791	700	420	148	3161

* Weight combined with landings in March for confidentiality purposes.

Source: Gilroy et al. 2015, based on landings from NMFS Restricted Access Management Division.

3.1.4.2 Wastage in the commercial halibut fishery

The IPHC reports annually on wastage in the commercial halibut fisheries, by area. Wastage includes the mortality of all halibut that do not become part of the landed catch, which are, by majority, fish that are captured and discarded because they are under the minimum 32” size limit for the fishery (U32). A calculation is also made for fish that die on lost or abandoned fishing gear. The final category of wastage is fish that are discarded for regulatory reasons (such as catching fish in excess of IFQ on the last fishing trip of the season), but the IPHC generally considers the latter to be only small amounts in Area 4, and not significant (Gilroy and Stewart 2015). Wastage of U32 fish is calculated using the IPHC setline survey as a proxy for the commercial fleet, so for the BSAI, the survey’s ratio of U32 to O32 for Area 4 as a whole is multiplied by the estimated annual commercial catch for that area. A mortality rate is then applied to the discarded catch, to calculate mortality. Since the implementation of the IFQ system in Alaska (in

1995), a universal mortality rate of 16% has been applied to all halibut discards in the commercial fishery. Table 3-19 illustrates IPHC estimates of halibut discard mortality in the Area 4 IFQ fishery since 2014, distinguishing the U32 mortality by area, and providing an Area 4 total for the combined wastage from U32 and lost gear.

Table 3-19 IPHC estimates of halibut discard mortality in the commercial halibut fishery in Area 4, 1995 to 2014, in net pounds (thousands).

Year	Wastage from estimated U32 mortality						Wastage from U32 mortality plus lost gear
	4A	4B	4C	4D	4E	Total – Area 4	Total - Area 4
1995	16	13	6	1	1	37	61
1996	19	13	14	15	3	64	139
1997	31	19	23	23	5	101	179
1998	48	35	18	18	3	122	175
1999	33	46	15	16	2	112	205
2000	66	36	4	4	1	111	181
2001	99	47	7	8	2	163	251
2002	83	20	3	4	1	111	161
2003	85	26	4	8	2	125	175
2004	63	22	5	9	2	101	140
2005	127	11	5	25	4	172	203
2006	95	9	6	31	5	146	164
2007	127	19	9	45	10	210	234
2008	138	18	18	63	15	252	285
2009	145	11	15	50	10	231	265
2010	130	30	20	53	10	243	270
2011	134	35	41	112	24	346	378
2012	90	35	17	44	11	197	208
2013	62	32	15	29	9	147	161
2014	33	46	16	28	6	129	138

Source: Gilroy and Stewart 2015.

Beginning in 2013, NMFS implemented changes to the Observer Program that included deploying observers on commercial halibut boats, based on a scientifically defensible deployment plan for the fleet under observer coverage. Halibut vessels less than 40 ft in length fall into the zero observer coverage category, representing 79 percent of the vessels landing halibut, and 25 percent of the landed catch, in Area 4. Beginning in 2013, NMFS has used observer estimates extrapolated to the fleet to estimate the disposition of halibut (and other incidentally caught species) in the commercial halibut fishery. Table 3-20 shows that according to NMFS data, approximately 21% of halibut was discarded in 2013, and approximately 34% in 2014. The combined BSAI mortality estimates of discarded halibut, in net weight pounds, equate to NMFS' estimation of mortality from U32 halibut in Area 4. Comparing Table 3-19 and Table 3-20, the NMFS data estimate U32 mortality (wastage) in Area 4 fisheries slightly higher in 2013 (147,000 lbs versus 165,350 lbs), and substantially higher in 2014 (129,000 lbs versus 232,670 lbs). Part of the different may be explained by the average weight used to calculate discards in the commercial halibut fishery by the Observer Program. The average weight is derived from all sizes of halibut, retained and discarded, even though there is a 32 inch minimum size limit in the halibut fishery. As such, fish discarded would have an average weight much smaller than the trip average. NMFS and IPHC are working together to review the discard and bycatch estimates, and the agencies plan to develop an improved process during the course of 2015.

Table 3-20 NMFS estimates of total and discarded halibut catch in the commercial halibut fishery in the Bering Sea and Aleutian Islands

Year	Area	Total catch of halibut (mt)	Discarded catch of halibut (mt)	Discarded as proportion of total	Discarded catch of halibut (lbs, net weight, thousands)	Mortality of discarded halibut[1] (lbs, net weight, thousands)	Discard mortality as proportion of total catch
2013	AI	986	210	21.3 %	348	56	3.4 %
	BS	1,883	402	21.3 %	665	106	3.4 %
	BSAI combined	2,870	613	21.3 %	1,013	162	3.4 %
2014	AI	939	319	34.0 %	528	84	5.4 %
	BS	1,575	543	34.5 %	898	144	5.5 %
	BSAI combined	2,514	862	34.3 %	1,425	228	5.5 %
2013-14 average	**BSAI combined**			**27.4 %**			**4.4 %**

[1] Applies the IPHC's 16% universal mortality rate for halibut discards in the commercial IFQ fisheries
Source: NMFS Catch Accounting System, queried by AKFIN 12/31/14.

3.1.4.3 Sport fishery

Halibut sport fishing is much less common in Bering Sea due to the relative remoteness of the ports. Management of sport halibut fisheries is the responsibility of NMFS, though data collection, fishery sampling and harvest estimation is conducted by the Alaska Department of Fish and Game (ADFG) Division of Sport Fish. The unguided (private) fishery harvest is projected using time series methods applied to estimates from the Statewide Harvest Survey (SWHS). As there is no sampling in the area, the IPHC has traditionally estimated the weight of the harvest in Area 4 by applying the average weight of halibut caught in Kodiak (Kaimmer 2014).

The sport fishery season in Area 4 is from February 1st to December 31st, with a two fish daily bag limit. The estimated 2014 harvests for these areas remain relatively low, at 25,000 pounds in Area 4A. Since 2005, annual harvests have ranged from 18,000 to 50,000 pounds in Area 4 (Table 3-21). A 6 percent release mortality rate is assumed for Area 4 (Kaimmer 2014).

Table 3-21 IPHC data on Area 4 halibut harvest history for sport fishers, subsistence/personal use, and retention of halibut under 32 inches in CDQ fisheries in Areas 4D and 4E, in thousands of pounds, net weight.

Year	Sport	Subsistence / personal use					
		4A	4B	4C	4D	4E	Retention of U32 in CDQ fisheries in 4D/4E
2005	50	36	1	8	6	54	23
2006	46	27	3	9	8	71	20
2007	44	15	2	15	3	52	19
2008	40	20	5	6	3	16	22
2009	24	34	1	6	1	9	11
2010	16	15	1	11	1	10	10
2011	17	14	1	2	1	6	17
2012	28	10	2	1	1	8	20
2013*	9	10	2	1	1	8	10
2014*	23	10	2	1	1	8	6

* preliminary: all 2014 data, and subsistence catches for 2013
Source: Kaimmer 2014 for subsistence, Gilroy and Williams 2015 for personal use, Williams 2015 for U32.

3.1.4.4 Subsistence Fisheries

Halibut is a widely used subsistence resource in Alaskan coastal communities. Management of subsistence halibut fisheries is the responsibility of NMFS, but data collection and harvest estimation is performed by the ADFG Division of Subsistence Fisheries under contract to NMFS. Halibut have been harvested for centuries by the indigenous coastal peoples of Southeast, Southcentral, and Western Alaska. Long ago, hooks were made of wood or bone, and often ornately carved with spirit figures to attract halibut. Lines were made of twisted fibers of cedar, animal sinew, or kelp. Halibut meat was preserved by drying or smoking.

Despite a long history of harvest, Federal halibut fishing regulations did not officially recognize and authorize the subsistence fishery until 2003. In May 2003, the NMFS published final regulations for a subsistence halibut fishery in Alaska. Residents of 118 rural communities and designated rural areas, and members of 123 tribes are eligible to participate. Members of federally recognized tribes as well as residents of designated rural areas and communities are eligible to obtain a Subsistence Halibut Registration Certificate (SHARC) in order to participate in this fishery. Special permits for community harvest, ceremonial, and educational purposes also are available to qualified Alaska communities and Alaska Native Tribes.

Subsistence harvest has been estimated in recent years using a survey of SHARC holders. Most of the subsistence harvest occurs in Southeast and Southcentral Alaska. The ADFG Division of Subsistence conducted a study to estimate the subsistence harvests of Pacific halibut in Alaska in 2012 (Fall and Koster 2014). Halibut subsistence harvests in Area 4, with proportion of the statewide total, were as follows:

- Area 4A (Eastern Aleutian Islands), 1% (9,543 lb)
- Area 4E (East Bering Sea Coast), 1% (8,384 lb)
- Area 4B (Western Aleutian Islands), less than 1% (1,698 lb)
- Area 4C (Pribilof Islands), less than 1% (1,176 lb)
- Area 4D (Central Bering Sea), less than 1% (672 lb)

Table 3-22 estimates the subsistence harvest of halibut from the Area 4 subareas, by community, in 2012. There are three communities in Area 4A: Akutan, Nikolski, and Unalaska-Dutch Harbor. Estimated harvest in 2012 was considerably lower than recent years (Figure 3-17; Table 3-21), and no Akutan residents returned the survey for 2012, so no subsistence harvest is estimated for Akutan. Area 4B (communities of Adak and Atka) experienced an increase in harvest compared to 2011. The 2012 estimate for Area 4C was the lowest since the SHARC program began in 2003. The number of valid SHARCs held by St. Paul residents has dropped to just 12 in 2012, compared to 246 in 2007, and an average of 43 for 2008 to 2011 (Figure 3-18). The 4D harvest estimate was slightly higher than the 2011 estimate, although the second lowest since the program began. In Area 4E, most of the harvest is from the Yukon-Kuskokwim Delta, with a smaller amount from Norton Sound and Bristol Bay, and the estimated harvest was an increase from 2011. Communities include Bethel, Chevak, Dillingham, Egegik, King Salmon, Kotlik, Koyuk, Manokotak, Naknek, Nightmute, Nome, Port Heiden, and Togiak. As with 4D, lower harvest estimates for Area 4E are likely in part attributable to the substantial drop in valid SHARCs held by tribal members and rural community residents of Area 4E in the last five years (Fall and Koster 2014).

Table 3-22 Estimated harvests of halibut in numbers of fish and pounds net weight by Area 4 subarea, 2012

Subarea	Reg. area	Number of SHARCs subsistence fished[c]	Est. subsistence harvest by gear type[a]									Est. sport harvest		
			Set hook gear			Hook and line or handline			All gear					
			Est. number respondents fished	Est. number halibut harvested	Est. pounds halibut harvested[b]	Est. number respondents fished	Est. number halibut harvested	Est. pounds halibut harvested[b]	Est. number respondents fished	Est. number halibut harvested	Est. pounds halibut harvested[b]	Est. number respondents fished	Est. number halibut harvested	Est. pounds halibut harvested[b]
Eastern Aleutians–East	4A	67	38	355	4,972	50	459	7,844	67	814	12,816	25	200	2,714
Eastern Aleutians–West	4A	5	4	14	330	4	20	460	5	33	790	7	11	255
Subtotal, Area 4A		**70**	**39**	**369**	**5,302**	**52**	**478**	**8,304**	**70**	**847**	**13,606**	**32**	**211**	**2,969**
Western Aleutians–East	4B	9	9	12	280	6	15	257	9	27	537	6	0	0
Subtotal, Area 4B		**9**	**9**	**12**	**280**	**6**	**15**	**257**	**9**	**27**	**537**	**6**	**0**	**0**
St. George Island	4C	4	4	20	490	0	0	0	4	20	490	0	0	0
St. Paul Island	4C	7	4	35	346	4	11	812	7	46	1,158	0	0	0
Subtotal, Area 4C		**11**	**8**	**55**	**836**	**4**	**11**	**812**	**11**	**66**	**1,648**	**0**	**0**	**0**
St. Lawrence Island	4D	8	7	22	556	3	1	60	8	23	615	0	0	0
Subtotal, Area 4D		**8**	**7**	**22**	**556**	**3**	**1**	**60**	**8**	**23**	**615**	**0**	**0**	**0**
Bristol Bay	4E	10	5	0	0	10	34	403	10	34	403	3	0	0
Yukon Delta	4E	78	26	198	2,089	65	497	3,194	78	695	5,283	6	14	264
Norton Sound	4E	5	5	21	482	0	0	0	5	21	482	0	0	0
Subtotal, Area 4E		**91**	**35**	**220**	**2,571**	**72**	**531**	**3,597**	**91**	**750**	**6,168**	**9**	**14**	**264**

a. "Setline" = longline or skate. "Hand-operated gear" = rod and reel, or handline
b. Weights given are "net weight." Pounds net (dressed, head off) weight = 75% of round (whole) weight.
c. Because fishermen may fish in more than one area, subtotals for regulatory areas might exceed the sum of the subarea values. Includes subsistence and sport fishing.

Source: ADF&G Division of Subsistence, SHARC survey, 2013, in Fall and Koster 2014.

Figure 3-17 Estimated subsistence halibut harvests, pounds net weight, by regulatory area fished, 2003 to 2011.

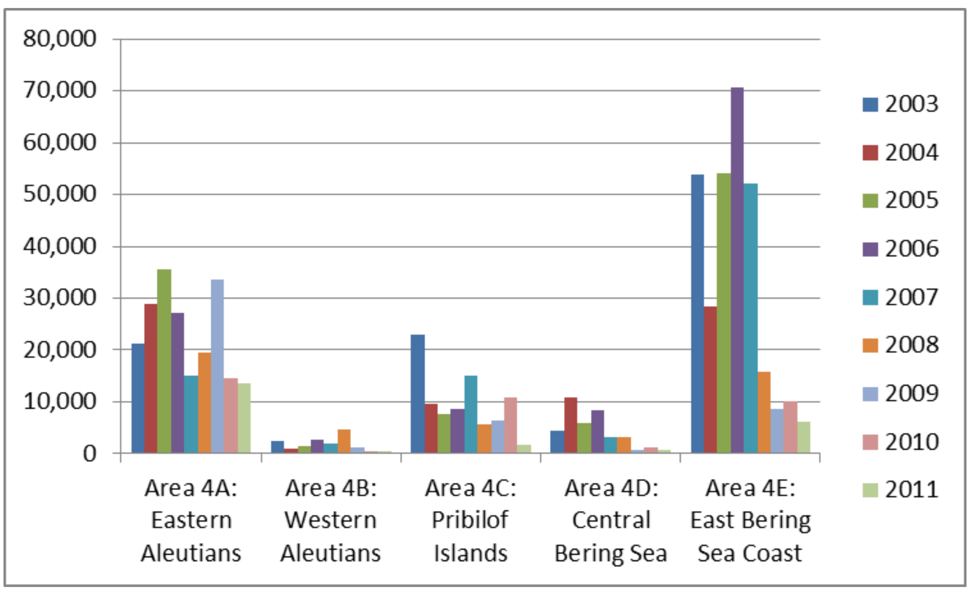
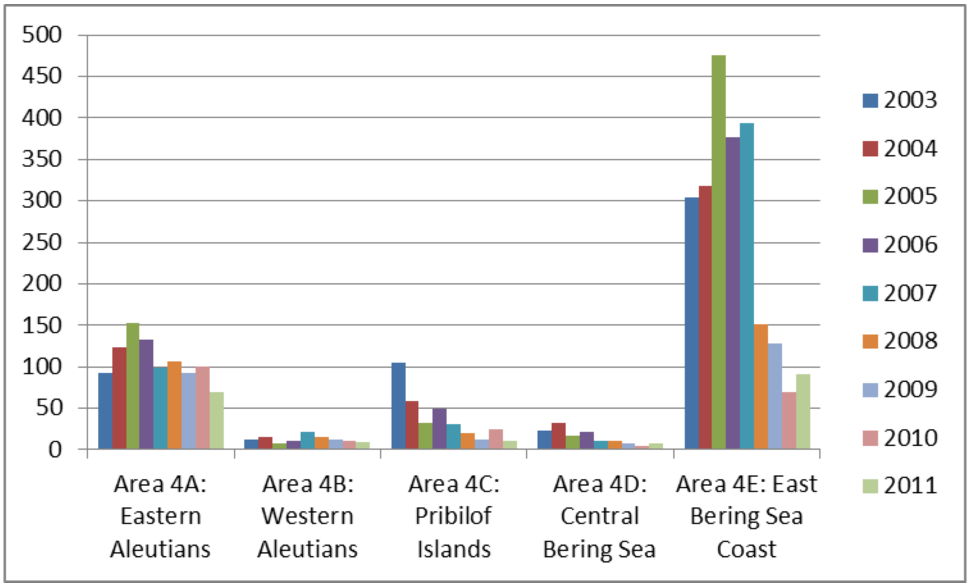


Figure 3-18 Estimated number of Alaska subsistence halibut fishermen in Area 4, 2003 to 2011, by regulatory area of tribe or rural community.



Retention of U32 halibut in the 4D/4E CDQ fisheries

Under an exemption requested by the Council, commercial halibut vessels fishing for certain CDQ organizations in Areas 4D and 4E have been permitted by the IPHC to retain halibut under 32 inches (U32), provided the vessels land all of their catch in Areas 4D or 4E. This harvest is in addition to the subsistence harvest reported by ADFG for these regulatory areas. The three CDQ groups to which this exemption applies are Bristol Bay Economic Development Corporation (BBEDC), the Coastal Villages Regional Fund (CVRF), and the Norton Sound Economic Development Corporation (NSEDC).

Overall amounts of U32 halibut retained by CDQ harvesters are reported in Table 3-21. In most years, the majority of the fish retained under this provision is from CVRF harvesters, although in 2014 there was a significant reduction in retained halibut. Generally, annual changes are a reflection of the amount of effort by the local small boat fleets, and the availability of fish in their nearshore fisheries (Williams 2015). Harvests by BBEDC fishermen were comparable to 2013, and there was a 12 percent decrease in NSEDC harvest, compared to 2013.

3.1.5 Effects of the Alternatives

Halibut PSC mortality in the groundfish fisheries, recreational and subsistence halibut catches, and wastage in the commercial halibut fishery are all considered before the IPHC sets commercial halibut catch limits each year. IPHC directed commercial fishery catch limits are reduced in consideration of the estimated mortality in other fisheries in order to minimize the chances of the stock decreasing below harvest reference points. However, the halibut stock is impacted by these removals in the form of reduced yield available to harvesters and reduced spawning biomass.

Impact criteria

Table 3-23 describes the criteria used to determine whether the impacts on Pacific halibut stocks are likely to be significant.

Table 3-23 Criteria used to estimate the significance of impacts on incidental catch of Pacific halibut.

No impact	No incidental take of Pacific halibut.
Adverse impact	There are incidental takes of Pacific halibut.
Beneficial impact	Natural at-sea mortality of Pacific halibut would be reduced – perhaps by the harvest of a predator or by the harvest of a species that competes for prey.
Significantly adverse impact	An action that diminishes protections afforded to Pacific halibut in the groundfish fisheries would be a significantly adverse impact.
Significantly beneficial impact	No benchmarks are available for significantly beneficial impact of the groundfish fishery on Pacific halibut, and significantly beneficial impacts are not defined for these species.
Unknown impact	Not applicable

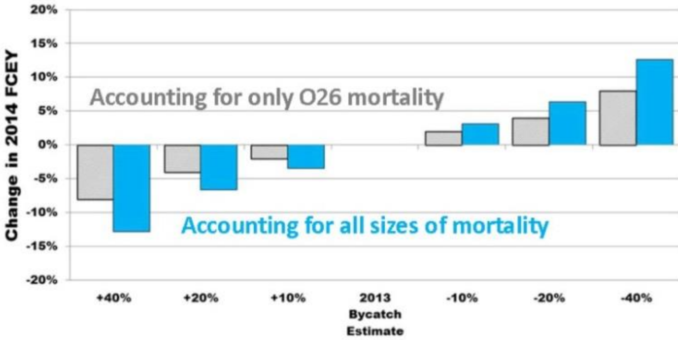
3.1.5.1 IPHC analyses on halibut PSC mortality impacts

Several previous IPHC analyses have investigated the effects of halibut PSC mortality on the halibut stock using metrics of fishery yield and lifetime spawning biomass contribution (Hare et al. 2012, Hare and Williams 2013). These analyses were conducted using equilibrium calculations based on relatively simple assumptions about growth and mortality. Results indicated that there was a 1.0 -1.14 pound loss of fishery yield per pound of bycatch (O26 and U26 combined). For each pound of bycatch, the potential lifetime contribution to female spawning biomass was found to be somewhat larger than the fishery yield.

More recently, Stewart et al. (2014a) reported to the Council on an evaluation of the impacts of halibut PSC limit reductions in the BSAI, using the stock assessment models, apportionment estimates, and current harvest policy calculations, and based on the actual bycatch estimates from each regulatory area in 2013. Coastwide TCEY and FCEY values were recalculated using coastwide and Area 4 bycatch values of 40, 20, and 10 percent above and below the estimates from 2013, and changes in bycatch showed a corresponding effect in Area 4 FCEYs. Results indicated that Area 4CDE is the most sensitive to bycatch fluctuations, as it has a much higher ratio of bycatch to directed fishery harvest. A second series of calculations addressed the impact of differing levels of U26 halibut PSC mortality, which are accounted for in the stock assessment as an effect on estimated productivity of the stock, but not explicitly addressed by the current harvest policy (see Section 3.1.2.2). Using the Spawning Potential Ratio (SPR)[9], which integrates fishing intensity across all sources and sizes of mortality, different levels of total and U26 bycatch were considered, and FCEY values adjusted via the stock assessment to maintain the same SPR target. The resulting response in directed fishery yields from proposed BSAI halibut PSC mortality reductions was greater than just the change in O26 mortality (accounting for the additional effect of the U26 removals). The results were consistent with previous analyses finding approximately a 1:1 relationship in total lost yield due to all sizes of bycatch (Figure 3-19). These changes were assumed to be distributed in proportion to the productivity of the stock as a whole, so affected other regulatory areas than just the BSAI.

[9] Spawning Potential Ratio is the spawning biomass per recruit at equilibrium, relative to an unfished level, given the current level of fishing mortality from all sources.

Figure 3-19 Coastwide impacts of halibut PSC mortality (bycatch) changes in the BSAI



Source: Stewart et al. 2014a

Major sources of uncertainty

There are several very important sources of uncertainty in the IPHC's analysis of current halibut stock status and impacts of halibut PSC mortality on yield, as described in Stewart et al. (2014a). Some of these sources are inherent to the biology and management of Pacific halibut and are not easily addressed (e.g., specific migration pathways and rates), while others are being worked on through additional data collection and analysis.

- Current uncertainty in setline survey indices in the Bering Sea is due to incomplete geographic coverage and could be improved through setline survey expansions planned over the next five years with better spatial coverage and a broader depth range. Pending logistical constraints, the IPHC is considering repeating the 2006 Bering Sea trawl survey calibration in 2015 (along with the Area 4D expansion), which could provide an updated estimate of the abundance in that area, particularly crucial given the current uncertainty in recent year classes.
- The current harvest policy makes the implicit assumption that the effects of this mortality are distributed across the entire stock, in proportion to the total productivity. If juveniles in some areas are less likely to disperse to other areas, or if these patterns change over time with environmental conditions or stock abundance, this assumption may not be a good one. Neither the directed fishery, nor the setline survey provides clear information on juvenile abundance distribution. Some information can be inferred from other sources, however, all of these are subject to many other uncertainties. The design of a targeted survey of juvenile halibut abundance and distribution is likely to be both technically unfeasible and prohibitively expensive.
- Juvenile natural mortality rates are highly uncertain, but are important to any evaluation of removals to population trend and productivity. For this analysis, several alternative comparisons were made of juvenile natural mortality rates resulting in the relative change in SPR being similar across alternatives.
- The stock assessment and application of the harvest policy relies on accurate and precise estimation of the removals from all fishing sectors, including the directed fishery, recreational and subsistence harvests, as well as discards from these fisheries and bycatch. There is a substantial amount of uncertainty in the current treatment of halibut PSC mortality due to: the estimation framework (data collection), the summary of the estimates (data processing), and the forecasting of bycatch and its biological properties from one year to the next. Under the current observer program, not all fisheries in the BSAI region have observer coverage of 100% of fishing trips, which may introduce bias into the estimates. Additionally, not all bycatch may be attributed to the correct regulatory area in each year, due to the imperfect alignment of IPHC and Alaska statistical reporting areas. Finally, IPHC receives halibut PSC mortality data in a form that makes it difficult to weight data among fishing sectors by size-, age-, and sex-specific estimates of the removals.

- The stock assessment and harvest policy calculations rely on an aggregate bycatch selectivity assumption. However, the size distribution of bycatch varies among regulatory areas, among fisheries and even annually within fisheries, in response to many extrinsic and intrinsic factors. Further, many of the tools proposed for bycatch reduction could have large effects on the potential size-distribution of future bycatch mortality through direct effects, or changes in the discard mortality estimates by fish size. These changes are difficult or impossible to predict, and therefore current practice is to use the values from the previous year for all calculations. This approach could introduce lags in response if clear trends occur.

Future directions for the total mortality accounting framework

The SPR-based evaluation method provides an accounting framework through which yield trade-offs can be evaluated. Specifically, it allows the explicit evaluation of trade-offs between removals of halibut associated with different fisheries and potential changes in the size structure of these removals in response to management actions. With respect to potential management actions such as are considered in this halibut PSC limit reduction analysis, this type of evaluation serves as a basis for direct comparisons within and among regulatory areas of the 'exchange rate' among fisheries, for example the groundfish fishery versus the directed halibut fishery, in terms of pounds of total halibut removals, and potential dollars earned in directed halibut fisheries and from fisheries for target species other than halibut which are responsible for incidental halibut removals.

The final report describing the methodology (Stewart et al. 2014b) suggests ways for the IPHC to add full accounting to the IPHC's annual process. The total mortality accounting report is being reviewed by the IPHC in the 2014/2015 meeting cycle, and also by the Council's Scientific and Statistical Committee at the February 2015 Council meeting.

3.1.5.2 Impacts of Alternative 1

Alternative 1 would result in no change to the amount of halibut PSC mortality in the trawl and longline groundfish fisheries. The Groundfish PSEIS (NMFS 2004a) and the Harvest Specifications SEIS (NMFS 2007) concluded that it is unlikely that groundfish fishing under the status quo, or Alternative 1, has direct or indirect impacts on Pacific halibut sustainability. While the halibut biomass has declined from peaks in the late 1990s, the estimated female spawning biomass appears to have stabilized or be slightly increasing (Section 3.1.1). Halibut mortality in the groundfish fisheries is taken into account when the commercial halibut quotas are set, to prevent significantly adverse impacts on the halibut stocks. Area closures to bottom trawl gear mitigate the potential for impacts to spawning habitat (Section 3.1.3.4, Figure 3-13).

Halibut PSC mortality removals in the groundfish fisheries are constrained by PSC limits, which provide an upper limit annually on halibut PSC mortality. Since 2008, halibut PSC mortality in the BSAI groundfish fisheries has been 70 to 84 percent of the regulated PSC limits (Table 3-9), and there is no indication that industry is intending to increase their halibut PSC mortality; on the contrary, industry members have been reporting to the Council on measures they are undertaking to reduce halibut PSC mortality. Also, the Groundfish PSEIS and the Harvest Specifications EIS evaluated the impact of halibut PSC practices at times when halibut PSC mortality was higher in the BSAI. Based on the 2014 TCEY values, however, if the combined BSAI groundfish fishery sectors each took their full PSC limits as allowed under regulation, there are some scenarios (depending on the distribution of the PSC mortality by regulatory area) in which the subarea-specific TCEYs would be insufficient to accommodate the increased halibut PSC mortality, and therefore the TCEYs in other areas would need to be proportionally reduced to achieve the target total coastwide TCEY (Stewart 2015). From the coastwide management of the stock, accounting for halibut PSC mortality would still be deducted from the total TCEY before directed fishery catch limits are set. There could be effects on the spatial distribution of the stock, if the available yield is insufficient to cover the entire halibut PSC mortality and reductions are taken in other areas to compensate.

The level of halibut removals in the trawl and longline groundfish fisheries under the status quo could result in reduced allocations to the directed halibut IFQ fisheries in Area 4 through reduced yield. The economic impacts of taking no action are discussed in the Regulatory Impact Review (Section 5.7.1). Coastwide, commercial halibut allocations have declined substantially since 2010 (Figure 3-4), with corresponding declines in Area 4 (Figure 3-5). IPHC staff harvest advice for 2015 includes a further substantial reduction for the directed fishery in Area 4CDE (the final allocation will not be decided until the IPHC annual meeting, in January 2015), which is specifically a response to higher projected halibut PSC mortality levels in that area for 2014 (and rolled over to 2015). Reductions in the directed fishery allocations affect the economic state of commercial halibut IFQ fishermen or the communities they impact. At the same time, hook-and-line and trawl industry efforts to reduce halibut PSC mortality taken in the prosecution of the groundfish fisheries may lower the amount of future removals the IPHC deducts from the TCEY.

It is unlikely that halibut harvests in unguided sport and subsistence fisheries are impacted by Alternative 1 because these fisheries do not have caps on removals in Area 4, and harvests in the halibut subsistence and unguided sport fisheries are also deducted from the TCEY prior to the commercial IFQ limits being set. Since subsistence and recreational removals are not restricted by catch limits, it is assumed that those sectors are not affected by the status quo or options that reduce the PSC limits.

3.1.5.3 Impacts of Alternative 2

Alternative 2 could reduce the amount of halibut PSC mortality in the trawl and longline groundfish fisheries. The alternative includes several options to apply PSC limit reductions to different sectors of the BSAI trawl and longline groundfish fleet. Table 2-2 summarizes the options in terms of halibut PSC mortality “savings” under the PSC limit reductions, and associated reallocations to the directed halibut fishery in terms of O26 and U26 fish. Only some of the options would result in a change to the status quo, given that the sectors regularly harvest less than the regulated PSC limit. For the Bering Sea trawl limited access sector and the Amendment 80 sector, any of the PSC limit reduction options would be constraining in some years, based on the multi-year simulation model described in Section 5.4, which uses the basis years of 2008 to 2013 to forecast how PSC limit reductions would affect the groundfish fisheries. For Pacific cod longline catcher processors, only reductions of 30 or 35 percent would constrain this sector, and for CDQ groups, only a reduction of 35 percent would be constraining. There is no effect of any of the reduction options on Pacific cod longline catcher vessels, or the PSC limit that is apportioned to other non-trawl fisheries (i.e., targeting species other than Pacific cod or sablefish).

Reductions in O26 halibut mortality resulting from PSC limit reductions will be directly reallocated to increased halibut yields available to harvesters in the directed halibut IFQ fisheries in Area 4, and therefore will have no effect on the halibut stock condition. IPHC analyses of the impact of halibut PSC mortality on the halibut stock have found that there is approximately a 1:1 relationship in total lost yield due to O26 halibut PSC mortality (Section 3.1.5.1). The O26 component is estimated to be 64 percent of the overall BSAI halibut PSC mortality in 2013 (the last full year of data), although it varies by sector and area (see discussion in Section 3.1.3.5). The O26 inch component taken as PSC has approximately the same effect on the halibut stock as O26 directed catch, and is treated the same: it is directly deducted from the TCEY. Thus any reduction in O26 halibut PSC mortality will accrue directly to the directed halibut fisheries in that regulatory area. As halibut PSC mortality is reduced and the “savings” taken up by the directed fisheries, the impact on directed yield is a pound for pound gain for the O26 component of that halibut PSC reduction.

These decreases in halibut mortality resulting from the PSC limit reduction options will also contribute to increased halibut yields available to harvesters in the directed halibut IFQ fisheries in all regulatory areas, in terms of U26 savings. U26 halibut are estimated to be 36 percent of halibut PSC mortality in the BSAI as a whole, based on the last full year of data (2013). The reduction in U26 halibut PSC mortality in groundfish fisheries, accruing in future yield to the directed halibut fisheries through increases to the exploitable biomass, is also pound for pound (Section 3.1.5.1), but removals of U26 halibut are implicitly assumed to have an equal effect on the productivity of all regulatory areas, and so the effects are distributed coastwide. Based on the setline survey, Area 4 represents 22 percent of the exploitable biomass (halibut over 32 inches) for the coastwide halibut stock (Figure 3-3), therefore approximately 22 percent of the U26 halibut PSC mortality reductions would, at some future time, accrue back to the Area 4 directed fisheries as halibut yield. The remainder of the U26 halibut “savings” would accrue to directed halibut users in other IPHC regions, in proportion to their share of the coastwide biomass.

With respect to whether removals of U26 halibut have an effect on the condition of the halibut stock, IPHC studies have demonstrated that removal of smaller halibut causes a steeper reduction in spawning biomass recruit. Consequently, a lower target rate on larger fish is required in order to “compensate” the stock to keep the spawning biomass per recruit at the target level. Mortality of juvenile halibut will have an effect on the distribution of the surviving fish, and therefore the subsequent spawning biomass. It is not currently known how important the spatial distribution of the spawning stock may be to short or long-term stock productivity, but greater mortality at younger ages is likely to change this distribution more than older removals. Decreases in U26 halibut mortality resulting from halibut PSC limit reductions could make more halibut of various sizes available in the BSAI. The extent to which this may affect the halibut spawning biomass coastwide depends on the importance of spatial distribution of the spawning stock, but any effect of the PSC limit reductions in the BSAI will be tempered by the proportion of the reduction that affects U26 halibut (currently 34 percent of halibut PSC mortality), and the BSAI’s overall proportion of total coastwide biomass (currently 22 percent). It is notable that while the majority of coastwide U26 halibut PSC mortality occurs in Area 4CDE, the proportion of the coastwide biomass in this area has been stable with a slight increase over the last fifteen years (Figure 3-3).

At a broader scale, fisheries management is much more robust to uncertainty of all types (harvest rates, incoming year-classes, fishery behavior, implementation, etc.) when the removals are taken from fish that have already been directly observed (in this case, halibut become available to the survey over roughly ages 6-10), those near the peak yield per recruit, and those that have reached the age at first maturity. A range of fishing mortality rates will produce similar yields when these conditions are met.

Any reductions in the amount of halibut PSC mortality should increase the amount available to the commercial IFQ fishery in the future. Council discussions of reducing the halibut PSC limits have resulted, and will likely continue to result, in members of industry working to develop methods to reduce halibut PSC mortality. Those efforts are ongoing under the status quo. The extent to which these efforts reduce the amount of PSC mortality depends on several factors. Those factors include changes in groundfish TACs, cost of implementing the measures to reduce PSC mortality, and external pressures applied to industry to reduce their halibut PSC mortality. As Alternative 2 options result in PSC limits that are more constraining, the groundfish fisheries wil try to optimize their groundfish harvest with a minimum of halibut PSC mortality, in order to avoid fishery closures. Note that the pollock fishery is not constrained by the current cap, nor are there options in the analysis to introduce such constaints. As a result, reduced PSC limits would not affect them directly. For other groundfish fisheries, this may result in some change to fishing patterns, for example, to the timing of fisheries, to avoid halibut. This may also cause the fleet to move into areas of lower catch per unit effort for target groundfish species, if by doing so, they are likely to increase the probability of avoiding halibut. Specific changes cannot be predicted, and will likely be annually variable, depending on the distribution of halibut encounters. Any changes to fishing under Alternative 2 would be to minimize the likelihood of halibut encounters in the groundfish fishery.

The economic impacts of reducing the halibut PSC limits are discussed in detail in Section 5. That analysis assumes that the benefits from decreasing the groundfish halibut PSC limits will accrue to the commercial halibut IFQ industry. Other users, such as halibut subsistence and unguided sport fisheries, will not be impacted because their halibut is accounted for before PSC mortality reductions are taken from the available halibut.

This analysis assumes that the relationship between reducing PSC limits and increased yield to the directed halibut fishery is a 1:1 relationship for both O26 and U26 fish, with O26 yield accruing exclusively to the Area 4 directed halibut fisheries, and U26 yield accruing coastwide (and out into the future), with the yield specifically to Area 4 being approximately 22 percent of that total (based on the Area 4 proportion of the coastwide biomass).

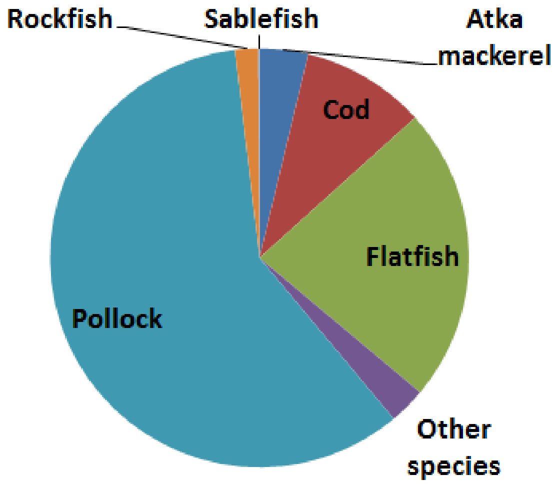
For the most part, the options in Alternative 2 which would result in a change from status quo, in terms of halibut PSC mortality, are unlikely to have a different effect on halibut, as catch will largely be reallocated from halibut PSC mortality to directed fishery catch, although there may be some conservation benefit to the stock with respect to reducing the mortality of U26 halibut. Alternative 2 is not anticipated to have a significant effect on the Pacific halibut biomass.

3.2 Groundfish FMP species

The Council recommends annual catch limits and allocations for the commercial groundfish fisheries in the BSAI. Target species managed in the BSAI FMP include: walleye pollock, Pacific cod, sablefish, various flatfishes (yellowfin sole, Greenland turbot, arrowtooth and Kamchatka flounders, northern rock sole, flathead sole, Alaska plaice, and others), various rockfish species (Pacific ocean perch, northern rockfish, rougheye and blackspotted rockfish, shortraker rockfish, and others), Atka mackerel, skates, sculpins, sharks, squids, and octopuses. Commercial groundfish catch levels (total allowable catch, or TACs) in the BSAI are set at 2 million mt each year, which is generally well below the sum of acceptable biological catches (ABCs) for the groundfish species. In 2015, the sum of ABCs was equal to 2.85 million mt. Figure 3-20 shows the distribution of the sum of ABCs among groundfish species. Total allowable catches (TACs) quotas are set well below the ABC levels due to optimum yield constraints.

The BSAI FMP also includes species in the ecosystem component, which are caught incidentally in the prosecution of the groundfish fisheries, but which are not targeted. These include forage fish that are a critical food source for many marine mammal, seabird, and fish species. Directed fishing for these species is prohibited in regulation, as well as limitations on allowable bycatch retention amounts, limitations on the sale, barter, trade, or any other commercial exchange, and processing of forage fish in a commercial processing facility. The ecosystem component also includes prohibited species, such as halibut, but also Pacific salmon species, crab, and herring. As describe in Section 3.1.3, catch of these species must be avoided while fishing for groundfish, and they must be returned to the sea with a minimum of injury except when their retention is required or authorized by other applicable law. There are PSC limits in place for herring and crab in the trawl fisheries, and for salmon in the pollock fishery. While these species are not assessed on an annual basis in the SAFE report, the impact of the groundfish fisheries on these species is considered in the Groundfish PSEIS (NMFS 2004) and in the annual analysis supporting the harvest specifications, including NMFS’ (2007a) Harvest Specifications EIS. The impact of salmon PSC in the pollock fishery is also under comprehensive review currently, and in initial review draft analysis was presented to the Council in December 2014 (NPFMC 2014).

Figure 3-20 BSAI groundfish species' proportion of total acceptable biological harvest (ABC), in 2015



Source: NPFMC 2014.

In the past, halibut PSC limits have been constraining on many BSAI groundfish fisheries. Directed fishing for many species has frequently been restricted before TACs were reached, in order to comply with PSC limits, even while TACs, especially for flatfish, were often set lower than they would otherwise have been. In 2008, the implementation of Amendment 80 established the opportunity for cooperative formation for the non-AFA head and gut catcher processor sector and gave them sector allocations for yellowfin sole, flathead sole, rock sole, Atka mackerel, Pacific ocean perch, and Pacific cod. In the same year, Amendment 85 created sector allocations for Pacific cod, allowing for a voluntary hook and line catcher processor cooperative to form in the Bering Sea in 2009. With these changes, many more vessels now have the flexible tools that allow them to maximize their groundfish catch while continuing to stay within the constraints of the halibut PSC limits that apply to their sectors.

For the purpose of setting halibut PSC limits, the BSAI Groundfish FMP sets separate PSC limits for trawl fisheries, hook-and-line fisheries, and CDQ fisheries. The hook and line PSC limit is apportioned in regulation to Pacific cod hook and line catcher processors (CPs) and catcher vessels (CVs), and to all other non-trawl fixed gear targets (noting that pot and jig gear, and the hook and line sablefish target fishery, are all exempt from PSC limits). The trawl PSC limits are apportioned between Amendment 80 and the Bering Sea trawl limited access sector, the latter allocated among the yellowfin sole fishery, the Pacific cod fishery, the rockfish fishery, and the pollock/Atka mackerel/ "other species" category. All the PSC limits are constraining on the sector or target fishery, meaning that the fishery closes when the limit is reached, with the exception of the pollock/Atka mackerel/"other species"[10] PSC limit, which only closes directed fishing for non-pelagic pollock, but not for midwater pollock.

The annual BSAI Groundfish SAFE Report (NPFMC 2014), which is considered by the Council during its annual December meeting for its determination of the biennial final harvest specifications, provides a detailed discussion of the status of individual groundfish stocks, and is incorporated by reference.

Effects of the Alternatives

The effects of the BSAI groundfish fisheries on target groundfish stocks are assessed annually in the BSAI SAFE report (NPFMC 2014). The effects of the fisheries on all groundfish FMP species were evaluated in the Alaska Groundfish Fisheries Harvest Specifications EIS (NMFS 2007a). Table 3-24 and

[10] includes sharks, skates, squids, sculpins, and octopuses

Table 3-25 describe the criteria used to determine whether the impacts on target fish stocks, ecosystem component stocks, and prohibited species are likely to be significant.

Table 3-24 Criteria used to determine significance of effects on target groundfish stocks.

Effect	Criteria			
	Significantly Negative	**Insignificant**	**Significantly Positive**	**Unknown**
Stock Biomass: potential for increasing and reducing stock size	Changes in fishing mortality are expected to jeopardize the ability of the stock to sustain itself at or above its MSST (minimum standing stock threshold)	Changes in fishing mortality are expected to maintain the stock's ability to sustain itself above MSST	Changes in fishing mortality are expected to enhance the stock's ability to sustain itself at or above its MSST	Magnitude and/or direction of effects are unknown
Fishing mortality	Reasonably expected to jeopardize the capacity of the stock to yield sustainable biomass on a continuing basis.	Reasonably expected not to jeopardize the capacity of the stock to yield sustainable biomass on a continuing basis.	Action allows the stock to return to its unfished biomass.	Magnitude and/or direction of effects are unknown
Spatial or temporal distribution	Reasonably expected to adversely affect the distribution of harvested stocks either spatially or temporally such that it jeopardizes the ability of the stock to sustain itself.	Unlikely to affect the distribution of harvested stocks either spatially or temporally such that it has an effect on the ability of the stock to sustain itself.	Reasonably expected to positively affect the harvested stocks through spatial or temporal increases in abundance such that it enhances the ability of the stock to sustain itself.	Magnitude and/or direction of effects are unknown
Change in prey availability	Evidence that the action may lead to changed prey availability such that it jeopardizes the ability of the stock to sustain itself.	Evidence that the action will not lead to a change in prey availability such that it jeopardizes the ability of the stock to sustain itself.	Evidence that the action may result in a change in prey availability such that it enhances the ability of the stock to sustain itself.	Magnitude and/or direction of effects are unknown

Table 3-25 Criteria used to estimate the significance of impacts on incidental catch of ecosystem component (including prohibited) species.

No impact	No incidental take of the ecosystem component species in question.
Adverse impact	There are incidental takes of the ecosystem component species in question
Beneficial impact	Natural at-sea mortality of the ecosystem component species in question would be reduced – perhaps by the harvest of a predator or by the harvest of a species that competes for prey.
Significantly adverse impact	An action that diminishes protections afforded to ecosystem component species in the groundfish fisheries would be a significantly adverse impact.
Significantly beneficial impact	No benchmarks are available for significantly beneficial impact of the groundfish fishery on the ecosystem component species, and significantly beneficial impacts are not defined for these species.
Unknown impact	Not applicable

Under Alternative 1, the status quo, the BSAI groundfish stocks are neither overfished nor subject to overfishing. Biomass levels are projected to increase into 2015. Levels of fishing on ecosystem component species (forage fish and prohibited species) are constrained by bycatch and PSC limits. The BSAI groundfish fishery under the status quo is considered to be sustainable for groundfish and ecosystem component stocks.

Alternative 2 would establish halibut PSC limit reductions in the GOA groundfish fisheries. Different options mean different limit reductions for each of the sectors that are subject to a PSC limit. Under some options, the PSC limit would allow for groundfish fishing at current levels, and impacts would likely be similar to the status quo fishery. Under more constraining options, reduced PSC limits may result in the groundfish fisheries closing before the TAC is reached. Members of industry will typically try to allocate their halibut PSC mortality to fish species with the greatest economic value. It is assumed that in the Amendment 80 sector, the fleet will continue to maximize their catch of Atka mackerel and rockfish, and then will harvest Pacific cod, rock sole, and yellowfin sole to the extent possible. Constraints resulting from halibut PSC limit reductions are most likely to result in reductions in catch in the less valuable flatfish targets such as arrowtooth flounder and Alaska plaice. For the Bering Sea trawl limited access fishery, the pollock fishery may have less flexibility to respond to halibut PSC limit changes, as they are already constrained by PSC limits for salmon. However the halibut PSC limit does not close the pollock fishery if it is reached, so reductions in the limit are unlikely to result in any reduction in pollock harvest. For other target fisheries in the Bering Sea trawl limited access sector, to the extent that the limits under the options are constraining, there is likely to be a higher reduction in the yellowfin sole fishery than in Pacific cod. Even under the most severe PSC limit reductions for longline catcher processors and CDQ fisheries, the analysis assumes that these sectors will still be able to achieve over 95 percent of their groundfish harvests.

If the groundfish TAC is not fully harvested, then fishing will have less impact on the stock, and there will be no significantly adverse impact on the groundfish stocks from the fishery. The potential biological effects of the alternatives are expected to be correctly incorporated in the present stock assessment and harvest specifications system, since conservation goals for maintaining spawning biomass would remain central to the assessment.

A response to constraining halibut PSC limits could be for vessels to change fisheries patterns or seasonal changes in the timing of the fishing, to increase halibut avoidance. This may result in a lower catch per unit effort, assuming that under a non-constraining limit, fisheries would be fishing in areas with the highest catch per unit effort. For groundfish stocks, any changes would be monitored and updated in future stock assessment for target fisheries, and there is no anticipated adverse impact to the groundfish stocks that would result from groundfish fisheries with lower catch per unit effort. Ecosystem component species are also managed under bycatch and PSC limits, and thus the risks to the stocks are considered minor. Thus any changes in fishing patterns or the timing of fishing pressure would not be expected to affect the sustainability of the stocks. Alternative 2 is considered insignificant for target groundfish stocks, and to have an adverse effect, but not significantly so, for ecosystem component species.

3.3 Marine Mammals

Alaska supports one of the richest assemblages of marine mammals in the world. Twenty-two species are present from the orders Pinnipedia (seals and sea lions), Carnivora (sea otters), and Cetacea (whales, dolphins, and porpoises). Some marine mammal species are resident throughout the year, while others migrate into or out of Alaska fisheries management areas. Marine mammals occur in diverse habitats, including deep oceanic waters, the continental slope, and the continental shelf (Lowry et al. 1982).

A number of concerns may be related to marine mammals and potential impacts of fishing. For individual species, these concerns include—

- listing as endangered or threatened under the Endangered Species Act (ESA);
- protection under the Marine Mammal Protection Act (MMPA);
- announcement as candidate or being considered as candidates for ESA listings;
- declining populations in a manner of concern to State or Federal agencies;
- experiencing large PSC or other mortality related to fishing activities; or
- being vulnerable to direct or indirect adverse effects from some fishing activities.

Marine mammals have been given various levels of protection under the current fishery management plans of the Council, and are the subjects of continuing research and monitoring to further define the nature and extent of fishery impacts on these species. The Alaska groundfish harvest specifications environmental impact statement (NMFS 2007) provides information regarding fisheries interactions with marine mammals. The most recent status information is available in the Marine Mammal Stock Assessment Reports (SARs) (Allen and Angliss 2014).

Marine mammals, including those currently listed as endangered or threatened under the ESA, that may be present in the action area are listed in Table 3-26. All of these species are managed by NMFS, with the exception of Pacific walrus, polar bears, and Northern sea otters, which are managed by USFWS. ESA Section 7 consultations with respect to the actions of the Federal groundfish fisheries have been completed for all of the ESA-listed species, either individually or in groups. Of the species listed under the ESA and present in the action area, several species may be adversely affected by commercial groundfish fishing. These include Steller sea lions, humpback whales, fin whales, and sperm whales (NMFS 2006; NMFS 2010).

Table 3-26 Marine mammals likely to occur in the Bering Sea and Aleutian Islands subareas.

Common Name	Scientific Name	ESA Status
Northern Right Whale	*Balaena glacialis*	Endangered
Bowhead Whale	*Balaena mysticetus*	Endangered
Sei Whale	*Balaenoptera borealis*	Endangered
Blue Whale	*Balaenoptera musculus*	Endangered
Fin Whale	*Balaenoptera physalus*	Endangered
Humpback Whale	*Megaptera novaeangliae*	Endangered
Sperm Whale	*Physeter macrocephalus*	Endangered
Steller Sea Lion[1]	*Eumetopias jubatus*	Endangered
Beluga Whale	*Delphinapterus leucas*	None
Minke Whale	*Balaenoptera acutorostrata*	None
Killer Whale	*Orcinus orca*	None
Dall's Porpoise	*Phocoenoides dalli*	None
Harbor Porpoise	*Phocoena phocoena*	None
Pacific White-sided Dolphin	*Lagenorhynchus obliquidens*	None
Beaked Whales	*Berardius bairdii and Mesoplodon spp.*	None
Northern Fur Seal	*Callorhinus ursinus*	None
Pacific Harbor Seal	*Phoca vitulina*	None
Pacific Walrus[2]	*Odobenus rosmarus divergens*	Precluded
Northern Sea Otter[2]	*Enhydra lutis*	Threatened
Bearded Seal	*Erignathus barbatus*	Proposed Listing
Spotted Seal	*Phoca largha*	Threatened
Ringed Seal	*Phoca hispida*	Proposed Listing
Ribbon Seal	*Phoca fasciata*	None
Polar Bear[2]	*Ursus maritimus*	Threatened

[1] Steller sea lions are listed as endangered west of Cape Suckling, 144° W longitude.
[2] Pacific walrus, Northern sea otters, and polar bears are under the jurisdiction of the USFWS. A walrus ESA is warranted but precluded (76 FR 7634, February 10, 2011), and scheduled for 2017.

The PSEIS (NMFS 2004) provides descriptions of the range, habitat, diet, abundance, and population status for marine mammals. Marine mammal stock assessment reports (SARs) are prepared annually for the strategic marine mammal stocks (Steller sea lions, northern fur seals, harbor porpoise, North Pacific right whales, humpback whales, sperm whales, and fin whales)[11]. The SARs provide population estimates, population trends, and estimates of the potential biological removal (PBR) levels for each

[11]The SARs are available on the NMFS Protected Resources Division website at http://www.nmfs.noaa.gov/pr/sars/region.htm.

stock. The SARs also identify potential causes of mortality and whether the stock is considered a strategic stock under the MMPA. The information from the PSEIS and the SARs is incorporated by reference.

The Alaska Groundfish Harvest Specifications EIS provides information on the effects of the groundfish fisheries on marine mammals (NMFS 2007), and has been updated with Supplemental Information Reports (SIRs) [NMFS 2014a]. These documents are also incorporated by reference. Direct and indirect interactions between marine mammals and groundfish fishing vessels may occur due to overlap in the size and species of groundfish harvested in the fisheries that are also important marine mammal prey, and due to temporal and spatial overlap in marine mammal occurrence and commercial fishing activities. This discussion focuses on those marine mammals that may interact with or be affected by the BSAI groundfish fisheries (Table 3-27 and Table 3-28).

Table 3-27 Status of Pinnipedia and Carnivora stocks potentially affected by the action.

Pinnipedia and Carnivora species and stock	Status under the ESA	Status under the MMPA	Population trends	Distribution in action area
Steller sea lion – Western (W) and Eastern (E) Distinct Population Segment (DPS)	Endangered (W)	Depleted & a strategic stock	For the WDPS, regional increases in counts in trend sites of some areas have been offset by decreased counts in other areas so that the overall population of the WDPS appears to have stabilized (NMFS 2010a). The EDPS is steadily increasing and is delisted.	WDPS inhabits Alaska waters from Prince William Sound westward to the end of the Aleutian Island chain and into Russian waters. EDPS inhabit waters east of Prince William Sound to Dixon Entrance. Occur throughout AK waters, terrestrial haulouts and rookeries on Pribilof Islands, Aleutian Islands, St. Lawrence Island, and off the mainland. Use marine areas for foraging. Critical habitat designated around major rookeries, haulouts, and foraging areas.
Northern fur seal Eastern Pacific	None	Depleted & a strategic stock	Recent pup counts show a continuing decline in the number of pups surviving in the Pribilof Islands. NMFS researchers found an approximately 9% decrease in the number of pups born between 2004 and 2006. The pup estimate decreased most sharply on St. Paul Island.	Fur seals occur throughout Alaska waters, but their main rookeries are located in the Bering Sea on Bogoslof Island and the Pribilof Islands. Approximately 55% of the worldwide abundance of fur seals is found on the Pribilof Islands (NMFS 2007b). Forages in the pelagic area of the Bering Sea during summer breeding season, but most leave the Bering Sea in the fall to spend winter and spring in the N. Pacific.
Harbor seal – Gulf of Alaska	None	None	A moderate to large population decline has occurred in the GOA stock.	GOA stock found primarily in the coastal waters and may cross over into the Bering Sea coastal waters between islands.
Ribbon seal Alaska	None*	None	Reliable data on population trends are unavailable.	Widely dispersed throughout the Bering Sea and Aleutian Islands in the summer and fall. Associated with ice in spring and winter and may be associated with ice in summer and fall. Occasional movement into the GOA (Boveng et al. 2008)
Northern sea otters – SW Alaska	Threatened**	Depleted & a strategic stock	The overall population trend for the southwest Alaska stock is believed to be declining, particularly in the Aleutian Islands.	Coastal waters from Central GOA to W Aleutians within the 40 m depth contour. Critical habitat designated in primarily nearshore waters with few locations into federal waters in the GOA.

Sources: Allen and Angliss 2014; List of Fisheries for 2014 (79 FR 49053, August 19, 2014). Northern fur seal pup data available from http://www.alaskafisheries.noaa.gov/newsreleases/2007/fursealpups020207.htm.
*NMFS determined that ribbon seals were not to be listed on September 23, 2008. The Center for Biological Diversity and Greenpeace filed suit against NMFS regarding this decision on September 3, 2009.
**Northern sea otter information from http://www.nmfs.noaa.gov/pr/pdfs/sars/seaotter2008_ak_sw.pdf and 74 FR 51988, October 8, 2009.

Table 3-28 Status of Cetacea stocks potentially affected by the action.

Cetacea species/stock	Status under the ESA	Status under the MMPA	Population trends	Distribution in action area
Killer whale – AT1 Transient, E N Pacific transient, W Coast transient, AK resident, Southern resident	Southern resident endangered; remaining stocks none	AT1 depleted and a strategic stock, Southern Resident depleted. The rest of the stocks: None	Southern residents have declined by more than half since 1960s and 1970s. Unknown abundance for the Alaska resident; and Eastern North Pacific GOA, Aleutian Islands, and Bering Sea transient stocks. The minimum abundance estimate for the Eastern North Pacific Alaska Resident stock is likely underestimated because researchers continue to encounter new whales in the Alaskan waters.	Southern resident do not occur in GOA. Transient-type killer whales from the GOA, Aleutian Islands, and Bering Sea are considered to be part of a single population.
Dall's porpoise Alaska	None	None	Reliable data on population trends are unavailable.	Found in the offshore waters from coastal Western Alaska throughout the GOA.
Pacific white-sided dolphin	None	None	Reliable data on population trends are unavailable.	Found throughout the GOA.
Harbor porpoise GOA	None	Strategic	Reliable data on population trends are unavailable.	Primarily in coastal waters in the GOA, usually less than 100 m.
Humpback whale – Western and Central North Pacific	Endangered and under status review	Depleted & a strategic stock	Increasing. The Structure of Populations, Levels of Abundance, and Status of Humpbacks (SPLASH) abundance estimate for the North Pacific represents an annual increase of 4.9% since 1991–1993. SPLASH abundance estimates for Hawaii show annual increases of 5.5% to 6.0% since 1991–1993 (Calambokidis et al. 2008).	W. Pacific and C. North Pacific stocks occur in GOA waters and may mingle in the North Pacific feeding area.
North Pacific right whale Eastern North Pacific	Endangered	Depleted & a strategic stock	This stock is considered to represent only a small fraction of its precommercial whaling abundance and is arguably the most endangered stock of large whales in the world. A reliable estimate of trend in abundance is currently not available.	Before commercial whaling on right whales, concentrations were found in the GOA, eastern Aleutian Islands, southcentral Bering Sea, Sea of Okhotsk, and Sea of Japan (Braham and Rice 1984). During 1965–1999, following large illegal catches by the U.S.S.R., there were only 82 sightings of right whales in the entire eastern North Pacific, with the majority of these occurring in the Bering Sea and adjacent areas of the Aleutian Islands (Brownell et al. 2001). Critical habitat near Kodiak Island in the GOA
Fin whale Northeast Pacific	Endangered	Depleted & a strategic stock	Abundance may be increasing but surveys only provide abundance information for portions of the stock in the Central-eastern and southeastern Bering and coastal waters of the Aleutian Islands and the Alaska Peninsula. Much of the North Pacific range has not been surveyed.	Found in the GOA, Bering Sea and coastal waters of the Aleutian Islands.
Beluga whale-Cook Inlet	Endangered	Depleted & a strategic stock	2008 abundance estimate of 375 whales is unchanged from 2007. Trend from 1999 to 2008 is not significantly different from zero.	Occurrence only in Cook Inlet.
Minke whale Alaska	None	None	There are no data on trends in Minke whale abundance in Alaska waters.	Common in the Bering and Chukchi Seas and in the inshore waters of the GOA. Not common in the Aleutian Islands.
Sperm whale North Pacific	Endangered	Depleted & a strategic stock	Abundance and population trends in Alaska waters are unknown.	Inhabit waters 600 m or more depth, south of 62°N lat. Widely distributed in North Pacific. Found year-round In GOA.
Baird's, Cuvier's, and Stejneger's beaked whale	None	None	Reliable data on population trends are unavailable.	Occur throughout the GOA.

Sources: Allen and Angliss 2014; List of Fisheries for 2014 (79 FR 49053, August 19, 2014); http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spermwhale.htm. North Pacific right whale included based on NMFS (2006a) and Salveson (2008). AT1 Killer Whales information based on 69 FR 31321, June 3, 2004. North Pacific Right Whale critical habitat information: 73 FR 19000, April 8, 2008. For beluga whales: 73 FR 62919, October 27, 2008.

Effects on Marine Mammals

Table 3-29 contains the significance criteria for analyzing the effects of the proposed action on marine mammals. Significantly beneficial impacts are not possible with the management of groundfish fisheries as no beneficial impacts to marine mammals are likely with groundfish harvest. Generally, changes to the fisheries do not benefit marine mammals in relation to incidental take, prey availability, and disturbances; changes increase or decrease potential adverse impacts. The only exception to this may be in instances when marine mammals target prey from fishing gear, as seen with killer whales and sperm whales removing fish from hook and line gear. In this example, the prey availability is enhanced for these animals because they need less energy for foraging.

Table 3-29 Criteria for determining significance of impacts to marine mammals.

	Incidental take and entanglement in marine debris	Prey availability	Disturbance
Adverse impact	Mammals are taken incidentally to fishing operations or become entangled in marine debris.	Fisheries reduce the availability of marine mammal prey.	Fishing operations disturb marine mammals.
Beneficial impact	There is no beneficial impact.	Generally, there are no beneficial impacts.	There is no beneficial impact.
Significantly adverse impact	Incidental take is more than PBR or is considered major in relation to estimated population when PBR is undefined.	Competition for key prey species likely to constrain foraging success of marine mammal species causing population decline.	Disturbance of mammal is such that population is likely to decrease.
Significantly beneficial impact	Not applicable	Not applicable	Not applicable
Unknown impact	Insufficient information available on take rates.	Insufficient information as to what constitutes a key area or important time of year.	Insufficient information as to what constitutes disturbance.

Incidental Take Effects

Marine mammals can be taken in groundfish fisheries by entanglement in gear (e.g., trawl, longline, and pot) and, rarely, by ship strikes for some cetaceans. The effects of the status quo fisheries on incidental takes of marine mammals are detailed in the 2007 harvest specifications EIS (NMFS 2007a) and Allen and Angliss (2014). The Harvest Specifications EIS contains a detailed description of the incidental take effects of the groundfish fisheries on marine mammals (NMFS 2007a) and is incorporated by reference. The annual Stock Assessment Report lists the species of marine mammals taken in the BSAI groundfish fisheries using observer data (Allen and Angliss 2014). In addition, the List of Fisheries for 2014[12] (79 FR 14418), describes known incidental takes of marine mammals in the groundfish fisheries. BSAI flatfish, pollock, and rockfish trawl fisheries are listed as category II, with occasional interactions with some marine mammals. The BSAI Pacific cod longline fishery is listed as category II, with a remote likelihood of interaction with Dall's porpoise and northern fur seal. Based on the annual stock assessment reports, the potential take of marine mammals in the BSAI groundfish fisheries is well below the PBRs or a very small portion of the overall human caused mortality for those species for which a PBR has not been determined (Allen and Angliss 2014). Therefore, the incidental takes under Alternative 1 have an insignificant effect on marine mammals.

Options under Alternative 2 may result in no change to the status quo, or may result in constraining PSC limits under which industry may change fishing patterns in order to maximize species with the greatest economic value. This could result in a response of reducing fishing effort, as the industry chooses not to

[12] http://www.nmfs.noaa.gov/pr/interactions/lof/final2014.htm

pursue less valuable fisheries in order to conserve halibut PSC mortality, or it could result in greater fishing effort at lower catch per unit effort, as vessels change fisheries patterns or seasonal changes in the timing of the fishing, to increase halibut avoidance. As a result, it is unclear exactly how the potential for incidental take of marine mammals will compare to the status quo under Alternative 2. Depending how constraining the halibut PSC limit is, however, the fisheries are unlikely to increase their take of marine mammals above the PBR, because they are currently well below that level in BSAI groundfish fisheries. Therefore, the incidental takes under Alternative 2 would have an insignificant effect on marine mammals.

Prey Availability Effects

Harvests of marine mammal prey species in the BSAI groundfish fisheries may limit foraging success through localized depletion, overall reduction in prey biomass, and dispersion of prey, making it more energetically costly for foraging marine mammals to obtain necessary prey. Overall reduction in prey biomass may be caused by removal of prey or disturbance of prey habitat. The timing and location of fisheries relative to foraging patterns of marine mammals and the abundance of prey species may be a more relevant management concern than total prey removals.

The Harvest Specifications EIS contains a detailed description of the effects of the groundfish fisheries on prey species for marine mammals (NMFS 2007a), and is incorporated by reference. The interaction of the BSAI groundfish fisheries with Steller sea lions, which potentially compete for prey, is comprehensively addressed in the Revised Steller Sea Lion Protection Measures EIS (NMFS 2014c). The BSAI groundfish fisheries may impact availability of key prey species of Steller sea lions, harbor seals, northern fur seals, ribbon seals; and fin, minke, humpback, beluga, and resident killer whales. Animals with more varied diets (humpback whales) are less likely to be impacted than those that eat primarily pollock and salmon, such as northern fur seals. Table 3-30 shows the BSAI marine mammal species and their prey species that may be impacted by BSAI groundfish fisheries.

Table 3-30 Prey species used by BSAI marine mammals that may be impacted by the BSAI groundfish fisheries.

Species	Prey
Fin whale	Zooplankton, squid, fish (herring, cod, capelin, and pollock), and cephalopods
Humpback whale	Zooplankton, schooling fish (pollock, herring, capelin, saffron, cod, sand lance, Arctic cod, and salmon)
Beluga whale	Wide variety of invertebrates and fish including salmon and pollock
Killer whale	Marine mammals (transients) and fish (residents) including herring, halibut, salmon, and cod.
Ribbon seal	Cod, pollock, capelin, eelpout, sculpin, flatfish, crustaceans, and cephalopods.
Harbor seal	Crustaceans, squid, fish (including salmon), and mollusks
Steller sea lion	Pollock, Atka mackerel, Pacific herring, Capelin, Pacific sand lance, Pacific cod, and salmon

Several marine mammals may be impacted indirectly by any effects that fishing gear may have on benthic habitat. Table 3-31 lists marine mammals that may depend on benthic prey and known depths of diving. Diving activity may be associated with foraging. The essential fish habitat (EFH) EIS provides a description of the effects of groundfish fishing on benthic habitat (NMFS 2005a). In the BSAI, estimated reductions of epifaunal and infaunal prey due to fishing are less than 1 percent for all substrate types. For living structure, overall impacts ranged between 3 percent and 7 percent depending on the substrate. In some local areas where pollock aggregate, effects are greater.

Sperm whales are not likely to be affected by any potential impacts on benthic habitat from fishing because they generally occur in deeper waters than where the groundfish fishery is conducted (Table 3-31). Harbor seals and sea otters are also not likely to have any benthic habitat affected by the groundfish fishery because they occur primarily along the coast where fishing is not conducted. Cook Inlet beluga whales also are not likely to have benthic habitat supporting prey species affected by the groundfish fishery because they do not range outside of Cook Inlet and do not overlap spatially with the trawl fisheries.

Table 3-31 Benthic dependent BSAI marine mammals, foraging locations, and diving depths

Species	Depth of diving and location
Ribbon seal	Mostly dive < 150 m on shelf, deeper off shore. Primarily in shelf and slope areas.
Harbor seal	Up to 183 m. Generally coastal.
Sperm whale	Up to 1,000 m, but generally in waters > 600 m.
Northern sea otter	Rocky nearshore < 75 m
Gray whale	Benthic invertebrates

Sources: Allen and Angliss 2010; Burns et al. 1981; http://www.adfg.state.ak.us/pubs/notebook/marine/rib-seal.php; http://www.afsc.noaa.gov/nmml/species/species_ribbon.php; http://www.adfg.state.ak.us/pubs/notebook/marine/harseal.php; http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spermwhale.htm

The Harvest Specifications EIS determined that competition for key prey species under the status quo fishery is not likely to constrain the foraging success of marine mammals or cause population declines (NMFS 2007a). The Steller sea lion EIS (NMFS 2014c) provided an updated review of BSAI groundfish fishery interactions with respect to prey availability. Based on a review of marine mammal diets, and an evaluation of the status quo harvests of potential prey species in the BSAI groundfish fishery, the effects of Alternative 1 on prey availability for marine mammals are not likely to cause population level effects and are therefore insignificant.

Options under Alternative 2 may result in no change to the status quo, or may result in constraining PSC limits under which industry may change fishing patterns in order to maximize species with the greatest economic value. This could result in a response of reducing fishing effort, as the industry chooses not to pursue less valuable fisheries in order to conserve halibut PSC mortality, or it could result in greater fishing effort at lower catch per unit effort, as vessels change fisheries patterns or seasonal changes in the timing of the fishing, to increase halibut avoidance. Shifts in the location or timing of fishing may change the availability of prey species to marine mammals in particular areas. However, there is already considerable interannual variability in the patterns of fishing across the BSAI groundfish sectors, as environmental conditions and avoidance of PSC species have caused vessels to adjust their fishing patterns. Any shift in fishing is unlikely to occur outside of the existing footprint of the groundfish fishery. Therefore it is unlikely that Alternative 2 would introduce a shift in fishing patterns to such an extent that it would constrain the availability of prey to marine mammals in such a way as to cause a population-level decline. As a result, prey availability under Alternative 2 would have an insignificant effect on marine mammals.

Disturbance Effects

The Harvest Specifications EIS contains a detailed description of the disturbance of marine mammals by the groundfish fisheries (NMFS 2007a). The interaction of the BSAI groundfish fisheries with Steller sea lions, which potentially compete for prey, is comprehensively addressed in the Revised Steller Sea Lion Protection Measures EIS (NMFS 2014c). The EISs concluded that the status quo fishery does not cause disturbance to marine mammals at a level that may cause population level effects. Fishery closures limit the potential interaction between fishing vessels and marine mammals (e.g., 3-nm no groundfish fishing areas around Steller sea lion rookeriesm walrus protection areas). Because disturbances to marine mammals under the status quo fishery are not likely to cause population level effects, the impacts of Alternative 1 are likely insignificant.

The effects of the proposed reductions to halibut PSC limits under Alternative 2 on disturbance of marine mammals would be similar to the effects on incidental takes. If a groundfish fishery reduces fishing effort in specific fisheries to conserve halibut PSC mortality for a more valuable fishery, then less potential exists for disturbance of marine mammals. If a groundfish fishery increases the duration of fishing in areas with lower concentrations of halibut, there may be more potential for disturbance if this increased fishing activity overlaps with areas used by marine mammals. None of the disturbance effects on other marine mammals under Alternative 2 are expected to result in population level effects on marine mammals. Disturbance effects are likely to be localized and limited to a small portion of any particular marine mammal population. Because disturbances to marine mammals under Alternative 2 is not likely to result in population level effects, the impacts of Alternative 2 is likely insignificant.

3.4 Seabirds

Thirty-eight species of seabirds breed in Alaska. Breeding populations are estimated to contain 36 million individual birds in Alaska, and total population size (including subadults and nonbreeders) is estimated to be approximately 30% higher. Five additional species that breed elsewhere but occur in Alaskan waters during the summer months contribute another 30 million birds.

Species nesting in Alaska

Tubenoses-Albatrosses and relatives: Northern Fulmar, Fork-tailed Storm-petrel, Leach's Storm-petrel
Kittiwakes and terns: Black-legged Kittiwake, Red-legged Kittiwake, Arctic Tern, Aleutian Tern
Pelicans and cormorants: Double-crested Cormorant, Brandt's Cormorant, Pelagic Cormorant, Red-faced Cormorant
Jaegers and gulls: Pomarine Jaeger, Parasitic Jaeger, Bonaparte's Gull, Mew Gull, Herring Gull, Glaucous-winged Gull, Glaucous Gull, Sabine's Gull
Auks: Common Murre, Thick-billed Murre, Black Guillemot, Pigeon Guillemot, Marbled Murrelet, Kittlitz's Murrelet, Ancient Murrelet, Cassin's Auklet, Parakeet Auklet, Least Auklet, Wiskered Auklet, Crested Auklet, Rhinoceros Auklet, Tufted Puffin, Horned Puffin

Species that visit Alaska waters

Tubenoses: Short-tailed Albatross, Black-footed Albatross, Laysan Albatross, Sooty Shearwater, Short-tailed Shearwater
Gulls: Ross's Gull, Ivory Gull

As noted in the PSEIS (NMFS 2004), seabird life history includes low reproductive rates, low adult mortality rates, long life span, and delayed sexual maturity. These traits make seabird populations extremely sensitive to changes in adult survival and less sensitive to fluctuations in reproductive effort. The problem with attributing population changes to specific impacts is that, because seabirds are long-lived animals, it may take years or decades before relatively small changes in survival rates result in observable impacts on the breeding population.

More information on seabirds in Alaska's EEZ may be found in several NMFS, Council, and USFWS documents:

- The URL for the USFWS Migratory Bird Management program is at: http://alaska.fws.gov/mbsp/mbm/index.htm
- Section 3.7 of the PSEIS (NMFS 2004) provides background on seabirds in the action area and their interactions with the fisheries. This may be accessed at http://www.alaskafisheries.noaa.gov/sustainablefisheries/seis/final062004/Chaps/chpt_3/chpt_3_7.pdf
- The annual Ecosystems Considerations chapter of the SAFE reports has a chapter on seabirds. Back issues of the Ecosystem SAFE reports may be accessed at http://www.afsc.noaa.gov/REFM/REEM/Assess/Default.htm.

- The Seabird Fishery Interaction Research webpage of the Alaska Fisheries Science Center: http://www.afsc.noaa.gov/refm/reem/Seabirds/Default.htm
- The NMFS Alaska Region's Seabird Incidental Take Reduction webpage: http://www.alaskafisheries.noaa.gov/protectedresources/seabirds.html
- The BSAI and GOA groundfish FMPs each contain an "Appendix I" dealing with marine mammal and seabird populations that interact with the fisheries. The FMPs may be accessed from the Council's home page at http://www.alaskafisheries.noaa.gov/npfmc/default.htm
- Washington Sea Grant has several publications on seabird takes, and technologies and practices for reducing them: http://www.wsg.washington.edu/publications/online/index.html
- The seabird component of the environment affected by the groundfish FMPs is described in detail in Section 3.7 of the PSEIS (NMFS 2004).
- Seabirds and fishery impacts are also described in Chapter 9 of the Alaska Groundfish Harvest Specifications EIS (NMFS 2007).

Effects on Seabirds

The PSEIS identifies how the BSAI groundfish fisheries activities may directly or indirectly affect seabird populations (NMFS 2004a). Direct effects may include incidental take in fishing gear and vessel strikes. Indirect effects may include reductions in prey (forage fish) abundance and availability, disturbance to benthic habitat, discharge of processing waste and offal, contamination by oil spills, presence of nest predators in islands, and disposal of plastics, which may be ingested by seabirds.

Table 3-32 explains the criteria used in this analysis to evaluate the significance of the effects of fisheries on seabird populations.

Table 3-32 Criteria used to determine significance of impacts on seabirds.

	Incidental take	**Prey availability**	**Benthic habitat**
Insignificant	No substantive change in takes of seabirds during the operation of fishing gear.	No substantive change in forage available to seabird populations.	No substantive change in gear impact on benthic habitat used by seabirds for foraging.
Adverse impact	Non-zero take of seabirds by fishing gear.	Reduction in forage fish populations, or the availability of forage fish, to seabird populations.	Gear contact with benthic habitat used by benthic feeding seabirds reduces amount or availability of prey.
Beneficial impact	No beneficial impact can be identified.	Availability of offal from fishing operations or plants may provide additional, readily accessible, sources of food.	No beneficial impact can be identified.
Significantly adverse impact	Trawl and hook and line take levels increase substantially from the baseline level, or level of take is likely to have population level impact on species.	Food availability decreased substantially from baseline such that seabird population level survival or reproduction success is likely to decrease.	Impact to benthic habitat decreases seabird prey base substantially from baseline such that seabird population level survival or reproductive success is likely to decrease. (ESA-listed eider impacts may be evaluated at the population level).
Significantly beneficial impact	No threshold can be identified.	Food availability increased substantially from baseline such that seabird population level survival or reproduction success is likely to increase.	No threshold can be identified.
Unknown impacts	Insufficient information available on take rates or population levels.	Insufficient information available on abundance of key prey species or the scope of fishery impacts on prey.	Insufficient information available on the scope or mechanism of benthic habitat impacts on food web.

The impacts of the Alaska groundfish fisheries on seabirds were analyzed in the Harvest Specifications EIS (NMFS 2007a). That document evaluates the impacts of the alternative harvest strategies on seabird takes, prey availability, and seabird ability to exploit benthic habitat. The focus of this analysis is similar, as any changes to the groundfish fisheries in the BSAI could change the potential for direct take of seabirds. Potential changes in prey availability (seabird prey species caught in the fisheries) and disruption of bottom habitat via the intermittent contact with non-pelagic trawl gear under different levels of harvest are discussed in NMFS (2007a). These changes would be closely associated with changes in take levels. Therefore, all impacts are addressed by focusing on potential changes in seabird takes.

Incidental Take of Seabirds in Trawl Fisheries

Seabirds can interact with trawl fishing vessels in several ways. Birds foraging at the water surface or in the water column are sometimes caught in the trawl net as it is brought back on board. These incidental takes of seabirds are recorded by fisheries observers as discussed below. In addition to getting caught in the fishing nets of trawl vessels, some species strike cables attached to the infrastructure of vessels or collide with the infrastructure itself. Large winged birds such as albatrosses are most susceptible to mortalities from trawl-cable strikes. Third wire cables have been prohibited in some southern hemisphere fisheries since the early 1990s due to substantial albatross mortality from cable strikes. No short-tailed albatross or black-footed albatross have been observed taken with trawl gear in Alaska fisheries, but mortalities to Laysan albatrosses have been observed.

Average annual estimate of incidental take of birds in trawling operations in the BSAI was 706 birds per year from 2007 through 2013 (NMFS 2014e). Northern fulmars comprised the majority of this take, with shearwaters and gulls also taken in almost every year. An estimate of 9 Laysan albatross is attributed to the BSAI trawl fisheries in 2009. A small number of storm petrels were taken in 2007 and 2008; there were a number of murres taken in 2010 and 2011, and a couple in 2007 and 2013. Three auklets were estimated to be taken in 2008, and 4 in 2013. The estimated takes of gulls, fulmars, and shearwaters in the entire groundfish fishery are very small percentages of these species' populations (NMFS 2014e).

Seabird takes in the BSAI trawl fisheries are relatively low, based on standard observer sampling and NMFS estimation. However, standard species composition sampling of the catch does not account for additional mortality due to gear interactions such as net entanglements or cable strikes. Special data collections of seabird gear interactions have been conducted, and preliminary information indicates that mortalities can be greater than the birds accounted for in the standard species composition sampling (Melvin et al. 2011). To date, striking of trawl vessels or gear by the short-tailed albatross has not been reported by observers. The probability of short-tailed albatross collisions with third wires or other trawl vessel gear in Alaskan waters cannot be assessed; however, given the available observer data and the observed at-sea locations of short-tailed albatrosses relative to trawling effort, the likelihood of short-tailed albatross collisions are very rare, but the possibility of such collisions cannot be completely discounted. USFWS' Biological Opinion included an Incidental Take Statement of two short-tailed albatross for the trawl groundfish fisheries off Alaska (USFWS 2003b).

Incidental Take of Seabirds in Longline Fisheries

Seabirds can be killed (taken) when they are attracted to baited hooks as they are being set, and become entangled in the gear, or caught on the hooks. Hook and line gear accounts for the majority of seabird take in the North Pacific groundfish fisheries. Annual BSAI hook and line bycatch of seabirds has been substantially reduced over that time, however, to the current numbers of about 5,300 birds annually (average for 2008 to 2013). This reduction has largely been due to the use of seabird avoidance techniques such as paired streamer lines. The species composition for seabird bycatch in the combined BSAI hook-and-line fisheries is primarily northern fulmars, shearwaters, and gulls, with a small proportion of seabirds unidentified (NMFS 2014e). There are also annual albatross takes and small numbers of kittiwake and murre takes.

As described in NMFS (2014e), although albatross take increased in 2013 to 438 birds, an increase of 25 percent compared to the previous 5 year average of 350, this increase was attributable to the halibut and sablefish fisheries, while the Pacific cod freezer longline fishery experienced reduced albatross bycatch numbers. Two short-tailed albatross were observed taken in the BSAI longline Pacific cod fishery in August and September of 2010, leading to an estimated take of 15 birds. Another single take was reported in October, 2011, leading to an estimate of 5 short-tailed albatross. Again in 2014, two short-tailed albatross were observed taken. The Biological Opinion for the Short-tailed albatross (USFWS 2003) allows for an expected incidental take of 4 birds in each two-year period for the demersal longline fishery. Note that this take is based on numbers of birds observed rather than the estimate of total take derived from the observed take. The takes recorded in 2010 were the first ones observed since 1998.

Impacts under the alternatives

The effects of the status quo fisheries on incidental take of seabirds are described in the Harvest Specifications EIS (NMFS 2007a). Estimated takes in the BSAI trawl groundfish fisheries average 706 birds per year, and in the longline fishery, 5,300 birds per year; in both, they primarily consist of northern fulmars (NMFS 2014e). These take estimates are small in comparison to seabird population estimates, and under the status quo alternative, it is reasonable to conclude that the impacts would continue to be similar. However, observers are not able to monitor all seabird mortality associated with trawl vessels. Several research projects are currently underway to provide more information on these interactions.

Various spatial restrictions on the trawl fisheries in the BSAI have been established as part of the groundfish management program, and these closures decrease the potential for interactions with seabirds in these areas. These restrictions are not anticipated to change, so this protection would continue to be provided under any of the alternatives in this analysis.

Options under Alternative 2 may result in no change to the status quo, or may result in constraining PSC limits under which industry may change fishing patterns in order to maximize species with the greatest economic value. This could result in a response of reducing fishing effort, as the industry chooses not to pursue less valuable fisheries in order to conserve halibut PSC mortality, or it could result in greater fishing effort at lower catch per unit effort, as vessels change fisheries patterns or seasonal changes in the timing of the fishing, to increase halibut avoidance. If a groundfish fishery reduces fishing effort in specific fisheries to conserve halibut PSC mortality for a more valuable fishery, then less potential exists for incidental take of seabirds. If a groundfish fishery increases the duration of fishing in areas with lower concentrations of halibut, there may be more potential for incidental take, compared to the status quo, if this increased fishing activity overlaps with areas used by seabirds. Shifts in the location or timing of fishing may occur as a result of Alternative 2. However, there is already considerable interannual variability in the patterns of fishing across the BSAI groundfish sectors, as environmental conditions and avoidance of PSC species have caused vessels to adjust their fishing patterns. Any shift in fishing is unlikely to occur outside of the existing footprint of the groundfish fishery. Take estimates in the BSAI groundfish fisheries are already small, compared to seabird population estimates, and are unlikely to increase to a level that would have a population-level effect on seabird species. The exception to this is incidental take of short tailed albatross, but the take of this species in BSAI groundfish fisheries are already closely monitored with respect to the incidental take statement in the Biological Opinion. As a result, Alternative 2 is not expected to result in a significant impact on seabirds.

Prey Availability Disturbance of Benthic Habitat

As noted in Table 3-33, prey species of seabirds in the BSAI are not usually fish that are targeted in the groundfish fisheries. However, seabird species may be impacted indirectly by effects of fishing gear on the benthic habitat of seabird prey, such as clams, bottom fish, and crab. The essential fish habitat final environmental impact statement provides a description of the effects of the groundfish fisheries on bottom habitat in the appendix (NMFS 2005), including the effects of the commercial fisheries on the BSAI slope and shelf.

It is not known how much seabird species use benthic habitat directly, although research funded by the North Pacific Research Board has been conducted on foraging behavior of seabirds in the Bering Sea in recent years. Thick-billed murres easily dive to 100 m, and have been documented diving to 200 m; common murres also dive to over 100 m. Since cephalopods and benthic fish compose some of their diet, murres could be foraging on or near the bottom (K. Kuletz, USFWS, personal communication, October 2008).

A description of the effects of prey abundance and availability on seabirds is found in the PSEIS (NMFS 2004a) and the Harvest Specifications EIS (NMFS 2007a). Detailed conclusions or predictions cannot be made regarding the effects of forage fish bycatch on seabird populations or colonies. NMFS (2007a) found that the potential impact of the entire groundfish fisheries on seabird prey availability was limited due to little or no overlap between the fisheries and foraging seabirds based on either prey size, dispersed foraging locations, or different prey (NMFS 2007a). The majority of bird groups feed in vast areas of the oceans, are either plankton feeders or surface or mid-water fish feeders, and are not likely to have their prey availability impacted by the nonpelagic trawl fisheries. There is no directed commercial fishery for those species that compose the forage fish management group, and seabirds typically target juvenile stages rather than adults for commercial target species. Most of the forage fish bycatch is smelt, taken in the pollock fishery, which is not included in this action.

Table 3-33 Seabirds in the Bering Sea: foraging habitats and common prey species.

Species	Foraging habitats	Prey
Short-tailed albatross	Surface seize and scavenge	Squid, shrimp, fish, fish eggs
Black-footed albatross	Surface dip, scavenge	Fish eggs, fish, squid, crustaceans, fish waste
Laysan albatross	Surface dip	Fish, squid, fish eggs and waste
Spectacled eider	Diving	Mollusks and crustaceans
Steller’s eider	Diving	Mollusks and crustaceans
Black-legged kittiwake	Dip, surface seize, plunge dive	Fish, marine invertebrates
Murrelet (Kittlitz’s and marbled)	Surface dives	Fish, invertebrates, macroplankton
Shearwater spp.	Surface dives	Crustaceans, fish, squid
Northern fulmar	Surface fish feeder	Fish, squid, crustaceans
Murres spp.	Diving fish-feeders offshore	Fish, crustaceans, invertebrates
Cormorants spp.	Diving fish-feeders nearshore	Bottom fish, crab, shrimp
Gull spp.	Surface fish feeder	Fish, marine invertebrates, birds
Auklet spp.	Surface dives	Crustaceans, fish, jellyfish
Tern spp.	Plunge, dive	Fish, invertebrates, insects
Petrel spp.	Hover, surface dip	Zooplankton, crustaceans, fish
Jaeger spp.	Hover and pounce	Birds, eggs, fish
Puffin spp.	Surface dives	Fish, squid, other invertebrates

Source: USFWS 2006; Dragoo et al. 2010

Seabirds that feed on benthic habitat, including Steller’s eiders, scoters, cormorants, and guillemots, may feed in areas that could be directly impacted by nonpelagic trawl gear (NMFS 2004b). A 3-year otter trawling study in sandy bottom of the Grand Banks showed either no effect or increased abundance in mollusk species after trawling (Kenchington et al. 2001), but clam abundance in these studies was depressed for the first 3 years after trawling occurred. McConnaughey et al. (2000) studied trawling effects using the Bristol Bay area Crab and Halibut Protection Zone. They found more abundant infaunal bivalves (not including *Nuculana radiata*) in the highly fished area compared to the unfished area. In addition to abundance, clam size is of huge importance to these birds. However, handling time is very important to birds foraging in the benthos, and their caloric needs could change if a stable large clam population is converted to a very dense population of small first year clams. Additional impacts from nonpelagic trawling may occur if sand lance habitat is adversely impacted. This would affect a wider array of piscivorous seabirds that feed on sand lance, particularly during the breeding season, when this forage fish is also used for feeding chicks.

Recovery of fauna after the use of nonpelagic trawl gear may also depend on the type of sediment. A study in the North Sea found biomass and production in sand and gravel sediments recovering faster (2 years) than in muddy sediments (4 years) (Hiddink et al. 2006). The recovery rate may be affected by the animal's ability to rebury itself after disturbance. Clams species may vary in their ability to rebury themselves based on grain size and whether they are substrate generalist, substrate specialist, or substrate sensitive species (Alexander, Stanton, and Dodd 1993).

Based on this information, the impacts of groundfish fisheries on seabird prey under both Alternative 1 (status quo) and Alternative 2 are insignificant because these fisheries do not harvest seabird prey species in an amount that would decrease food availability enough to impact survival rates or reproductive success, nor do they impact benthic habitat enough to decrease seabird prey base to a degree that would impact survival rates or reproductive success.

Summary

Many seabird species use the marine habitat of the BSAI. Several species of conservation concern and many other species could potentially interact with the vessel and gear types associated with this proposed action. Biological Opinions prepared by the USFWS (2003a and 2003b) concluded that the groundfish fisheries are unlikely to jeopardize populations of listed species or adversely modify or destroy critical habitat for listed species.

Alternative 2 would institute reductions to the halibut PSC limits for the previously described components of the groundfish fishery in the BSAI. This action likely would not have any effects on seabird takes beyond those already analyzed for the BSAI groundfish fisheries in previous biological opinions and environmental impact statements (USFWS 2003a,b; NMFS 2007).

3.5 Habitat

Fishing operations may change the abundance or availability of certain habitat features used by managed fish species to spawn, breed, feed, and grow to maturity. These changes may reduce or alter the abundance, distribution, or productivity of species. The effects of fishing on habitat depend on the intensity of fishing, the distribution of fishing with different gears across habitats, and the sensitivity and recovery rates of specific habitat features. In 2005, NMFS and the Council completed the EIS for EFH Identification and Conservation in Alaska (NMFS 2005b). The EFH EIS evaluates the long term effects of fishing on benthic habitat features, as well as the likely consequences of those habitat changes for each managed stock, based on the best available scientific information. Maps and descriptions of EFH for groundfish species are available in the EFH EIS (NMFS 2005b). This document also describes the importance of benthic habitat to different groundfish species and the impacts of different types of fishing gear on benthic habitat.

Effects of the Alternatives

Table 3-34 describes the criteria used to determine whether the impacts on EFH are likely to be significant.

Table 3-34 Criteria used to estimate the significance of impacts on essential fish habitat.

No impact	Fishing activity has no impact on EFH.
Adverse impact	Fishing activity causes disruption or damage of EFH.
Beneficial impact	Beneficial impacts of this action cannot be identified.
Significantly adverse impact	Fishery induced disruption or damage of EFH that is more than minimal and not temporary.
Significantly beneficial impact	No threshold can be identified.
Unknown impact	No information is available regarding gear impact on EFH.

The EFH EIS (NMFS 2005b) found no substantial adverse effects to habitat in the BSAI caused by fishing activities. The analysis in the EFH EIS concludes that current fishing practices in the BSAI groundfish fisheries have minimal or temporary effects on benthic habitat and essential fish habitat. These effects are likely to continue under Alternative 1, and are not considered to be significant.

Options under Alternative 2 may result in no change to the status quo, or may result in constraining PSC limits under which industry may change fishing patterns in order to maximize species with the greatest economic value. This could result in a response of reducing fishing effort, as the industry chooses not to pursue less valuable fisheries in order to conserve halibut PSC mortality, or it could result in greater fishing effort at lower catch per unit effort, as vessels change fisheries patterns or seasonal changes in the timing of the fishing, to increase halibut avoidance. Shifts in the location or timing of fishing may occur as a result of Alternative 2. However, there is already considerable interannual variability in the patterns of fishing across the BSAI groundfish sectors, as environmental conditions and avoidance of PSC species have caused vessels to adjust their fishing patterns. Any shift in fishing is unlikely to occur outside of the existing footprint of the groundfish fishery in the BSAI, and therefore these impacts are not likely to be substantial. To the extent that Alternative 2 reduces effort in the BSAI groundfish fishery, those alternatives would reduce impacts on habitat relative to the status quo. Because the proposed alternatives are not likely to result in significantly adverse effects to habitat, the impacts are likely insignificant. Overall, the combination of the direct, indirect, and cumulative effects on habitat complexity for both living and non-living substrates, benthic biodiversity, and habitat suitability is not likely to be significant under Alternative 2.

3.6 Ecosystem

Ecosystems consist of communities of organisms interacting with their physical environment. Within marine ecosystems, competition, predation, and environmental disturbance cause natural variation in recruitment, survivorship, and growth of fish stocks. Human activities, including commercial fishing, can also influence the structure and function of marine ecosystems. Fishing may change predator-prey relationships and community structure, introduce foreign species, affect trophic diversity, alter genetic diversity, alter habitat, and damage benthic habitats.

The BSAI groundfish fisheries potentially impact the BSAI ecosystem by relieving predation pressure on shared prey species (i.e., species that are prey for both target groundfish and other species), reducing prey availability for predators of the target groundfish, altering habitat, imposing PSC and bycatch mortality, or by ghost fishing caused by lost fishing gear. Ecosystem considerations for the groundfish fisheries are summarized annually in the Stock Assessment and Fishery Evaluation report (Zador 2014). These considerations are summarized according to the ecosystem effects on the groundfish fisheries, as well as the potential fishery effects on the ecosystem.

As explained in Chapter 3, Section 3.3.1 of the Harvest Specifications EIS (NMFS 2007), NMFS and the Council continue to develop their ecosystem management measures for groundfish fisheries. The Council has created a committee to inform the Council of ecosystem developments and to assist in formulating positions with respect to ecosystem-based management. The Council's Scientific and Statistical Committee holds regular ecosystem scientific meetings, and the Council is considering development of a Bering Sea Fishery Ecosystem Plan. In addition to these efforts to explore how to develop its ecosystem management efforts, the Council and NMFS continue to initiate efforts to take account of ecosystem impacts of fishing activity by designating EFH protection areas and habitat areas of particular concern. Ecosystem protection is supported by an extensive program of research into ecosystem components and the integrated functioning of ecosystems, carried out at the AFSC. Exempted fishing permits currently support investigation of new management approaches for the control of halibut removals through halibut excluder devices http://alaskafisheries.noaa.gov/ram/efp.htm.

3.7 Cumulative Effects

NEPA requires an analysis of the potential cumulative effects of a proposed federal action and its alternatives. Cumulative effects are those combined effects on the quality of the human environment that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of which federal or non-federal agency or person undertakes such other actions (40 CFR 1508.7, 1508.25(a) and 1508.25(c)). Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. The concept behind cumulative effects analysis is to capture the total effects of many actions over time that would be missed if evaluating each action individually. Concurrently, the Council on Environmental Quality (CEQ) guidelines recognize that it is most practical to focus cumulative effects analysis on only those effects that are truly meaningful. Based on the preceding analysis, the effects that are meaningful are potential effects on Pacific halibut, if the alternatives result in a change in the spatial or size distribution of halibut removals, and marine mammals and seabirds, to the extent that the fisheries respond to constraining limits by spatial or seasonal changes in fishing patterns that affect localized species. The cumulative effects on the other resources have been analyzed in numerous documents and the impacts of this proposed action and alternatives on those resources are minimal, therefore there is no need to conduct an additional cumulative impacts analysis.

The EA is intended to analyze the cumulative effects of each alternative and the effects of past, present, and reasonably foreseeable future actions (RFFAs). The past and present actions are described in the previous sections in this chapter. This section provides a review of the RFFAs that may result in cumulative effects on Pacific halibut, marine mammals or seabirds. Actions are understood to be human actions (e.g., a proposed rule to designate northern right whale critical habitat in the Pacific Ocean), as distinguished from natural events (e.g., an ecological regime shift). CEQ regulations require consideration of actions, whether taken by a government or by private persons, which are reasonably foreseeable. This requirement is interpreted to indicate actions that are more than merely possible or speculative. In addition to these actions, this cumulative effects analysis includes climate change.

Actions are considered reasonably foreseeable if some concrete step has been taken toward implementation, such as a Council recommendation or NMFS's publication of a proposed rule. Actions only "under consideration" have not generally been included because they may change substantially or may not be adopted, and so cannot be reasonably described, predicted, or foreseen. Identification of actions likely to impact a resource component within this action's area and time frame will allow the public and Council to make a reasoned choice among alternatives.

The following RFFAs are identified as likely to have an impact on a resource component within the action area and timeframe:

- Experimental fishing permits (EFPs) for deck sorting of halibut on Amendment 80 trawl catcher processors. As described in Section 4.8, industry is trying to work through the procedures required for sorting halibut on deck in the flatfish fisheries, so that the halibut can be returned to the sea more expeditiously, and hopefully improve the mortality rate of halibut intercepted in the fishery. An EFP has been proposed for 2015 whereby the industry would pay for an additional sea sampler (observer) on deck, to monitor halibut discards. For 2016, the industry is exploring a camera option. The implementation of deck sorting procedures should benefit the halibut stock by reducing the mortality of halibut resulting from groundfish fishery interactions.
- IPHC direct fishery harvests. The catch limit process for the halibut fisheries is under the authority of the IPHC. In the last two years (2013 and 2014), the IPHC has chosen to set catch limits that result in total removals of the halibut resource above the recommendation of the IPHC's harvest policy. The IPHC is also in the process of reconsidering harvest rates that are part of the harvest policy. Any changes to the IPHC's harvest policy, or its implementation, will have an impact the Pacific halibut stock.

Considering the direct and indirect impacts of the proposed action when added to the impacts of past and present actions previously analyzed in other documents that are incorporated by reference and the impacts of the reasonably foreseeable future actions listed above, the cumulative impacts of the proposed action are determined to be not significant.

4 Discussion items requested by the Council

4.1 Catch and halibut PSC in the IPHC Closed Area

Background on need for and designation of IPHC Closed Area

The IPHC Bering Sea Closed Area was created by the IPHC in 1967 to protect a nursery area for juvenile halibut, in response to severe declines in halibut abundance. The current Closed Area is slightly smaller than the original definition due to reductions that occurred when Areas 4C and 4E were created. The Closed Area had historically accounted for a relatively small percentage (<10%) of the directed halibut landings in the Bering Sea but was a source of significant halibut mortality from foreign vessel bottom trawling. The IPHC recommended the closure to both directed halibut fishing, which was under IPHC jurisdiction, and to bottom trawling, which was not under Commission jurisdiction. However, through negotiations within the International North Pacific Fisheries Commission and bilateral agreements with foreign governments, the Closed Area was also closed to foreign bottom trawling. Throughout the late 1960s until the early 1970s, the Closed Area provided significant protection for juvenile halibut, with bycatch mortality dropping to an estimated low of 4.21 Mlb in 1985. Coincidentally, halibut abundance improved dramatically, fuelled in part by strong year classes of the mid 1970s.

With the Americanization of the Bering Sea trawl fisheries in the early 1980s, following promulgation of the U.S. Extended Economic Zone, the protection to juvenile halibut afforded by the Closed Area diminished. Mortality on halibut again increased substantially in the 1985-1991 period, reaching a peak of approximately 10.7 Mlb in 1992. Bottom trawling within the Closed Area accounts for a significant proportion of the halibut mortality in the Bering Sea. The Closed Area remains open to all fishing except directed halibut longline fishing.

The IPHC requested a review of the Closed Area in 1998 (Trumble 1999). That review examined the purpose of the Closed Area and its value to halibut management. The summary of that review is reproduced below:

> *The closed area does not reduce halibut PSC mortality. Bycatch is managed by bycatch mortality limits through the NPFMC, with quota reductions and harvest rate reductions by the IPHC.*
>
> *Ecosystem effects from the IPHC closed area have little benefit. The fishing by other gear types throughout the Bering Sea- Aleutian Island area, especially on the Bering Sea shelf, preclude an undisturbed ecosystem. A small no-trawl zone occurs on the eastern edge of the IPHC closed area. Evaluation of ecosystem stability in the Bering Sea must include the other fisheries, both in and out of the IPHC closed area and the no-trawl zone.*
>
> *Of the issues favoring development of MPAs, only uncertainty of the stock assessment and concomitant management program apply to Pacific halibut. Stock assessment results in the Bering Sea are currently inadequate because of insufficient time series of catch and survey data (Sullivan and Parma 1998), and because exploitation rates are low. Question still remain on stock assessment issue in the Gulf of Alaska.*

The IPHC requested another review of the Closed Area in 2012. The 2012 report noted that the area remained closed after 1989 as a hedge against uncertainty concerning assessment and management of halibut in the Bering Sea. Since 1998, the Commission has accumulated sufficient data and has been able to generate stock assessments for the Bering Sea with considerably greater confidence than was possible in 1998. Therefore, in 2012 the IPHC staff no longer saw a purpose for the Closed Area as a guard against uncertainty.

It also stated that halibut PSC mortality was managed through Prohibited Species Catch limits for various directed fisheries, with particular time and area specificity, and the IPHC Closed Area played no role in the management of bycatch. Therefore, in 2012 the IPHC staff conclusion was from a halibut assessment and management perspective, they perceived no continued purpose in maintaining the current Closed Area to the directed halibut fishery in the eastern Bering Sea. In 2012, the IPHC took no action to open the Bering Sea Closed Area to the directed halibut fishery. The IPHC treats Area 4CDE, including the Closed Area, as a single management unit. If the Closed Area was to open to the directed halibut fishery, allocations within the new area would have to be incorporated in the Council's Area 4CDE halibut catch sharing plan.

Catch of groundfish and halibut PSC within the IPHC Closed Area

The Council requested a discussion of the levels of groundfish catch and halibut PSC, by fishery, within and outside of the IPHC closed area. Figure 4-1 through Figure 4-5 illustrate groundfish catches and halibut PSC rates from 2008 through 2013 in the BSAI. These maps are also discussed in Section 3.1.3.4.

For both the BSAI trawl limited access sector (Figure 4-1) and Amendment 80 sector (Figure 4-2), groundfish catches were highest within the IPHC Closed Area, while the highest halibut PSC rates occurred outside the IPHC Closed Area. Overall, the highest levels of halibut PSC rates within the IPHC Closed Area occurred along the western boundary in Federal reporting area 517.

The hook-and-line sector had a very broad distribution of groundfish catch and halibut PSC rates along the Bering Sea shelf (Figure 4-3). The areas of highest halibut PSC rates within the Closed Area corresponded with areas of high groundfish catch for the hook-and-line sector. For the hook-and-line Community Development Quota (CDQ) sector, most groundfish catch was outside the IPHC Closed Area along the Bering Sea shelf break (Figure 4-4). Areas of high halibut PSC rates within the Closed Area correspond with relatively low groundfish catch within the Closed Area. Nearly all fishing by the non-pelagic trawl CDQ sector occurs within the IPHC Closed Area, and this sector has low overall halibut PSC rates (Figure 4-5).

For trawl gear, the IPHC Closed Area includes areas that are currently closed to trawl gear at § 679.22. These include Federal reporting area 512, where no fishing with trawl gear is allowed at any time, and Federal reporting area 516, where no fishing with trawl gear is allowed during March 15 through June 15. Also, Federal reporting area 508 is part of the Bristol Bay Trawl Closure Area, § 679.22(a)(9), where no trawl fishing with trawl gear is allowed at any time. The Red King Crab Savings Area, which straddles 509 and 516, is closed to non-pelagic trawling year-round (Figure 3-13). Also, parts of Federal reporting areas 509 and 517 are part of the Catcher Vessel Operation Area (CVOA) (Figure 2 to part 679), and a catcher processor authorized to fish for BSAI pollock under § 679.4 is prohibited from conducting directed fishing for pollock in the CVOA during the pollock B season, defined at § 679.23(e)(2)(ii), unless it is directed fishing for pollock CDQ.

Figure 4-1 Average groundfish catch in metric tons (top panel) and average halibut PSC rates (bottom panel) in the BSAI and IPHC Closed Area from 2008 through 2013 by the BSAI trawl limited access sector

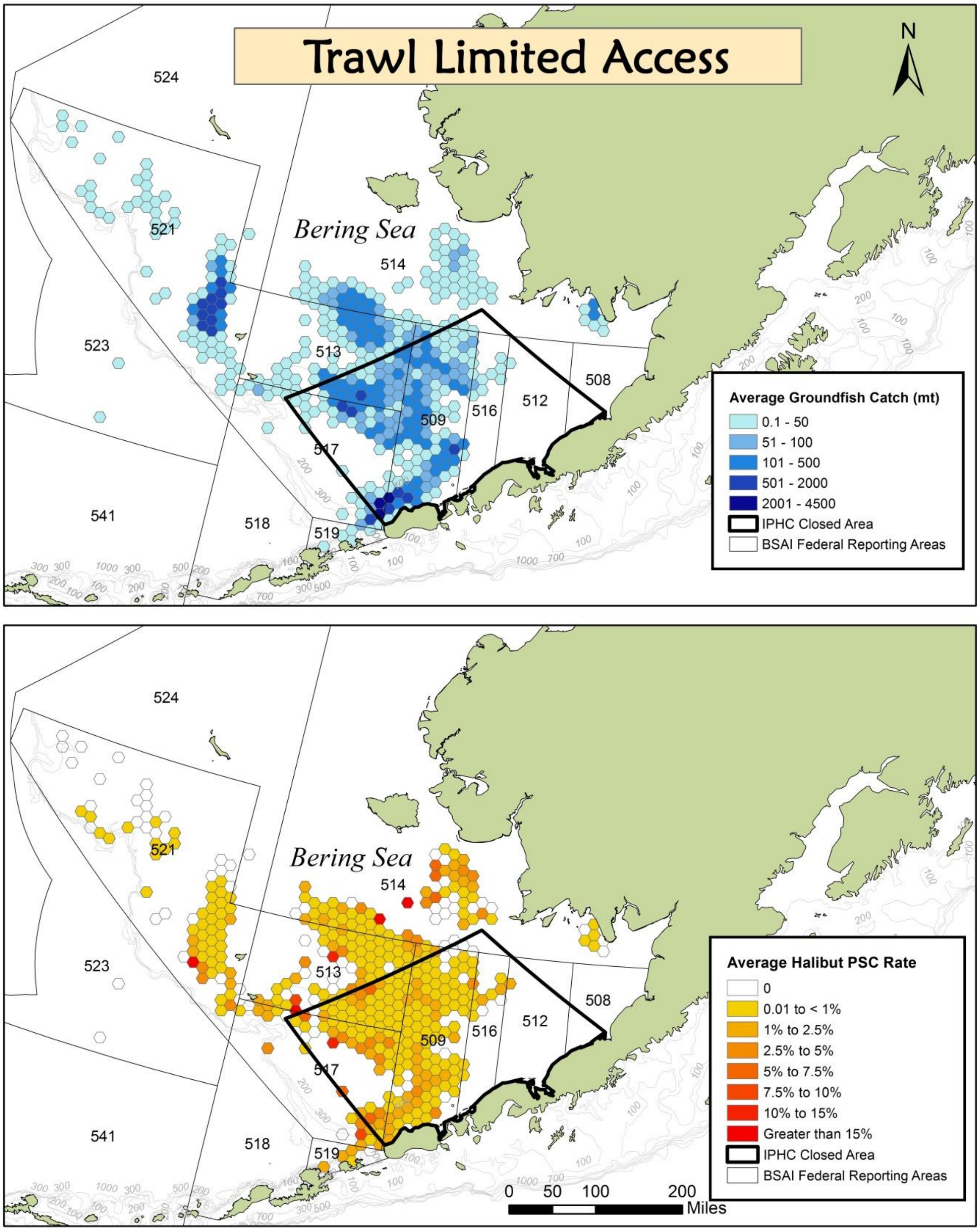


Figure 4-2 Average groundfish catch in metric tons (top panel) and average halibut PSC rates (bottom panel) in the BSAI and IPHC Closed Area from 2008 through 2013 by the Amendment 80 sector

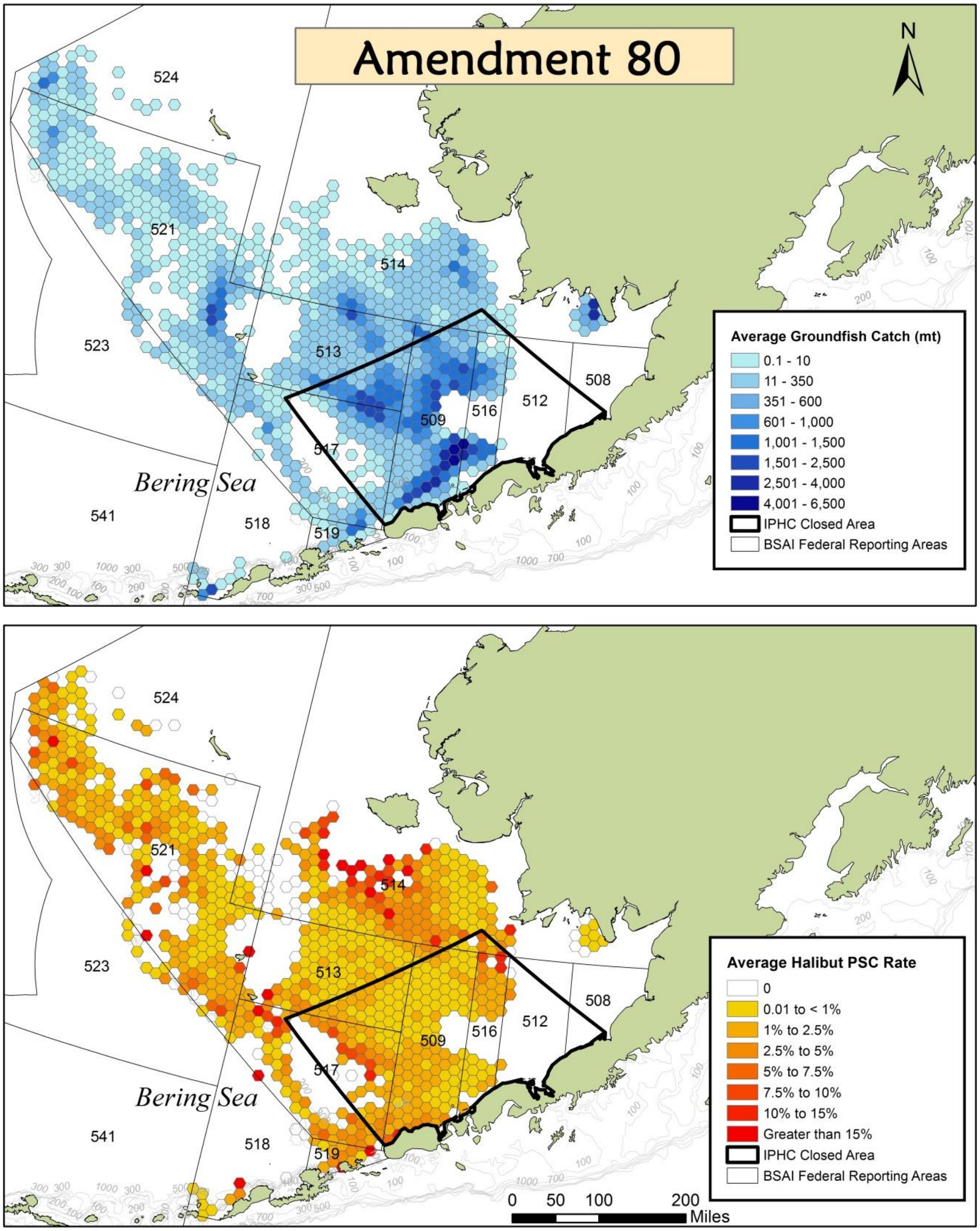


Figure 4-3 Average groundfish catch in metric tons (top panel) and average halibut PSC rates (bottom panel) in the BSAI and IPHC Closed Area from 2008 through 2013 by the hook-and-line catcher vessel and catcher-processor vessel sectors combined

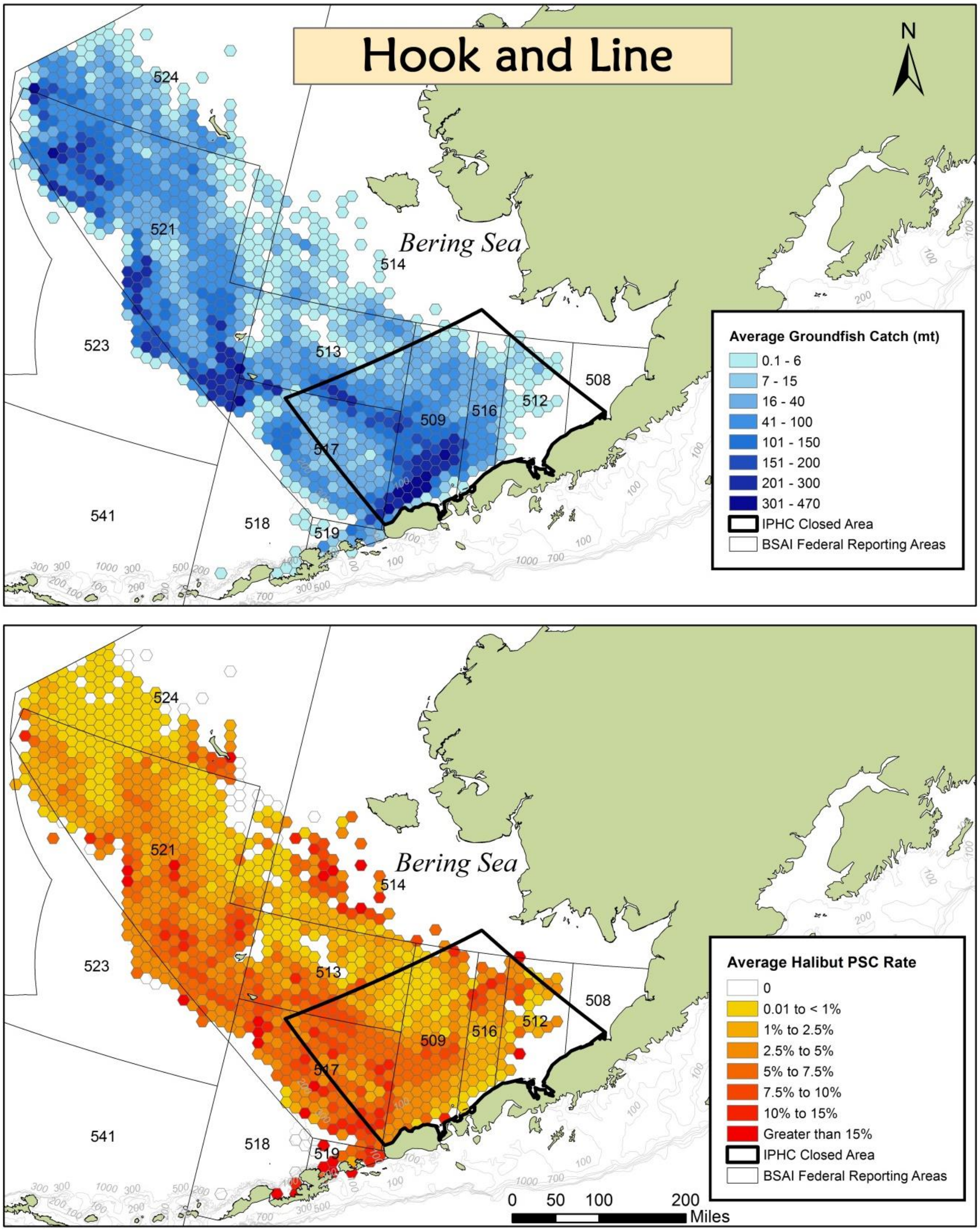


Figure 4-4 Average groundfish catch in metric tons (top panel) and average halibut PSC rates (bottom panel) in the BSAI and IPHC Closed Area from 2008 through 2013 by the hook-and-line Community Development Quota (CDQ) sector.

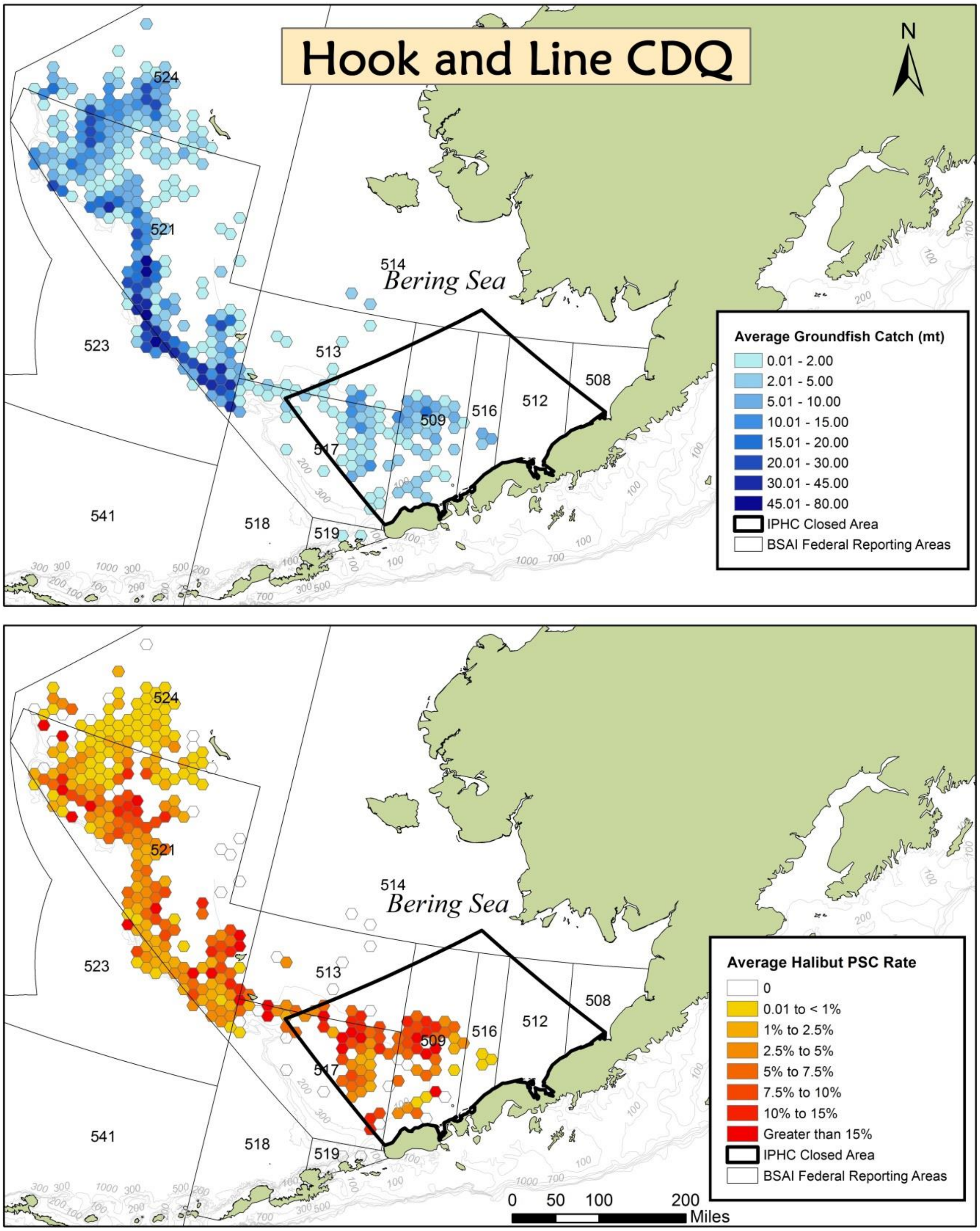
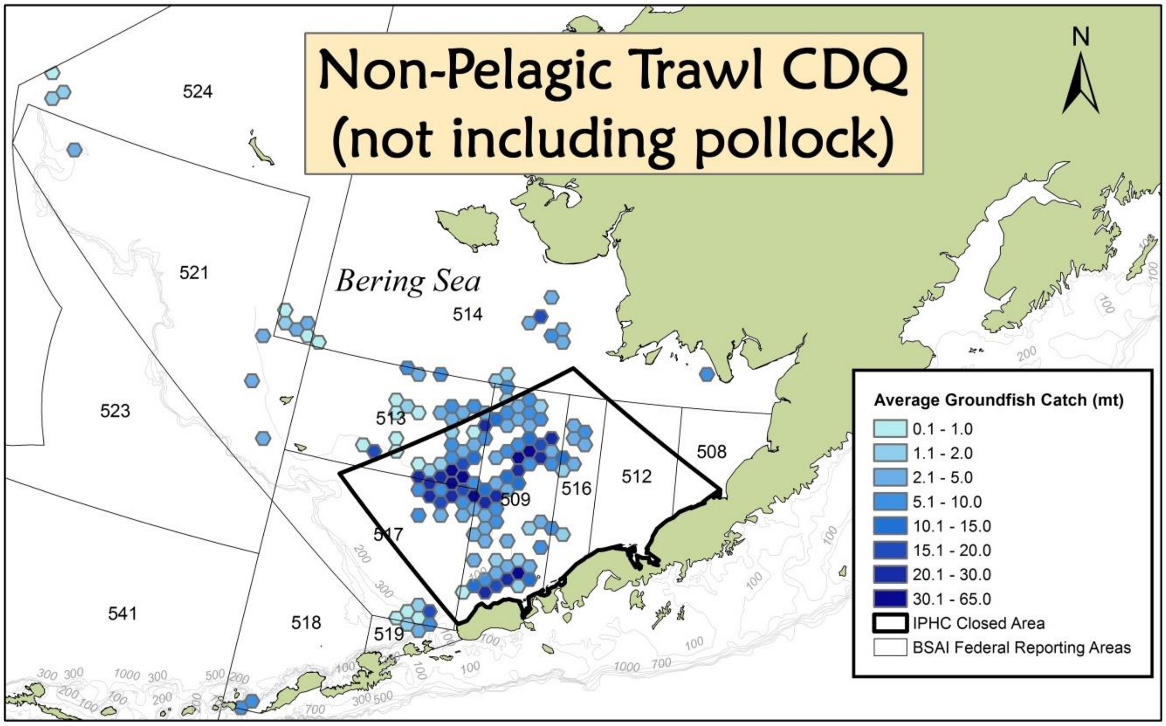
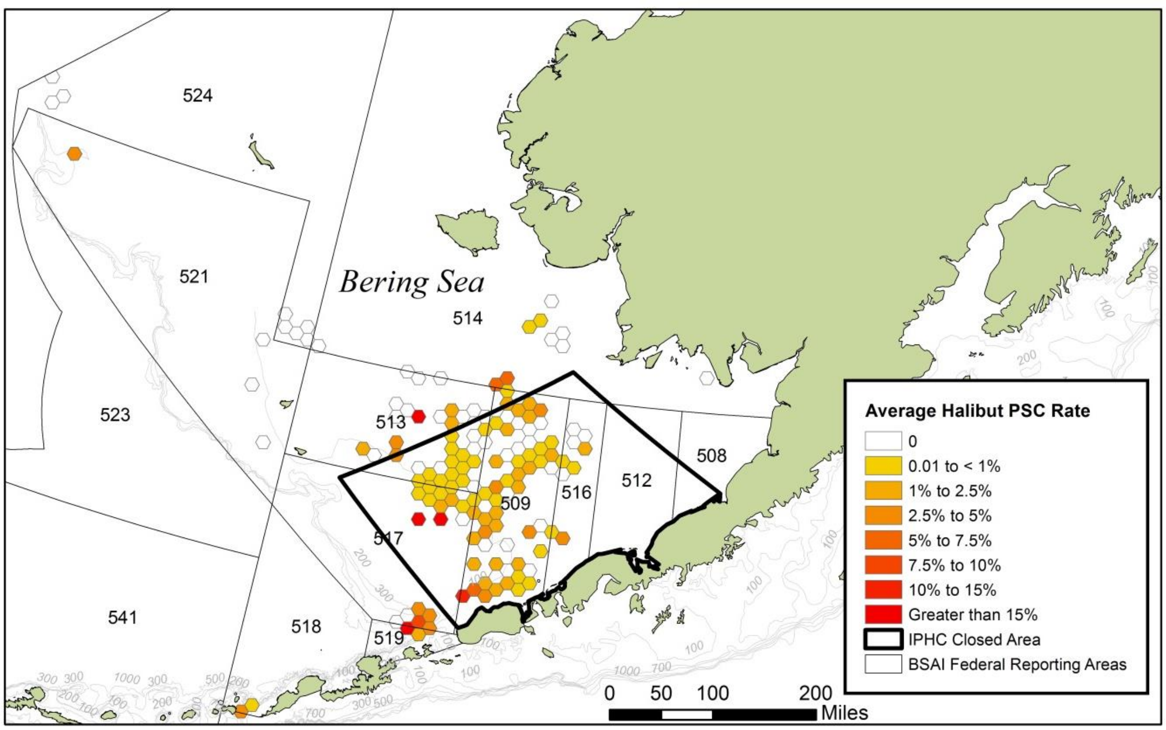


Figure 4-5 Average groundfish catch in metric tons (top panel) and average halibut PSC rates (bottom panel) in the BSAI and IPHC Closed Area from 2008 through 2013 by the non-pelagic trawl Community Development Quota (CDQ) sector.
Average groundfish harvests shown exclude CDQ catches of walleye pollock.

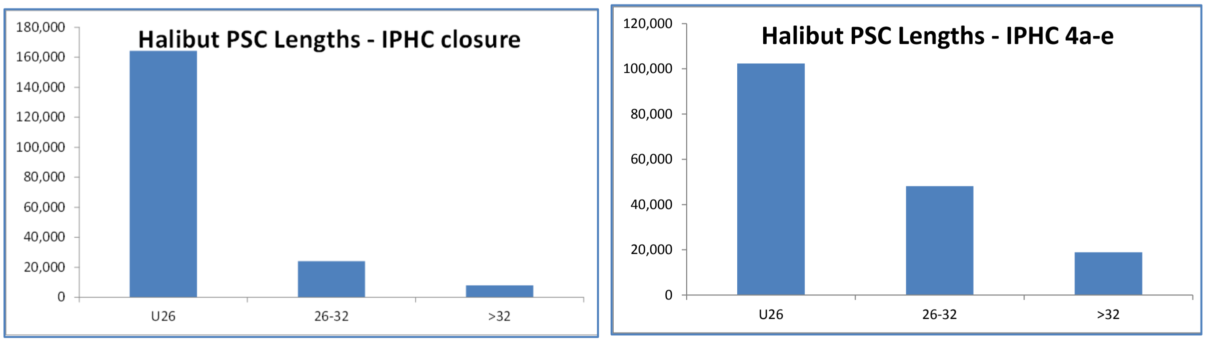




Size distribution of halibut PSC

Section 3.1.3.5 provides a description of the size distribution of halibut PSC in the BSAI, based on an evaluation of observer data from 2008 to 2014. The number of sampled fish under 26 inches is much higher in the IPHC closure area than in other IPHC areas (Figure 4-6). This could, however, be influenced by the variability of size by target fisheries. Rock sole was the most prevalent target fishery inside the closure, while Pacific cod was the most prevalent target fishery in the other IPHC BSAI areas.

Figure 4-6 Halibut PSC length distribution in the IPHC Closed Area versus other Area 4 regulatory areas. Note different y-axis scales, denoting number of fish sampled.



Source: AKFIN.

4.2 PSC limit for IFQ sablefish

History of the halibut PSC limit and the exemption for the IFQ sablefish fishery

In 1994, management agencies and industry representatives raised concerns that current regulations imposed halibut bycatch restrictions on the GOA and BSAI hook-and-line gear fisheries for sablefish that could prevent achievement of important goals of the halibut and sablefish IFQ program: reduced competition within the fleet and a slower paced fishery, with reduced bycatch of undersized fish and prohibited species.

The first halibut and sablefish IFQ fisheries opened March 1995. Although it was acknowledged that halibut bycatch in the sablefish hook-and-line fishery would continue under the IFQ program, overall halibut discard mortality was expected to decrease for two reasons. First, operators of vessels with halibut quota shareholders on board must retain all legal-sized halibut. Second, persons issued sablefish quota share are anticipated to fish in a manner that would optimize revenue for a given amount of quota share. This would mean fishing in prime sablefish fishing grounds at depths where halibut, though uncommon, are predominantly of legal size. Without the IFQ program, the sablefish fishery likely would have continued to be a fast paced fishery with high halibut bycatch rates as fishermen attempted to harvest their sablefish before the hook-and-line fishery for sablefish closed due to reaching a halibut PSC limit. Preventing the need to race for fish was one of the objectives of the IFQ program. In addition, some halibut that would have been counted as PSC in an open access fishery is retained under the IFQ program. The remaining halibut PSC was not likely to be any greater than it was under open access management.

At its April and September 1994 meetings, the Council responded to the above concerns by requesting NMFS to prepare a rule that would: (1) Revise the management of seasonal bycatch allowances in the BSAI nontrawl fisheries, and (2) either exempt the GOA and BSAI sablefish hook-and-line gear fisheries from halibut PSC limits or specify a separate halibut PSC limit for those fisheries during the annual groundfish harvest specification process.

In 1995, NMFS implemented a final rule (43 FR 12149, March 6, 1995) to separately define the BSAI groundfish jig gear fishery and the BSAI sablefish hook-and-line gear fishery under § 675.21(b)(2)(ii) so that these fisheries annually either receive a separate halibut bycatch allowance or are exempted from halibut bycatch restrictions. Since 1995 the Council has recommended that the GOA and BSAI sablefish hook-and-line gear fisheries be exempt from halibut PSC limits. After consulting with the Council, NMFS in the harvest specifications exempts pot gear, jig gear, and the sablefish IFQ hook-and-line gear fishery categories from halibut bycatch restrictions for the following reasons: (1) the pot gear fisheries have low halibut PSC mortality; (2) NMFS estimates halibut mortality for the jig gear fleet to be negligible because of the small size of the fishery and the selectivity of the gear; and (3) the IFQ program requires legal-size halibut to be retained by vessels using hook-and-line gear if a halibut IFQ permit holder or a hired master is aboard and is holding unused halibut IFQ (subpart D of 50 CFR part 679). Most vessels in the jig gear fleet are exempt from observer coverage requirements. As a result, observer data are not available on halibut bycatch in the jig gear fishery. However, as mentioned above, NMFS estimates the jig gear sector will have a negligible amount of halibut PSC mortality because of the selective nature of jig gear and the low mortality rate of halibut caught with jig gear and released.

During the 1995 harvest specifications process the Council reduced the halibut PSC limit for the GOA nontrawl sector, except for demersal shelf rockfish fishery category, to 290 mt from 740 mt in 1994. From 1995 through 2013, 290 mt has been the nontrawl halibut PSC limit and 10 mt has been the demersal shelf rockfish halibut PSC limit. In 2014 the GOA halibut PSC limits were reduced by Amendment 95 (79 FR 9625, February 20, 2014). In the BSAI, the 900 mt halibut PSC limit for the BSAI nontrawl fishery category was not reduced during the 1995 harvest specifications and remains at 900 mt. However, as described above the Council added two fishery categories for nontrawl PSC limit in the BSAI: groundfish jig gear and sablefish hook-and-line gear. In 1998, another change in the BSAI nontrawl halibut PSC limits occurred with the implementation of the multi-species CDQ program. The Council apportioned 67 mt of the 900 mt BSAI nontrawl halibut PSC limit for use by the multi-species CDQ Program. The remaining 833 mt (900 mt minus 67 mt) is further apportioned to the non-trawl fisheries categories as shown in Table 4-1.

Table 4-1 Final 2014 and 2015 prohibited species catch allowances for non-trawl fisheries

Non-trawl fisheries	Catcher/processor (mt)	Catcher vessel (mt)
Pacific cod -Total	760	15
January 1 - June 10	455	10
June 10 - August 15	190	3
August 15 - December 31	115	2
Other non-trawl -Total	58	
May 1 - December 31	58	
Groundfish pot and jig	Exempt	
Sablefish hook-and-line	Exempt	
Total non-trawl PSC mortality	**833**	

Currently, separate halibut bycatch allowances may be established for the BSAI and GOA sablefish hook-and-line gear fisheries under the annual harvest specification process if halibut discard mortality in these fisheries is determined to need further reductions. If the Council determines that a separate halibut PSC limit is necessary for the sablefish hook-and-line fishery category, then the Council will need to decide how to fund the new halibut PSC limit. The Council could chose to add a halibut PSC limit and increase the overall halibut PSC limit of 900 mt. This action would require a regulatory amendment because the current 900 mt non-trawl halibut PSC limit is set in regulations. Also, the Council may recommend reducing the halibut PSC limits of other fishery categories and add a halibut PSC limit for sablefish during the harvest specification process. Currently in the BSAI, the nontrawl halibut PSC limit is apportioned by three fishery categories (A, B, and F listed below) including Pacific cod hook-and-line catcher vessel fishery, Pacific cod hook-and-line catcher/processor, and other nontrawl fisheries. The apportionments for these fishery categories may change during the harvest specifications process, but since 2008 they have remained at 15 mt for CVs and 760 mt for C/Ps. Prior to 2008, the CV and C/P sectors were combined in the Pacific cod fishery category. The other nontrawl fishery category mainly supports the Greenland turbot fishery and has been apportioned 58 mt since 2002. Also, there are three more fisheries categories, (C through E listed below), including sablefish hook-and-line fishery, that are not currently receiving halibut PSC limit apportionments as recommended by the Council and approved by NOAA Fisheries as discussed above.

For purposes of apportioning the nontrawl halibut PSC limit among fisheries, the following fishery categories are specified and defined in terms of round-weight equivalents of those BSAI groundfish species for which a TAC has been specified under § 679.20.

(A) Pacific cod hook-and-line catcher vessel fishery.
(B) Pacific cod hook-and-line catcher/processor fishery.
(C) Sablefish hook-and-line fishery.
(D) Groundfish jig gear fishery.
(E) Groundfish pot gear fishery.
(F) Other nontrawl fisheries. This means fishing for groundfish with nontrawl gear during any weekly reporting period which results in a retained catch of groundfish and does not qualify as any of the fisheries A through E. The main target in this category is the hook-and-line catcher/processor Greenland turbot target.

Table 4-2 shows that the three nontrawl fisheries categories with halibut PSC limits are not reaching their combined 833 mt halibut PSC limit. Therefore the Council could choose to reduce the halibut PSC limit for one or more of these fisheries categories to fund the halibut PSC limit for the sablefish hook-and-line fishery category.

Table 4-2 BSAI halibut PSC mortality for non-trawl fishery categories not exempt from halibut PSC limits

Year	Other Non-trawl			Pacific cod hook-and-line C/P			Pacific cod hook-and-line CV			Total		
	PSC	Limit	Remaining	PSC	Limit	Remaining	PSC	Limit	Remaining	PSC	Limit	Remaining
2008	1	58	57	564	760	196	5	15	10	570	833	263
2009	6	58	52	556	760	204	3	15	12	565	833	268
2010	10	58	48	489	760	271	2	15	13	501	833	332
2011	4	58	54	477	760	283	1	15	14	483	833	350
2012	6	58	52	550	760	210	2	15	13	557	833	276
2013	1	58	57	458	760	302	3	15	12	463	833	370
2014*	1	58	57	314	760	446	6	15	9	322	833	511

Source: NOAA, Alaska Region, Catch Accounting System
* 2014 is through October 25, 2014

Retention and regulatory discards in the IFQ sablefish fishery

Participants in the IFQ halibut fishery are prohibited from discarding halibut or sablefish caught with fixed gear from any catcher vessel when any IFQ permit holder on board holds unused halibut or sablefish IFQ for that vessel category and the IFQ regulatory area in which the vessel is operating, unless halibut discarding is required for other reasons such as halibut below the legal size limit (50 CFR 679.7(f)(11)). This same requirement does not apply to the halibut CDQ allocations. In other words, the operator of a vessel using fixed gear to fish on behalf of a CDQ group is not required to retain halibut CDQ if the CDQ group has unused halibut CDQ. If a participant does not have an IFQ permit holder with available IFQ on board, then catch of halibut must be treated as a prohibited species. After allowing for sampling by an observer, (if an observer is on board), catch must be sorted immediately after retrieval of the gear and, halibut must be returned to the sea immediately, with a minimum of injury, regardless of its condition.

Catch accounting for Halibut PSC in the IFQ sablefish fishery

Since 1995 when the sablefish hook-and-line fishery was exempted from halibut PSC limits, NMFS has contined to refine the programming in the Alaska Region's catch accounting system (CAS) to more accurately estimate halibut PSC on sablefish hook-and-line trips. Currently, the CAS assumes that if the catch report (e.g., observer haul information, landing report, or production report) shows retained halibut, then an IFQ permit holder with unused halibut IFQ was on board the vessel. NMFS will use the reported retained halibut to accrue to the IFQ halibut account in the NMFS IFQ database and also will estimate from observer data the amount of halibut discard (i.e., halibut wastage). No estimate of halibut PSC will be calculated. If a catch report shows no retained halibut, then the CAS assumes that no IFQ permit holder with unused IFQ halibut was on board. If there was no retained halibut, then halibut discards will be not be estimated, and instead only halibut PSC will be estimated. Halibut PSC is estimated by using observer data (on observed trips) or using observer data to generate a halibut PSC rate and applying those rates to unobserved trips.

However, there are still some limitations and situations with halibut accounting that make it difficult to determine if IFQ halibut discards or halibut PSC should be estimated. In the CAS, it is not possible to know if an IFQ permit holder with unused halibut IFQ was on board a vessel if no halibut was retained. In addition, the CAS cannot account for halibut PSC on trips during which the vessel had available IFQ and retained halibut during the first part of the trip, but during the second part of the trip the vessel reached its IFQ limit and starting discarding halibut as PSC, nor on trips that span the end of the IFQ season after which halibut IFQ cannot be retained. That being said, NMFS estimated halibut PSC mortality in the sablefish fishery to be 1 mt in 2013, and 8 mt in 2014.

Vessels that participate in both IFQ halibut and sablefish fisheries

Although halibut and sablefish IFQ are allocated to a person and not the vessel, it may be informative to look at the number of vessels that participate in both fisheries. Figure 3.13 from the 2012 Report to the Fleet (NMFS 2014d) shows the numbers of vessels fishing in both the halibut and sablefish IFQ fisheries from 1995 through 2012. Based on this figure the number of vessels with both halibut and sablefish IFQ landings (of the total number of vessels with IFQ landings) has increased from 28 percent in 1995 to 31 percent in 2012. Note, this is a statewide figure; there is far less overlap between sablefish and halibut vessels fishing in the BSAI.

4.3 Biomass-based halibut PSC limits

The Council asked for a discussion of possible methods for establishing biomass-based limits, how each method could work within Council process (e.g., how would the Council initially select a threshold, and how would the limit fluctuate with changing biomass), and the relative pros/cons of switching to biomass-based thresholds. IPHC staff is working on drafting a discussion paper for the Council on this topic, which will be available during the staff presentations at initial review.

4.4 Halibut PSC Limit Rollovers

Currently, unused halibut PSC limit allocations to the BSAI trawl limited access sector may be reallocated to the Amendment 80 sector. Since the implementation of the Amendment 80 program in 2008, this has happened in 2010, 2013, and 2014. As stated in § 679.91(f)(2), in the decision for a reallocation from one sector to the other, the Regional Administrator may consider the biological harm to a species or species group, current and historic catches, and PSC use in both the Amendment 80 and BSAI trawl limited access sectors, and harvest capacity and stated intent of both sectors.

The reallocations generally occur later in the year when the remainder of the year's fishing patterns are easier to predict. The Regional Administrator has not reallocated halibut PSC limits if there was any likelihood that the reduced PSC limit would become constraining to the BSAI trawl limited access sector. In 2010 and 2013, the halibut PSC limit reallocations were made in conjunction with other species groups (yellowfin sole and crab PSC limits) that were not likely to be harvested or used by the BSAI trawl limited access sector. In 2014, the halibut PSC limit reallocation was a standalone action. Since halibut PSC and Pacific cod tend to be the most common limiting species for the Amendment 80 sector, halibut PSC is more likely to become limiting when Pacific cod stocks and quotas are large, as they have been in recent years.

When the Regional Administrator decides that a reallocation of halibut PSC limited is warranted, the Regional Administrator will reallocate to the Amendment 80 sector 95% of the amount of halibut PSC limit allocation deducted from the BSAI trawl limited access sector. The remaining 5% of halibut PSC limit allocation will no longer be available to support any directed fisheries. The halibut PSC limit reallocated to the Amendment 80 sector will be further reallocated between the Amendment 80 cooperatives. This will be done in proportion to the Amendment 80 halibut PSC limit allocated to each cooperative for that calendar year.

If the Council were to eliminate the reallocation of the unused halibut PSC limit from BSAI trawl limited access sector to the Amendment 80 sector, the impact would probably vary depending on the amounts of groundfish species allocated each year. In years with lower Pacific cod TAC, halibut PSC has not been overly constraining to the Amendment 80 sector. In these years, the elimination of reallocations would likely not add additional constraints on the sector. However, there has been some recent experimentation with Pacific cod excluders by some of the Amendment 80 catcher/processors. If these Pacific cod excluders prove to be effective, halibut PSC and not Pacific cod may become the primary limiting species for the Amendment 80 sector in most years.

Another factor in halibut PSC use is the size of the annual pollock TACs. In years with large pollock TACs, the flatfish TACs tend to be smaller. Conversely, when pollock TACs are smaller, the 2 million metric ton BSAI TAC limit is not constraining, and flatfish TACs may be larger. Since halibut PSC primarily limits flatfish fishing in the Amendment 80 sector, it is likely that in years of high Pacific cod abundance and low pollock abundance, any reduction in halibut PSC limits available to the Amendment 80 sector will reduce the amount of flatfish that the sector will be able to harvest. Since the quota share allocation of halibut PSC limits is not homogenous across the permits in the Amendment 80 sector, the impact will be different between cooperatives, and among different Amendment 80 companies. Generally, the impact will be more severe to those entities with a higher ratio of flatfish allocations to halibut PSC limits than to those with a lower ratio of flatfish allocations to halibut PSC limits. The Amendment 80 sector usually targets yellowfin sole at the end of the year when halibut PSC rates are lower. However, in some years the halibut PSC rate may be higher and prevent the Amendment 80 sector from fully harvesting their yellowfin sole allocations or other groundfish species that they target at the end of the year.

Currently, the Amendment 80 sector is working on methods to reduce their halibut PSC rates (see Section 4.8 of this analysis). If these efforts are successful, the impact from eliminating halibut PSC reallocations could be reduced.

4.5 Fishing practices to reduce bycatch (wastage) in the directed halibut fishery

The Council's motion asked for a short discussion of fishing practices that reduce halibut bycatch in the commercial halibut fishery. During testimony at the June 2014 meeting, the Council heard some suggestions from participants in the Area 4 halibut fisheries, such as education to fishermen regarding halibut release methods, and improving safe release mechanisms. This is also a subject area that the IPHC is pursuing. At the upcoming IPHC annual meeting in January 2015, there will also be an analysis of lowering the minimum size limit for the commercial fishery, which would reduce regulatory wastage by allowing fishermen to keep more of the smaller fish that would otherwise be discarded.

Staff will provide more information on this topic in the next iteration of this analysis.

4.6 Amendment 80 measures

In the June 2014 motion, the Council asked for an evaluation of three measures with respect to their potential to reduce halibut PSC mortality– moving the Amendment 80 start date, fleatifsh specifications flexibility, and changes to the current Amendment 80 area closures. These measures are discussed below.

4.6.1 Moving the Amendment 80 start date

The last year that the BSAI and GOA trawl gear groundfish fisheries opened on January 1 was 1991. In 1992, BSAI and GOA trawl gear groundfish fisheries opened on January 20. NMFS implemented this delay in 1992 to assure that trawl groundfish fisheries would open when sea lion protection measures, Amendments 20 and 25, became effective on January 20, 1992 (57 FR 381, January 6, 1992). The purpose of the Steller sea lion protection measures was to minimized potential adverse effects of trawl gear groundfish fisheries on Steller sea lion foraging activity in sensitive habitat areas. Since 1993, BSAI and GOA trawl gear groundfish fisheries have opened January 20 as a method of reducing halibut and salmon bycatch rates under Amendments 19 and 24 (57 FR 39137, August 28, 1992). January 20 was proposed as an opening date by an industry group that represented various components of the trawl fishery.

Reasons for January 20 trawl gear season opening date in 1992

Reduced Halibut and Salmon PSC– The analysis for Amendments 19 and 24 provided some evidence that a delay in the BSAI and GOA trawl gear fisheries opening dates could reduce average halibut and salmon bycatch rates in some groundfish fisheries. In 1990 and 1991, when trawl gear opened on January 1, the highest Chinook salmon PSC rates in the BSAI occurred in the first few weeks of the year. Also, there was substantial bycatch of salmon in the first few weeks of the year in the GOA. At that time there were halibut PSC limit to help decrease halibut PSC, but no salmon PSC limits in the BSAI and GOA to help decrease salmon PSC.

Competition between BSAI and GOA – Another reason for delaying the trawl gear opening date for the GOA until January 20 was to limit competition between the BSAI and GOA fisheries. Concurrent season openings in the BSAI and GOA were needed to decrease the opportunity for vessels that fish principally in the BSAI to also fish in the GOA from January 1 to 20.

Allowed for TAC to be harvested – The analysis for Amendments 19 and 24 considered whether a delay of two to three weeks would have an adverse effect on the fisheries and concluded that total annual catch would not change if the fisheries were delayed. There was sufficient harvesting and processing capacity to allow most TACs to be fully utilized in fisheries that last much less than 12 months. In an open access fishery, each fishing operations has an incentive to begin fishing as soon as possible, even if it is in the best interest of the fleet as a whole to delay the start of a fishery. Therefore, by delaying the start of a fishery to a mutually beneficial date, the Council provided benefits that the fleet would not have otherwise received.

Currently, many of the BSAI trawl vessels are in a catch share program and if the cooperative exceeds its PSC limits it is an enforcement violation. Other BSAI trawl vessels are working together to decrease their halibut and salmon PSC use. As part of this action, the Amendment 80 sector proposed changing their 80 season opening date from January 20 to January 1 to allow for maximum flexibility as discussed below.

Reasons to continue the January 20 trawl gear season opening date

Gear conflict in the Bering Sea – Currently the season for non-trawl gear (hook-and-line, pot, and jig) opens on January 1 in the BSAI and GOA. Several fisheries for Pacific cod using pot gear occur in early January in the same locations where the non-pelagic trawl C/Ps fish after January 20. Over the years there have been anecdotal reports of gear conflict when the fisheries for these gear types overlap. Table 4-3 shows that in some years the BSAI pot Pacific cod fisheries close before or around January 20, but in some years they remain open longer. In 2014, 45 vessels using pot gear fished between January 1 and 20 and 25 C/Ps using non-pelagic trawl gear (including 10 AFA C/Ps) fished starting January 20. Changing the Amendment 80 season opening date from January 20 to January 1 may exacerbate gear conflicts in areas of the Bering Sea where pot and non-pelagic trawl fisheries occur.

Table 4-3 BSAI pot gear Pacific cod A season closure dates

Year	CVs greater than 60 ft using pot gear	CP	CVs less than or equal to 60 ft using pot / hook-and-line gear
2014	January 24	January 26	February 4
2013	January 22	January 28	February 7
2012	January 20	January 23	February 17
2011	January 21	January 24	March 8
2010	January 28	February 23	March 25

Fair start for trawl fisheries – Changing the opening date for the Amendment 80 sector would be unfair to the GOA trawl and BSAI trawl limited access sectors because those sectors would still have a January 20 opening date. Changing the season opening date for the Amendment 80 sector may enable the Amendment 80 sector to market their incidental catch of pollock prior to when the AFA sector starts fishing on January 20. Therefore, the AFA sector also would likely ask for a January 1 opening date. At their December 2005 meeting, the Council received a discussion paper about changing the AFA pollock opening date to as early as January 15 and decided not to continue consideration at that time.

Steller sea lion protection measures – Sea lion protection measures implemented under the 2015 final rule (79 FR 70286, November 25, 2014) are intended to minimize potential adverse effects of the groundfish fisheries on sea lion foraging activity in sensitive habitat areas. The measures include closure of areas around specified sea lion rookeries, together with spatial and temporal restrictions. The EIS and Biological Opinion (NMFS 2014c, 2014b) for these protection measures analyzed the opening date of January 20 for Pacific cod, pollock, and Atka mackerel. NMFS Sustainable Fisheries and Protected Resources would consult on the effects of the modified opening date on threatened and endangered species under section 7 of the ESA.

No stand-down between years – Currently, the Amendment 80 sector has at least a 20 day stand down from fishing from the end of the fishing year, December 31, until January 20. A January 1 opening date would allow continuous fishing from the end of one year into the next year. This 20-day stand down may be beneficial to the resource.

Reasons to change the January 20 trawl gear season opening date to January 1

Flexibility – An opening date of January 1 would increase the Amendment 80 sector's flexibility in their fishing seasons. Individual fishing operations have many different reasons for determining their optimal fishing seasons. Also, the Amendment 80 sector operates in cooperatives that are prohibited from exceeding their PSC limits and are continuously trying to lower PSC rates and discards. If a January 1 date allows for further reductions of PSC and discards, then the Council may want to support this date change.

Annual variability of seasonal bycatch rates – It is difficult to identify a January 1 opening date as being clearly preferable in terms of its effects on bycatch. The effects of a January 1 opening date on bycatch will vary from year to year. Therefore, it is difficult to know with any certainty what bycatch by species will be as the result of a specific opening date.

4.6.2 Flatfish specifications flexibility and Amendment 80 closures

With increased flexibility, the Amendment 80 fleet will be better able to respond to constraining halibut PSC limits while optimizing groundfish catch.

Flatfish specifications flexibility, which was implemented in 2015, allows Amendment 80 cooperatives, and CDQ groups, the opportunity to exchange their quota share of one of three species (flathead sole, rock sole, and/or yellowfin sole) for an equivalent amount of another of thre three species, within limits that ensure that neither the ABCs for these species will not be exceeded, nor the BSAI groundfish fishery optimum yield limit of 2 million mt. Under Amendment 105, which is effective as of October 23, 2014, an ABC reserve is specified for the three flatfish species, which will be allocated to CDQ groups and Amendment 80 cooperatives using the same formulas that are used in the annual harvest specifications process. The ABC reserve for each species will be specified by the Council, by evaluating the ABC surplus for the species (i.e., the difference between the ABC and TAC), considering whether the amount needs to be reduced by a discretionary buffer amount based on social, economic, or ecological considerations. The Council will annually designate some, all, or none of the ABC surplus as the ABC reserve.

Although the fleet has not yet had the opportunity to fish under the flatfish flexibility program, the amendment was developed to allow the fleet to maximize flatfish TAC utilization, to the extent that additional constratints in targeting flatfish could be resolved through inseason flexibility in the choice of a flatfish target. The flexibility to exchange quota among target species allows the fleet to shift between targets when unexpected changes occur, including changing environmental and/or market conditions. In the same manner, this tool may be helpful to the Amendment 80 sector in responding to areas of higher halibut interception, by allowing them an opportunity to continue fishing by switching to a different flatfish target.

With respect to the Amendment 80 closures, the fleet is currently constrained by the Red King Crab Savings Area and the *Chinoceates Opilio* Bycatch Limitation Zone (COBLZ) (see Figure 3-13, on page 55), as they are sometimes required to move out of areas that may otherwise have low halibut PSC in order to comply with these regulatory closure areas. These closures were put into effect prior to the implementation of cooperatives for the Amendment 80 sector, in order to protect BSAI crab. Figure 4-2 provides the spatial distribution of groundfish catch and halibut PSC by the Amendment 80 fleet. A detailed analysis would be required to evaluate the degree to which adjusting these closures might be effective for halibut PSC reduction, and assessing the degree to which these closures continue to provide protection to crab PSC species. Such an evaluation has not been attempted at this time.

4.7 Seasonal apportionment of halibut PSC limits

Through 2007, BSAI trawl halibut PSC limits were apportioned for all trawl sectors (except CDQ) and were seasonally apportioned for the fishery categories: yellowfin sole (four seasons), rock sole/other flatfish/flathead sole (three seasons), and rockfish (one season; see 2007 example in Table 4-4). In 2008, with implementation of the Amendment 80 Program, halibut PSC limits for Amendment 80 cooperatives were no longer apportioned by fishery category or season. Rather, the cooperative is apportioned a single halibut PSC limit as a hard cap, the attainment of which shuts down the cooperative from all fishing. Halibut PSC limits continue to be apportioned to the BSAI trawl limited access sector, and the Amendment 80 limited access sector through 2010. Since 2011, all Amendment 80 vessels have joined one of two cooperatives, and there is no Amendment 80 limited access sector.

Table 4-4 2007 Halibut PSC mortality allowances for the BSAI trawl fisheries

Trawl Fisheries	BSAI Halibut mortality (mt)				
	Total	Seasonal allowances			
Yellowfin sole	936	Jan 20 - April 1	April 1 - May 21	May 21 - July 1	July 1 - Dec 31
		312	195	49	380
Rock sole/other flat/flathead sole[2]	829		April 1 - July 1		July 1 - Dec 31
			164		167
Turbot/arrowtooth/sablefish[3]	n/a				
Rockfish	69				July 1 - Dec 31
Pacific cod	1,334				
Midwater trawl pollock	n/a				
Pollock/Atka mackerel/other[4]	232				
Total trawl PSC mortality	**3,400**				

[2] "Other flatfish" for PSC monitoring includes all flatfish species, except for halibut (a prohibited species), Greenland turbot, rock sole, yellowfin sole and arrowtooth flounder.
[3] Greenland turbot, arrowtooth flounder, and sablefish fishery category.
[4] Pollock other than pelagic trawl pollock, Atka mackerel, and "other species" fishery category.

Section 679.21(e)(3) requires, after subtraction of PSQ reserves for the CDQ Program, that halibut trawl PSC limit be apportioned between the BSAI trawl limited access sector and Amendment 80 sector. Table 35 to part 679 lists the amount of halibut PSC limit assigned to the BSAI trawl limited access sector as 875 mt and to the Amendment 80 sector as 2,325 mt (reduced from 2,525 mt in 2008 by Amendment 80). Pursuant to § 679.21(e)(1)(iv) and 679.91(d) through (f), trawl halibut PSC limit assigned to the Amendment 80 sector is then sub-allocated to Amendment 80 cooperatives as PSC cooperative quota (CQ) and to the Amendment 80 limited access fishery. The PSC CQ assigned to Amendment 80 cooperatives is not allocated to specific fishery categories. However, § 679.21(e)(3)(i)(B) requires the apportionment of each trawl PSC limit to the BSAI trawl limited access and Amendment 80 limited access into PSC limits for seven specified fishery categories. As discussed above, since 2011 all Amendment 80 vessels have joined a cooperative, so there has been no Amendment 80 limited access sector.

The BSAI trawl fishery categories are:

1. Yellowfin sole
2. Rock sole/other flatfish/flathead sole (other flatfish for PSC monitoring includes all flatfish species, except for halibut (a prohibited species), Greenland turbot, rock sole, yellowfin sole, arrowtooth flounder, and Kamchatka flounder
3. Greenland turbot/arrowtooth flounder/sablefish (includes Kamchatka flounder)
4. Rockfish
5. Pacific cod
6. Midwater trawl pollock

7. Pollock/Atka mackerel/other species

The BSAI trawl limited access sector does not receive apportionments of the 875 mt halibut PSC limit for the rock sole/flathead sole/other flatfish or Greenland turbot/arrowtooth flounder/sablefish fisheries categories for several reasons. First, the sector does not receive allocations of rock sole and flathead sole groundfish under the Amendment 80 Program. Therefore, no halibut PSC limit needs to support directed fisheries for these two species. Second, the sector does not target Alaska plaice, other flatfish, Greenland turbot, arrowtooth flounder, Kamchatka flounder, or sablefish. (For trawl PSC accounting, Kamchatka flounder is in the Greenland turbot/arrowtooth flounder/sablefish category and Alaska plaice is in the rock sole/flathead sole/other flatfish category.) The BSAI trawl limited access sector includes a large portion of American Fisheries Act (AFA) vessels which are managed under AFA sideboard limits. Most of the sideboard limits for these species are not large enough to support directed fisheries and directed fishing is closed. All 16 trawl C/Ps fishing in the BSAI trawl limited access sector are AFA vessels and have sideboard limits for these groundfish species. From 2008 through 2014, the average number of trawl CVs fishing in the BSAI was 106, with 93 AFA CVs and 13 non-AFA CVs. Other reasons that the non-AFA vessels may choose to not target these species is the difficulty in locating trawlable amounts, the amount of halibut PSC needed to prosecute the target fishery, or the lack of a market. However, if this sector ever was allowed and chose to target these fisheries then during the harvest specifications process the Council could recommend halibut and crab PSC limits for the appropriate fishery category.

The BSAI trawl limited access sector does receive apportionments of the 875 mt halibut PSC limit to the rockfish, Pacific cod, pollock/Atka mackerel/other species, and yellowfin sole fisheries categories. For 2008 and 2009, the BSAI trawl limited access sector’s halibut PSC limits had no seasonal apportionments. From 2010 through 2014, the rockfish fishery category has had one halibut PSC limit seasonal allowance of 5 mt from April 15 through December 31. This allows the directed fishery for rockfish to open at noon, Alaska local time, April 15 when the halibut PSC limit becomes available. The Council recommended this seasonal allowance after public testimony from the BSAI trawl limited access sector participants that target Pacific ocean perch (POP) in the Aleutian Islands. The start date of April 15 allows for a fair start by all participants since the BSAI trawl limited access sector’s POP fishery is still prosecuted under a race for fish by a few vessels. Unless the BSAI trawl limited access sector’s allocation of POP was further allocated by vessel or there were other changes to the BSAI rockfish fisheries it is expected that the halibut PSC limit for the rockfish fishery category will continue to have a seasonal allowance for April 15 through December 31. No other fishery category has a season allowance of the halibut PSC limit.

The BSAI trawl limited access sector has allocations of Atka mackerel, Pacific cod, and pollock. These groundfish species, Atka mackerel, Pacific cod, and pollock, all have season allowances of their TACs for all trawl sectors (Table 4-5). The seasons were developed for Steller sea lion protections measures and these seasonal allowances control when the TAC for species are caught. Therefore, it may not be necessary to have an additional seasonal apportionment of the halibut PSC limit.

Table 4-5 BSAI groundfish species with seasonal allowances

Species	Season dates and proportional allowances[1]					
	A season		B season		C season	
Atka mackerel	Jan 20 – June 10	50%	June 10 – Dec 31	50%	n/a	
Pacific cod						
Catcher vessels	Jan 20 – April 1	74%	April 1 – Sep 1	11%	Sep 1 – Nov 1	15%
Catcher processors	Jan 20 – April 1	75%	April 1 – Sep 1	25%	Sep 1 – Nov 1	0
Amendment 80 and CDQ	Jan 20 – Dec 31	100%	n/a		n/a	
Pollock	Jan 20 – June 10	40%	June 10 – Dec 31	60%	n/a	

[1]In 2015, season dates changed with implementation of the revised Steller sea lion protection measures for Atka mackerel to December 31 and Pacific cod for CDQ and Amendment 80 to December 31.

The fishery category "other species" includes skates, sculpins, sharks, squids, and octopuses. These "other species" are not open for directed fishing for any gear type. Therefore, no halibut PSC limit is needed to support an "other species" directed fishery.

Yellowfin sole is the only species with a BSAI trawl limited access sector allocation, developed directed fishery, and no seasonal allocation of the TAC. Yellowfin sole is not one of the primary prey species for Steller sea lions and no protection measure to spatially and temporally distribute the catch of yellowfin sole have been developed. From 2008 through 2011, yellowfin sole was reallocated to the Amendment 80 cooperative(s) as the BSAI trawl limit access sector did not catch its allocation of the TAC, see Table 4-6. Since 2013, the BSAI trawl limited access sector has caught its full allocation of the yellowfin sole TAC. In 2013, the sector was closed due to reaching its yellowfin sole TAC allocation. In 2014, the halibut PSC limit was a limiting factor. The BSAI trawl limited access sector was projected reached the halibut PSC limit assigned to the yellowfin sole fishery category and directed fishing closed on May 18, 2014. At their June 2014 meeting, the Council recommended and NMFS approved, a reallocation of the BSAI trawl limited access sector's halibut PSC limits. This increased the yellowfin sole halibut PSC limit from 167 mt to 227 mt, and NMFS opened directed fishing for BSAI yellowfin sole by the BSAI trawl limited access sector on June 25, 2014. See Section 4.4 for explanation of the reallocation of BSAI trawl limited access sector halibut PSC limits.

Table 4-6 BSAI trawl limited access sector yellowfin sole in the yellowfin sole target by year

Year	Initial allocation	Reallocation	Final Allocation	Total Catch	% Caught	# of Vessels
2008	44,512	(6,000)	38,512	19,382	50	15
2009	39,514	(6,000)	33,154	10,394	31	9
2010	42,369	(20,000)	22,369	19,485	87	9
2011	34,153	(2,000)	32,153	25,375	79	12
2012	36,297	-	36,297	28,501	79	15
2013	34,868	-	34,868	34,786	100	13
2014	29,707	-	29,707	26,952	91	13

Source: Alaska Region Catch Accounting System. 2014 catch is as of November 24, 2014.

Section 679.21(e)(5) authorizes NMFS, after consultation with the Council, to establish seasonal apportionments of PSC amounts in order to maximize the ability of the fleet to harvest the available groundfish TAC and to minimize bycatch. The factors to be considered are:

(1) seasonal distribution of prohibited species,
(2) seasonal distribution of target groundfish species,
(3) PSC bycatch needs on a seasonal basis relevant to prohibited species biomass,
(4) expected variations in bycatch rates throughout the year,
(5) expected start of fishing effort, and
(6) economic effects of seasonal PSC apportionments on industry sectors.

The BSAI trawl limited access sector's yellowfin sole fishery category may benefit from a seasonal allowance of the halibut PSC limit. The six factors listed above are further discussed below. See Section 3.1.1 for information on factor 1, the seasonal distribution of Pacific halibut.

For factor 2 above, the 2014 SAFE report provides some information on the seasonal distribution of yellowfin sole. The yellowfin sole (*Limanda aspera*) is one of the most abundant flatfish species in the eastern Bering Sea (EBS) and is the target of the largest flatfish fishery in the world. They inhabit the EBS shelf and are considered one stock. Abundance in the Aleutian Islands region is negligible. Yellowfin sole are distributed in North American waters from off British Columbia, Canada, to the Chukchi Sea and south along the Asian coast to off the South Korean coast in the Sea of Japan. Adults exhibit a benthic lifestyle and occupy separate winter, spawning and summertime feeding distributions on the eastern Bering Sea shelf. From over-winter grounds near the shelf margins, adults begin a migration onto the inner shelf in April or early May each year for spawning and feeding. The directed fishery has typically occurred from late winter through autumn (Wilderbuer et al. 1992). Yellowfin sole are managed as a single stock in the BSAI management area as there is presently no evidence of stock structure (Wilderbuer et al. 2014).

Table 4-7 shows the total catch of yellowfin sole by season if there was an A season and B season allocation. From 2008 through 2010 for this sector as the yellowfin sole total catch increases so does the catch in the B season.

Table 4-7 BSAI trawl limited access yellowfin sole total catch in the yellowfin sole target by season (catch is in metric tons)

Year	A season[1]		B season[1]		Total
	Total catch	Percent of Total	Total catch	Percent of Total	
2008	17,022	88	2,360	12	19,382
2009	9,824	95	570	5	10,394
2010	19,485	100	-	0	19,485
2011	17,740	70	7,635	30	25,375
2012	16,697	59	11,804	41	28,501
2013	29,090	84	5,696	16	34,786
2014	17,084	63	9,868	37	26,952

[1]A season is January 20 to June 10, B season is June 10 to December 31.
Source: Alaska Region Catch Accounting System. 2014 catch is through November 24, 2014.

For items 3 and 4 in the list above, Table 4-8 shows that halibut PSC can vary from year to year and season to season.

Table 4-8 BSAI Trawl Limited Access halibut PSC mortality in the yellowfin sole target by season (in metric tons)

Year	A season[1]		B season[1]		Total
	PSC mortality	Percent of Total	PSC mortality	Percent of Total	
2008	116	75	39	25	155
2009	95	96	4	4	99
2010	27	100	-	0	27
2011	24	30	57	70	81
2012	40	28	103	72	143
2013	127	69	58	31	185
2014	150	84	29	16	179

[1]A season is January 20 to June 10, B season is June 10 to December 31.
Source: Alaska Region Catch Accounting System. 2014 catch is through October 25, 2014.

For item 5 above, Table 4-9 shows for the BSAI trawl limit access sector that the first week of yellowfin sole catch is the first week that trawl gear opens (January 20), and the last week of yellowfin sole catch varies from year to year. However, from 2011 through 2013, the catch has continued into November and December.

Table 4-9 BSAI trawl limited access timing of yellowfin sole catch in the yellowfin sole target

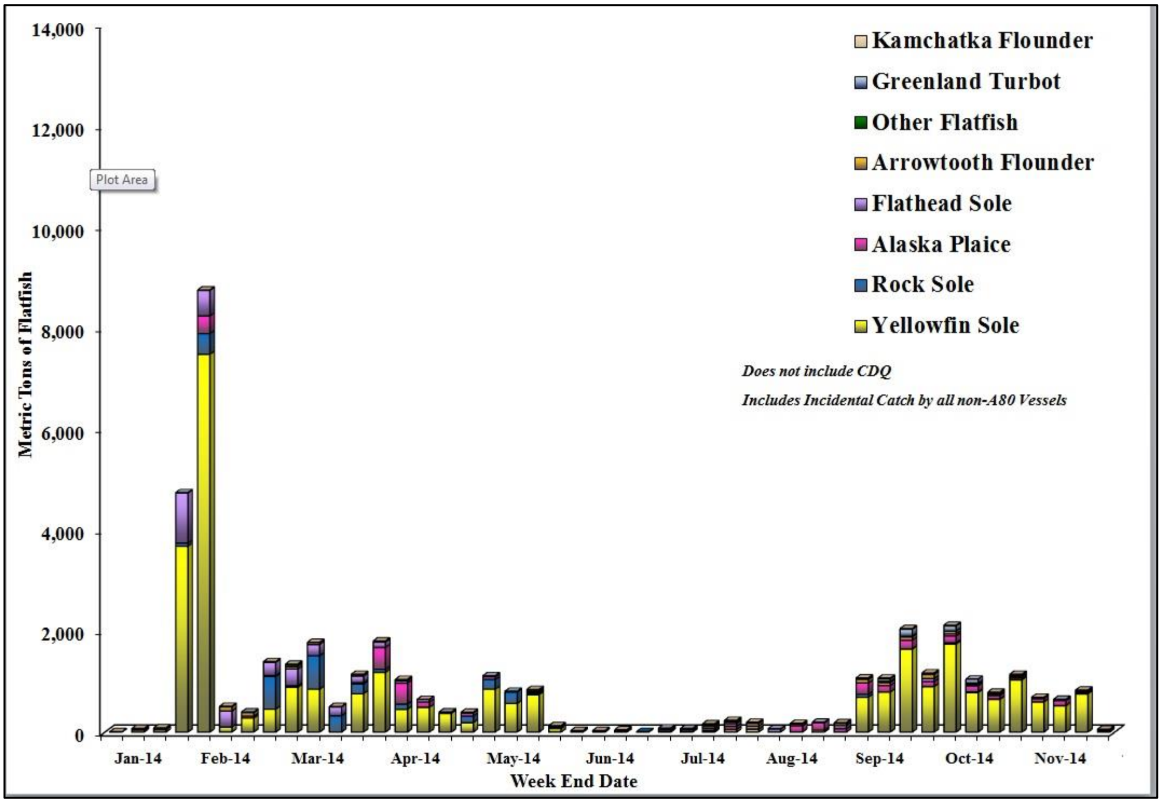
Year	First week of catch	Last week of catch	# of days
2008	26-Jan-08	29-Nov-08	308
2009	24-Jan-09	29-Aug-09	217
2010	23-Jan-10	20-Mar-10	56
2011	22-Jan-11	26-Nov-11	308
2012	21-Jan-12	01-Dec-12	315
2013	26-Jan-13	16-Nov-13	294
2014	25-Jan-14	n/a	n/a

Source: Alaska Region Catch Accounting System

As shown in Figure 4-7, the non-Amendment 80 sector catches most of the yellowfin sole at the start of the A season and after the B season for pollock. The figure includes all non-Amendment 80 yellowfin sole by all gear and targets, for confidentiality reasons.

For factor 6, the economic effects of seasonal PSC apportionments on the BSAI trawl limited access sector may not be too large since most of the yellowfin sole is caught early in the A season, and the sector does not target yellowfin sole from June through August.

Figure 4-7 BSAI flatfish catch by non-Amendment 80 vessels in 2014



4.8 Halibut deck sorting on Amendment 80 Catcher Processors

The Alaska Seafood Cooperative (AKSC) operates under Amendment 80 to the BSAI FMP. Amendment 80 allocates target species allowances and prohibited species catch limits to cooperatives. Regulations on PSC, and particularly the halibut PSC limits, have traditionally constrained yields in flatfish fisheries and other non-pollock Bering Sea trawl fisheries. The potential for halibut PSC mortality to limit the Amendment 80 sector increased to some extent with the program's implementation because the halibut PSC mortality available to the sector was reduced by 50 mt per year over a four-year period. One goal of the AKSC is to minimize prohibited species bycatch through research collaborations on gear modification and bycatch reduction programs so that available yields of target fish can be maximized.

Cooperative members have been using two approaches to reduce halibut bycatch rates. First, all member vessels participate in the co-op's bycatch avoidance program. Second, AKSC members have developed gear modifications to flatfish nets called halibut "excluders" that use sorting grates installed in the trawl intermediate to allow halibut to escape while retaining a high fraction of the target flatfish. Although significant progress has been made to control halibut bycatch with excluders, the AKSC is seeking methods to further reduce halibut bycatch and halibut mortality.

In addition to gear modifications to avoid halibut bycatch, modifications to fishing practices such as reducing haul sizes and tow times may improve the viability of halibut that are caught; however, changes to fishing practices alone would not result in improvements to halibut mortality rates; regulatory changes would also be required. One of the key factors affecting halibut viability is the amount of time the fish spend out of water prior to being sampled by observers and returned to the sea. Current catch handling regulations for Amendment 80 fisheries require that all halibut be delivered to the factory for sampling by an observer. While these procedures are currently needed to ensure that all catch is accounted for, the downside is that some halibut remain out of the water for up to several hours and consequently suffer higher mortality rates. Any viability gains from reducing haul sizes and tow times are lost by the time observers sample and discard halibut. Changes to fishing practices combined with modified catch handling regulations are necessary to make meaningful, cost-effective improvements in halibut bycatch survival.

Industry has suggested that if halibut could be sorted on deck and returned to the sea sooner, discard mortality rates could be reduced. Two exempted fishing permits (EFPs)[13] have been issued, and research under those permits has been completed to evaluate how modified fishing practices and deck sorting might be combined to reduce halibut PSC mortality. The AKSC is developing a third EFP proposal to build upon what has been learned from the first two. A summary of the two previous EFPs follows.

2009 Exempted Fishing Permit (#09-02)

In May 2009, the AKSC conducted a pilot study under EFP #09-02 to evaluate a set of alternative fishing practices in combination with changes in trawl catcher processor catch handling procedures to help the industry learn about both the operational feasibility of these modifications and their effectiveness for minimizing halibut PSC mortality. The 2009 EFP focused on a discrete set of summer fisheries considered to have the highest chances of success due to favorable weather conditions, ability to work with relatively small catch amounts per haul, and other operational factors. In this study, an average mortality rate of 45% was achieved for halibut sorted on deck, compared to the published mortality rates of approximately 75-80% in the factory for the fisheries that were the subject of this study. The 2009 EFP

[13] An exempted fishing permit is a permit issued by the Alaska Region of NMFS to allow groundfish fishing activities that would otherwise be prohibited under regulations for groundfish fishing. These permits are issued for limited experimental purposes to support projects that could benefit the groundfish fisheries and the environment. Examples of past projects supported by an EFP include the development of new gear types for an underutilized fishery and development of devices that reduce prohibited species bycatch.

recommended that further research should explore a broader range of target fisheries, seasonal weather conditions, and vessel sizes to obtain a more realistic assessment of the feasibility of the alternative fishing practices and procedures for sorting and accounting for halibut on deck.

The final report for EFP #09-02 (Gauvin 2010) is available on the NMFS website at http://alaskafisheries.noaa.gov/ram/efp.htm.

2012 Exempted Fishing Permit (#12-01)

EFP #12-01 expanded upon EFP #09-02 to explore the feasibility of deck sorting of halibut. The 2012 EFP tested a wider subset of Amendment 80 fisheries, vessel sizes, and weather conditions over a longer time span, and sought to develop an improved and more efficient sampling protocol. One out of five deck-sorted halibut were randomly selected for length and viability assessment instead of the census approach used in 2009. The 2009 census approach was suspected to have upwardly biased mortality rates on some tows in the 2009 EFP. Primary target fisheries tested in this EFP included yellowfin sole (in "fall" fishing mode), arrowtooth flounder, flathead sole, and rock sole, and to a lesser extent, Pacific cod, bottom pollock, and rex sole. The "fall mode" yellowfin sole fishery tends to catch more and larger halibut than the spring fishery. The bottom pollock fishery is a non-pelagic trawl fishery with a mixed catch composition, primarily pollock.

Results from EFP#12-01 showed that across all vessels and target fisheries, more than 80% of the halibut were sorted out of the catch on deck (less than 20% had to be sorted in the factory). The average halibut mortality rate for the deck-sorted halibut was approximately 57%, higher than in 2009. This increase may be the result of testing deck sorting procedures over a wider variety of fisheries with larger hauls and higher rates of halibut bycatch than those tested in 2009. Halibut mortality was shown to increase with time out of water, with 20-30 minutes being the critical time window for effective mortality reduction. The sampling protocols implemented in this EFP reduced handling times relative to the 2009 EFP.

The general consensus from interviewed skippers and vessel personnel was that halibut deck sorting to reduce mortality would be more practical in fisheries with relatively smaller haul sizes (≤ 30 mt) and where larger, hence easier to sort, halibut are encountered. Deck sorting in high volume fisheries with high halibut bycatch (e.g., rock sole) could be feasible and likely beneficial with some modifications to the EFP protocols. Deck sorting in high volume fisheries with low bycatch (e.g., yellowfin sole) would not likely be worthwhile because the large amount of effort and personnel required for deck sorting would yield only small savings of halibut PSC mortality. Interviewees also noted that harsh weather conditions could restrict the on-deck duties of sea samplers or observers to quantify and assess deck-sorted halibut. This would negatively affect fishing operations.

Results from the 2012 EFP identified several priority areas where further research is needed:

(1) Focus deck sorting efforts on lower catch rate fisheries (e.g., flathead sole, bottom pollock, Pacific cod, arrowtooth flounder, rex sole);
(2) Explore how deck sorting could be allowed in the higher catch rate target fisheries (e.g., rock sole and possibly yellowfin sole), while simultaneously allowing fish to be passed over the factory flow scale to speed processing;
(3) Consider ways to allow deck sorting during the critical time window for any Amendment 80 fisheries in which halibut PSC mortality is constraining, by applying a separate halibut mortality rate to halibut sorted on deck and a default IPHC rate to those accounted for in the factory;
(4) Design vessel decks for future rebuilds that allow for better catch accounting and reduced handling of deck-sorted halibut while providing more sheltered areas and safer deck conditions for observers; and

(5) Develop electronic monitoring (EM) technology to quantify deck-sorted halibut within the critical time window to reduce the need for sea samplers and observers on deck. EM could also be used in the factory to ensure that halibut are not discarded while the observer or sea sampler is performing on-deck duties.

The final report for EFP #12-01 (Gauvin 2014) is available on the NMFS website at http://alaskafisheries.noaa.gov/ram/efp.htm.

2016 Exempted Fishing Permit

In June 2014, the Council requested as part of this EA/RIR/IRFA the analysis of an alternative for implementing management measures that would allow deck sorting of halibut for Amendment 80 sector to reduce halibut mortality. In October 2014, the Council received an update from NMFS and Amendment 80 sector representatives indicating that further research is needed before management measures can be developed that would allow deck sorting of halibut to occur with sufficient accountability. To wait for the results of this research for inclusion as an alternative in this analysis would likely delay the implementation of any of the other alternatives for PSC mortality reductions. The Council acknowledged that a new EFP that builds upon the results of EFPs #09-02 and 12-01 to further explore deck sorting may be necessary and that this alternative should be considered in a separate action. The following section summarizes progress in development of a new EFP, and the objectives for that proposed study.

The purpose of a new EFP would be to refine appropriate sampling protocols and monitoring requirements, evaluate the durability of the technology over two years of fishing, and test whether and in which fisheries the deck sorting protocol would be preferentially used by vessels. The AKSC is working with NMFS to develop another EFP to conduct an operational test of motion-compensated scales and electronic monitoring on the decks of multiple Amendment 80 vessels. To date, AKSC has conducted proof of concept testing using both a stereo camera and motion-compensated scale, in addition to their previous EFPs discussed above. The AKSC expects to present its EFP application to the Council by June 2015 and fishing under the EFP would commence in 2016.

The EFP would allow participating vessels to be exempted from having to use the single fish handling protocol available to Amendment 80 vessels currently. No additional halibut PSC mortality allowance would be requested for this EFP. Previous studies indicate that fishing under the EFP will result in immediate savings of halibut PSC mortality. The exemption and other aspects of the EFP would allow participants to have the option of handling halibut under an alternative fish handling protocol designed to accurately account for the halibut catch and its viability while rapidly returning halibut sorted on deck to the sea so as to minimize mortality. All participating EFP vessels would have a sea sampler meeting the requirements of the EFP on board whenever EFP catch handling procedures are occurring. The principle duties for the sea sampler would be halibut mortality accounting and viability sampling based on a random sampling design that provides adequate information about viability relative to the default rate used to account for halibut mortality usage during the EFP. Additionally, all participating vessels would be required to have 1) an approved motion-compensated conveyor scale, and 2) an approved deck monitoring video system in operation whenever EFP catch handing activities are occurring. The EFP shall occur over a two-year period with periodic reporting of results to NMFS and the Council during that time to assess whether the EFP is accomplishing its objectives. A default halibut mortality rate would be used to strike a balance between incentivizing fishermen to minimize halibut mortality and leaving a portion of those savings "in the water" as part of the Council's efforts to improve management of halibut PSC mortality in groundfish fisheries of the Bering Sea.

2015 Expedited Exempted Fishing Permit

At the December 2014 Council meeting, in response to the IPHC staff recommendations for a very low directed halibut fishery in Area 4CDE because of high bycatch in the BSAI groundfish fisheries in that area, industry informed the Council that they intended to apply for an expedited EFP that would be operable in 2015, in order to reduce halibut mortality from groundfish fisheries in 2015. In order to put a program on the water as expeditiously as possible, industry members proposed to mimic the procedures used in the 2012 halibut deck sorting EFP, which used on deck sea samplers, as this methodology has already been reviewed by the agency, and would likely result in a quicker approval process. On December 24, 2014, NMFS received an application from Mr John Gauvin on behalf of the Alaska Seafood Cooperative (AKSC) for an exempted fishing permit. The EFP would allow operators of non-pelagic trawl CP vessels to sort halibut on deck rather than routing halibut over the flow scale and below deck. The purpose of the experiment is to continue to test methods that reduce halibut mortality in fisheries for flatfish by reducing the amount of halibut handling and time out of water. The goal of the EFP is to reduce mortality of halibut bycatch in the Amendment 80 sector in 2015**.**

On January 12, 2015, the AFSC found the EFP application constitutes a valid fishing experiment appropriate for further consideration. The objectives for the EFP are to: (1) assess the reduction in halibut mortality when deck sorting is available as an optional catch handling procedure; (2) evaluate the frequency of tows where deck sorting is used relative to the existing catch handling procedures; (3) evaluate the percentage of a participating vessel’s halibut catch that is sorted on deck; and (4) evaluate the utility of deck sorting in the context of the rules and constraints of the FEP. The EFP would exempt participating AKSC CPs from selected prohibitions and monitoring and observer requirements otherwise in regulation for Amendment 80 fisheries. The EFP would begin in early 2015, and continue until the end of 2015. NMFS has initiated consultation with the Council on this EFP, which is scheduled for review at the February 2015 Council meeting.

5 Regulatory Impact Review

This Regulatory Impact Review (RIR)[14] examines the benefits and costs of a proposed regulatory amendment to reduce Pacific halibut prohibited species catch (PSC) limits in the Bering Sea/Aleutian Islands (BSAI) groundfish fisheries. PSC limit reductions are considered for various sectors, including the BSAI trawl limited access sector, the Amendment 80 sector, longline catcher vessels, longline catcher processors, and the Community Development Quota sector (i.e., a reduction to the CDQ's allocated prohibited species quota reserve). The objective of reducing PSC limits would be to minimize bycatch to the extent practicable, potentially provide additional harvest opportunities in the directed halibut fishery, and help improve halibut stock conditions.

The preparation of an RIR is required under Presidential Executive Order (E.O.) 12866 (58 FR 51735: October 4, 1993). The requirements for all regulatory actions specified in E.O. 12866 are summarized in the following Statement from the E.O.:

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

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

- Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, local or tribal governments or communities;
- Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
- Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
- Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

5.1 Statutory Authority

Under the Magnuson-Stevens Fishery and Conservation Act (Magnuson-Stevens Act) (16 USC 1801, *et seq*.), the United States has exclusive fishery management authority over all marine fishery resources found within the exclusive economic zone (EEZ). The management of these marine resources is vested in the Secretary of Commerce (Secretary) and in the regional fishery management councils. In the Alaska Region, the Council has the responsibility for preparing fishery management plans (FMPs) and FMP amendments for the marine fisheries that require conservation and management, and for submitting its

[14] If the RIR/IRFA is a stand-alone document because the action qualifies for a CE, add this footnote:
"The proposed action has no potential to effect individually or cumulatively on the human environment (as defined in NAO 216-6). The only effects of the action are economic, as analyzed in this RIR/IRFA. As such, it is categorically excluded from the need to prepare an Environmental Assessment."

recommendations to the Secretary. Upon approval by the Secretary, NMFS is charged with carrying out the federal mandates of the Department of Commerce with regard to marine and anadromous fish.

The BSAI groundfish fishery in the EEZ off Alaska is managed under the FMP for Groundfish of the BSAI Management Area. The proposed action under consideration would amend this FMP and Federal regulations at 50 CFR 679. Actions taken to amend FMPs or implement other regulations governing these fisheries must meet the requirements of Federal law and regulations.

5.2 Purpose and Need for Action

Consistent with the MSA's National Standard 1 and National Standard 9, the Council and NMFS use halibut PSC limits to minimize halibut bycatch (halibut PSC mortality) in the groundfish fisheries to the extent practicable, while achieving, on a continuing basis, the optimum yield from the groundfish fisheries. Although fishermen are required by regulation to avoid the capture of any prohibited species in groundfish fisheries, the use of halibut PSC limits in the groundfish fisheries provide an additional constraint on halibut PSC mortality, and promote conservation of the halibut resource. Halibut PSC limits provide a regulated upper limit to halibut interceptions, as continued groundfish fishing is prohibited once a halibut PSC limit has been reached for a particular sector and/or season. This provides the maximum benefit to fishermen and communities that depend on both halibut and groundfish resources, as well as U.S. consumers.

The halibut resource is fully allocated. The IPHC accounts for incidental halibut removals in the groundfish fisheries, recreational and subsistence catches, and other sources of halibut mortality before setting commercial halibut catch limits each year. Declines in the exploitable biomass of halibut since the late 1990s, and decreases in the Pacific halibut catch limits set by the IPHC for the directed BSAI halibut fisheries, have raised concerns about the levels of halibut PSC mortality by the commercial groundfish trawl and hook-and-line sectors. Reductions in halibut PSC mortality have not been proportional to the reductions in directed halibut harvest limits over this time period, although Council recognizes industry efforts to reduce halibut PSC mortality. The effect of reduced catch limits for the directed halibut fishery is most pronounced in Area 4CDE, and under National Standard 8, the Council is beholden to provide for the sustained participation of and to minimize adverse economic impacts on fishing communities, such as the coastal communities in this area.

The proposed action would reduce the halibut PSC limits in the BSAI, which are established for the BSAI trawl and fixed gear sectors in Federal regulation, and in some cases, in the BSAI Groundfish FMP. Overall halibut PSC limits can be modified only through an amendment to the regulations and the FMP, although seasonal and some fishery apportionments of those PSC limits would continue to be set annually through the BSAI groundfish harvest specifications process.

The purpose of the proposed action is to minimize halibut PSC mortality in the commercial groundfish fisheries to the extent practicable, while preserving the potential for the full harvest of the groundfish total allowable catches (TACs) assigned to the trawl and hook-and-line sectors. The proposed action minimizes halibut PSC mortality to the extent practicable in consideration of the management measures currently available to the groundfish fleet, the uncertainty about the extent to which halibut PSC mortality in the groundfish fishery has adverse effects on the halibut resource, and the need to ensure that catch in the trawl and hook-and-line fisheries contributes to the achievement of optimum yield in the groundfish fisheries. Minimizing halibut PSC mortality while achieving optimum yield is necessary to maintain a healthy marine ecosystem, ensure long-term conservation and abundance of halibut, provide maximum benefit to fishermen and communities that depend on halibut and groundfish resources, as well as U.S. consumers, and comply with the Magnuson-Stevens Act and other applicable Federal law.

Halibut savings that would occur from reducing halibut PSC mortality below current usage would accrue to the directed halibut fisheries in both the near term and long term. Near term benefits would result from the PSC mortality reductions of halibut that are over 26 inches in length (O26). These halibut would be available to the commercial halibut fishery in the year that the PSC mortality is foregone, or when the fish reach the legal size limit for the commercial halibut fishery (greater than or equal to 32 inches in total length). Longer term benefits in the directed fisheries would accrue from a reduction of halibut PSC mortality that are less than 26 inches (U26). Benefits from these smaller halibut would occur as they recruit into the directed halibut fisheries.

5.3 Alternatives

In June 2014 the Council adopted the following set of alternatives. In keeping with the Council's intent, staff has proposed certain modifications to the alternatives, which are indicated in underline and strikeout. The modifications, and the alternatives, are discussed in further detail in Chapter 2. This RIR will analyze the modified set of alternatives and options.

Alternative 1 No action.

Alternative 2 Amend the BSAI Groundfish FMP to revise halibut PSC limits as follows *(more than one option can be selected)*.

- ~~**Option 1** Establish seasonal apportionment of halibut PSC mortality in the BSAI trawl limited access sector.~~
- **Option 2** Reduce halibut PSC limit for the BSAI Trawl Limited Access Sector by:
  a) 10 percent b) 20 percent c) 30 percent or d) 35 percent
- **Option 3** Reduce halibut PSC limit for the Amendment 80 Sector by:
  a) 10 percent b) 20 percent c) 30 percent or d) 35 percent
- **Option 4** Reduce halibut PSC limit for Pacific cod hook and line catcher vessel sector by:
  a) 10 percent b) 20 percent c) 30 percent or d) 35 percent
- **Option 5** Reduce halibut PSC limit for Pacific cod hook and line catcher processor sector by:
  a) 10 percent b) 20 percent c) 30 percent or d) 35 percent
- **Option 6** Reduce the CDQ halibut PSQ limit by:
  a) 10 percent b) 20 percent c) 30 percent or d) 35 percent
- Option 7 Reduce halibut PSC limit for other non-trawl (i.e., hook and line catcher vessels and catcher processors targeting anything except Pacific cod or sablefish) by:
  a) 10 percent b) 20 percent c) 30 percent or d) 35 percent

~~**Alternative 3.** Implement measures in the Amendment 80 sector to provide opportunities for deck sorting of halibut, or other handling practices that may provide an opportunity to reduce mortality of halibut that cannot be avoided.~~

5.4 Methodology for Analysis of Impacts

In order to estimate the future impacts of reductions in halibut PSC limits in the BSAI Groundfish fishery, a very complicated series of calculations, assumptions, and estimates must be made, most of which include a significant amount of uncertainty. In addition to the uncertainty found in many of the assumptions and estimates, the calculations are dynamic in that assumptions and calculations made in one year affect the assumptions and calculations made in later years.

After a thorough assessment of potential methodologies to assess impact of bycatch reductions, analysts at Northern Economics, Inc. (NEI) have concluded that a multi-year simulation model that is repeated over 10,000 iterations, with random selections of key variables in each iteration, will provide more robust results than other methodologies. This model has been named the "Iterative Multi-year Simulation Model" or IMS Model.

Previous Council PSC mortality analyses have used a retrospective analysis of when a PSC limit reduction would have constrained fishing in a given set of past years, assuming no change in fishing behavior in response to the new limit. Although this represents a maximum impact of the PSC limit reduction on affected groundfish fisheries, it is unrealistic to assume that fishermen will not change their behavior during the course of the year in order to optimize their groundfish catch under a new limit. The IMS Model includes parameters to reflect some measure of optimization, although outputs are still subject to uncertainty, as fishermen's exact response, and future fishery and environmental conditions, cannot be predicted.

There are two aspects to the modeling of impacts of PSC limit reductions in the BSAI groundfish fisheries. The first, as alluded to above, is how to account for fishermen's response to constraining limits by optimizing their groundfish fishing to the extent possible (noting that their ability to respond effectively is more difficult when PSC limit reductions, or other management measures affecting them, are more constraining). The second aspect is how "savings" of halibut PSC mortality in the groundfish fisheries affect other sectors, in this case, the commercial halibut fishery. Section 5.4.1 addresses the first aspect, optimization in the groundfish fisheries; Section 5.4.2 describes how halibut PSC mortality reductions are modeled with respect to their impact on halibut fisheries. The section includes a detailed description of the algorithms used by IPHC staff to generate their recommendations for the coming year's Fishery Constant Exploitation Yield (FCEY). The algorithms link changes in halibut PSC mortality in the groundfish fisheries to changes in the allowable catch (the FCEY) in the commercial halibut fisheries. After describing this process, in Section 5.4.3 we go on to show, through a series of examples, why we believe the IMS model can provide a more robust set of estimates of fishery impacts. The section ends with an example of IMS Model results.

5.4.1 Description of IMS Model for the Groundfish Fisheries

Because of the need to have multiple years in the model, and because of the inherent variability of halibut PSC mortality, the analysts have determined that the best modelling approach is to use an iterated multi-year model to simulate the impacts of reduction in PSC limit alternatives. We call this model the Iterated Multi-year Simulation Model or IMS Model. The model looks out into the future starting with 2014 and runs through 2023. (We note that in terms of complete data, 2014 is a future year for this analysis.)

Bycatch for each of the future years in all subareas will be simultaneously determined via a random selection of Basis Years from 2008 to 2013. The same set of selected years will be used in a status quo calculation of impacts, and then to calculate the impacts under the particular PSC limit reduction option. The set of selected years will be used for all subareas during each iteration. The results will be reported as the net change from the status quo under the alternative. The selection of Basis Years and the calculation of impacts will be repeated 10,000 times for each of the four reduction options for each affected participant group.[15]

[15] As will be discussed later in the analysis, many of the proposed options will have no material impact on particular participant groups. For example, longline catcher vessels did not take even 50 percent of their 15 mt PSC limit in the Pacific cod fishery in any year from 2008 to 2013. Because of this, we did not run the IMS model for options affecting longline CVs.

For the groundfish fishery, the random selection of Basis Years to represent future years not only determines the halibut PSC mortality, they also determine groundfish harvests, and wholesale revenues generated.[16]

Algorithms used in the IMS Model to Drop Harvest Records to Reduce Halibut Bycatch

One of the major analytical issues is the determination of the means by which a reduction in the PSC limit will play out within a given fishery. For fisheries that can be characterized as a "race-for-fish," a reduction in the PSC limit will most likely mean that harvests at the end of the year will be cut—i.e., the last fish caught in the year will be the first fish cut. Cuts will continue until the total halibut PSC mortality no longer exceeds the reduced PSC limit.

For this analysis it was determined that the only fisheries that could be characterized as operating under a race for fish were the longline CV fishery for Pacific cod, and the BSAI TLA target fisheries for yellowfin sole, Pacific cod and rockfish.[17] An IMS Model was not run for the longline CV fishery for Pacific cod, because halibut PSC mortality in the fishery is below 50 percent of the PSC Limit in all of the basis years (2008 to 2013), and therefore none of the options materially affect the sector.

Vessels in the BSAI TLA target fisheries would be affected by all four of the reduction options, and although the BSAI TLA pollock fishery is clearly not a race-for-fish, the target fisheries for which there are PSC limits all have at least some of the characteristic of a race-for-fish; therefore, it is possible to model PSC Limit reductions on a last caught-first cut basis. A more complete discussion of this issue is included in the impact analysis for Option 2, which affects the BSAI TLA fisheries.

For this overview of the IMS Model, it is sufficient to indicate that modeling PSC limit reductions in a race-for-fish fishery is a fairly straightforward process, with some minor complications. The biggest issue is the relative precision of the data. For this analysis we had monthly harvest data on a vessel-by-vessel basis. The records were specific to a given trip target and a 3-digit management zone. All of the records indicated the gear used, the target fishery, and the 3-digit management area in which the harvest took place. Each record reported the total groundfish tons, the total halibut PSC mortality, and the estimated nominal ex-vessel and wholesale values generated from the groundfish that were harvested and eventually processed and sold.

Because the data were provided in monthly increments, we needed a way to order the records so they could be dropped in a successive basis if necessary to get the fishery below the PSC limit. In order to eliminate potential bias that could occur if the records were sorted by volume, we assigned each record a unique random number. If the records were part of the race-for-fish fishery and cuts were needed to keep the fishery below the new PSC limit, the records were sorted by the target fishery for which the PSC limit was applicable, then by month (last to first) and finally by the randomly assigned record number. The records within the last month were dropped according to the highest random number until halibut PSC mortality fell below the cap. Additional details on this methodology will be described in Section 0, which summarizes impacts of the reductions for vessel in the BSAI TLA fisheries.

A similar process type of process was used to sort and drop records for fisheries that are considered "rationalized." The A80-CPs with their cooperatives certainly fall into this category, as do the longline CPs—even though their cooperative is not officially recognized in regulations. The CDQ fisheries are

[16] In all cases for both the groundfish fishery and the commercial halibut fishery, revenues are adjusted for inflation to the equivalent of 2013 dollars. Future year revenues are discounted at 5 percent per year.

[17] The AFA pollock fisheries, are of course highly rationalized, and are considered part of the BSAI TLA fishery. Further, halibut taken in pollock target fisheries do count against the overall PSC limit for the BSAI TLA because 250 mt of 875 mt of the PSC limit are assigned to the pollock fishery in the status quo. The pollock fishery is not shut down when they hit the 250 mt limit, and total halibut PSC mortality in BSAI TLA may exceed the 875 mt limit.

also considered to be rationalized, since each participating CDQ group is issued an exclusive share of the CDQ allocations and the halibut PSC limit.

Vessels in rationalized fisheries have more opportunities to determine how they will reduce their halibut PSC mortality. If participants were to perfectly optimize their harvests patterns, and they had perfect knowledge about their catch and bycatch even before they set their nets, they would eliminate all of the tows that generated the lowest amounts of wholesale revenue per ton of halibut PSC mortality. Unfortunately, fishers cannot tell in advance which tow will be the worst and which will not be so bad.

Participants in rationalized fisheries do have the ability to look back over time and determine the months and target fisheries in which they generated their lowest levels of revenue per ton of halibut PSC mortality and eliminate target fisheries in those months first, knowing that even if they do not fish in that month for that target, they will have the ability to fish in the remaining months. The analysis relies on this type of logic to drop target months from rationalized fisheries.

For each participant group, the IMS Model determines in advance two related methodologies by which harvest records are dropped to meet the new PSC limit. Each of the two methods is considered a "Scenario" for the group. Scenario A reduces halibut PSC in a way that generates fewer negative impacts to the fleet, while Scenario B uses a similar methodology but generates greater negative impacts to the fleet. The two scenarios are designed to form reasonable lower and upper bounds.

The following scenarios are used in this document for each sector:

Bering Sea Trawl Limited Access Sector

- Scenario A: Under Scenario A, the PSC limits for all four of the BSAI TLA target fishery apportionments are reduced by the suboption reduction percentage including the apportionment for Pollock|Atka Mackerel|Other Species.
- Scenario B: Under Scenario B, the PSC limit for Pollock|Atka Mackerel|Other Species is held constant at 2014 levels, and PSC mortality apportionments for the three other target fisheries are reduced by an amount greater than the suboption reduction percentage such that the overall reduction for the sector equals the suboption reduction percentage.

Amendment 80 CPs

- Scenario A: Under Scenario A it is assumed that operators of A80-CPs, using sector-wide fishery data for the years 2008 to 2013, determine the particular months and target fisheries that generate the lowest wholesale revenue per ton of halibut PSC mortality. They then avoid fishing for those targets in those months. For analytical purposes it is assumed that operators know in advance how much halibut savings will be created by dropping these target months from their repertoire.
- Scenario B: Under Scenario B it is assumed that each A80 company is assigned its own halibut cap by the cooperative in which it operates. Companies that have excess PSC mortality are assumed to transfer PSC mortality to companies that don't have enough PSC mortality. It is also assumed, however, that each company with excess PSC mortality holds back 5 percent of their halibut in case they need it later in the year. Finally, it is assumed that if transfers of halibut are not available, then companies with a PSC mortality shortfall will reduce the length of time that its least "efficient" vessel operates.

Longline CPs

- Scenario A: Under Scenario A it is assumed that operators of longline CPs, using sector-wide fishery data for the years 2008 to 2013, determine the particular months and target fisheries that generate the lowest wholesale revenue per ton of halibut PSC mortality. They then avoid fishing for those targets in those months. For analytical purposes, it is assumed that operators know in advance how much halibut savings will be created by dropping these target months from their repertoire.

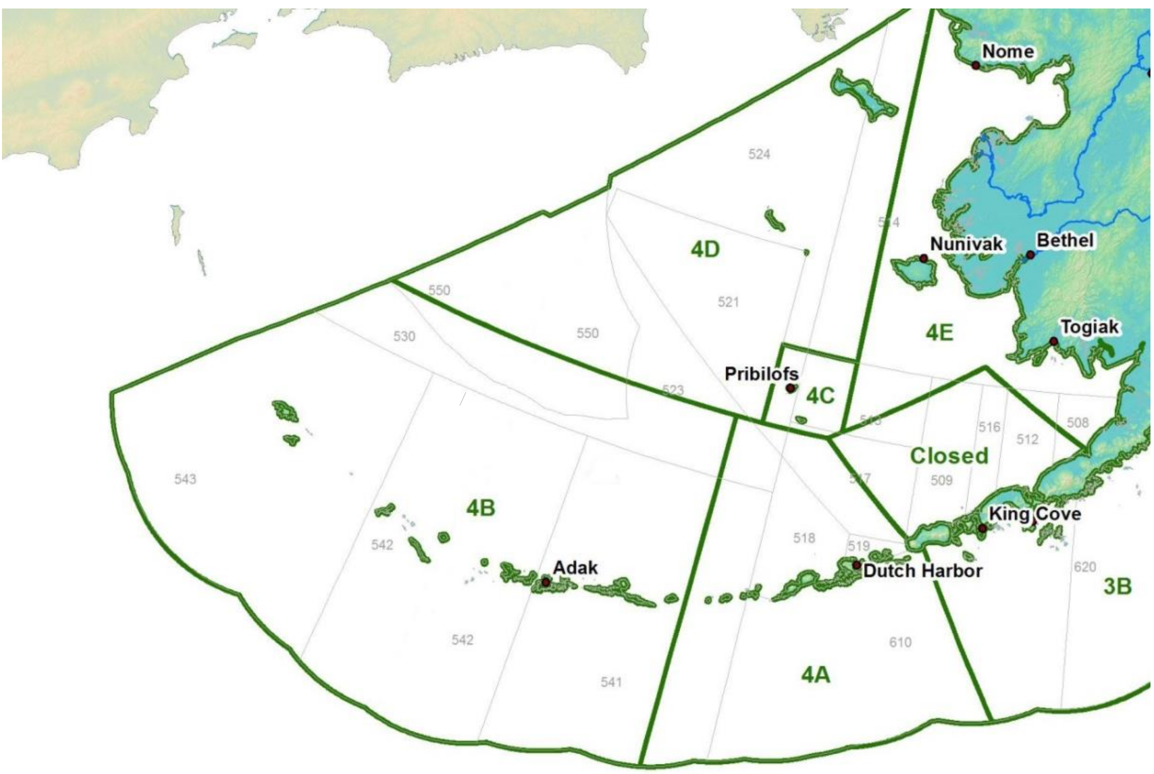
- Scenario B: Under Scenario B it is assumed that each longline CP company is assigned its own halibut cap by the cooperative. Companies that have excess PSC mortality are assumed to transfer PSC mortality to companies that do not have enough PSC mortality. It is also assumed, however, that each company with excess PSC mortality holds back 5 percent of their halibut in case they need it later in the year. Finally, it is assumed that if transfers of halibut are not available, then companies with a PSC mortality shortfall will reduce the length of time that its least "efficient" vessel operates.

The CDQ sector was modeled as an amalgam of their fishing activity in each of the three sectors listed above. There were no scenarios developed for longline CVs or the other non-trawl fisheries, as the PSC limit reductions under consideration do not result in an impact to these fisheries.

5.4.2 Description of IPHC Algorithms for Calculating Fishery Constant Exploitation Yield

Before getting into the details of the IPHC FCEY algorithms and the specifications of the IMS Model, it is important to provide a detailed map showing location of the both IPHC areas and subareas, as well as NMFS management areas (Figure 5-1).

Figure 5-1 Regulatory Areas for Federal Fisheries in Alaska



Source: Adapted from NMFS Alaska Region map by Northern Economics Inc.

This section provides a description of algorithms used by the IPHC staff to generate their recommendations[18] to the IPHC Commissioners for FCEY values for the commercial halibut fisheries in each of the three major units of Area 4 including areas 4A, 4B, and 4CDE.[19] This section is fairly detailed because the process used to calculate FCEYs and to link change in halibut PSC mortality is complex, and in general does not appear to be well understood by persons who are not directly involved in the process.

It is important to note that the FCEY for each IPHC area is more or less the halibut fishery equivalent of the groundfish TACs, or Total Allowable Catches, that are adopted by the Council and NMFS for a particular groundfish species by groundfish management area or reporting areas (e.g., the TAC for sablefish in the BS, or the TAC for Atka Mackerel in Western Aleutian Islands (reporting area 543)). In addition to the differences in terminology it must be noted that, in all of their management processes the IPHC adjusts all weights to "net-weight" equivalents, including estimates of biomass and bycatch. Further, the IPHC uses pounds rather than metric tons. These issues will be discussed in the first subsection (5.4.2.1).

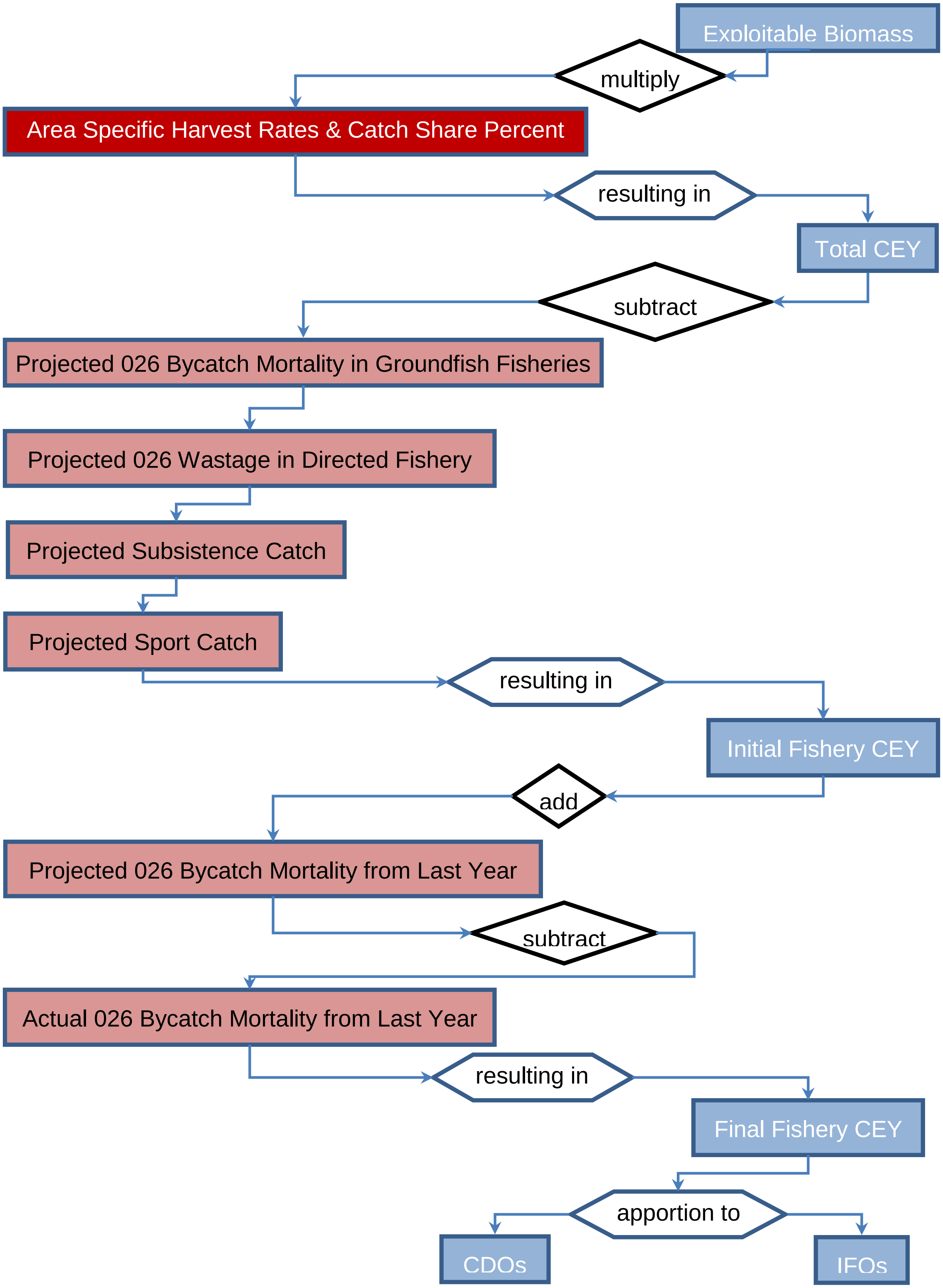
The remainder of Section 5.4.2 is organized in a manner similar to the process described in Figure 5-2. We start with a summary of the process used to move from estimates of total exploitable biomass to what the IPHC defines as the TCEY or Total Constant Exploitation Yield (Subsection 5.4.2.2). The TCEY is more or less equivalent to the Allowable Biological Catch (ABC) that is developed annually by the Groundfish Plan Team and vetted through the Council's Scientific and Statistical Committee.

After describing the process the IPHC uses to develop area-specific TCEYs the summary moves on to describe the various estimates of "removals" that are subtracted from the TCEY to arrive at the Initial FCEY. The removals outside of the landings in the directed fishery include estimates of subsistence harvests, estimate of recreational harvests, estimates of wastage (halibut mortality) in the directed halibut fisheries, and estimates of mortality resulting from bycatch in the commercial groundfish fisheries (halibut PSC mortality), as well as bycatch mortality, if it exists, from other Bering Sea fisheries, such as the fisheries for king crab and snow crab. After the Initial FCEY is estimated, additional adjustments are made that account for differences in projected bycatch mortality relative to the actual bycatch mortality. The Final FCEYs for the Area 4 subareas is then apportioned to the CDQ and IFQ fisheries.

[18] The IPHC staff make a range of recommendations to the Commissioners. The algorithm that is summarized in the section is intended to represent the IPHC Staff's "blue line" recommendation. The Commissioners are not bound by their staff recommendations and they may set FCEYs using other criteria and input.

[19] It is important to note that this summary has been developed by analysts that are not affiliated with the IPHC. While we believe it to be an accurate representation of the IPHC methodology, it has, as of the date of publication, not been fully vetted by the IPHC staff. It should also be noted that most of the definitions of IPHC management terminology have been taken from an IPHC publication for the 2012 Annual meeting titled "Halibut Terminology – What You May Hear (IPHC 2012a).

Figure 5-2 Flowchart of the Process Used to Calculate FCEYs for the Directed Halibut Fisheries



Source: Adapted by NEI from an original flow chart developed by the IPHC (IPHC 2012b).

5.4.2.1 Differences in the Unit of Measure used by the IPHC and Unit used by NMFS

The IPHC uses dressed-weight pounds as their basic unit of volume. A dressed halibut is a western cut halibut—i.e. a headed and gutted halibut with the collarbone intact, noting that the collarbone is the bone just behind the gills. In their reports and data tables IPHC refers to dressed weight as "net weight", and this analysis will also refer to dressed weights as "net weight". The IPHC uses a standard factor of 75 percent to convert whole fish (round weight) to net weight. NMFS uses round weight metric tons to report total halibut interceptions and halibut PSC mortality, but uses net weight pounds (in 1,000s) when reporting commercial catch in directed fisheries for halibut. The IPHC also typically reports halibut in 1,000s of net weight pounds.

Conversion Rates:

- To convert round weight halibut to net weight multiply the round weight by 0.75. To convert net weight to round weight, divide the net weight by 0.75.[20]
- To convert a metric ton to pounds multiply metric tons by 2,204.6.
- To convert metric tons to 1,000s of pounds multiply by 2.2046.
- To convert a metric ton of round-weight halibut to pounds of net weight halibut multiply by 2,204.6 then multiply the result by 0.75, or simply multiply by 1,653.45 noting that 2,204.6 × 0.75 = 1,653.45.

We also note that in addition to converting halibut PSC mortality to 1,000s of net weight pounds, the IPHC also groups halibut PSC mortality, and mortality of halibut that are discarded or otherwise killed in the directed halibut fishery (i.e. "wastage in the commercial halibut fishery"), as "O26" and "U26" halibut. These two size classes (defined below) will be discussed in more detail in subsection 5.4.2.3, which deals with "removals" outside of the directed fishery:

- U26 halibut are less than 26 inches in length as measured from the tip of the head to inner curve of the tail. U26 halibut are fish that the IPHC considers unlikely to grow long enough in the coming year such that they would be legally retainable in the directed halibut fishery—halibut must be at least 32 inches long to be retained in the directed halibut fishery.
- O26 halibut are greater than or equal to 26 inches. These are fish that already are at least 32 inches, or fish from 26 to 31 inches, which are likely to grow to 32 inches in the coming year and therefore be a part of the exploitable biomass for the directed fishery in the coming year.

5.4.2.2 Total Constant Exploitation Yield Estimation

The IPHC's basic goal when setting their FCEYs is to exploit the total halibut biomass at a target harvest rate that is both sustainable in the long-run and at a rate that is constant over time. The "Total Constant Exploitation Yield" or TCEY is estimated by multiplying the estimated exploitable biomass by that predetermined rate.[21] For the Area 4 (and for Area 3B) the IPHC has determined that the target harvest rate should be 16.125 percent. For all other areas, the target harvest rate is set at 21.5 percent (Webster 2013a).

The IPHC generates separate estimates of exploitable biomass for Area 4A, 4B, and for 4CDE, noting that exploitable biomass for 4CDE includes biomass in the Closed Area (see Figure 5-1 on page 121).

[20] A potential source of error is the tendency by analysts to multiply net weight by 1.33 rather than divide by 0.75.
[21] The IPHC defines the exploitable biomass as the portion of total biomass can be caught by hook and line gear.

The IPHC treats the 4CDE as a single unit up through the estimation of the Final FCEY. The Final FCEY is then further apportioned to each of the three subareas using the Catch Sharing Plan (CSP) developed by the Council. Table 5-1 shows estimates of total exploitable biomass and its distribution within Area 4. The final section of Table 5-1 shows NEI's estimates of TCEY for Area 4 and subareas. The estimates were generated by multiplying the exploitable biomass by the distribution percentages for each subarea (in the second section of the table) and then multiplying that result by the 16.125 percent target harvest rate.

Table 5-1 Coast-wide Biomass, Distribution of Biomass in Area 4, and Estimated Area 4 TCEYs, 2003 to 2014

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Coast-wide Biomass (Areas 2, 3, & 4 Combined) in millions of pounds (net weight)											
Spawning Biomass	390.5	347.5	307.7	274.3	248.9	229.1	206.3	197.6	193.5	193.6	194.9	196.8
Exploitable Biomass	458.6	403.1	353.7	308.6	268.4	235.2	202.7	185.3	174.6	168.9	168.4	170.3
	Distribution of Coastwide Biomass Area 4 subareas (as a percent of total)											
4A	7.2%	7.0%	6.3%	6.1%	5.0%	6.8%	7.7%	6.9%	5.8%	6.7%	5.7%	5.7%
4B	3.6%	3.1%	3.5%	4.5%	5.1%	6.0%	6.3%	5.1%	5.5%	3.6%	4.2%	4.3%
4CDE	11.3%	11.0%	8.7%	9.8%	8.9%	8.7%	10.6%	11.0%	9.9%	10.0%	10.6%	10.6%
Area 4 Total	22.1%	21.1%	18.5%	20.4%	19.0%	21.5%	24.6%	23.0%	21.2%	20.3%	20.5%	20.6%
	Estimated TCEY by in Area 4 in millions of pounds (net weight)											
4A	5.32	4.55	3.59	3.04	2.16	2.58	2.52	2.06	1.63	1.82	1.55	1.57
4B	2.66	2.01	2.00	2.24	2.21	2.28	2.06	1.52	1.55	0.98	1.14	1.18
4CDE	8.36	7.15	4.96	4.88	3.85	3.30	3.46	3.29	2.79	2.72	2.88	2.91
Area 4 Total	**16.34**	**13.71**	**10.55**	**10.15**	**8.22**	**8.15**	**8.04**	**6.87**	**5.97**	**5.53**	**5.57**	**5.66**

Notes: The estimated TCEYs for Area 4 and subareas are calculated by multiplying the coast-wide exploitable by the distribution percentages in the second part of the table, and then multiplying that result by 16.125%. The estimates of TCEY at the bottom of the table have been calculated by NEI based on the biomass and percentage in two upper sections. Actual TCEYs established by the IPHC may vary for a variety of reasons.
Source: Developed by NEI based of information in Stewart (2014a), and Webster (2014a)

For purposes of this analysis, we need to mirror as close as is reasonable the IPHC's algorithms to establish TCEYs and catch limits (FCEYs). There are and will be differences in the methods we describe here, and historical data that may be found in other sources. For example the IPHC's conservation remit, is to manage the Pacific halibut in waters coast-wide, and while they develop area specific estimates for setting catch limits, their ultimate responsibility is conservation at the coast-wide level. As a result the Area 4 TCEY and the FCEY estimates that result using the algorithm described above, may not be exactly equal to the TCEY and catch limits that are ultimately adopted by the commission. In the absence of more information regarding intent, this appears to be the most appropriate basis for assessing impacts of PSC limit reductions at this time.

5.4.2.3 Halibut Removals that are Not Reported in the Directed Halibut Fishery

The next step in the IPHC process for generating a Final FCEY is to reduce the TCEY by removals that are not reported in the directed halibut fisheries. These removals include:

- Removals for subsistence/personal use and recreational use
- Wastage from the directed halibut fisheries
- Halibut PSC mortality from groundfish fisheries

In the current IPHC algorithm—as used to set FCEYs for fishing year 2014—the IPHC generates estimates of O26 and U26 halibut for wastage and for halibut PSC mortality and deducts only the O26 portion from the TCEY. The U26 fish from these two sources of mortality are included in biomass estimates, but are not deducted from the TCEYs.

Halibut Removals for Subsistence/Personal Use, Recreation Use and Wastage in Directed Halibut Fisheries

Table 5-2 and Table 5-3 summarize IPHC estimates of subsistence/personal use removals, and removals by recreational users in Area 4. These estimates are included here because they are not summarized elsewhere in the analysis. Since 2009, these two sources of removals, when combined, have accounted for less than 100,000 pounds (lb) (net weight) over all of Area 4, and therefore these removals represent less than 2 percent of the TCEY.

Table 5-2 Estimates of Personal Use Harvest by IPHC Area, 2003 to 2013

Year	4A	4B	4C	4D	4E	4D/4E CDQ	Total
			1,000 Pounds Net Weight				
2003	20.7	2.5	23.8	4.4	54.5	14.3	120.2
2004	28.9	0.9	9.7	10.9	28.5	16.2	95.1
2005	35.6	1.4	7.7	5.8	54.0	23.2	127.7
2006	27.0	2.8	8.5	8.3	70.7	19.7	137.0
2007	14.9	2.0	15.0	3.2	52.1	19.0	106.2
2008	19.6	4.7	5.7	3.1	15.9	21.8	70.8
2009	33.5	1.2	6.3	0.6	8.7	10.3	60.6
2010	14.5	0.5	10.9	1.2	10.1	9.5	46.7
2011	13.6	0.5	1.6	0.6	6.2	16.9	39.4
2012	9.5	1.7	1.2	0.7	8.4	20.2	41.7
2013	n/a	n/a	n/a	n/a	n/a	10.0	n/a

Notes: 1) Estimates for 2013 are preliminary.
2) CDQ groups in 4D and 4E are allowed to retain for subsistence/personal use, halibut that are less than legal size (i.e. less than 32” or U32) that are caught in CDQ fisheries. These removals are reported in the next-to-last row on the right.
Source: Adapted by NEI from Williams (2013a).

Table 5-3 Recreational Use Harvests in Area 4, 2003 to 2013

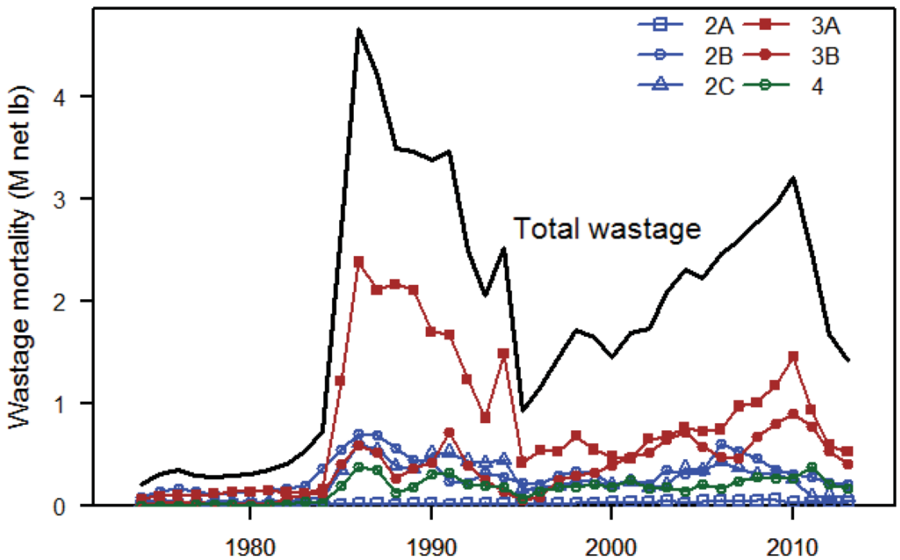
2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
					1,000 Pounds Net Weight					
31.0	53.0	5.0	46.0	44.0	4.0	24.0	16.0	17.0	28.0	25.0

Note: Estimates for 2013 are preliminary
Source: Adapted by NEI from Williams (2013b).

A third source of removals deducted from the TCEY is “Wastage” in the directed halibut fisheries. The IPHC defines wastage of halibut that are killed in the directed fishery but which are not landed. There are two primary sources of wastage: 1) discards in the directed fishery—primarily undersized fish (less than 32 inches [U32]), and 2) halibut that are estimated to have been killed by lost or abandoned gear.

The IPHC provide current year estimates (2013) of O26 and U26 wastage (Webster 2014a) as well as longer term summary graphics (Stewart, 2014b). In 2013 O26 wastage was estimated for all of Area 4 at 150,000 lb (net weight) while U26 wastage was estimates at 20,000 lb (net weight). Summing the two components generates an overall total of 170,000 lb (net weight). Estimated O26 wastage in 2013 is broken down by subarea as follows: 4A – 70,000 lb, 4B – 30,000 lb, 4CDE – 50,000 lb. Figure 5-3 below indicates that wastage in 2011 in Area 4 was at its highest level since prior to 2000 at approximately 350,000 lb.

Figure 5-3 Wastage in the Commercial Halibut Fishery by Regulatory Area, 1974 to 2013



Source: Copied directly from Stewart (2014b).

Removals due to Halibut PSC Mortality in Groundfish Fisheries

The largest source of removals in Area 4, other than landings in the directed halibut fisheries, is due to halibut PSC mortality in the groundfish fisheries. Prior to 2012, landings in the directed halibut fisheries were greater than halibut PSC mortality in the groundfish fisheries. However, halibut PSC mortality was greater than directed fishery landings in 2012 and 2013. Table 5-4 (on the next page) provides a comparison of landings in the directed halibut commercial fishery with IPHC estimates of halibut PSC mortality in the groundfish fisheries in Area 4 and subareas from 2003 to 2013.

Table 5-5 (shown immediately after Table 5-4) summarizes NMFS estimates of halibut PSC mortality as reported in Alaska Fisheries Information Network (AKFIN) databases. This table is divided into three sections. The left-hand section summarizes halibut PSC mortality as estimated by NMFS for the trawl and longline fisheries for which the Council specified halibut PSC Limit reduction alternatives. The middle section of the table summarizes estimates of halibut PSC mortality from fisheries for which there are no halibut PSC limits (i.e., exempt fisheries). While these fisheries are exempt from PSC limits, they do generate halibut PSC mortality, which in theory should be included in the removals that are subtracted from IPHC TCEYs. Also included in this middle section are estimates of halibut PSC mortality from data records within the AKFIN data for which no gear or management area is specified. The final section of Table 5-5 combines the left and middle sections to generate an Area 4 total estimate of halibut PSC mortality from NMFS and AKFIN data records.

Table 5-4 Comparison of Area 4 Landings in the Directed Halibut Fishery to Halibut PSC mortality in Groundfish Fisheries, 2003 to 2013

	4A	4B	4CDE	Area 4 Total	4A	4B	4CDE	Area 4 Total
Year	Landings in the Directed Halibut Fishery (Net Weight Lb – Millions)				IPHC Estimates of Halibut PSC mortality (Net Weight Lb – Millions)			
2003	5.02	3.86	3.26	12.14	1.58	0.75	4.49	6.82
2004	3.56	2.72	2.92	9.2	1.56	0.74	4.44	6.74
2005	3.4	1.98	3.48	8.86	1.78	0.84	5.07	7.69
2006	3.33	1.59	3.23	8.15	1.74	0.82	4.94	7.49
2007	2.83	1.42	3.85	8.1	1.68	0.8	4.78	7.26
2008	3.02	1.76	3.88	8.66	1.52	0.72	4.32	6.56
2009	2.53	1.59	3.31	7.43	1.46	0.69	4.15	6.30
2010	2.33	1.83	3.32	7.48	1.41	0.67	4.01	6.08
2011	2.35	2.05	3.43	7.83	1.19	0.56	3.38	5.14
2012	1.58	1.74	2.34	5.66	1.78	0.63	3.86	6.27
2013	1.23	1.24	1.78	4.25	1.1	0.46	3.65	5.21

Source: Adapted from Stewart (2014c)

Table 5-5 NMFS Alaska Region Estimates of Halibut PSC mortality, 2003 to 2013

	Trawl and Longline Fisheries except IFQ Sablefish				Exempt Fisheries (Pot/Jig Fisheries & IFQ Sablefish) plus AKFIN Records with Unspecified Areas				Area 4 Total – All Fisheries
	4A	4B	4CDE	Area 4 Sub-total	4A	4B	4CDE	Unspecified Area 4	
Year	NMFS Estimates of Halibut PSC mortality (Converted from Round weight mt to Net Weight lb – Millions)								
2003	1.775	0.247	4.629	6.651	0.009	0.026	0.001	0.309	7.00
2004	2.142	0.235	4.124	6.501	0.008	0.011	0.001	0.028	6.55
2005	1.775	0.214	4.900	6.888	0.006	0.011	0.001	0.029	6.93
2006	1.429	0.282	4.821	6.533	0.012	0.028	0.001	0.016	6.59
2007	1.558	0.432	4.695	6.685	0.005	0.021	0.000	0.001	6.71
2008	1.196	0.322	4.258	5.775	0.008	0.028	0.002	0.000	5.81
2009	1.527	0.418	3.869	5.814	0.005	0.046	0.002	0.006	5.87
2010	1.028	0.472	4.118	5.618	0.008	0.042	0.000	0.006	5.68
2011	1.096	0.455	3.662	5.213	0.016	0.016	0.002	0.033	5.28
2012	1.739	0.589	3.813	6.141	0.007	0.020	0.003	0.045	6.22
2013	1.251	0.413	4.292	5.957	0.003	0.012	0.002	0.000	5.98

Notes:
1) NMFS generates their estimates of halibut PSC mortality using kilograms (round weight) as their basic unit, but they generally report halibut PSC mortality in metric tons (round weight). The estimates shown in this table have been converted to millions of net weight pounds.
2) Data on the left-hand side of the table summarize total halibut PSC mortalityof fisheries to which the PSC mortality Reduction Alternatives apply. Pot and jig fisheries for Pacific cod and IFQ sablefish fisheries are exempt from halibut PSC limits, and were not included in the PSC mortality Reduction Alternatives.
3) NMFS data as reported by AKFIN include a number of records that show halibut PSC mortality, but don't specify the gear used, or area in which the fishery occurred.

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

A comparison of halibut PSC mortality as estimated by NMFS (Table 5-5) and halibut PSC mortality as estimated by the IPHC (Table 5-4), reveals shows that in an average year from 2003 to 2013, IPHC estimates are higher than NMFS estimates by 268,000 lb (net-weight), but there is a fair amount of variability. In 2013, the NMFS estimate was 765,000 net-weight lb greater than the IPHC estimate, while in 2006 the IHPC estimate of halibut PSC mortality exceeded the estimate of NMFS by 900,000 net-weight lb.

There are several potential explanations for these differences. One potential explanation is that NMFS and AKFIN are continually updating and correcting data when there is sufficient evidence to do so. Unless the IPHC regularly updates the historic data that they have received from NMFS, any changes NMFS makes will not necessarily be reflected in IPHC data. Other potential sources of divergence include the following:

- The use of differing Halibut Discard Mortality Rates by gear, target fishery or year. These rates are part of the Annual Specification Process, and will be discussed in detail later in this section.
- The use of differing assumptions with respect to halibut PSC mortality taken in groundfish fisheries that are technically in IPHC Area 4A, but which are actually harvested south of the Aleutian Islands. Groundfish fisheries that occur in this portion of Area 4A are managed as part of the Gulf of Alaska and would be reported as part of the Western Gulf or NMFS Zone # 610 (see Figure 5-4). It is assumed by the analysts that all halibut PSC mortality that is taken in Area 610 is assigned to Area 3B rather than Area 4A.
- Inconsistent inclusion or exclusion of PSC mortality from groundfish fisheries that are exempt from halibut PSC limits. As mentioned in the discussion of Table 5-5, pot and jig fisheries for Pacific cod and IFQ sablefish and non-trawl CDQ sablefish fisheries are all exempt from halibut PSC limits. However, these fisheries do generate halibut PSC mortality and inevitably will induce some level of halibut PSC mortality.
- The inclusion or exclusion of halibut bycatch that occurs in Western Alaska Crab fisheries. The current analysis does not examine whether or how much halibut bycatch is taken in crab fisheries, but if there is halibut mortality in these fisheries, then it presumed that IPHC would try to account for it.

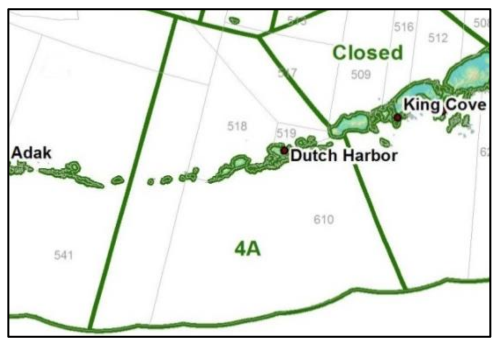


Figure 5-4 IPHC Area 4A with NMFS Reporting Areas

The bulleted list above addresses potential reasons for overall differences in Area 4 total estimates of halibut PSC mortality. In addition to the Area 4 total, estimates of halibut PSC mortality by IPHC Subareas between NMFS and the IPHC are also likely to differ. One source of these differences is the “mismatch” between IPHC subareas and NMFS reporting areas (3-digit management areas). Looking back to the regulatory area map in Figure 5-1 on page 121, it is clear that while many of NMFS reporting areas would be unambiguously assigned to one and only one IPHC subarea, others could fall within two subareas and one (Area 523) falls into three subareas (4A, 4B, and 4D). Table 5-6 on the following page shows the translation table that is currently used by IPHC to map NMFS reporting areas to IPHC Subareas. It should also be noted that NMFS reporting areas that correspond **primarily** to the “closed area” are assigned, for PSC mortality accounting purposes, to IPHC subArea 4CDE.

Table 5-6 Standard Translation of NMFS Reporting Areas into IPHC Subareas.

NMFS Area	IPHC Area	NMFS Area	IPHC Area
517	4A	508	4CDE
518	4A	509	4CDE
519	4A	512	4CDE
NMFS Area	**IPHC Area**	513	4CDE
541	4B	514	4CDE
542	4B	516	4CDE
543	4B	521	4CDE
530	4B	523	4CDE
550	4B	524	4CDE

Source: Developed by NEI based on personal communication with IPHC staff (Stewart 2014d)

Table 5-7 shows the halibut discard mortality rates as specified by NMFS for 2003 to 2014. These rates are applied to the estimated PSC mortality of halibut to generate the estimates of mortality in each CDQ or Non-CDQ target fishery by gear. The table will be discussed in more detail on the next page.

Table 5-7 Pacific Halibut Discard Mortality Rates (Percentages) for the BSAI, 2003 to 2014

Gear	Target Fishery	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Non-CDQ hook-and-line	Greenland turbot	18	15	15	15	13	13	13	11	11	11	13
	Other species	12	11	11	11	11	11	11	10	10	10	9
	Pacific cod	12	11	11	11	11	11	11	10	10	10	9
	Rockfish	25	16	16	16	17	17	17	9	9	9	4
Non-CDQ trawl	Arrowtooth flounder					75	75	75	76	76	76	76
	Atka mackerel	75	78	78	78	76	76	76	76	76	76	77
	Flathead sole	67	67	67	67	70	70	70	74	74	74	73
	Greenland turbot	70	72	72	72	70	70	70	67	67	67	64
	Non-pelagic pollock	76	76	76	76	74	74	74	73	73	73	77
	Pelagic pollock	84	85	85	85	88	88	88	89	89	89	88
	Other flatfish	71	71	71	71	74	74	74	72	72	72	71
	Other species	67	67	67	67	70	70	70	71	71	71	71
	Pacific cod	67	68	68	68	70	70	70	71	71	71	71
	Rockfish	69	74	74	74	76	76	76	81	81	81	79
	Rock sole	76	77	77	77	80	80	80	82	82	82	85
	Sablefish	50	49	49	49	75	75	75	75	75	75	75
	Yellowfin sole	81	78	78	78	80	80	80	81	81	81	83
Non-CDQ Pot	Other species	8	8	8	8	7	7	7	8	8	8	8
	Pacific cod	8	8	8	8	7	7	7	8	8	8	8
CDQ trawl	Atka mackerel	80	85	85	86	86	85	85	85	85	85	86
	Greenland turbot								88	88	88	89
	Flathead sole	90	90	67	67	70	87	87	84	84	84	79
	Non-pelagic pollock	90	85	85	85	85	86	86	85	85	85	83
	Pacific cod								90	90	90	90
	Pelagic pollock	89	89	90	89	90	90	90	90	90	90	90
	Rockfish	90	90	74	74	76	82	82	84	84	84	80
	Rock sole						86	86	87	87	87	88
	Yellowfin sole	83	82	84	85	86	86	84	85	85	85	86
CDQ hook-and-line	Greenland turbot	4	4	15	15	13	4	4	4	4	4	4
	Pacific cod	11	11	10	10	10	10	10	10	10	10	10
CDQ pot	Pacific cod	2	2	8	8	7	7	7	8	8	8	8
	Sablefish	46	36	33	30	34	34	35	32	32	32	34

Source: Developed by NEI based on data from NMFS (2014f)

In general, the halibut discard mortality rates are recalculated and re-specified every three years—in Table 5-7 the shaded bars indicate the three-year update period. Rates are generated through an analysis of observer data on the viability ratings of discarded halibut. The most recent specification began in 2013 and is expected to run through 2015. As is readily evident in Table 5-7, discard mortality rates for trawl fisheries are much higher than for non-trawl fisheries. Less obvious is the fact that CDQ trawl fisheries are assigned higher discard mortality rates than non-CDQ trawl fisheries for the same target fisheries. For example, in 2013 the discard mortality rate in the non-CDQ trawl fishery for Atka mackerel is 76 percent, while the rate is 86 percent in the CDQ Atka mackerel fishery. CDQ discard mortality rates for longline (hook and line) gear are lower than rates for non-CDQ fisheries.

The analysts note that if the halibut discard mortality rate can be measurably reduced, the effect on the halibut FCEY and the long-term exploitable biomass is the same as a reduction in actual halibut PSC of the same percentage. Assume, for example, that a fishery has a total PSC of 400 mt and the fishery is assigned a 60 percent halibut discard mortality rate. The halibut PSC mortality for the fishery is calculated to be 240 mt (400 mt × 60% = 240 mt). Now assume that participants in the fishery are able reduce their halibut PSC by 10 percent to 360 mt. If the halibut discard mortality rate remains at 60 percent, then the halibut PSC mortality is reduced by 10 percent to 216 mt (360 mt × 60% = 216 mt). Alternatively, if the participants implement a mortality reduction policy involving perhaps shorter tows, deck sorting, and careful release, etc., and they are able to reduce their halibut discard rate by ten percent (i.e., to 54%), the same amount of halibut would be saved, without the potential for reducing groundfish catch and revenues—i.e. 400 × 54% = 216 mt).

Projected Amounts of Halibut PSC Mortality versus the PSC Limit

A major issue for the IPHC when setting their FCEY for the directed fishery is the fact that halibut PSC mortality varies from year to year, and because the IPHC is creating the FCEY for the coming year, they need to project (or forecast) what halibut PSC mortality will be in the coming year. If the groundfish fisheries are always constrained by the PSC limits, then it is very easy to project halibut PSC mortality in the coming year—i.e., it will be equal to the PSC limit.

If, on the other hand, halibut PSC mortality is not constrained by the PSC limit, and varies from year to year at levels that may be well below the cap, then using the PSC Limit as the projected PSC mortality for the coming year is likely to create an FCEY that is noticeably lower than it would have been, if a better projection were available.

The IPHC does have options for projecting the halibut PSC mortality in the coming year,[22] but in their current algorithm, they have chosen to use the estimated PSC mortality in the year that has just been completed for the projected amount in setting the FCEY in the coming year.[23] In other words, the FCEY for fishing year 2015 ($FCEY_{2015}$) uses the halibut PSC mortality from fishing year 2014 (PSC_{2014}) as its projected halibut PSC mortality, or more generally $FCEY_y$ uses PSC_{y-1}, where y = the year for which the FCEY is being set.

Estimates of O26 and U26 Halibut PSC Mortality and Their Application in the FCEY Process

Once the IPHC comes up with their projection of total halibut PSC mortality (which they set equal to PSC_{y-1}), they explicitly recognize that halibut caught as PSC mortality are often smaller than halibut

[22] For example, they could use a two-year average of halibut PSC mortality or even a three-year average.
[23] In reality the IPHC staff produce their initial estimates of TCEY, halibut PSC mortality, other removals, and FCEY in November in time for their interim meetings that take place in December. With rationalization of many of the groundfish fisheries, it is more and more common that groundfish fisheries are operating (and generating halibut PSC mortality) in November and December. This makes it even more difficult for the IPHC staff to utilize actual halibut PSC mortality for the current year in the FCEY recommendations for the coming year. Instead they are forced to forecast halibut PSC mortality for the last few months of the current year fishery.

caught in the directed fishery. While the legal size limit for retaining halibut in the directed fishery is 32 inches, the IPHC biologists focus on halibut that are over 26 inches (O26), because as fish that are 26 to 31 inches in length grow, most will be of legal size (O32) at some point during the fishing year (y) for which the FCEY is being set. From this perspective, all O26 halibut killed as PSC in the previous year (y-1) would have been a part of the $FCEY_y$ had they not been killed. Halibut killed as PSC mortality that are U26, will become a factor in the FCEY in later years, but under the current IPHC policy, only as a reduction in exploitable biomass.[24]

Because of the increasing importance of the split between O26 and U26 halibut PSC mortality, and increasing evidence that the ratio of O26 to U26 varies significantly between fisheries, the IPHC staff indicates that starting with the 2015 FCEY setting process they will move away from a fixed ratio of 60 percent. Instead they will use fishery-specific O26/U26 ratios based on data from the observer program (Stewart 2014d). Because of the delay in getting all of the observer data for a given year, IPHC staff indicates that they will use the O26/U26 split for the most recent full year of data. This means that for setting the $FCEY_{2015}$ they will multiply PSC $mortality_{2014}$ in each fishery by the O26/U26 percentages from 2013 observer data.

Table 5-8 summarizes O26/U26 percentages for each of the three major BSAI participant groups for which observer data are available. There is a fair amount of variability both within each participant group, and across participant groups. Some of the more obvious trends are listed below.

- BSAI TLA O26 percentages are generally the lowest of the three groups.
- Longline CPs most often have the highest O26 percentage of the three groups.
- The O26 percentage of both longline CPs and BSAI TLA vessels had a steady downward trend from 2008 to 2012, but saw increases in 2013.
- A80-CPs have had the lowest O26 percentage (2010), and the highest (2011 to 2013) of the three groups when comparing same year percentages.

Table 5-8 Estimated O26/U26 Percentages by Major Participant Group, 2008 to 2013

	A80-CPs		BSAI TLA		Longline CPs	
	O26	U26	O26	U26	O26	U26
Year	Percent of Halibut PSC Mortality by Year					
2008	61.8%	38.2%	68.6%	31.4%	75.2%	24.8%
2009	61.2%	38.8%	57.9%	42.1%	68.3%	31.7%
2010	56.4%	43.6%	59.0%	41.0%	69.8%	30.2%
2011	65.6%	34.4%	51.5%	48.5%	63.4%	36.6%
2012	64.7%	35.3%	43.9%	56.1%	61.5%	38.5%
2013	64.1%	35.9%	52.8%	47.2%	63.5%	36.5%
Weighted Average	61.6%	38.4%	56.2%	43.8%	66.6%	33.4%

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Based on the FCEY process summarized in Figure 5-2, all of the information necessary to set the "Initial FCEYs" have been discussed. The bullets below recap the process discussed to this point.

- The exploitable biomass and the distribution of the exploitable biomass into areas and subareas is estimated by IPHC scientists and staff.

[24] This is the case under the "staff recommendation policy" that was in place for setting FCEYs for the 2014 fishing year. The IPHC is considering a change in this policy. If the "staff recommendation policy" changes to a "Full Accounting Policy", U26 halibut PSC mortality from the projection year (y-1) will be explicitly considered when they set $FCEY_y$.

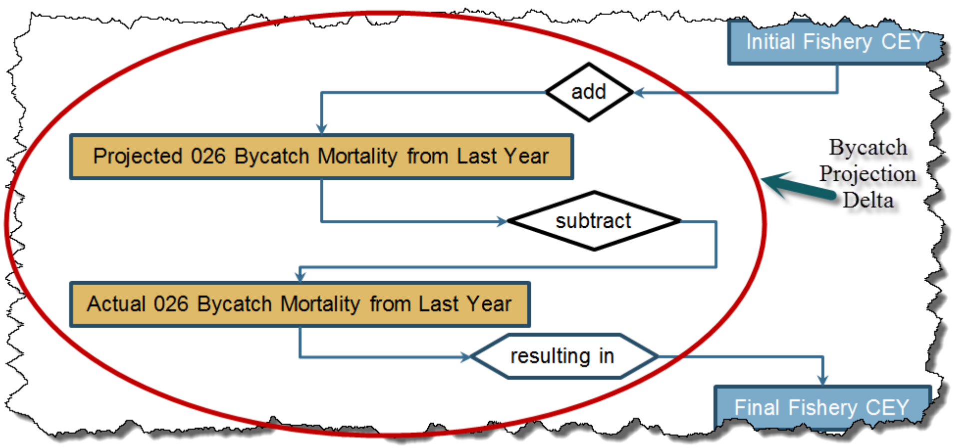
- TCEYs are calculated by multiplying the exploitable biomass in Area 4 (and subareas) by the target harvest rate for Area 4 (16.125 percent).
- Projected removals are calculated for four sources of halibut PSC mortality other than landings in the directed halibut fishery:
  - Subsistence/personal use
  - Recreational harvests
  - O26 wastage in the directed halibut fishery
  - O26 halibut PSC mortality in the groundfish and crab fisheries (i.e., for the groundfish fishery, halibut PSC mortality).

  Projections are based on estimates of removals from the year prior to the fishing year for which the FCEYs are calculated.
- Initial FCEYs are calculated by subtracting the projected removals from the TCEYs.

Final Adjustments Used to Generate the Recommended FCEY

In this section we discuss the final adjustment made in the calculation of FCEYs. We describe this final step as the "Bycatch Projection Delta" adjustment, noting that this term is not a term used by the IPHC, but rather one that is developed by NEI. Figure 5-5 is an extract of the full FCEY Process figure shown earlier (Figure 5-2 on page 123) that captures Bycatch Projection Delta (BPD) adjustment.

Figure 5-5 The Bycatch Projection Delta Adjustment



Source: Adapted by NEI from an original flow chart developed by the IPHC (IPHC 2012b).

The BPD adjustment arises from the recognition that, because of the variability in halibut PSC mortality, the projected amount of O26 halibut PSC mortality used to generate the FCEY in the previous year (i.e., $FCEY_{y-1}$) may have been measurably lower (or higher) than the actual O26 halibut PSC mortality in the previous year (i.e., $O26PSC_{y-1}$). Based on the algorithm, the projection that was used in the previous year is actually the O26 halibut PSC mortality from two years ago (i.e. $O26PSC_{y-2}$). The difference (delta) from last year's projected O26 PSC mortality and the actual O26 PSC mortality equals the BPD. In other words, the BPD = $O26PSC_{y-2} - O26PSC_{y-1}$.

The BPD is then added to the Initial FCEY and the result is Final FCEY. If halibut PSC mortality is declining, then the BPD is positive and the Final FCEY is larger than the Initial FCEY. In this case, the directed fishery is "compensated" for the higher-than-necessary projection of halibut PSC mortality that was used in the previous year and which resulted in a lower-than-necessary Final FCEY in the previous year.

If, however, halibut PSC mortality is increasing, the BPD is negative and the Final FCEY for the current year is lower than the initial FCEY. In this case, the directed fishery is "penalized" for the lower-than-necessary projection of halibut PSC mortality in the previous year, which therefore resulted in a higher-than-necessary Final FCEY for the previous year.

The following numerical examples (which use fictional numbers and years) are designed to clarify the BPD adjustment and calculation of the Final FCEY. In the first example, (Table 5-9) we show the calculation of Initial and Final FCEYs for the year 2104—this is year "y". In this example, halibut PSC mortality has declined over the three previous years while the TCEY and other removals have remained constant. We note that if information is not known, it is shown in the table as #N/A. We also note that if the cell is irrelevant to any other calculations in the table, it is shaded black. The Initial FCEY for 2014 ($InitialFCEY_y$) is 1,500. This is calculated by subtracting the projected amount of "other removals" and projected O26PSC from the TCEY (i.e. 2,000 – 100 – 400 = 1,500). Note that the values of projected "other removals" and projected O26PSC are the actual values from previous year—Projected $O26PSC_y$ = Actual $O26PSC_{y-1}$. In the next step, we calculate the BPD (i.e., the difference between the previous year's projected value of O26PSC and the previous year's actual value of O26PSC (i.e., BPD = O26 PSC_{y-2} – $O26PSC_{y-1}$ or 50 = 450 – 400). The BPD is then added to $InitialFCEY_y$ resulting in ($FCEY_y$) or 1,550. Note that if the halibut PSC mortality has been declining, the BPD adjustment creates higher FCEYs than would otherwise have been realized.

Table 5-10 adds one more year of fictional data, to highlight in effect of the BPD adjustment if halibut PSC mortality has increased. In the table, the lightly shaded cells indicate that new information has become available with the passing of the additional year. Note also that years labeled as y, y-1, etc., in Table 5-9 are labeled as y-1, y-2, etc., in Table 5-10, and the current year 2105 has become y.

Table 5-9 Hypothetical Example Calculations of Initial and Final FCEY in a Period of Declining Halibut PSC Mortality

			Other Removals		Actual	O26 PSC			Previous Year's O26 PSC			
Year	Year Code	TCEY	Actual	Projected	PSC	Actual	Projected	Initial FCEY	Projected	Actual	BPD	Final FCEY
2101	y-3		100		833.3	500						
2102	y-2	2,000	100	100	750.0	450	500	1,400		500		
2103	y-1	2,000	100	100	666.7	400	450	1,450	500	450	50	1,500
2104	Y	2,000	#N/A	100	#N/A	#N/A	400	1,500	450	400	50	1,550

Source: Developed by Northern Economics.

Table 5-10 Hypothetical Example Calculations of Initial and Final FCEY with One More Year with Higher Halibut PSC Mortality

			Other Removals		Actual	O26 PSC			Previous Year's O26 PSC			
Year	Year Code	TCEY	Actual	Projected	PSC	Actual	Projected	Initial FCEY	Projected	Actual	BPD	Final FCEY
2101	y-4		100		833.3	500						
2102	y-3	2,000	100	100	750.0	450	500	1,400		500		
2103	y-2	2,000	100	100	666.7	400	450	1,450	500	450	50	1,500
2104	y-1	2,000	100	100	875.0	525	400	1,500	450	400	50	1,550
2105	Y	2,000	#N/A	100	#N/A	#N/A	525	1,375	400	525	-125	1,250

Note: Lightly shaded cells indicate that the value in the cell has changed from the previous table.

In Table 5-10, the trend of declining halibut mortalities from 2101 to 2103 reverses, and halibut PSC mortality in 2104 is 125 units higher than halibut PSC mortality in the previous year. This effectively results in a doubling of the pain for the directed fishery. With respect to 2105 (y), the increase in PSC_{y-1} causes the projected PSC_y to be 525, and thus $InitialFCEY_y$ is 125 units lower than $InitialFCEY_{y-1}$. Then the BPD adjustment kicks in—since the previous year's (y-1) projected halibut mortality was too low by 125 units, the directed fishery is penalized for their "over-harvest".

Additional Proposed Adjustments to the FCEY

The IPHC and its staff are discussing the possibility of changing the way that U26 halibut PSC mortality enter the FCEY calculus. This concept has been called a "full accounting of U26 bycatch mortality" (Stewart et al. 2014b). As understood by NEI, the basic premise of "full accounting of U26 bycatch mortality"—assuming halibut PSC is declining—is that if the U26 halibut that were projected to have been taken in y-1 were not taken, and instead were allowed to grow and eventually become part of the exploitable biomass over the next 15 to 20 years they would increase the biomass over time by an amount approximately equal to the amount that was originally over-projected. Alternatively worded, the volume of U26 halibut that are killed as PSC, would eventually grow large. After accounting for all other forms of mortality, the volume of O26 halibut that would eventually be captured in the directed fishery over the next 15 to 20 years is roughly equivalent to the volume of U26 halibut that were killed in the first place. Under the "full accounting of U26 bycatch mortality" the savings of U26, assuming halibut PSC is declining, would be added into the next year's FCEY. In years that halibut PSC increases, the U26 halibut PSC mortality overage would be deducted from the next year's FCEY.

Currently this concept is assumed to be realized through changes in the stock assessment and the exploitable biomass estimation process. In other words, it is assumed that the estimates of the exploitable biomass for a given year will account for all of the fish that are available for harvest in that year. Whether or not they might have been taken as halibut PSC mortality in some earlier year as a U26 halibut is assumed to be irrelevant to the current year FCEY process.

Baseline Estimates of Area 4 FCEYs, Removals from Halibut PSC Mortality and Other Sources, and Imputed TCEYs

In this section we provide the baseline estimates for all of Area 4 that will be used throughout the remainder of the analysis. Table 5-11 shows the Final FCEYs for the years 2007 to 2014, along with imputed estimates of TCEYs and Initial FCEYs. The Final FCEYs are taken from NMFS (2014f) and are the actual number by which the IFQ and CDQ fisheries were managed. In the table, data for "Realized O26 PSC mortality" are calculated directly from NMFS/AKFIN data shown in Table 5-5. Specifically, these use the Area 4 sub-total for halibut PSC mortality as shown in the middle column of Table 5-5 and thus do not include estimated removals due to halibut PSC in pot groundfish fishery or in sablefish fisheries. The estimates of O26 halibut PSC mortality are calculated by multiplying Total PSC mortality by 60 percent. For purpose of the analysis, "Other Removals" in Table 5-11 have been "fixed" at 2013 levels as described above in Section 5.4.2.3. Predicted Removals in the third set of columns in Table 5-11 are simply the previous year's realized removals. The BPD (Bycatch Projection Delta) Adjustments start with the prior year's predicted O26 removal (i.e. the realized O26 PSC mortality from y-2), then net out the prior year's realized removals (i.e. O26 PSC mortality from y-1), leaving the BPD.

In this table we have imputed the initial FCEYs as wells as the TCEYs using the actual data as described above. The imputed Initial FCEY equals the FCEY after subtracting out the BPD. (If the BPD is positive, the Final FCEY is higher than the initial FCEY, and in this way the BPD is not part of the TCEY.) After imputing the FCEYs, we can impute the TCEYs. The TCEY equals the Initial FCEY plus predicted values of O26 PSC mortality and Other Removals. Because TCEYs in this table are imputed for purposes of the analysis, they will not match IPHC historical TCEYs.

Table 5-11 Final FCEY, Imputed TCEYs and Halibut PSC Mortality Removals that Will Serve as the Baseline for the Analysis

		Realized Removals			Predicted Removals			BPD Adjustments			
							Imputed	Prior Year O26 PSC			
Year	TCEY	Total PSC	O26 PSC	Other Removals	O26 PSC	Other Removals	Initial FCEY	Predicted	Realized	BPD	Final FCEY
All number (except years) are shown in millions of net weight pounds											
2005	#N/A	6.89	4.13	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
2006	#N/A	6.53	3.92	0.22	4.13	0.22	#N/A	#N/A	#N/A	#N/A	#N/A
2007	12.36	6.68	4.01	0.22	3.92	0.22	8.22	4.13	3.92	0.21	8.43
2008	13.17	5.78	3.47	0.22	4.01	0.22	8.94	3.92	4.01	-0.09	8.85
2009	11.02	5.81	3.49	0.22	3.47	0.22	7.33	4.01	3.47	0.55	7.88
2010	11.80	5.62	3.37	0.22	3.49	0.22	8.09	3.47	3.49	-0.02	8.07
2011	11.35	5.21	3.13	0.22	3.37	0.22	7.76	3.49	3.37	0.12	7.87
2012	9.01	6.14	3.68	0.22	3.13	0.22	5.66	3.37	3.13	0.24	5.90
2013	9.22	5.96	3.57	0.22	3.68	0.22	5.32	3.13	3.68	-0.56	4.76
2014	6.96	#N/A	#N/A	0.22	3.57	0.22	3.16	3.68	3.57	0.11	3.28

Note: Because TCEYs in this table are imputed they will not be an exact match with IPHC's historical data.
Source: Developed by NEI for analytical purposes using data from AKFIN (Fey 2014) and NMFS (2014f).

5.4.3 Demonstration of the Need for, and Specification of the IMS Model

In this section we build on the information in Table 5-11 to demonstrate the "need" for an Iterated Multi-year Simulation Model (IMS Model). The need for a multi-year model arises from three primary factors:

1) As described in the previous section, the FCEYs that would develop if there were halibut PSC mortality would only be fully realized over a three year period because of the lags involved with in the FCEY setting process.
2) There has been and presumably will continue to be large variations in the amount of halibut PSC mortality in any given year, and there isn't a reliable method of predicting halibut PSC mortality in the coming year.
3) Because multiple years are necessary to capture the full-range of impacts of halibut PSC mortality reduction on FCEY and total harvest in the commercial fishery, a net present value calculation using discounted values of future year revenue streams should be used.

In order to fully model the effects of the alternatives a multi-year model is proposed. In order to focus on changes in halibut PSC mortality that are likely to result from reduction in the PSC Limits we are proposing to hold future TCEY levels constant at the imputed value for the 2014 fishing year (6.96 million net weight lb) as shown in Table 5-11.

However, because of the year-over-year variability of halibut PSC mortalities, there is not an obvious choice of a year to use for projecting halibut PSC mortality out into future years under the status quo or under the proposed options to reduce PSC limits. In Table 5-12, we adjust the Imputed TCEYs from Table 5-11 to be equal to the Imputed TCEY from 2014. We then recalculate Initial and Final FCEYs while holding all estimates of the removals constant. With a TCEY that is assumed constant at 6.96 million net weight lb, the Final FCEYs vary from a low of 2.50 to high of 3.85 million net weight lb—i.e., the highest FCEY is 54 percent higher than the lowest FCEY. The variability is likely to be even more extreme when the halibut PSC mortality amounts are broken down to individual subareas, as will be done in the actual modeling process.

Table 5-12 Demonstration of the Impact of the Variability of Halibut PSC Mortality on FCEYs

		Realized Removals			Predicted Removals			BPD Adjustments			
							Imputed	Prior Year O26 PSC			
Year	TCEY	Total PSC	O26 PSC	Other Removals	O26 PSC	Other Removals	Initial FCEY	Predicted	Realized	BPD	Final FCEY
All number (except years) are shown in millions of net weight pounds											
2005	#N/A	6.89	4.13	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
2006	**6.96**	6.53	3.92	0.22	4.13	0.22	**2.61**	#N/A	#N/A	#N/A	#N/A
2007	**6.96**	6.68	4.01	0.22	3.92	0.22	**2.82**	4.13	3.92	0.21	**3.03**
2008	**6.96**	5.78	3.47	0.22	4.01	0.22	**2.73**	3.92	4.01	-0.09	**2.64**
2009	**6.96**	5.81	3.49	0.22	3.47	0.22	**3.27**	4.01	3.47	0.55	**3.82**
2010	**6.96**	5.62	3.37	0.22	3.49	0.22	**3.25**	3.47	3.49	-0.02	**3.23**
2011	**6.96**	5.21	3.13	0.22	3.37	0.22	**3.37**	3.49	3.37	0.12	**3.49**
2012	**6.96**	6.14	3.68	0.22	3.13	0.22	**3.61**	3.37	3.13	0.24	**3.85**
2013	**6.96**	5.96	3.57	0.22	3.68	0.22	**3.05**	3.13	3.68	-0.56	**2.50**
2014	6.96	#N/A	#N/A	0.22	3.57	0.22	3.16	3.68	3.57	0.11	3.28

Note: Numbers shown in bold have are changed from Table 5-11. TCEYs are set equal to the imputed TCEY for 2014. Final FCEYs are imputed based on the realized and predicted removals.

Source: Developed by NEI for analytical purposes using data from AKFIN (Fey 2014) and NMFS (2014f).

The variability of halibut PSC mortality is also critically important when determining whether a reduced PSC Limit will have an effect on a given year. Table 5-13 shows the impact of a hypothetical reduction in the overall halibut PSC limit down to 5.833 million net weight pounds. The limit constrains both O26 and U26 halibut PSC mortality and is assumed to be strictly enforced on all included fisheries. Since we have assumed a 60/40 split of O26/U26 halibut PSC mortality, the new (assumed) limit would cap O26 halibut PSC mortality at 3.5 million new weight pounds. ($5.833 \times 0.60 = 3.5$). Realized O26 halibut PSC mortality removals that in the previous table were greater than 3.5 have been set to equal 3.5 million net weight lb. As seen in Table 5-13, O26 halibut PSC mortality for five of the nine years has been reduced, but four years were unaffected. The other numbers affected by reductions are shown in bolded text.

Table 5-13 Demonstration of the Impacts on Final FCEYs of a Hypothetical Reduction in PSC Limits

		Realized Removals			Predicted Removals			BPD Adjustments			
							Imputed	Prior Year O26 PSC			
Year	TCEY	Total PSC	O26 PSC	Other Removals	O26 PSC	Other Removals	Initial FCEY	Predicted	Realized	BPD	Final FCEY
All number (except years) are shown in millions of net weight pounds											
2005	#N/A	**5.83**	**3.50**	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
2006	6.96	**5.83**	**3.50**	0.22	**3.50**	0.22	**3.24**	#N/A	#N/A	#N/A	#N/A
2007	6.96	**5.83**	**3.50**	0.22	**3.50**	0.22	**3.24**	**3.50**	**3.50**	-	**3.24**
2008	6.96	5.78	3.47	0.22	**3.50**	0.22	**3.24**	**3.50**	**3.50**	-	**3.24**
2009	6.96	5.81	3.49	0.22	3.47	0.22	3.27	**3.50**	3.47	0.03	**3.31**
2010	6.96	5.62	3.37	0.22	3.49	0.22	3.25	3.47	3.49	-0.02	3.23
2011	6.96	5.21	3.13	0.22	3.37	0.22	3.37	3.49	3.37	0.12	3.49
2012	6.96	**5.83**	**3.50**	0.22	3.13	0.22	3.61	3.37	3.13	0.24	3.85
2013	6.96	**5.83**	**3.50**	0.22	**3.50**	0.22	**3.24**	3.13	**3.50**	-0.37	**2.87**
2014	6.96	#N/A	#N/A	0.22	**3.50**	0.22	**3.24**	**3.50**	**3.50**	-	**3.24**

Source: Developed by NEI for analytical purposes using data from AKFIN (Fey 2014) and NMFS (2014f).

As described above, the analysts have determined that the best modelling approach is to use an iterated multi-year model to simulate the impacts of reduction in PSC limit alternatives. The model looks out into the future starting with 2014 and runs through 2023 (noting that 2014 is considered a future year.)

The model will use the 2014 FCEYs for each for each IPHC subarea in the BSAI which will be taken from NMFS (2014f). These FCEYs will be combined with O26 halibut PSC mortality estimates from 2013 and 2012 to impute the 2014 TCEY for each IPHC subarea. The imputed TCEY will be used for each of the future years through 2023.

Halibut PSC mortality for each of the future years in all subareas will be simultaneously determined via a random selection of Basis Years from 2008 to 2013. The same set of selected years will be used in a status quo calculation of impacts, and then to calculate the impacts under the particular PSC limit reduction option. The set of selected years will be used for all subareas during each iteration. The results will be reported as the net change from the status quo under the alternative for each IPHC subarea. The selection of Basis Years and the calculation of impacts will be repeated 10,000 times for each of the four reduction options for each affected participant group.[25] Table 5-14 shows an example of the randomly selected Basis Year for a single iteration. Note that the Realized O26 PSC mortality for the Basis Year equals the Realized O26 PSC mortality when the Basis Year was the fishing year. Also, with the exception of determining the FCEY, the selection of Basis Years has no bearing on revenues generated in the commercial halibut fisheries.

Table 5-14 Example Iteration of Halibut PSC mortality and FCEY Estimates with Randomly Selected Basis Year for 2014 to 2023

			Realized Removals			Predicted Removals			BPD Adjustments			
								Imputed	Prior Year O26 PSC			
Fishing Year	Basis Year	TCEY	Total PSC	O26 PSC	Other	O26 PSC	Other	Initial FCEY	Predicted	Realized	BPD	Final FCEY
All number (except years) are shown in millions of net weight pounds												
2008	2008	13.17	5.78	3.47	0.22	4.01	0.22	8.94	3.92	4.01	-0.09	8.85
2009	2009	11.02	5.81	3.49	0.22	3.47	0.22	7.33	4.01	3.47	0.55	7.88
2010	2010	11.80	5.62	3.37	0.22	3.49	0.22	8.09	3.47	3.49	-0.02	8.07
2011	2011	11.35	5.21	3.13	0.22	3.37	0.22	7.76	3.49	3.37	0.12	7.87
2012	2012	9.01	6.14	3.68	0.22	3.13	0.22	5.66	3.37	3.13	0.24	5.90
2013	2013	9.22	5.96	3.57	0.22	3.68	0.22	5.32	3.13	3.68	-0.56	4.76
2014	2011	6.96	5.21	3.13	0.22	3.57	0.22	3.16	3.68	3.57	0.11	3.28
2015	2010	6.96	5.62	3.37	0.22	3.13	0.22	3.61	3.57	3.13	0.45	4.06
2016	2010	6.96	5.62	3.37	0.22	3.37	0.22	3.37	3.13	3.37	-0.24	3.12
2017	2008	6.96	5.78	3.47	0.22	3.37	0.22	3.37	3.37	3.37	-	3.37
2018	2012	6.96	6.14	3.68	0.22	3.47	0.22	3.27	3.37	3.47	-0.09	3.18
2019	2011	6.96	5.21	3.13	0.22	3.68	0.22	3.05	3.47	3.68	-0.22	2.83
2020	2008	6.96	5.78	3.47	0.22	3.13	0.22	3.61	3.68	3.13	0.56	4.17
2021	2009	6.96	5.81	3.49	0.22	3.47	0.22	3.27	3.13	3.47	-0.34	2.94
2022	2013	6.96	5.96	3.57	0.22	3.49	0.22	3.25	3.47	3.49	-0.02	3.23
2023	2011	6.96	5.21	3.13	0.22	3.57	0.22	3.16	3.49	3.57	-0.09	3.08

Sources: Developed by NEI for purposes of this analysis, using various sources. TCEYs are imputed from 2008 to 2014, and assumed from 2015 to 2023. Final FCEYs are from NMFS (2014f) for 2008 to 2014, and imputed for 2014 to 2023. Realized PSC mortality removals from 2008 to 2013 are from AKFIN.

[25] As will be discussed later in the analysis, many of the proposed options will have no material impact on particular participant groups. For example, longline catcher vessels did not take even 50 percent of their 15 mt PSC limit in the Pacific cod fishery in any year from 2008 to 2013. Because of this, we did not run the IMS model for options affecting longline CVs.

An Example of the Results Generated with the IMS Model

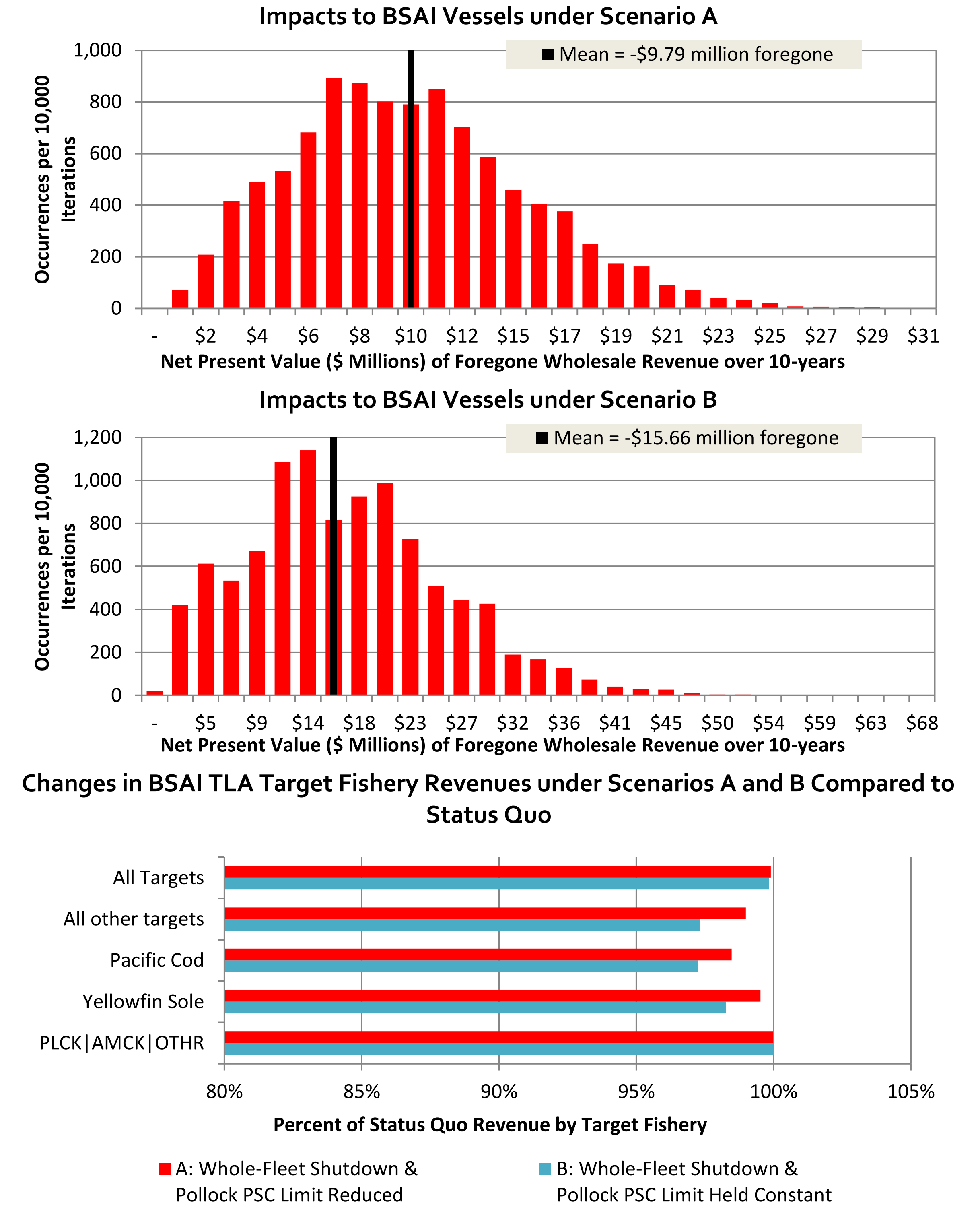
Figure 5-7, Figure 5-6 and Table 5-15 on the following pages provide an example of IMS Model results. In this case the results shown are for Option 2.1, which would reduce BSAI TLA halibut PSC limits to 90 percent of the Status Quo levels.

As described, results from two scenarios are presented. Scenario A shows the impacts assuming that each of the target fisheries for which BSAI TLA halibut PSC limits are set are reduced by 10 percent. In Scenario B, the PSC limit for BSAI TLA activity in the Pollock|Atka Mackerel|Other Species target fishery are not reduced (since the pollock is not bound by the limit), and the remaining three target fishery limits (for Pacific cod, yellowfin sole and rockfish) are reduced by proportionally higher amounts such that the overall limit is reduced by 87.5 mt from 875 mt in the status quo.

Figure 5-6 focuses on the groundfish fishery and comprises three separate graphics. The first two distribution over 10,000 model iterations of the net present value of changes in wholesale revenue relative to the status quo for Scenario A and Scenario B—it is important to note that the horizontal axes of the two figures are not the same and the negative impacts are higher under Scenario B. The graphic at the bottom summarizes the impact of the two scenarios to the four specific target fisheries. There is virtually no impact to the Pollock|Atka Mackerel|Other Species fisheries because the pollock fishery is not constrained by the limits.

Figure 5-7 shows impacts for the commercial halibut fishery. The histogram show the distribution of the estimated change from the status quo of the net present value of wholesale revenues over the 10-year period modelled. The figure comprises two columns each consisting of four histograms that show the distribution of change over the 10,000 model iterations. The mean change in net present value is called out in each of the graphics. The column on the left shows Scenario A while Scenario B is on the right. The rows show subarea impacts in Area 4A, 4B and 4CDE while the histograms at the bottom shows the aggregate impacts on Area 4 as a whole. Impacts of Scenario B are generally higher than impacts of Scenario A because the overall reductions of halibut PSC mortality are greater under Scenario A than they are under Scenario A.

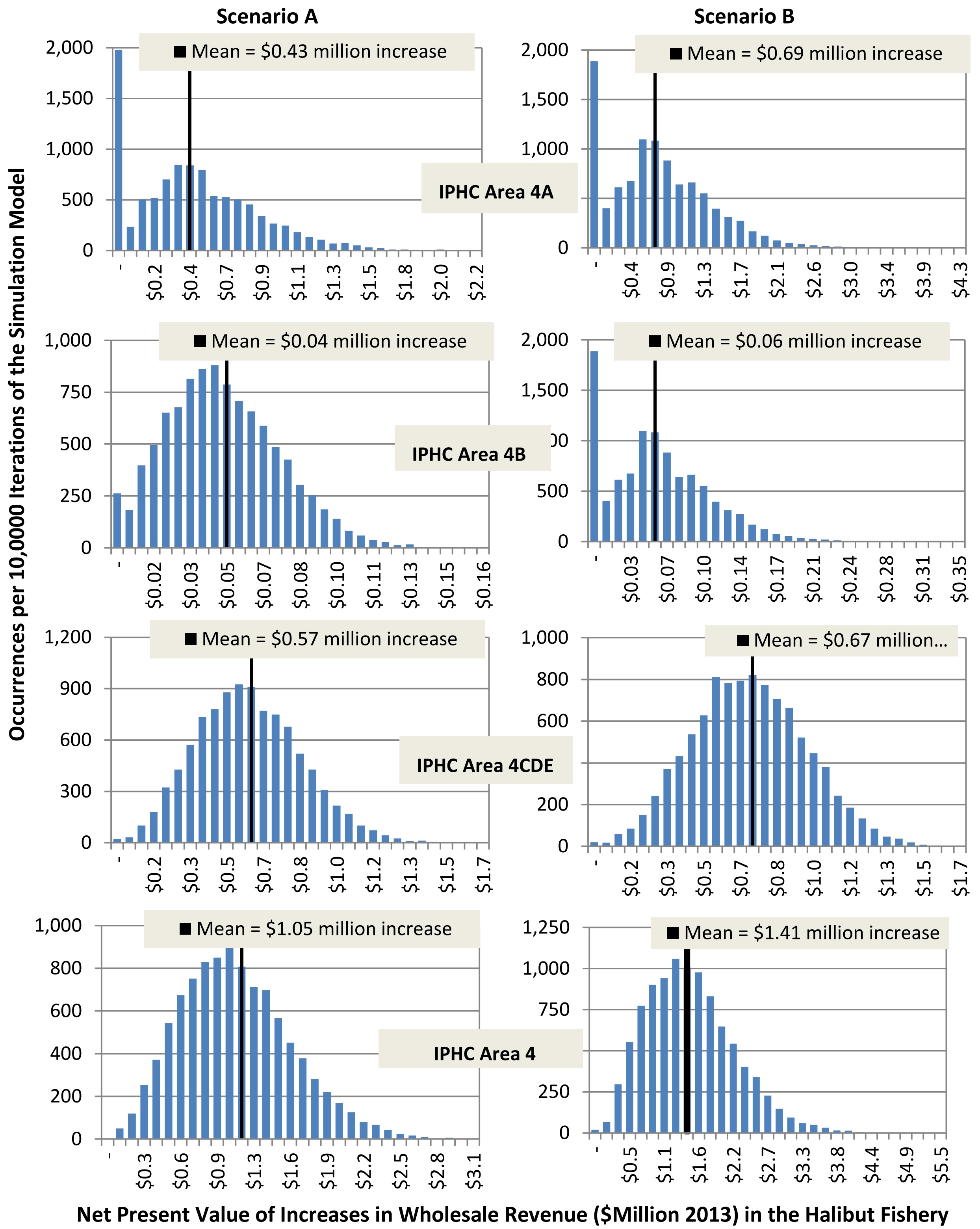
Figure 5-6 Impacts to BSAI TLA Vessels under Option 2.1—10% Reductions in Halibut PSC Limits



1) Scenario A assumes that pollock caps are reduced in the same proportion as all other caps.
2) Scenario B assumes that pollock caps are not reduced, but that caps for other targets are reduced to meet the PSC reduction goal.

Source: Developed by Northern Economics based on AKFIN data (Fey 2014)

Figure 5-7 10-year Net Present Value of Revenue Impacts ($Millions) to Directed Fisheries of Option 2.1



Note: Scenario A assumes that all caps including pollock caps are reduced, while Scenario B assumes that pollock caps are not reduced, but that caps for other targets are reduced to meet the PSC reduction goal.

Source: Developed by Northern Economics based on AKFIN data (Fey 2014)

Table 5-15 provides more quantitative information regarding the changes generated in the 10,000 iterations of the IMS Model for Option 2.1.

Table 5-15 Measures Summarizing the Impacts of Option 2.1 on BSAI TLA Vessels

	Directed Halibut Fishery Impacts								Groundfish	
	Scenario A				Scenario B				Scenario A	Scenario B
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4	All Areas	
Iterations with No Change in Net Present Value (NPV)	1,980	262	23	0	1,888	1,888	20	20	0	20
	Net Change in the Net Present Value of Wholesale Revenue Over all Iterations ($2013 Millions)									
Minimum Change in NPV	-	-	-	$0.00	-	-	-	-	($30.10)	($65.35)
Maximum Change in NPV	$2.13	$0.16	$1.60	$3.02	$4.15	$0.34	$1.60	$5.29	($0.23)	-
Mean Change in NPV	$0.43	$0.04	$0.57	$1.05	$0.69	$0.06	$0.67	$1.41	($9.79)	($15.66)
Standard Deviation of Changes in NPV	$0.37	$0.03	$0.24	$0.48	$0.57	$0.05	$0.26	$0.70	$4.75	$8.83
Median Change in NPV	$0.38	$0.04	$0.55	$1.00	$0.61	$0.05	$0.67	$1.35	($9.38)	($14.77)
	Change in Average Annual Halibut (mt)									
Mean Annual Change in Halibut PSC mortality (Round Weight mt)	-5.00	-0.49	-6.57	-12.06	-7.94	-0.64	-7.95	-16.53	-12.06	-16.53
Mean Annual Change in Directed Catch (Net Weight mt)	1.83	0.19	2.40	4.41	2.91	0.23	2.85	5.99	-	-

Note: Option 2.1 sets the PSC Limits for the BSAI TLA at 90 percent of Status Quo levels (10 percent reduction).
Source: Developed by NEI from the IMS Model.

The two graphics tableaux and the table described above are provided for each of the Options and suboptions for which the IMS Model was run. The bulleted list below summarizes the options for which the IMS model was not run.

- Option 4, which would reduce PSC limits in the longline CV fishery for Pacific cod, would not have a material impact on the fishery under any of the suboptions.
- Option 5 would reduce PSC limits in the longline CP fishery for Pacific cod. Setting the PSC limit at 90 or 80 percent of the status quo (Option 5.1 and Option 5.2) would not have a material effect on the longline CP fishery.
- Option 6 would reduce PSC limits in the CDQ groundfish fishery. Options 6.1–Option 6.3 would not materially affect the CDQ fisheries. The IMS Model was only run for Option 6.4, which would set the PSC limit at 65 percent of the status quo.
- Option 7 would reduce PSC limits in all hook and line fisheries (longline CPs and longline CVs) in target fisheries other than Pacific cod or sablefish. None of the suboptions would have a material effect on either group.

A Caveat Regarding the Impact of U26 halibut PSC mortality in the IMS Model and the Assessment of Impacts

As mentioned in Section 5.4.2.3, under the current harvest policy U26 halibut that would be "saved" under PSC reduction options are assumed to become part of the TCEYs and FCEYs as they grow into mature fish that become part of the exploitable biomass. The IMS Model and the assessment of impacts rely on this assumption. We do not make any further adjustments to account for any savings of U26 fish. We also note that under proposed changes to the IPHC harvest policy, any savings of U26 that would be generated and potentially added to the FCEY would be distributed across all IPHC areas coastwide. Based on coastwide biomass percentages shown in Table 5-1 on page 125, only 20 percent of any projected savings of U26 halibut would accrue to catch limits in Area 4.

5.5 Description of BSAI Groundfish Fisheries

This section provides an overview of the BSAI groundfish fisheries in terms that are relevant to the proposed action to reduce halibut PSC limits.

Under Alternative 2 and its options, reductions in the current halibut PSC limits would be considered for five different components of the BSAI groundfish fishery. A separate subsection for each of these five components (as listed below) is provided beginning on page 150.

1) Vessels participating in BSAI Trawl Limited Access (BSAI TLA) under Option 2;
2) Amendment 80 Catcher Processors (A80-CPs) under Option 3;
3) Longline Catcher Vessels (longline CVs) under Option 5 and Option 7;
4) Longline Catcher Processors (longline CPs) under Option 5 and Option 7;
5) Community Development Quota (CDQ) groundfish harvesters under Option 6.

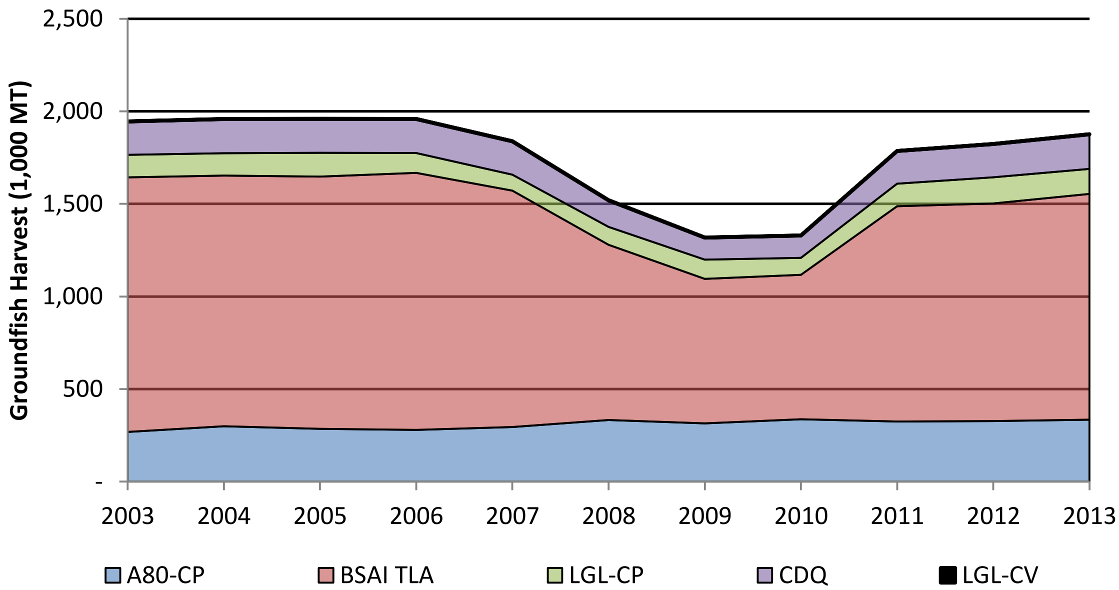
The remainder of this introductory section provides an overview of the affected groundfish fisheries. It should be noted that three components of the BSAI groundfish fishery are not directly analyzed in this assessment because they are not directly affected by proposed regulatory changes. These components include the following:

1) Participants in the Pacific cod pot and jig fisheries who are excluded because pot and jig gears are exempted halibut PSC limits.
2) Participants in the IFQ and CDQ fixed gear fisheries for sablefish are excluded because the halibut PSC mortality in these fisheries are exempted from the PSC limits.
3) Shore-based, floating and mothership processors are not separately analyzed. These processors are indirectly affected when CVs in the BSAI TLA are affected (Option 2), when longline CVs are affected (Options 4 and 7), or when CVs operating in the CDQ groundfish fisheries are affected.

5.5.1 Overview of Affected BSAI Groundfish Fisheries

The pages that follow contain a brief overview of the BSAI Groundfish fisheries that are affected by Alternatives. Figure 5-8 provides a summary of groundfish harvests by participant group. (Note that these data for 2008 to 2013 are reproduced along with wholesale revenue estimates in Table 5-16.) In Figure 5-8, the very noticeable drop in total catch from 2008 to 2010 reflects the reduction in the pollock TAC that occurred in those years. Overall groundfish catch rose again in 2011, largely due to increases in the pollock TACs, and have increased gradually each year since.

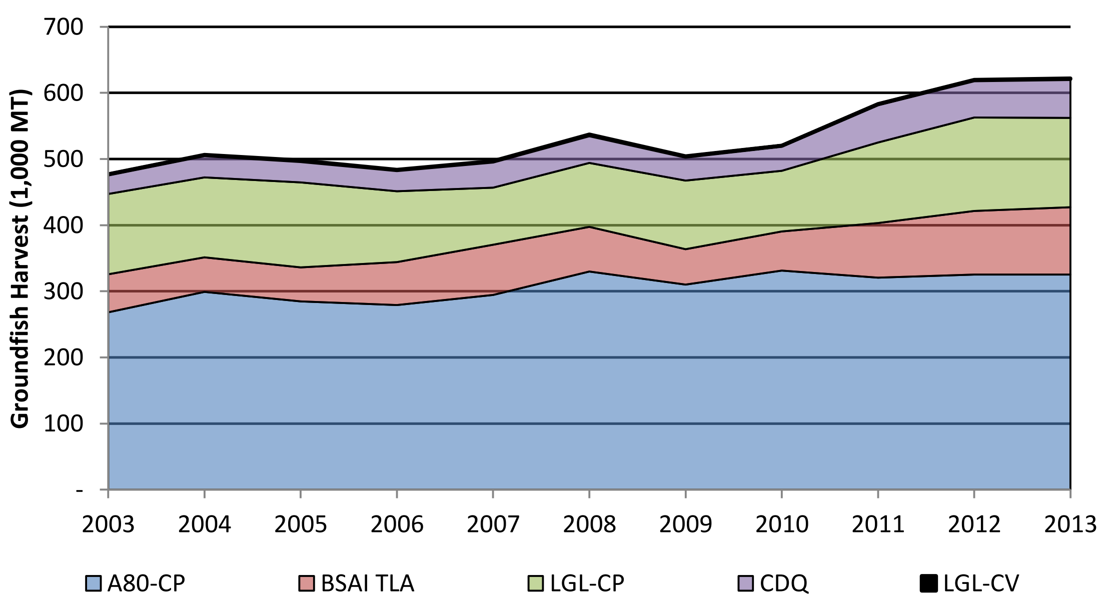
Figure 5-8 Groundfish Harvests of Affected Participants in the BSAI, 2003 to 2013



Notes: 1) LGL-CP = Longline CPs; LGL-CV = Longline CVs
2) Average harvests of the Longline CVs were less than 1,000 mt per year.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

As noted in the previous paragraph, changes in the pollock fishery of the BSAI TLA and CDQ participants tends to overwhelm changes in the other target fisheries. Figure 5-9 shows BSAI groundfish harvests of the affected participants excluding the pollock target harvests. From this "non-pollock" perspective it is clear that groundfish harvests in all target fisheries increased steadily from 2003 to 2013.

Figure 5-9 BSAI Groundfish Harvests Excluding Pollock Target Harvests of Affected Groups, 2003 to 2013



Notes: 1) LGL-CP = Longline CPs; LGL-CV = Longline CVs
2) Average harvests of the Longline CVs were less than 1,000 mt per year.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-16 provides more details regarding groundfish harvests and nominal wholesale revenues generated by the affected vessels and their processors. Wholesale revenues and implicit wholesale values per harvested tons of groundfish are summarized in more detail in the following pages.

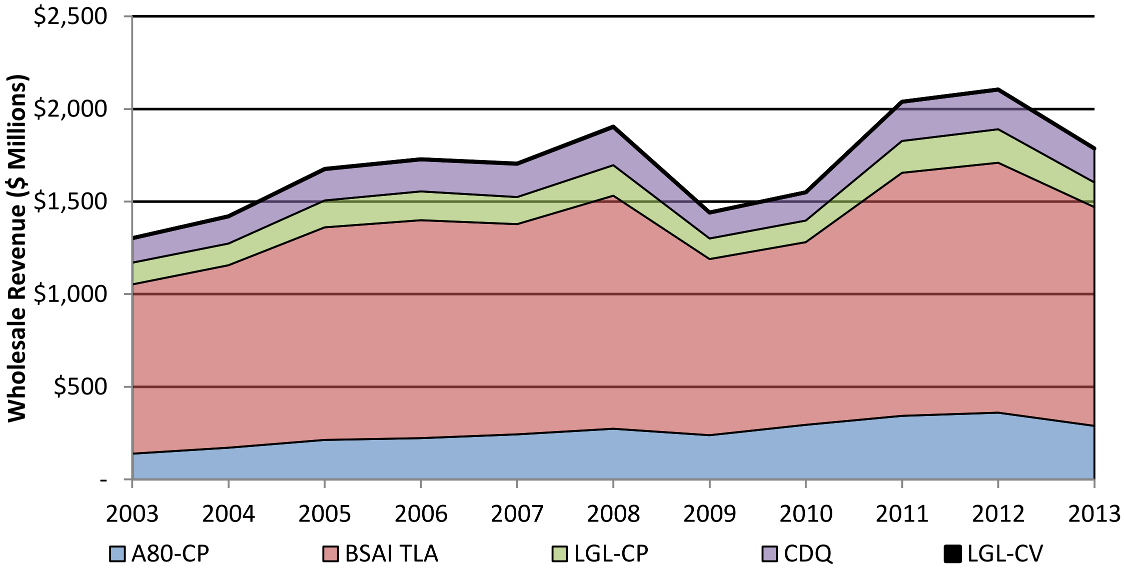
Table 5-16 Harvests and Nominal Wholesale Revenue in Groundfish BSAI Target Fisheries, 2007 to 2013

Affected Component	2007	2008	2009	2010	2011	2012	2013	Average
				BSAI Groundfish Catch (1,000 mt)				
A80-CP	294.88	332.81	314.70	336.76	324.68	327.02	334.52	323.63
BSAI TLA	1,276.82	946.43	780.55	780.31	1,162.84	1,175.57	1,219.60	1,048.87
Longline CP	86.30	96.66	103.78	91.70	121.83	141.33	135.11	110.96
CDQ	179.91	143.24	118.85	120.50	176.41	179.44	186.56	157.85
Longline CV	0.87	1.29	0.69	0.36	0.48	0.75	1.03	0.78
All Affected Components	**1,838.80**	**1,520.43**	**1,318.58**	**1,329.64**	**1,786.25**	**1,824.10**	**1,876.81**	**1,642.09**
				Nominal Wholesale Revenue ($ Millions)				
A80-CP	$243.22	$273.52	$238.65	$294.69	$343.22	$360.38	$289.04	$291.82
BSAI TLA	$1,135.09	$1,258.46	$950.99	$986.22	$1,312.29	$1,349.41	$1,181.16	$1,167.66
Longline CP	$146.09	$164.57	$111.18	$116.73	$171.92	$180.72	$133.11	$146.33
CDQ	$179.34	$206.16	$139.48	$152.23	$211.20	$213.83	$182.68	$183.56
Longline CV	$1.54	$2.24	$0.82	$0.52	$0.82	$1.23	$1.31	$1.21
All Affected Components	$1,705.28	$1,904.95	$1,441.12	$1,550.40	$2,039.45	$2,105.58	$1,787.30	$1,790.58

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

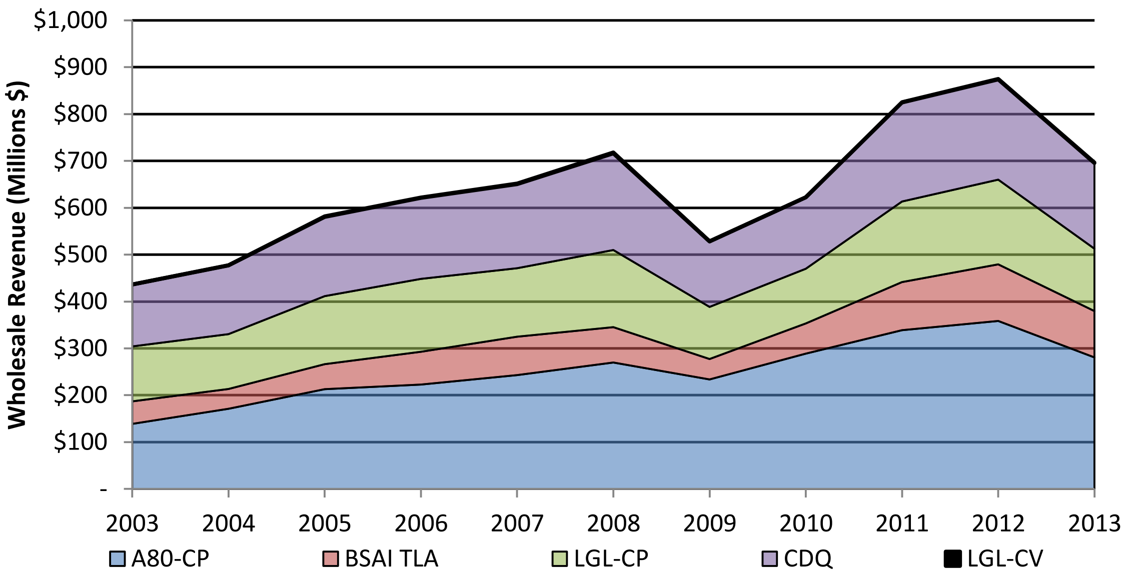
Figure 5-10 shows nominal wholesale revenue in the BSAI groundfish fisheries of affected participants. Revenue declines in 2009 and continued low revenue in 2010 appear to have been a combination of the global recession and the low pollock TACs. Relatively high prices for pollock offset much of the revenue impact of low pollock TACs in 2008. Figure 5-11 shows nominal wholesale revenues in the BSAI groundfish fisheries of affected participants excluding harvests in pollock target fisheries. This graphic clearly shows the effect of low prices in 2009 resulting from the global recession. The significant drop in wholesale revenues in 2013 does not appear to be linked to any single pervasive cause, and appears to have affected all sectors and all species.

Figure 5-10 Nominal Wholesale Revenue from BSAI Groundfish of Affected Participants



Notes: 1) LGL-CP = Longline CPs; LGL-CV = Longline CVs
2) Wholesale revenues of the Longilne CVs averaged less than $1.5 million per year.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-11 Nominal Wholesale Revenues from BSAI Groundfish Excluding Harvests in Pollock Targets



Note: LGL-CP = Longline CPs; LGL-CV = Longline CVs
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-17 shows calculated nominal wholesale revenue per ton of groundfish harvest in target fisheries. The values shown represent wholesale values from harvests in trawl fisheries with the exception of the last row, which shows wholesale per harvested ton in Pacific cod longline target fisheries. The implicitly derived wholesale values in the table stretch back to 2007 in order to show the significant jump in wholesale prices that were experienced in 2008, and which led to an overall increase in total revenue in 2008 despite significantly lower harvests of pollock. The table also includes estimates of the year-over-year percentage change in wholesale values. The year-over-year percentage change serves to highlight pervasive declines in wholesale value per ton in 2013 that contributed to the significant drop in overall wholesale revenues from BSAI Groundfish.

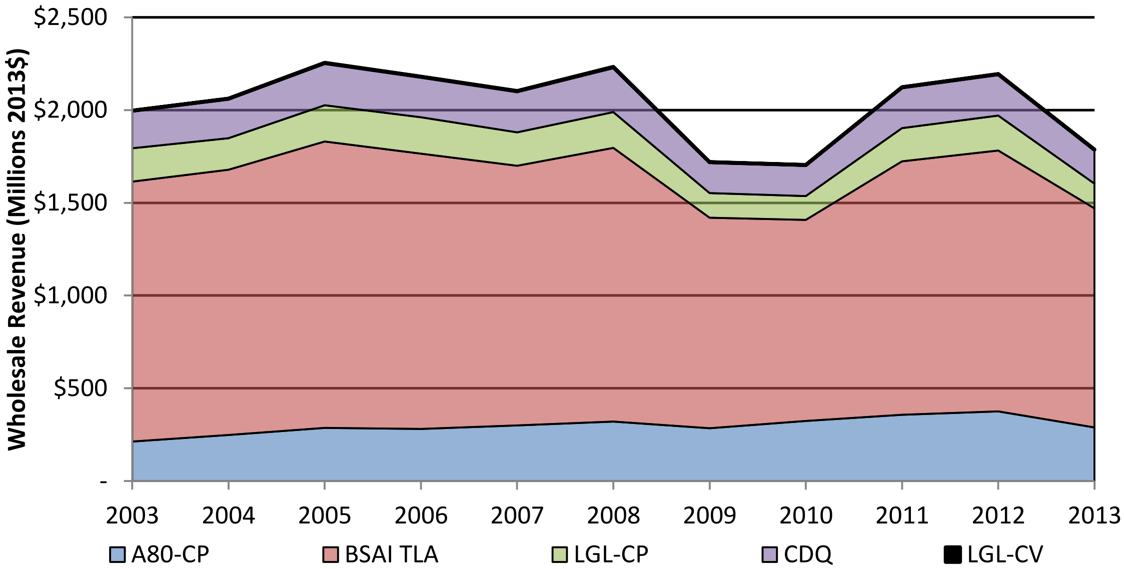
Table 5-17 Wholesale Revenue per Harvested Ton of Groundfish in BSAI Target Fisheries, 2007 to 2013

	2007	2008	2009	2010	2011	2012	2013
	Nominal Wholesale Revenue per mt of Harvest						
Yellowfin Sole	$714	$742	$673	$768	$893	$993	$773
Rock Sole	$782	$830	$699	$831	$944	$1,001	$784
Arrowtooth or Kamchatka Flounder	$716	$791	$698	$773	$905	$1,003	$804
Flathead Sole	$692	$837	$745	$822	$973	$1,016	$786
Atka Mackerel	$747	$816	$859	$1,073	$1,476	$1,495	$1,455
Rockfish	$1,062	$922	$852	$1,234	$1,790	$1,477	$1,147
Pollock	$887	$1,364	$1,251	$1,282	$1,127	$1,144	$971
Pacific Cod (Trawl Caught)	$1,267	$1,527	$993	$1,298	$1,484	$1,455	$1,131
Pacific Cod (Longline Caught)	$1,826	$4,576	$3,461	$3,767	$4,590	$3,826	$2,875
	Year over Year Change in Nominal Wholesale Revenue per mt of Harvest						
Yellowfin Sole	-8.2%	3.9%	-9.2%	14.1%	16.3%	11.2%	-22.1%
Rock Sole	-6.1%	6.1%	-15.8%	18.8%	13.6%	6.1%	-21.7%
Arrowtooth or Kamchatka Flounder	16.3%	10.5%	-11.7%	10.8%	17.0%	10.9%	-19.8%
Flathead Sole	-13.1%	21.0%	-11.0%	10.3%	18.4%	4.4%	-22.6%
Atka Mackerel	16.0%	9.3%	5.2%	25.0%	37.5%	1.3%	-2.7%
Rockfish	-23.4%	-13.2%	-7.6%	44.9%	45.1%	-17.5%	-22.4%
Pollock	5.3%	53.7%	-8.3%	2.5%	-12.1%	1.5%	-15.1%
Pacific Cod (Trawl Caught)	15.5%	20.5%	-34.9%	30.7%	14.3%	-1.9%	-22.3%
Pacific Cod (Longline Caught)	-11.5%	150.5%	-24.4%	8.8%	21.9%	-16.6%	-24.9%

Note: Year over year percentage changes are calculated by subtracting last year's value from this year's value and dividing the difference by last year's value.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-12 shows inflation-adjusted wholesale revenues from the affected groundfish BSAI fisheries. In general, the analysis will use inflation adjusted revenue values. The inflation adjustment brings nominal dollar values up to the equivalent value of the dollar in 2013. The adjustments use the standard producer price index calculated by U.S. Bureau of Labor Statistic that is used by NMFS Alaska Fisheries Science Center for adjusting ex-vessel and wholesale values in the seafood industry. The index can be found at http://data.bls.gov/timeseries/WPU0223. A comparison of the inflation-adjusted wholesale values in Figure 5-12 to the nominal wholesale values shown in Figure 5-10 is instructive. From Figure 5-10 we might infer that the groundfish industry is doing quite well with total revenues increasing over time. In Figure 5-12, however, we see that wholesale revenues have really just been keeping up with inflation, with some poor years (2009, 2010, and 2013) where the industry revenues have lost ground, and some better years where revenue increased relative to inflation (2004, 2005, 2008, 2011, 2012).

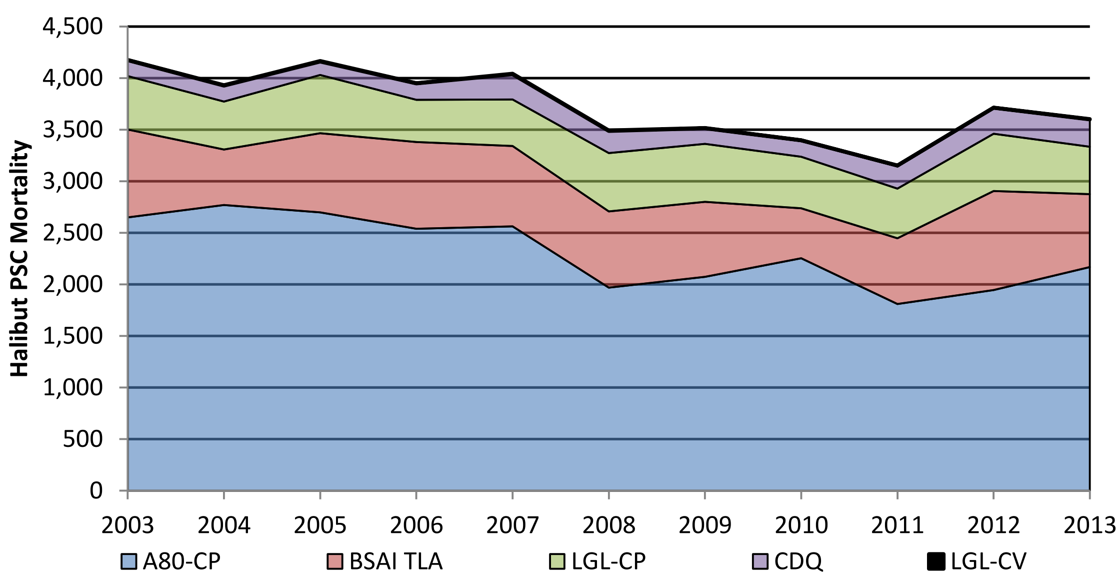
Figure 5-12 Inflation Adjusted Wholesale Revenue from BSAI Groundfish (2013$) of Affected Participants



Notes: 1) LGL-CP = Longline CPs; LGL-CV = Longline CVs
2) Average harvests of the Longline CVs were less than 1,000 mt per year.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

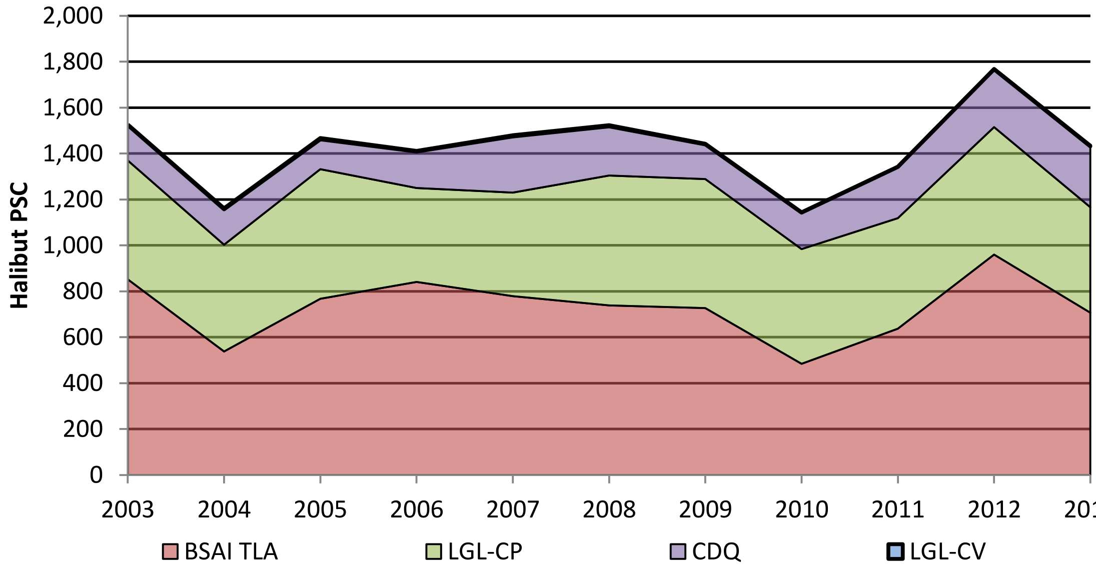
Figure 5-13 shows halibut PSC mortality in the BSAI groundfish target fisheries of affected participants from 2003 to 2013. In 2003, total halibut mortality across all participants was over 4,100 mt. By 2011, halibut PSC mortality dropped to 3,100 mt before jumping back above 3,500 mt in 2012 and 2013. As shown in Figure 5-14 on the following page, the overall decline is due mostly to reductions of the A80-CPs following implementation of A80 in 2008. As seen in Figure 5-13, halibut PSC mortality generated by other participants does not appear to have had a significant trend either up or down from 2003 forward.

Figure 5-13 Halibut PSC mortality in BSAI Groundfish Target Fisheries of Affected Participants, 2003 to 2013



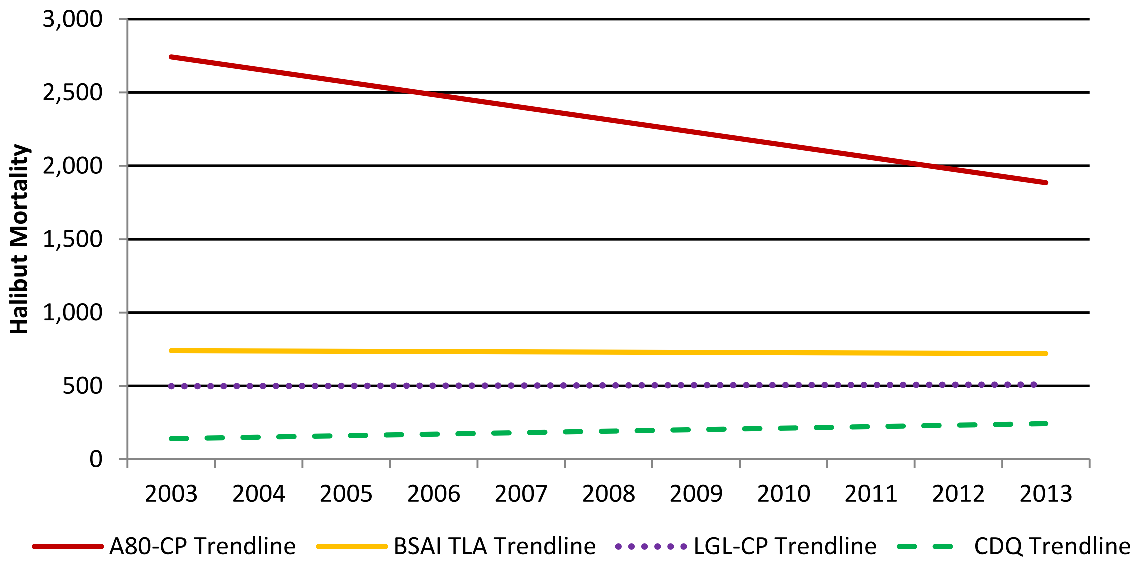
Notes: 1) LGL-CP = Longline CPs; LGL-CV = Longline CVs
2) Average halibut PSC mortality of Longline CVs was less than 3.6 mt per year.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-14 Halibut PSC mortality in BSAI Groundfish Target Fisheries of Affected Participants Excluding A80-CPs



Notes: 1) LGL-CP = Longline CPs; LGL-CV = Longline CVs
2) Average halibut PSC mortality of Longline CVs was less than 3.6 mt per year.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-15 Linear Trends in Halibut Mortality of Affected Participants, 2003 to 2013



Notes: 1) LGL-CP = Longline CPs; LGL-CV = Longline CVs
2) Average halibut PSC mortality of Longline CVs was less than 3.6 mt per year.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-18 summarizes the halibut PSC limits that have been in place since 2008. The table also shows the percent of the effective limit taken in BSAI groundfish target during the year. The PSC limits for A80-CPs were reduced by a total of 150 mt under A80 regulations from 2,525 in 2008 to 2,375 in 2011 to 2013. Halibut PSC limits for groundfish CDQ fisheries increased by 50 mt in 2010 to 393 mt. PSC limits for the three remaining groups of affected participants were unchanged during the period. It should be noted that the limit for the BSAI TLA fleet was first defined and set in 2008 under A80. Also it should be noted that the PSC limit for the hook and line sectors (longline CPs and longline CVs) were not separately defined until 2008 under Amendment 85. Finally, we note that the PSC limit for "All Other Targets" excludes sablefish and is set at 58 mt. Officially, this PSC mortality apportionment is shared between longline CPs and longline CVs, but since 2008 there have been exactly zero instances of longline CVs being assigned a "target" other than Pacific cod or sablefish.

Table 5-18 Halibut PSC Limits in the BSAI and Percent Taken from 2008 to 2013

Affected Participants	2008	2009	2010	2011	2012	2013	Average
			PSC Limit (mt of Halibut Mortality)				
A80-CPs (Coops + A80 Limited Access)	2,525	2,475	2,425	2,375	2,325	2,325	2,408
BSAI TLA (All Target Fisheries)	875	875	875	875	875	875	875
Longline CPs (for Pacific Cod + All Other Targets)	818	818	818	818	818	818	818
CDQ (All Target Fisheries)	343	343	393	393	393	393	376
Longline CVs (for Pacific cod only)	15	15	15	15	15	15	15
All BSAI Halibut PSC Limits	**4,576**	**4,526**	**4,526**	**4,476**	**4,426**	**4,426**	**4,493**
			Percent of 2013 Limit Taken				
A80-CPs (Coops + A80 Limited Access)	78%	84%	93%	76%	84%	93%	85%
BSAI TLA (All Target Fisheries)	84%	83%	55%	73%	110%	81%	81%
Longline CPs (for Pacific Cod + All Other Targets)	69%	68%	61%	59%	68%	56%	64%
CDQ (All Target Fisheries)	62%	44%	40%	57%	64%	67%	56%
Longline CVs (for Pacific cod only)	33%	20%	13%	7%	13%	20%	18%
All BSAI Halibut PSC Limits	**76%**	**78%**	**75%**	**70%**	**84%**	**81%**	**77%**

Source: Developed from information on the NMFS Annual Specifications (NMFS 2014f) and from AKFIN data (Fey 2014).

The bottom half of Table 5-18 shows total PSC mortality of each of the affected participant groups by year as a percentage of the PSC limit in place during that year. This part of the table is particularly useful for getting a general sense of the potential impacts of reducing halibut PSC limits, particularly for affected groups for which the limits have been unchanged throughout the period. As an example, the CDQ groups have taken an average of 54 percent of their combined halibut PSC limit for pollock, Pacific cod and for all other targets. Relatively small reductions in the CDQ limit would not have affected the ability of the CDQ group to harvest the groundfish they harvested in any of the years. Significantly Lower limits (e.g. reductions of 30% or 35%) would potentially limit their ability to expand their operations and take a greater percentage of their CDQ apportionments.

The following five subsections provide much more detail for each of the directly affected groundfish components.

5.5.2 Bering Sea Trawl Limited Access Fisheries

The BSAI Trawl Limited Access (BSAI TLA) fisheries were formally defined under A80. A80 was implemented in 2008, and formally divided the trawl apportionments of the primary trawl target fisheries between the A80-CPs, and the remaining three harvest sectors of the trawl fishery including: 1) catcher processors authorized to fish for BSAI Pollock under the American Fisheries Act (AFA-CPs), 2) catcher vessels authorized to fish for BSAI Pollock under the American Fisheries Act (AFA-CVs), and 3) all other trawl catcher vessels that have licenses and endorsements to participate in trawl fisheries under the North Pacific License Limitation Program (LLP).

5.5.2.1 Description of Participants in the BSAI Trawl Limit Access Fisheries

BSAI TLA Harvesting Vessels

141 unique vessels participated in BSAI TLA fisheries between 2008 and 2013 (Table 5-19). Of the 141 unique vessels, 70 percent were AFA-CVs primarily targeting pollock[26], and Pacific cod. The remaining fleet operated as non-AFA CVs (18 percent) and AFA-CPs (12 percent) and targeted a wider array of species, although pollock was clearly the most important fishery for AFA-CPs and the least important for trawl CVs (non-AFA). To determine unique vessel counts, the study team counted each active vessel in a year once. However, within each harvest sector, the columns do not sum to the "All Target" total. This is due to the fact that some vessels participate in multiple target fisheries. In the table, the shaded cell indicate that fewer than three vessels participated in that year, meaning that catch and value data for that cell cannot be disclosed.

Table 5-19 Types and Numbers of Vessels Participating in BSAI TLA Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	2008–2013
AFA-CPs				**Number of Unique Vessels**			
Pollock|Atka Mackerel|Other Species	16	14	14	15	16	16	17
Yellowfin Sole	12	8	9	9	10	8	13
Pacific Cod	1	1	2	2	4	1	6
All other targets	6	7	5	2	4	4	12
All Targets	**17**	**15**	**15**	**16**	**16**	**16**	**17**
AFA-CVs				**Number of Unique Vessels**			
Pollock|Atka Mackerel|Other Species	89	89	89	86	89	85	96
Yellowfin Sole	-	-	-	-	-	2	2
Pacific Cod	52	40	37	38	44	42	56
All other targets	-	-	-	-	1	-	1
All Targets	**95**	**96**	**92**	**92**	**94**	**90**	**99**
Trawl-CVs (Non-AFA)				**Number of Unique Vessels**			
Pollock|Atka Mackerel|Other Species	2	1	2	3	3	3	5
Yellowfin Sole	3	1	-	2	3	3	5
Pacific Cod	15	14	11	12	16	12	24
All other targets	2	2	2	3	3	3	5
All Targets	**15**	**14**	**11**	**13**	**16**	**12**	**25**
All BSAI TLA Vessels				**Number of Unique Vessels**			
Pollock|Atka Mackerel|Other Species	107	104	105	104	108	104	118
Yellowfin Sole	15	9	9	11	13	13	86
Pacific Cod	68	55	50	52	64	55	86
All other targets	8	9	7	5	8	7	18
All Targets	**127**	**125**	**118**	**121**	**126**	**118**	**141**

Note: Shaded cells indicate that catch and revenue data for that sub-set of vessels in that year for that target fishery cannot be disclosed due to confidentiality rules.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Since 2008, BSAI TLA vessel owners predominately resided in states other than Alaska—primarily in Washington and Oregon (Table 5-20). The regions of residence displayed in this table are:

[26] In this table and throughout this subsection the analysis uses the term "Pollock|Atka Mackerel|Other Species" because that is the term used by NMFS to apportion halibut PSC limits for the BSAI TLA. Almost all (99.7%) of the groundfish harvests in the "Pollock|Atka Mackerel|Other Species" target were actually taken in pollock target fisheries between 2008–2013 with the remaining 0.3 percent attributed to Atka Mackerel and exactly 0 percent attributed to the "Other Species" TAC category.

- Northwest Alaska (NW AK), which includes coastal areas north of Bristol Bay;
- Southwest Alaska (SW AK), including the Bristol Bay region, the AK Peninsula, Aleutian Islands, and Kodiak;
- Other Alaska (Other AK) which covers the all other regions in Alaska;
- Other U.S. (Other US) which includes all other U.S. participants.

Of the total number of unique vessels operating in the BSAI TLA fisheries between 2008 and 2013, only 12 of the 141 owners resided in Alaska at some point during the six-year period. This includes vessel owners that may have moved from Alaska to another state and vice versa. The number of vessels owners residing in Alaska in any given year ranged from five percent to seven percent between 2008 and 2013. Again, no vessel is included twice in any given year.

Table 5-20 BSAI TLA Vessel Owner's Place of Residence, 2008 to 2013

	2008	2009	2010	2011	2012	2013	2008–2013
AFA-CPs				**Number of Unique Vessels**			
NW Alaska	-	-	-	-	-	-	-
SW Alaska	-	-	-	-	-	-	-
Other Alaska	-	-	-	1	1	1	1
Other U.S.	17	15	15	15	15	15	17
Total Unique Vessels	**17**	**15**	**15**	**16**	**16**	**16**	**17**
AFA-CVs				**Number of Unique Vessels**			
NW Alaska	-	-	-	-	-	-	-
SW Alaska	5	5	5	5	5	5	6
Other Alaska	-	-	-	-	-	-	-
Other U.S.	90	91	87	87	89	85	95
Total Unique Vessels	**95**	**96**	**92**	**92**	**94**	**90**	**99**
Trawl CV (Non-AFA)				**Number of Unique Vessels**			
NW Alaska	-	-	-	-	-	-	-
SW Alaska	1	3	-	2	3	1	6
Other Alaska	1	1	1	-	-	-	1
Other U.S.	13	10	10	11	13	11	21
Total Unique Vessels	**15**	**14**	**11**	**13**	**16**	**12**	**25**
All BSAI TLA Vessels				**Number of Unique Vessels**			
NW Alaska	-	-	-	-	-	-	-
SW Alaska	6	8	5	7	8	6	12
Other Alaska	1	1	1	1	1	1	2
Other U.S.	120	116	112	113	117	111	133
Total Unique Vessels	127	125	118	121	126	118	141

Note: There were a total of 6 vessels whose owners lived in multiple regions over the 6-year period. Also note that shaded cells indicate that catch and revenue data for that sub-set of vessels in that year for that target fishery cannot be disclosed due to confidentiality rules.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

BSAI TLA Processors

There are six types of processors participating in the BSA TLA fisheries. These include the following:

1) **AFA shore-based plants and floating processors**: These plants are authorized under AFA to take deliveries of BSAI pollock and include the three plants in Dutch Harbor/Unalaska, three plants in Akutan, King Cove and Sandpoint, and a floating processor (the Northern Victor)

operating out of Beaver Inlet on the Northwest side of Unalaska Island. Another AFA shore-based plant (the Arctic Enterprise) has not operated since 2006.

2) **Other shore plants**: Several other non-AFA shore plants in SW Alaska are presumed to have operated in BSAI TLA fishery. The data we have currently available to us do not allow us to generate a count of these processors.
3) **AFA motherships**: There are three motherships that are authorized under AFA to process BSAI Pollock—the Excellence, the Golden Alaska, and the Ocean Phoenix.
4) **AFA-CP**s: These are catcher processors authorized under AFA to catch and process BSAI Pollock. Seventeen AFA-CPs have operated in the BSAI TLA since 2008.
5) **Other floating processors**: Six floating processors have operated in the BSAI TLA from 2008 to 2013 including Arctic Star, Bering Star, Independence, Snopac Innovator, and the Gordon Jensen. Floating processors are defined separately from motherships because they only operate within State of Alaska waters. These vessels are not authorized to process BSAI pollock except as incidental catch.
6) **Other Motherships**: Six vessels that otherwise operate as either AFA-CPs or A80-CPs have also operated as motherships between 2008 and 2013. These include American Triumph, Katie Ann, and Northern Eagle (all AFA-CPs) and Ocean Peace, Seafreeze, and Seafisher (all A80-CPs). These vessels are not authorized to take deliveries and process BSAI pollock except as incidental catch.

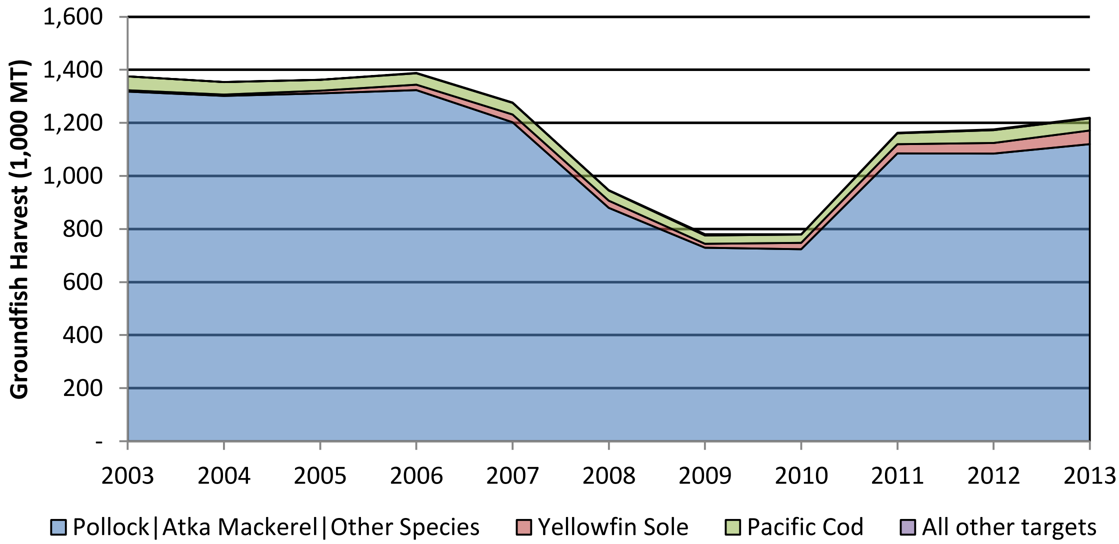
5.5.2.2 Catch and Revenue in Target Fisheries of BSAI TLA

In this section and others that follow, groundfish harvests in BSAI TLA fisheries are reported based on target fishery groups for which the BSAI TLA is apportioned halibut PSC limits. Since 2008 (with A80), the BSAI TLA has been apportioned halibut PSC mortality for the following four Target Fishery Groups: 1) Pollock|Atka Mackerel|Other Species; 2) Pacific Cod; 3) Yellowfin Sole; and 4) Rockfish. Because landings in the rockfish fisheries have been very limited, landings data for some years are confidential and cannot be reported. Therefore, the analysis combines landings in the rockfish target fisheries with landings in all other target fisheries that were assigned to BSAI TLA vessels during the year. These miscellaneous targets include rock sole, Alaska plaice, flathead sole, and arrowtooth and Kamchatka flounder.

Groundfish harvests in BSAI TLA target fisheries began declining in 2006, falling nearly 50 percent to 780 tons by 2009 (Figure 5-16). The decline in groundfish harvest is largely due to the reduction in pollock TAC that occurred in those years. Overall groundfish harvest rose again in 2011, largely due to increases in the pollock TACs, and have increased gradually each year since. Within the Pollock|Atka Mackerel|Other Species target group, pollock accounted for 99.7 percent of harvest with the remaining 0.3 percent attributed to the Atka mackerel fishery. No BSAI TLA vessels had landings assigned specifically to the “Other Species” category from 2008 to 2013. Therefore, changes within this target group are almost entirely driven by the pollock fishery. From 2008 to 2013, the pollock fishery accounted for 92 percent of the total harvest in BSAI TLA fisheries. Because pollock is so overwhelming within the BSAI TLA fisheries, Figure 5-17, provided below, displays total harvest in the BSAI TLA fishery, excluding pollock. In that figure, the increasing importance of the Yellowfin sole target fishery for some BSAI TLA participants can readily be seen. In 2013, landings of yellowfin sole for BSAI TLA vessels exceeded landings of Pacific cod for the first time.

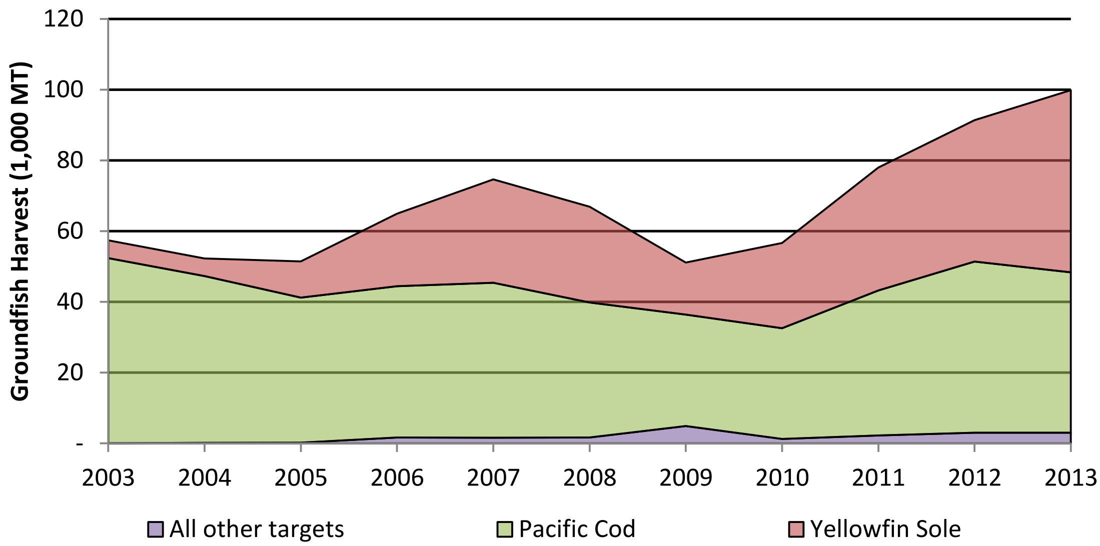
While the analysis primarily focuses on the years between 2008 and 2013, many figures in each of the subsequent subsections provide historical background dating back to 2003. Tables which accompany many of these figures provide detailed data for the years of primary focus (2008 to 2013). Groundfish harvest in the BSAI TLA fisheries is shown below in Table 5-21.

Figure 5-16 Groundfish Harvests in Target Fisheries of BSAI TLA Vessels, 2003 to 2013



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-17 Non-pollock Groundfish Harvests in Target Fisheries of BSAI TLA Vessels, 2003 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

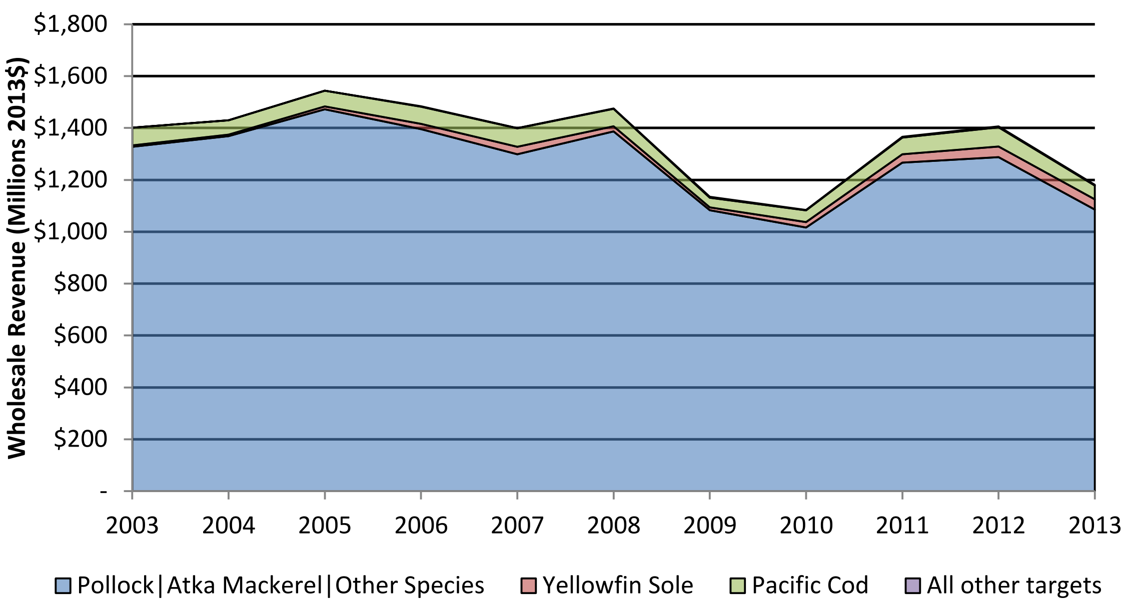
Table 5-21 Groundfish Harvest in Target Fisheries of BSAI TLA Vessels, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Groundfish Harvest (1,000 mt)**						
Pollock|Atka Mackerel|Other Species	879.55	729.45	723.67	1,084.89	1,084.21	1,119.77	5,621.53
Yellowfin Sole	27.07	14.72	24.10	34.75	39.98	51.49	192.11
Pacific Cod	38.17	31.50	31.29	40.98	48.38	45.33	235.67
All other targets	1.65	4.88	1.24	2.22	3.00	3.00	15.99
All Targets	**946.43**	**780.55**	**780.31**	**1,162.84**	**1,175.57**	**1,219.60**	**6,065.30**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

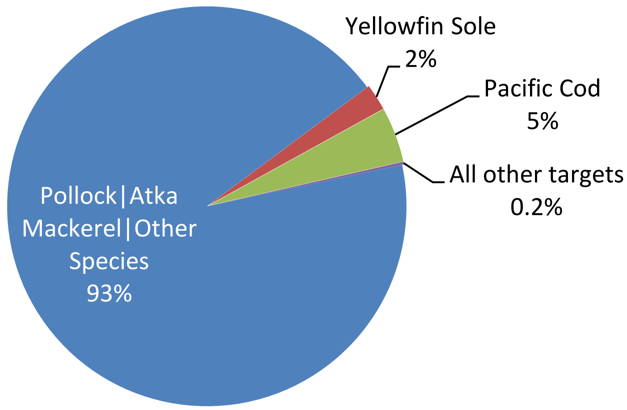
Wholesale revenues in the BSAI TLA groundfish fisheries remained relatively flat from 2006 to 2008, with higher prices in 2008 helping to offset significantly lower pollock harvests (Figure 5-18). The sharp decline in 2009 is attributed to the combination of the second year of low pollock TACs and the global recession. A decline in wholesale revenues in 2013 is seen, despite small increases in total BSAI TLA groundfish harvest. The decline is a function of lower revenues per ton across all major species in 2013 as discussed earlier in Table 5-17 on page 147. As documented in Figure 5-19, pollock accounts for 93 percent of total wholesale revenue for BSAI TLA vessels.

Figure 5-18 Wholesale Revenue in Target Fisheries of BSAI TLA Vessels, 2003 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

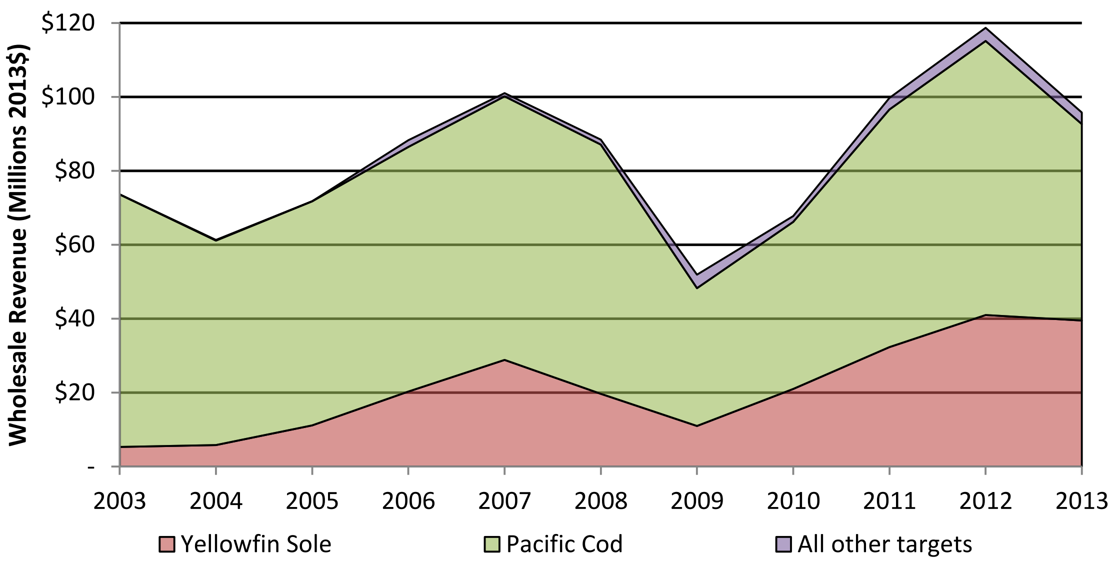
Figure 5-19 Average Percentage of Wholesale Revenue by Target Fishery for BSAI TLA Vessels, 2008 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-20 shows nominal wholesale revenues in the BSAI TLA groundfish fishery, excluding harvests in pollock target fisheries. This graphic clearly shows the effect of low prices in 2009 resulting from the global recession. Despite increases in harvests for all species other than Pacific cod, significant revenue declines occurred in all target fisheries in 2013.

Figure 5-20 Non-pollock Wholesale Revenue in Target Fisheries of BSAI TLA Vessels, 2003 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

Table 5- on the following page documents real wholesale revenues by target group for the BSAI TLA vessels. These same data are depicted for 2008 to 2013 in Figure 5-18 and Figure 5-20.

Table 5- Real Wholesale Revenue in Target Fisheries of BSAI TLA Vessels, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Wholesale Revenue (in millions of 2013 $)**						
Pollock|Atka Mackerel|Other Species	$1,386.85	$1,082.94	$1,016.24	$1,266.43	$1,287.58	$1,085.41	$7,125.44
Yellowfin Sole	$19.66	$10.96	$20.98	$32.30	$40.97	$39.49	$164.35
Pacific Cod	$67.41	$37.27	$45.18	$64.27	$74.13	$53.14	$341.40
All other targets	$1.34	$3.65	$1.58	$3.14	$3.56	$3.13	$16.40
All Targets	**$1,475.26**	**$1,134.82**	**$1,083.98**	**$1,366.13**	**$1,406.24**	**$1,181.16**	**$7,647.59**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

5.5.2.3 Distribution of Harvest and Processing between Vessel and Processor Types

Harvests in the BSAI TLA were distributed among the three types of vessels described earlier: AFA-CPs, AFA-CVs, and non-AFA Trawl CVs. Catcher Processors by definition catch fish and process the fish on board. When they sell their products they generate wholesale revenues. The two groups of CVs deliver their harvests to offshore motherships, shore plants, or inshore floating processors, and in making deliveries receive ex-vessel revenues. The processing facilities then turn the raw fish into products and sell them to generate wholesale revenues. Table 5-22 summarizes the distribution of wholesale revenues between the different processor types. In the table we combine shore plants and floating processors to protect confidential information.[27] AFA-CPs accounted for an average of 42 percent of the wholesale revenues, motherships for 11 percent, while shore plants and inshore floating processors generated an average of 47 percent. It also should be noted that floating processors participated only in the non-pollock target fisheries.

Table 5-22 Distribution of Wholesale Revenue among Processors in the BSAI TLA

Processor Type	2008	2009	2010	2011	2012	2013	Average
	Wholesale Revenue ($ millions 2013)						
AFA-CP	$653	$469	$444	$574	$574	$478	$532
Motherships (Offshore)	$153	$97	$119	$167	$160	$133	$138
Shore Plants & Inshore Floating Processors	$669	$569	$521	$625	$672	$570	$604
Total	$1,475	$1,135	$1,084	$1,366	$1,406	$1,181	$1,275
	Wholesale Revenue ($ millions 2013)						
AFA-CP	44%	41%	41%	42%	41%	40%	42%
Motherships (Offshore)	10%	9%	11%	12%	11%	11%	11%
Shore Plants & Inshore Floating Processors	45%	50%	48%	46%	48%	48%	47%
Total	100%	100%	100%	100%	100%	100%	100%

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-23 separates out ex-vessel revenues and processing value added in BSAI TLA fisheries involving CVs. This is important because otherwise it might be inferred that AFA-CVs and non-AFA Trawl CVs capture all of the wholesale revenue generated by their harvest activities. In reality, the CVs deliver to processors and receive ex-vessels payment for their fish. The processors in turn add value to the raw fish they purchased from the CVs by turning it into products such as surimi, fillets, or headed and gutted fish. When these products are sold, the processors generate wholesale revenue.

[27] There were a total of five different inshore floating processors that participated in these fisheries over the six-year period, but there were only two years in which three or more participated. It should be noted that the Northern Victor is counted as a shore plant rather than as a floating processor.

In Table 5-19 we saw that there were three types of harvesting vessels active in the BSAI TLA: AFA-CPs, AFA-CVs and non-AFA Trawl CVs. Table 5-23 summarize the ex-revenues generated by AFA-CVs and non-AFA Trawl-CVs in BSAI TLA Fisheries from 2008 to 2013. AFA-CPs are not included because there is no transaction in which ex-vessel revenues are generated. As might be expected by the sheer number of vessels, AFA-CVs (99 vessels) generate much more ex-vessel revenue than do non-AFA Trawl CVs (25 vessels). Between 2008 and 2013, AFA-CVs averaged a total of $241 million in ex-vessel revenues while non-AFA Trawl CVs generated an average of $9 million. Both types of CVs deliver to motherships and to shorebased processors or inshore floating processors. The processors added an average of $492 million in value to the groundfish delivered by CVs in the BSAI TLA from 2008 to 2013.

Table 5-23 Ex-Vessel Revenue and Processing Value Added in BSAI TLA Fisheries

	2008	2009	2010	2011	2012	2013	Average
	Ex-Vessel Revenue ($ millions 2013)						
AFA-CVs	$302	$213	$174	$252	$273	$235	$241
Non-AFA Trawl CVs	$9	$5	$5	$10	$14	$12	$9
Total Ex-Vessel Value	**$311**	**$218**	**$179**	**$262**	**$286**	**$247**	**$251**
	Value Added by Processors ($ millions 2013)						
Mothership Value Added	$102	$59	$81	$114	$105	$86	$91
Shore Plants & Inshore Floating Processors	$409	$388	$380	$416	$440	$370	$401
Total Value Added	**$511**	**$447**	**$461**	**$530**	**$546**	**$457**	**$492**
	Total Wholesale Value of CV Harvests						
CV Based Wholesale Value	**$822**	**$666**	**$640**	**$792**	**$832**	**$703**	**$743**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-24 summarizes the ex-vessel revenue generated by vessels in the BSAI TLA fisheries by the vessel owner's state of residence. As shown earlier in Table 5-20, a total of 13 of the 124 unique CVs operating in BSAI TLA fisheries have been registered to Alaskans at some point during the six-year period shown, but in any given year no more than 8 vessels were active. As shown in Table 5-24, Alaskan-owned CVs participating in the BSAI TLA fisheries have generated an average $6 million in ex-vessel revenues from 2008 to 2013, or 2.3 percent of the total generated in the fisheries. There is currently one AFA-CP that is listed as being owned by an Alaska firm or individual. The wholesale revenue of that single vessel cannot be reported because of non-disclosure rules, but given that there were 16 AFA-CPs operating, the wholesale revenue of any one vessel may be approximated as the average revenue of fleet. From 2011 to 2013 (the years when the AFA-CP was reported as "Alaska-owned", the average AFA-CP generated $33.86 million in wholesale revenue.

Table 5-24 Distribution of Ex-Vessel Revenue by Vessel Owners State of Residence.

	2008	2009	2010	2011	2012	2013	Average
	Ex-Vessel Revenue ($ millions 2013)						
Alaska	$7	$5	$5	$5	$7	$6	$6
Other States	$304	$213	$174	$257	$279	$241	$245
Total Ex-Vessel Value	**$311**	**$218**	**$179**	**$262**	**$286**	**$247**	**$251**
Alaska Percent of Total	2.2%	2.2%	2.7%	2.0%	2.5%	2.4%	2.3%

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

5.5.2.4 Halibut PSC Limits and Halibut PSC Mortality in Target Fisheries of BSAI TLA Vessels

Halibut PSC limits by target species in the BSAI TLA fisheries are shown in Table 5-25. Since 2008, total halibut PSC limits for BSAI TLA fisheries have remained unchanged with some variation occurring in the apportionments between target fishery groups. Apportionment of the 875 mt limit is set each year in the Council's harvest specifications process. In 2013, Pacific cod was apportioned the highest amount of halibut PSC mortality, followed by Pollock|Atka Mackerel|Other Species and yellowfin sole.

Table 5-25 Halibut PSC Limits and Apportionment to Target Fisheries for BSAI TLA Vessels, 2008 to 2013

Target Group	2008	2009	2010	2011	2012	2013
	Apportionment of Halibut PSC Limit (in Round Weight mt) to Target Fisheries					
Rockfish	3	5	5	5	5	5
Pollock|Atka Mackerel|Other Species	125	175	250	250	250	250
Yellowfin Sole	162	187	167	167	167	167
Pacific Cod	585	508	453	453	453	453
All targets combined	**875**	**875**	**875**	**875**	**875**	**875**

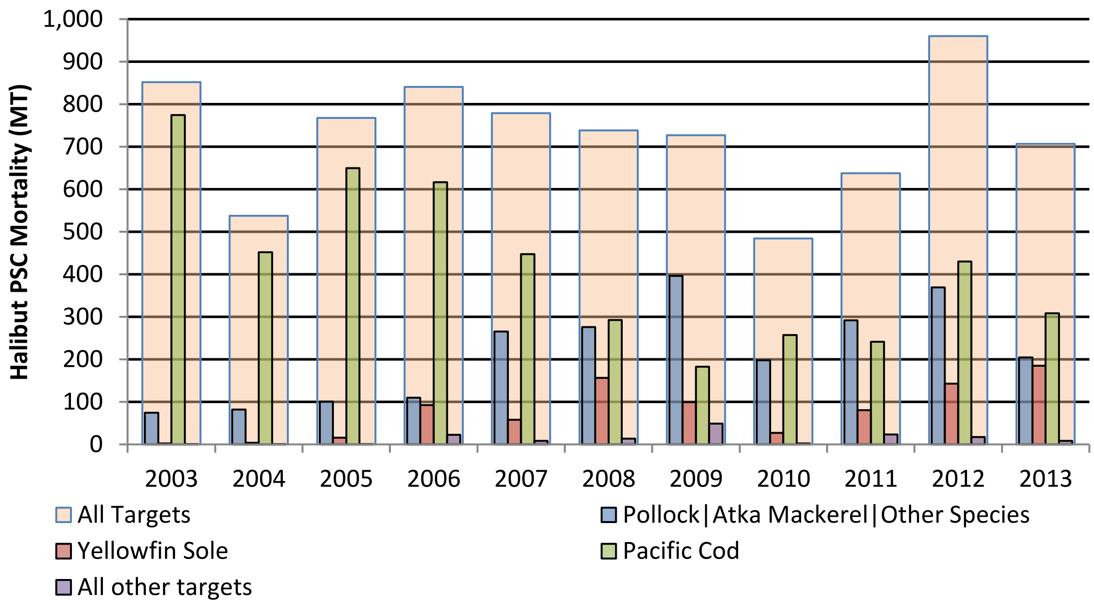
Source: Developed by NEI using data from NMFS' Alaska Groundfish Specification Tables (NMFS 2014f).

Figure 5-21 summarizes halibut PSC mortality in the BSAI TLA fisheries from 2003 to 2013. Actual halibut mortality data are shown in Table 5-26 for 2008 to 2013. In 2003, over 90 percent of halibut mortality in the BSAI TLA target fisheries was caught in the Pacific cod fishery. Halibut PSC mortality in BSAI TLA Pacific cod fisheries has generally declined since then to a low in 2009 of 183 mt. During that same period, halibut mortality in the Pollock|Atka Mackerel|Other Species target group increased steadily to a peak in 2009 of 395 mt. Halibut PSC mortality in BSAI TLA yellowfin sole fisheries generally increased from 2005 to 2008, fell in 2009 and 2010 and increased each year from 2011 to 2013. Total halibut PSC mortality in BSAI TLA fisheries has been relatively volatile—during the 11-year period shown in the figure, there have been five years with a year-over-year change in absolute terms of over 200 mt—over 23 percent of the 875 mt PSC limit.

In 2012, the halibut PSC mortality in the BSAI TLA actually exceed the 875 mt limit reaching 960 mt. As discussed earlier in the document, halibut PSC mortality is not a binding constraint for the BSAI pollock fishery. If the halibut PSC limit for Pollock|Atka Mackerel|Other Species is reached, BSAI TLA may no longer participate in target fisheries for Atka mackerel or "Other Species", but they may continue to fish with mid-water trawl gear for pollock.

As seen in Figure 5-22 at the bottom of the next page, over the six-year period from 2008 to 2013, halibut PSC mortality in target fisheries Pollock|Atka Mackerel|Other Species has averaged 41 percent of the total halibut PSC mortality taken in BSAI TLA fisheries, noting again that 99.7 percent of the groundfish taken in this target fishery group is harvested in pollock target fisheries. During the same period, 40 percent of halibut PSC mortality has been taken in Pacific cod target fisheries and 16 percent has been taken in yellowfin sole target fisheries.

Figure 5-21 Halibut PSC Mortality in BSAI TLA Target Fisheries, 2003 to 2013



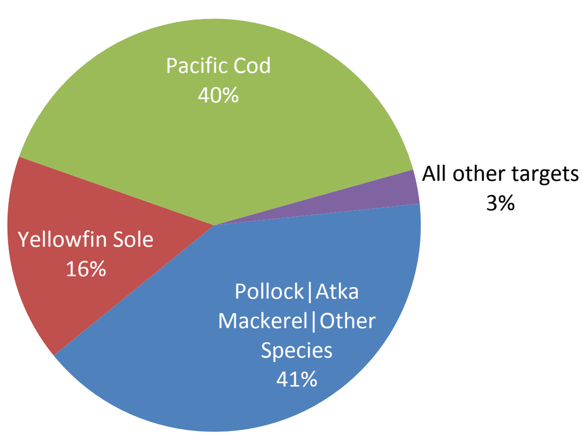
Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-26 Halibut PSC mortality in BSAI TLA Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Average
Target Group	**Halibut PSC mortality (in Round Weight mt)**						
Pollock|Atka Mackerel|Other Species	275.7	395.9	198.0	291.9	369.4	204.6	1,735.6
Yellowfin Sole	156.7	98.9	26.8	80.8	143.1	185.2	691.5
Pacific Cod	292.6	183.0	257.0	241.4	430.1	308.3	1,712.4
All other targets	13.7	49.0	2.4	23.2	17.4	8.6	114.2
All Targets	**738.6**	**726.9**	**484.2**	**637.3**	**960.0**	**706.8**	**4,253.8**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-22 Average Percentage of Total Halibut PSC mortality by Target Fishery for BSAI TLA, 2008 to 2013

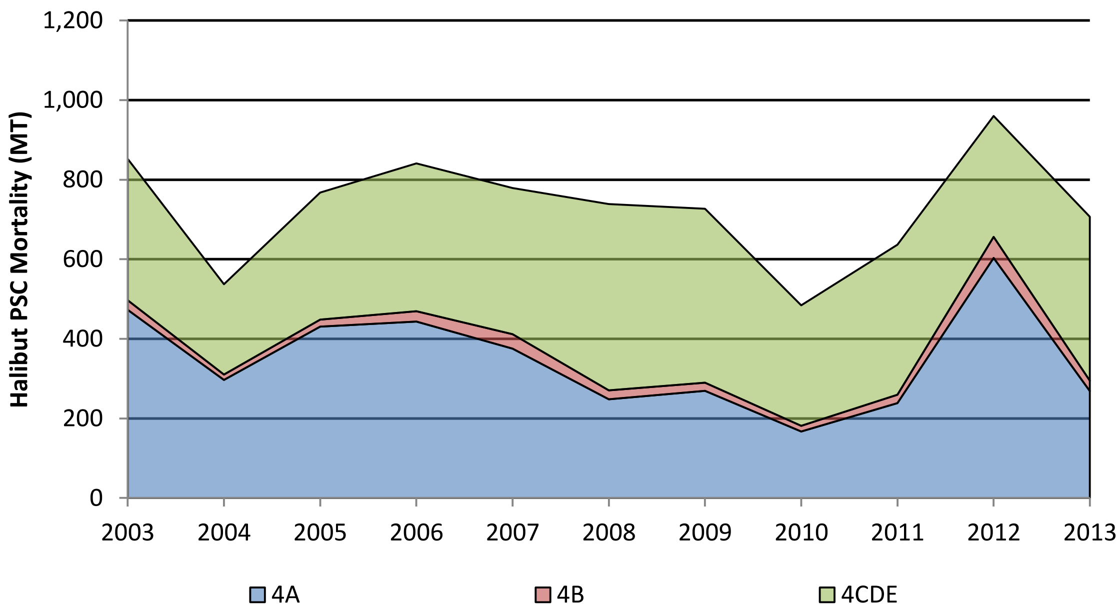


Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-23 and Table 5-27 summarize halibut mortality in BSAI TLA fisheries by IPHC area. Halibut PSC primarily occurs in IPHC areas 4A and 4CDE—only 4 percent of BSAI TLA halibut from 2008 to

2013 has been taken in IPHC 4B. From 2003 to 2007, the majority of halibut PSC mortality occurred in Area 4A, but beginning in 2008, Area 4CDE overtook 4A as the area in which the majority of halibut PSC mortality occurred, with the exception of 2012, when Area 4A experienced a 150 percent increase in halibut PSC mortality.

Figure 5-23 Halibut PSC Mortality in BSAI TLA Fisheries by IPHC Area



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

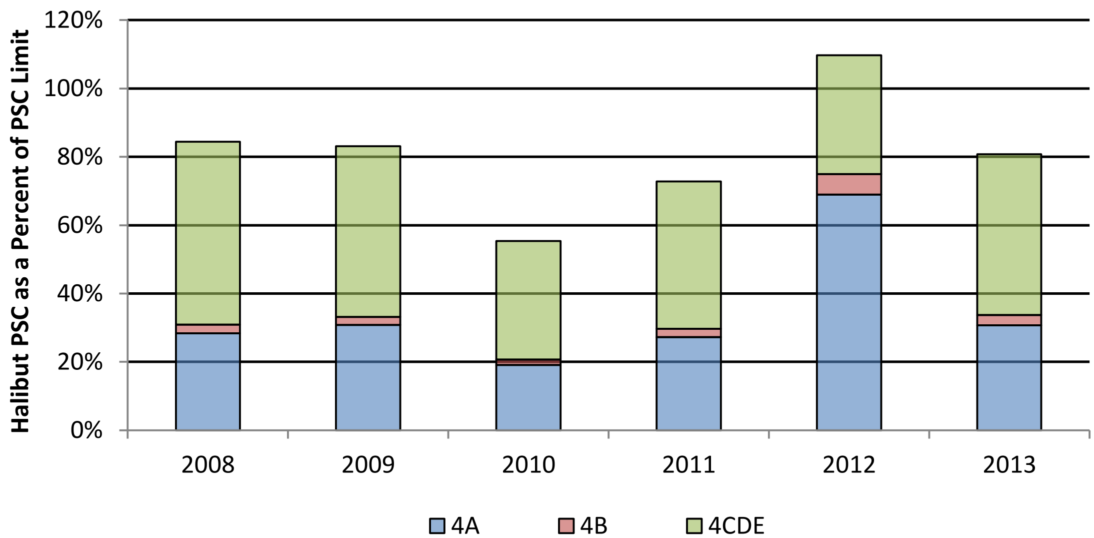
Table 5-27 Halibut PSC Mortality in BSAI TLA Fisheries by IPHC Area, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	Halibut PSC Mortality (in Round Weight mt)						
IPHC Area 4A	248.1	269.3	167.2	238.4	603.3	268.7	1,795.1
IPHC Area 4B	22.4	20.5	14.3	21.1	53.0	26.1	157.4
IPHC Areas 4CDE	468.1	437.0	302.8	377.0	303.7	411.9	2,300.6
All Areas	**738.6**	**726.9**	**484.2**	**636.6**	**960.0**	**706.8**	**4,253.1**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-24 shows the amount of Halibut PSC mortality taken by BSAI TLA fisheries as a percentage of the 875 mt PSC limit that has been in effect since 2008. As seen in the figure, the BSAI TLA fisheries exceeded their halibut PSC limit in 2012. In 2012 there was a large increase taken in IPHC Area 4A, and as seen in Table 5-26 there were big increases in halibut PSC mortality in the pollock target fisheries (up nearly 80 mt), in the yellowfin sole target fisheries (up nearly 83 mt), and in the Pacific cod fisheries (up nearly 170 mt).

Figure 5-24 Percentage of the 2014 Halibut PSC Limit Harvested in BSAI TLA fisheries, by IPHC Area



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-28 summarizes calculation of the wholesale revenue generated per ton of halibut mortality in each of the four target fishery groups for the BSAI TLA fisheries. This measure is an indication of how much wholesale revenue the average participant in the BSAI TLA fisheries would have to give up during an average trip if they were required to reduce halibut mortality by one mt. The numbers shown in the table are calculated by summing the wholesale revenue for the target group and year and then dividing by the halibut morality for the same target group and year. It should be noted that because there is significant variability in halibut PSC rates over the course of the year and across vessels, there is also significant variability in the wholesale value generated per ton of halibut mortality in a given fishery.

It is clear that the wholesale revenue generated per ton of halibut mortality in the pollock fisheries (averaging $4.17 million per ton from 2008 to 2013) is significantly higher than is generated in the other BSAI TLA target fisheries. Wholesale revenue per ton of halibut in the BSAI TLA Pacific cod fisheries averaged $250,000 from 2008 to 2013, while the yellowfin sole fishery generated $200,000 per ton of halibut mortality.

Table 5-28 Average Wholesale Revenue per Ton of Halibut PSC Mortality in BSAI TLA Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Average
Target Group	Average Wholesale Revenue Per Halibut PSC Ton (in millions of 2013 $ per mt)						
Pollock|Atka Mackerel|Other Species	$5.09	$2.74	$5.13	$4.35	$3.72	$5.30	$4.17
Pacific Cod	$0.13	$0.11	$0.78	$0.40	$0.29	$0.24	$0.25
Yellowfin Sole	$0.23	$0.20	$0.18	$0.27	$0.17	$0.17	$0.20
All Other Targets	$0.10	$0.07	$0.65	$0.14	$0.20	$0.36	$0.14
All Targets	**$2.01**	**$1.56**	**$2.24**	**$2.15**	**$1.50**	**$1.73**	**$1.82**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

5.5.2.5 Reliance of BSAI TLA Vessels on BSAI Groundfish and Diversification of BSAI TLA Vessels into Other Fisheries

Vessels participating the BSAI TLA fisheries also participate in a relatively limited way in other fisheries throughout the state and on the West Coast. The level of participation in other fisheries is important because it provides context regarding the relative importance of the groundfish fisheries that are affected by the proposed alternatives to reduce halibut PSC Limits. Table 5-29 through Table 5-32 summarize activities in fisheries other than BSAI TLA fisheries in which these vessels are active. Table 5-29 summarizes other fishery activities in Alaska and the U.S. West Coast for all vessels in the BSAI TLA from 2008 to 2013. The other three remaining tables summarize activities for each of the three component fleets.

As shown in Table 5-29, BSAI TLA vessels were active in several other fisheries, and from 2008 to 2013 generate an average of $167 million in wholesale and ex-vessel revenues[28] in these other fisheries. These other revenues increase the total revenue generated by the BSAI TLA vessels by approximately 21 percent over the revenues generated in the BSAI TLA alone. It should be noted that 76 percent of all non-BSAI TLA revenues were generated in BSAI Groundfish CDQ fisheries, which are also subject to change under the proposed halibut PSC limit reductions.

In 2013, AFA-CPs accounted for 74 percent of all additional revenues earned from BSAI TLA vessels in other fisheries. AFA-CPs participate in CDQ Groundfish fisheries and other West Coast fisheries. AFA-CVs' participation rate in other fisheries is the highest of the three fleet components, with 39 vessels participating in the GOA Groundfish and West Coast fisheries in 2013.

Table 5-29 Total BSAI TLA Vessels Participating Other Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013
Number of BSAI TLA Vessels Participating Other Fisheries						
BSAI Pot Groundfish	-	-	1	-	-	-
CDQ Groundfish	19	17	12	17	18	18
All Halibut	3	4	5	2	2	1
All Fixed Gear Sablefish	2	2	2	-	-	-
GOA Groundfish	30	33	29	33	30	28
AK Salmon	1	6	3	2	2	2
All Other AK Fisheries	3	4	4	5	4	4
West Coast Fisheries	35	30	34	31	25	26
Additional Revenue of BSAI TLA Vessels in All Other Fisheries						
All Other Fisheries	$170.1	$124.0	$145.4	$187.9	$197.0	$177.8

Note: For CPs, wholesale revenue is used in the revenue calculations; for CVs ex-vessel revenue is used.
Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

[28] The revenue information in the diversity tables summarize wholesale revenue if the vessel is a CP and ex-vessel revenue if the vessel is a CV.

Table 5-30 Number of AFA-CPs Participating Other Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013
Number of AFA-CPs Participating Other Fisheries						
BSAI Pot Groundfish	-	-	-	-	-	-
CDQ Groundfish	12	12	12	15	15	15
All Halibut	-	-	-	-	-	-
All Fixed Gear Sablefish	-	-	-	-	-	-
GOA Groundfish	-	-	-	-	-	-
AK Salmon	-	-	-	-	1	-
All Other AK Fisheries	-	-	-	-	-	-
West Coast Fisheries	8	4	6	9	9	9
Wholesale Revenue of AFA-CPs in All Other Fisheries						
All Other Fisheries	$135.5	$94.7	$107.8	$138.5	$149.7	$131.0

Table developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-31 Number Vessels AFA-CVs Participating Other Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013
Number Vessels AFA-CVs Participating Other Fisheries						
BSAI Pot Groundfish	-	-	-	-	-	-
CDQ Groundfish	6	4	-	-	-	-
All Halibut	2	3	3	2	2	1
All Fixed Gear Sablefish	1	1	-	-	-	-
GOA Groundfish	22	24	22	23	23	22
AK Salmon	-	-	-	-	-	-
All Other AK Fisheries	2	2	2	3	3	2
West Coast Fisheries	25	23	26	20	16	17
Ex-Vessel of AFA-CV Revenue in All Other Fisheries						
All Other Fisheries	$29.0	$22.4	$30.6	$38.5	$38.4	$39.8

Table developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-32 Number of Non-AFA Trawl CVs Participating Other Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013
Number of non-AFA Trawl-CVs Participating Other Fisheries						
BSAI Pot Groundfish	-	-	1	-	-	-
CDQ Groundfish	1	1	-	2	3	3
All Halibut	1	1	2	-	-	-
All Fixed Gear Sablefish	1	1	2	-	-	-
GOA Groundfish	8	9	7	10	7	6
AK Salmon	1	6	3	2	1	2
All Other AK Fisheries	1	2	2	2	1	2
West Coast Fisheries	2	3	2	2	-	-
Ex-Vessel Revenue in All Other Fisheries						
All Other Fisheries	$5.7	$6.9	$7.0	$10.9	$9.0	$7.0

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

5.5.3 Amendment 80 Catcher Processors

Amendment 80 Catcher Processors (A80-CPs) have been formally defined since approval and implementation of Amendment 80 (A80) to the BSAI Groundfish FMP. A80 was implemented in 2008, and provided A80-CPs with the ability to rationalize their fishery by providing exclusive access to the sector's primary target fisheries and prohibited species limits. In addition, groups within the sector were authorized to form cooperatives to manage their catch and PSC.

Since 2008 A80-CPs have harvested approximately 58 percent of the non-pollock BSAI Groundfish fishery harvests by volume and have generated an average of $325 million in wholesale revenue (2013$). Overall, the A80-CPs generate approximately 16 percent of the wholesale revenue of affected groundfish fisheries.

5.5.3.1 Description of Participants in the A80-CP Fisheries

BSAI A80 Harvesting Vessels

Table 5-33 summarizes the number of vessels participating in A80 target fisheries by year from 2008 to 2013. Since 2008, 23 unique A80-CP vessels participated in the BSAI Groundfish fisheries. The number of vessels participating in each target fishery has gradually decreased throughout the time series, from 22 unique vessels in 2008, to 18 unique vessels in 2013. This is primarily the result of consolidation taking place among Amendment 80 permit holders.

Table 5-33 Types and Numbers of Vessels Participating in BSAI Target Fisheries of A80-CPs, 2008 to 2013

	2008	2009	2010	2011	2012	2013	2008–2013
Yellowfin Sole	22	20	19	20	19	18	23
Rock Sole	21	21	19	18	19	17	23
Atka Mackerel	9	12	7	8	10	9	14
Arrowtooth or Kamchatka Flounder	16	15	12	20	19	15	22
Rockfish	10	11	14	16	15	15	19
Flathead Sole	15	15	14	12	13	11	19
Pacific Cod	11	15	14	14	13	16	20
All other targets	18	21	16	15	16	16	22
All Targets	**22**	**21**	**20**	**20**	**19**	**18**	**23**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

As seen in Table 5-34, all of the owners of A80-CPs are based outside of Alaska. One of the five companies, O'Hara Corporation, which owns three A80-CPs is based in Maine, while the other four companies are based in Seattle.

Table 5-34 A80-CP Vessel Owner's Place of Residence, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Unique Vessels
Region	Number of Participating Vessels						
NW Alaska	-	-	-	-	-	-	-
SW Alaska	-	-	-	-	-	-	-
Other Alaska	-	-	-	-	-	-	-
Other U.S.	22	21	20	20	19	18	23
Total	22	21	20	20	19	18	23

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

5.5.3.2 Catch and Revenue in Target Fisheries of A80-CPs

Following implementation of A80 in 2008, total groundfish harvest of A80 CPs has increased 13 percent (Figure 5-25). Since implementation, Pacific cod harvest decreased 44 tons, nearly 90 percent of 2007 levels. Those losses were largely offset by increases in yellowfin sole, rock sole, arrowtooth or Kamchatka flounder, and flathead sole. Total harvest in 2013 increased to nearly 3.35 mt, largely due to increased harvest in yellowfin sole; Table 5-35, following the figure, provides details of total groundfish harvest by target fishery from 2008 to 2013.

Figure 5-25 Groundfish Harvests in Target Fisheries of A80-CPs, 2003 to 2013

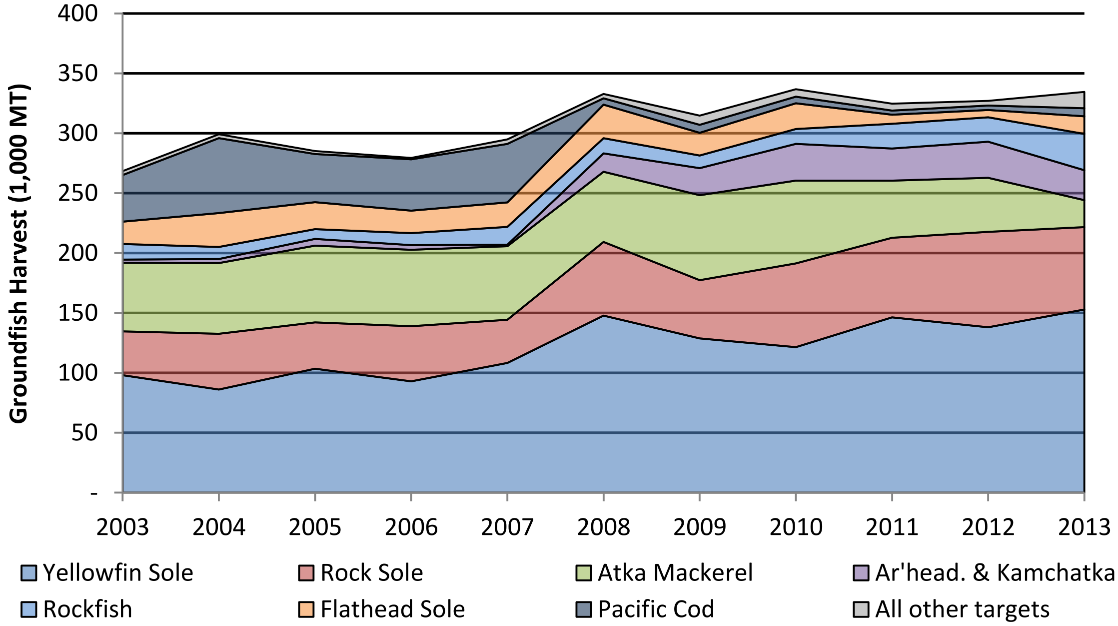


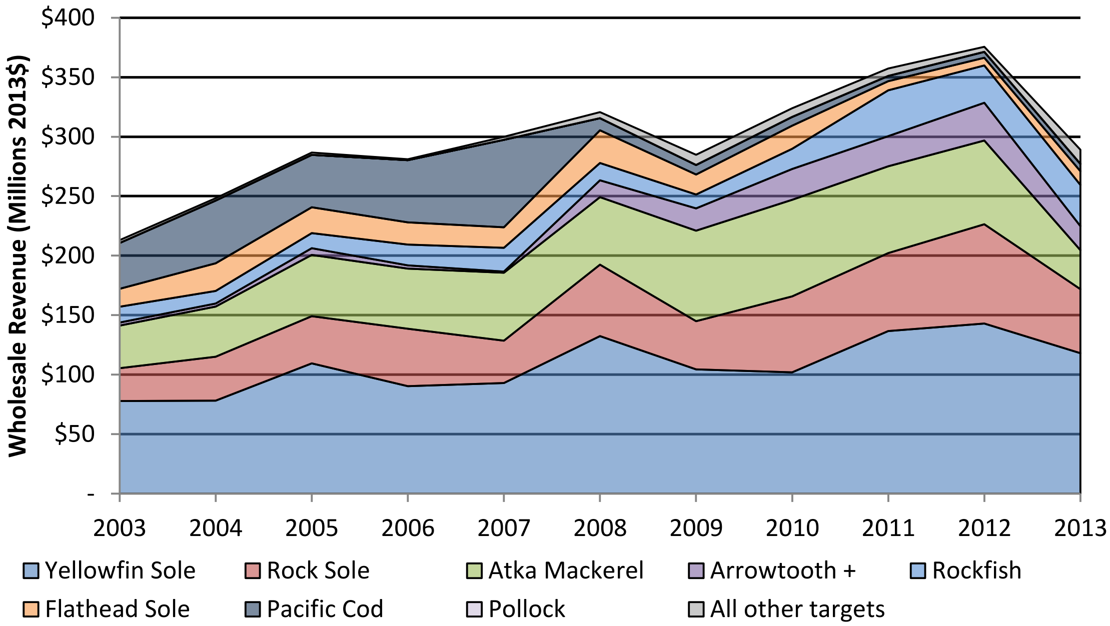
Table 5-35 Groundfish Harvest in Target Fisheries of A80-CPs, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Metric Tons of Groundfish (of All Species) Harvested in A80-CP Target Fisheries**						
Yellowfin Sole	147.77	128.75	121.45	146.31	138.04	152.86	835.16
Rock Sole	61.50	48.60	69.90	66.44	79.66	68.76	394.85
Atka Mackerel	58.57	70.93	69.11	47.69	45.08	22.53	313.92
Arrowtooth or Kamchatka Flounder	15.34	22.59	30.66	26.80	30.15	24.98	150.53
Rockfish	12.68	10.54	12.41	20.64	20.39	30.32	106.97
Flathead Sole	28.00	18.93	21.48	7.57	6.09	14.67	96.75
Pacific Cod	5.29	6.69	5.52	3.45	3.71	6.74	31.39
All other targets	3.67	7.68	6.24	5.78	3.90	13.66	40.94
All Targets	**332.81**	**314.70**	**336.76**	**324.68**	**327.02**	**334.52**	**1,970.50**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

As show in Figure 5-26, inflation adjusted wholesale revenue has largely tracked total harvest since 2008; both increasing after implementation of A80 in 2008 and decreasing in 2009. Wholesale value increased steadily thereafter through 2012. However, in 2013, declines in wholesale revenue in the yellowfin sole, rock sole, Atka mackerel, arrowtooth or Kamchatka flounder, and rockfish target groups contributed to a 23 percent decrease in wholesale revenues, dropping to near 2009 levels, despite a slight increase in total harvest.

Figure 5-26 Wholesale Revenue in Target Fisheries of A80-CPs, 2003 to 2013



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

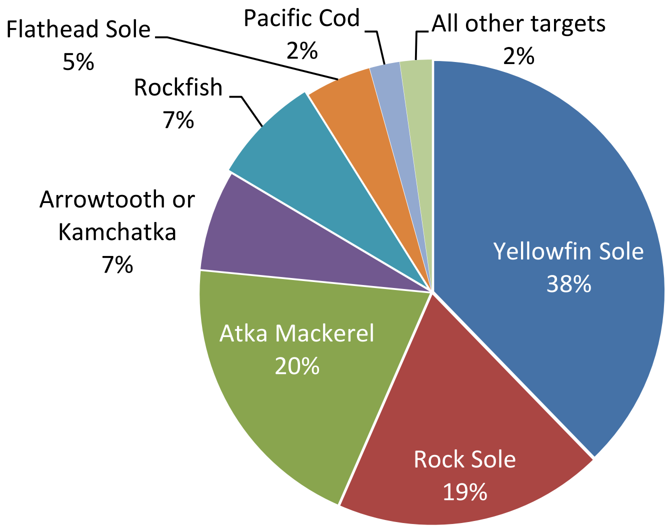
Table 5-36 Real Wholesale Revenue in Target Fisheries of A80-CPs, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Wholesale Revenue (in millions of 2013 $)**						
Yellowfin Sole	$132.39	$104.41	$101.92	$136.64	$142.96	$118.03	$736.35
Rock Sole	$60.04	$40.51	$63.84	$65.52	$83.44	$53.78	$367.14
Atka Mackerel	$56.77	$76.07	$81.18	$72.97	$70.39	$32.79	$390.16
Arrowtooth or Kamchatka Flounder	$14.14	$18.74	$25.90	$25.32	$31.70	$20.19	$135.99
Rockfish	$14.55	$11.67	$16.96	$38.54	$31.38	$34.64	$147.73
Flathead Sole	$27.48	$16.80	$19.44	$7.66	$6.45	$11.52	$89.36
Pacific Cod	$10.17	$8.00	$7.37	$4.43	$4.98	$6.14	$41.10
All other targets	$5.11	$8.58	$7.29	$6.23	$4.26	$11.94	$43.41
All Targets	**$320.65**	**$284.78**	**$323.90**	**$357.31**	**$375.56**	**$289.04**	**$1,951.24**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Amendment 80 wholesale revenue is largely dependent upon three main target fisheries; the yellowfin sole, Atka mackerel, and rock sole. These fisheries account for over two-thirds of revenue, as shown in Figure 5-27.

Figure 5-27 Average Percentage of Wholesale Revenue by Target Fishery for A80-CPs, 2008 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

5.5.3.3 Regional Impacts of A80-CPs

Since all of the A80-CPs are based outside of Alaska, the majority of economic impacts generated by A80 vessels accrue outside the state of Alaska. For most BSAI groundfish harvesting and processing sectors there have not been any recent peer-reviewed studies that estimate the full economic impact of the sector's activities. This is not the case for A80-CPs. A recent study published by Waters et al. (2014) evaluated the total economic contribution of the A80 sector (multiplier effects) and estimated the portion of the economic contribution for Alaska. The report estimates that the A80 sector's $281 million in first wholesale revenues (estimated from 2008 COAR data) led to a total economic contribution in the U.S. of approximately $1.03 billion, a multiplier effect of 3.56. The report estimated that approximately 47 percent total contribution (or $487 million) was generated in Alaska, and that 18 percent was attributed to the West Coast and that the final 35 percent was distributed elsewhere throughout the U.S.

5.5.3.4 Halibut PSC Limits and Halibut PSC Mortality in Target Fisheries of A80-CPs

Halibut PSC limits in the A80-CP target fisheries were reduced by 200 mt or 8 percent from 2008 to 2012 The halibut PSC limit reductions were built into A80 when it was approved by the Council and NMFS. Halibut PSC mortality is apportioned between A80 cooperatives based on the groundfish catch histories of the member vessels. Currently there are two A80 cooperatives that receive halibut PSC mortality apportionments.

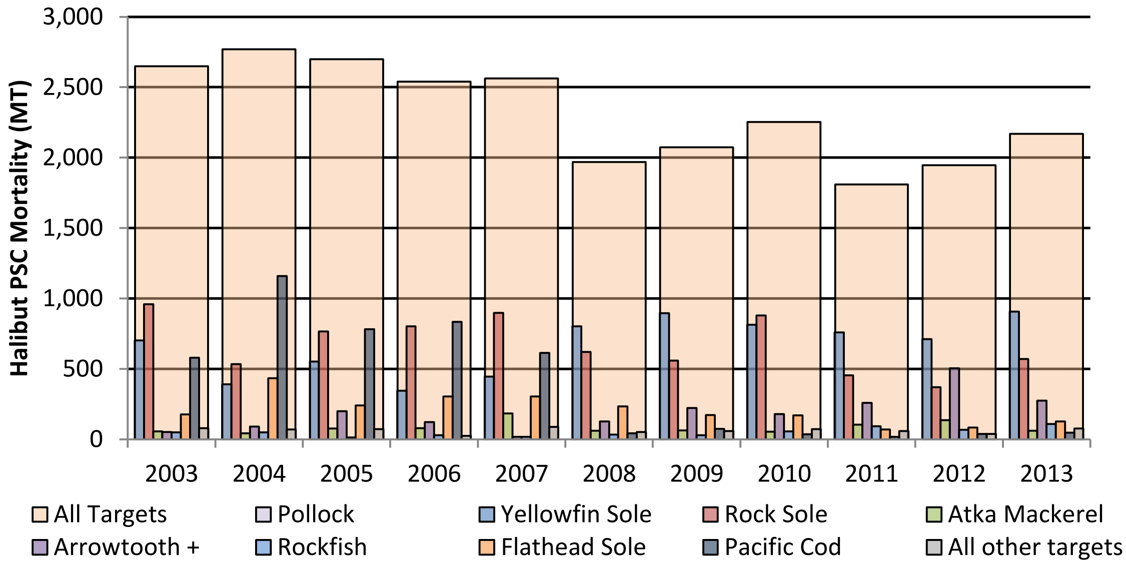
Table 5-37 Halibut PSC Limits and Apportionment to Target Fisheries for A80-CPs, 2008 to 2013

Target Group	2008	2009	2010	2011	2012	2013
	Halibut PSC Mortality Limit (in Round Weight mt)					
All targets combined	2,525	2,475	2,425	2,375	2,325	2,325

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

As shown in Figure 5-28, halibut PSC mortality decreased 23 percent in 2008. The biggest impact on a target fishery basis was seen the much lower halibut PSC mortality experienced in Pacific cod target fisheries. This decline is a result of the significant decrease in A80-CPs' activity in Pacific cod target fisheries, and in fact, the decrease in halibut PSC mortality in 2008 in the Pacific cod fishery is similar in proportion to the decrease in total harvest experienced by the Pacific cod fishery. Similarly, increases in halibut PSC mortality in both the yellowfin sole and arrowtooth or Kamchatka flounder target fisheries are correlated with increases in harvest in 2008. However, total halibut mortality decreased 23 percent in 2008 despite a 13 percent increase in total overall harvest.

Figure 5-28 Halibut PSC Mortality in A80-CPs Target Fisheries, 2003 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

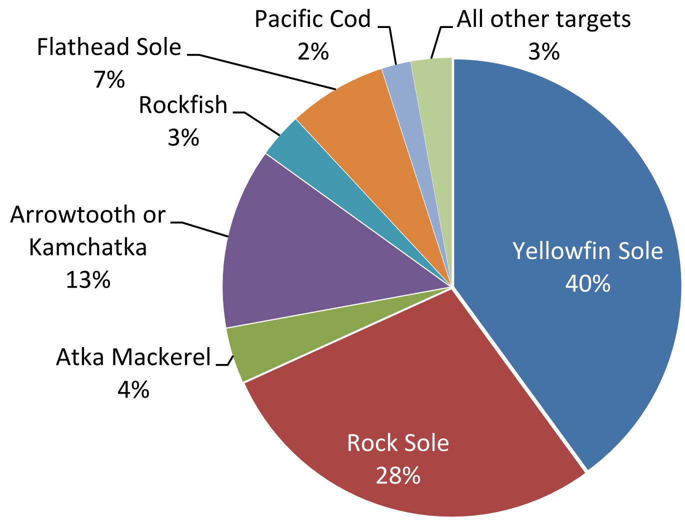
Table 5-38 Halibut PSC Mortality in A80-CPs Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Halibut PSC Mortality (in Round Weight mt)**						
Yellowfin Sole	802.4	894.1	813.6	758.1	710.8	905.7	4,884.5
Rock Sole	620.5	558.1	878.5	453.3	370.8	570.2	3,451.4
Atka Mackerel	60.0	63.4	52.9	104.5	136.3	60.9	478.0
Arrowtooth or Kamchatka Flounder	127.1	222.8	178.8	257.9	504.3	274.5	1,565.5
Rockfish	32.3	29.5	55.5	92.4	67.0	107.7	384.4
Flathead Sole	233.1	172.1	168.5	68.4	82.5	126.1	850.7
Pacific Cod	42.4	74.9	34.7	16.7	36.9	46.1	251.7
All other targets	51.1	58.8	71.1	58.9	36.8	77.2	354.0
All Targets	**1,969.0**	**2,073.7**	**2,253.6**	**1,810.2**	**1,945.4**	**2,168.3**	**12,220.1**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

As shown in Figure 5-29, the yellowfin sole, rock sole, and arrowtooth/Kamchatka flounder target fisheries have accounted for over 80 percent of the halibut mortality of A80-CPs since 2008.

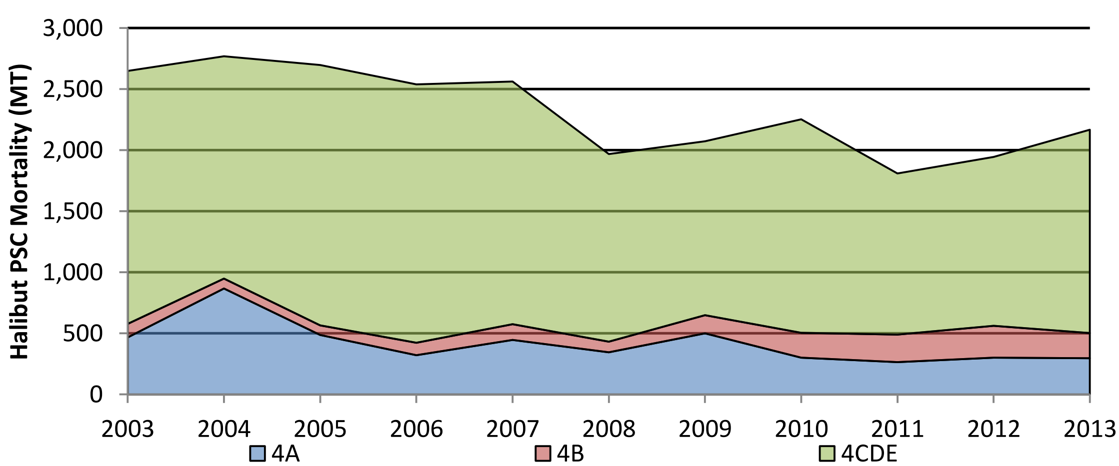
Figure 5-29 Average Percentage of Total Halibut PSC Mortality by Target Fishery for A80-CPs, 2008 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

The majority of halibut PSC mortality in the A80 sector takes place in IPHC Area 4CDE, as shown in Figure 5-30. However, after implementation of A80 in 2008, the IPHC Area 4CDE has also accounted for the majority of decreases in halibut PSC mortality. Since 2008, IPHC Area 4CDE accounted for 74 percent of total halibut PSC mortality in the A80 sector. Table 5-39, on the following page, provides the details of halibut PSC mortality by IPHC Area from 2008 to 2013.

Figure 5-30 Halibut PSC Mortality in A80 Fisheries, by IPHC Area



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-39 Halibut PSC Mortality in A80 Fisheries by IPHC Area, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Halibut PSC Mortality (in Round Weight mt)**						
IPHC Area 4A	345.2	500.5	301.3	264.8	301.1	296.5	2,009.5
IPHC Area 4B	87.2	148.6	203.5	225.6	261.1	206.3	1,132.2
IPHC Areas 4CDE	1,536.6	1,424.6	1,748.8	1,319.8	1,383.3	1,665.5	9,078.5
All Areas	**1,969.0**	**2,073.7**	**2,253.6**	**1,810.2**	**1,945.4**	**2,168.3**	**12,220.1**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-31 shows the amount of halibut PSC mortality taken by the A80 sector as a percentage of the sector's current halibut PSC limit of 2,325 mt. The figure provides an indication that halibut PSC mortality taken in the A80 fishery increased from 2008 through 2010, when the fishery took 97 percent of its current halibut PSC limit. The percent of halibut PSC mortality harvested by the A80 sector fell below 80 percent of the current limit in 2011, but since then has moved upward through 2013, where halibut PSC mortality approached 93 percent of the current limit. On average between 2008 and 2013, the A80 fishery took 87.5 percent of its current halibut PSC limit.

Figure 5-31 Percentage of 2014 Halibut PSC Limits taken by A80-CPs, 2008 to 2013

Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-40 shows the average wholesale revenue generated by the A80 sector per ton of halibut PSC mortality. On average over all target fisheries between 2008 and 2013, the A80 sector earned $160,000 per ton of halibut PSC mortality. The wholesale value generated per ton of halibut mortality is a measure of how much revenue on average would be forgone if A80-CPs were to reduce their halibut PSC. Values per ton of halibut PSC mortality for specific target fisheries ranged from a low of $0.09 million in the arrowtooth or Kamchatka flounder target group, to a high of $0.82 million in Atka mackerel target fisheries. The variation by target fishery in wholesale value per ton of halibut PSC mortality provides an indication of the target fisheries that would most likely be cut if A80-CPs were forced to reduce their halibut PSC mortality under the proposed alternatives.

Table 5-40 Average Wholesale Revenue per Ton of Halibut PSC Mortality in A80-CP Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Average
Target Group	**Average Wholesale Revenue Per Ton (in millions of 2013 $ per mt)**						
Yellowfin Sole	$0.16	$0.12	$0.13	$0.18	$0.20	$0.13	$0.15
Rock Sole	$0.10	$0.07	$0.07	$0.14	$0.23	$0.09	$0.11
Atka Mackerel	$0.95	$1.20	$1.53	$0.70	$0.52	$0.54	$0.82
Arrowtooth or Kamchatka Flounder	$0.11	$0.08	$0.14	$0.10	$0.06	$0.07	$0.09
Rockfish	$0.45	$0.40	$0.31	$0.42	$0.47	$0.32	$0.38
Flathead Sole	$0.12	$0.10	$0.12	$0.11	$0.08	$0.09	$0.11
Pacific Cod	$0.24	$0.11	$0.21	$0.27	$0.14	$0.13	$0.16
All other targets	$0.10	$0.15	$0.10	$0.11	$0.12	$0.15	$0.12
All Targets	**$0.16**	**$0.14**	**$0.14**	**$0.20**	**$0.19**	**$0.13**	**$0.16**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

5.5.3.5 Reliance of A80-CPs on BSAI Groundfish and Diversification of A80-CPs into Other Fisheries

Of the 23 unique A80 vessels participating in the BSAI groundfish fishery, between 13 and 17 participated in the GOA groundfish fishery and between 2008 and 2013 (Table 5-41). In addition, A80-CPs also participated in the CDQ groundfish fishery and fixed gear sablefish fisheries. Wholesale revenue earned by A80-CPs in other fisheries increased 35 percent in 2010 to $44.7 million and 49 percent in 2011 to $66.4 million. Since 2011, wholesale revenues have returned to 2009 values.

Table 5-41 Number of A80-CPs Participating in Other Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013
	Number of A80-CPs Participating in Other Fisheries					
BSAI Pot Groundfish	-	-	-	-	-	-
CDQ Groundfish	4	5	7	8	6	6
All Halibut	-	-	-	-	-	-
All Fixed Gear Sablefish	1	1	-	-	-	-
GOA Groundfish	13	17	16	16	16	13
AK Salmon	-	-	-	-	-	-
All Other AK Fisheries	-	-	-	-	-	-
West Coast Fisheries	-	-	-	-	-	-
	A80-CP Wholesale Revenue in All Other Fisheries					
All Other Fisheries	$38.3	$33.2	$44.7	$66.4	$59.7	$44.3

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

5.5.4 Longline Catcher Vessels

Longline catcher vessels (CVs) represent the smallest sector among the groups that are potentially affected by the alternative to reduce halibut PSC limits in the BSAI. Among the affected groups, longline CVs account for less than 0.05 percent of total groundfish harvest and 0.1 percent of non-pollock groundfish harvest between 2008 and 2013.

5.5.4.1 Description of Participants in Longline Catcher Vessel Target Fisheries

Longline CV Harvesting Vessels

Between 2008 and 2013, 42 unique vessels participated in the longline CV fishery for Pacific cod, as shown in Table 5-42. The number of vessels operating in the longline CV fishery has mostly decreased since 2008, reaching 9 unique vessels in 2011 and 2012. The number of vessels increased in 2013 to 11. From 2010 to 2013 the number of vessels was fairly steady ranging between 11 and 9 vessels. While the actual count of vessels in the longline CV Pacific cod fishery has been relatively flat from 2010 to 2013 fishery, participation by individual vessels has varied and there have been a total of 21 different active vessels in the last 4 years. Of these 21 vessels, three were active in 3 of the 4 years, four were active in 2 years, and the remaining 14 vessels had only one year of activity in the fishery. The lack of steady participation by individual vessels in an indication that the longline CV Pacific cod fishery is a part-time fishery for the participating vessels. This is backed up at the end of the longline CV summary, where the diversity of fisheries in which these vessels participate is summarized.

Table 5-42 Number of Vessels Participating in Longline CV Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	2008–2013
Pacific Cod	**20**	**13**	**11**	**9**	**9**	**11**	**42**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-43 summarizes the number of unique longline CVs by region of owner residence. As shown, the majority of unique longline CVs operating between 2008 and 2013 were registered as Alaskan (74 percent). As the number of unique vessels had steadily decreased since 2008, reductions have occurred in nearly every region of residence. The number of vessels registered to Other Alaska and Other States—primarily in Washington and Oregon, have only decreased since 2008, while the NW and SW Alaska regions have small increases in participation in 2012 and 2013.

Table 5-43 Longline CV Vessel Owner's Place of Residence, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Unique Vessels
Region	Number of Participating Vessels						
NW Alaska	-	-	-	-	-	1	1
SW Alaska	6	7	5	4	5	7	14
Other Alaska	8	6	3	2	2	1	16
Other U.S.	6	-	3	3	2	2	11
Total	20	13	11	9	9	11	42

Note: Shaded cells indicate that catch and revenue data for that sub-set of vessels in that year for that target fishery cannot be disclosed due to confidentiality rules.

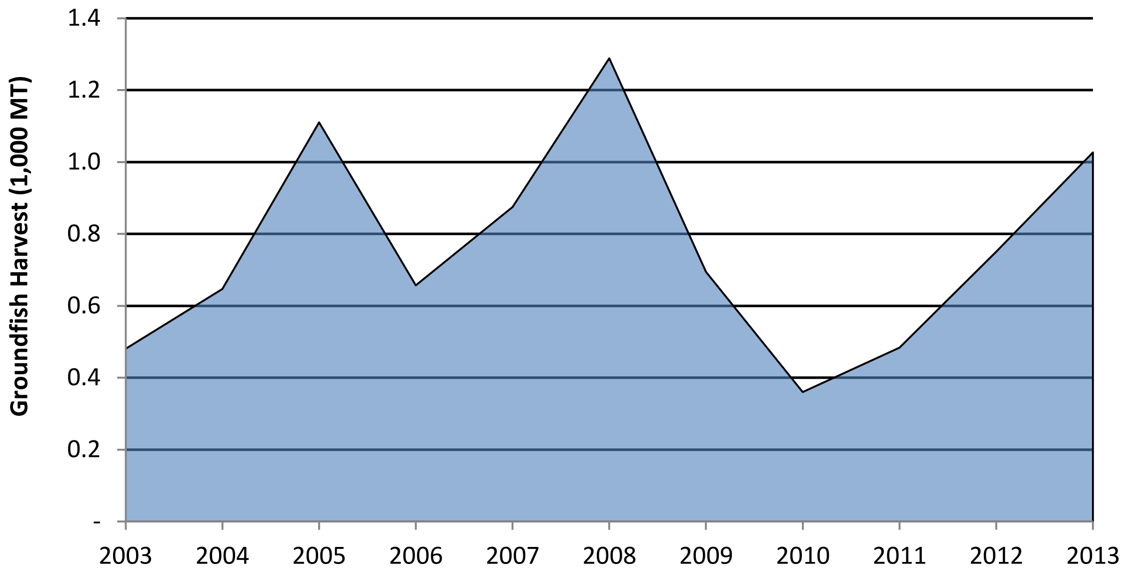
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

5.5.4.2 Catch and Revenue in Longline CV Target Fisheries

After subtraction of the CDQ reserve, 2 percent of the BSAI Pacific cod TAC is allocated to longline CVs less than 60 feet length overall, and 0.2 percent is allocated to longline CVs greater than 60 ft length overall. Vessels greater than 60 feet must have a catcher vessel Pacific cod endorsement to target BSAI Pacific cod.

Figure 5-32 summarizes harvests in the longline CV fishery between 2003 and 2013. As previously noted, the longline CV fishery solely targets Pacific cod with longline gear. Peak harvest in the longline CV Pacific cod fishery occurred in 2008 with nearly 1,300 mt. Steep declines followed in 2009 and 2010, bringing the total harvest to 360 mt in 2010. Since 2010, harvests by longline CVs have steadily increased back to 1,000 mt. Total harvest appears relatively volatile between 2008 and 2013 compared to other Pacific cod fisheries in the BSAI. The fact the most of the vessels operating in the longline CV Pacific cod fishery participate in other fisheries with more revenue potential, as discussed at the end of this section (see Section 5.5.4.5), may indicate that Pacific cod is a "fishery of opportunity" for these participants, but not a fishery upon which they rely heavily.

Figure 5-32 Groundfish Harvests in Longline CV Pacific Cod Fishery, 2003 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

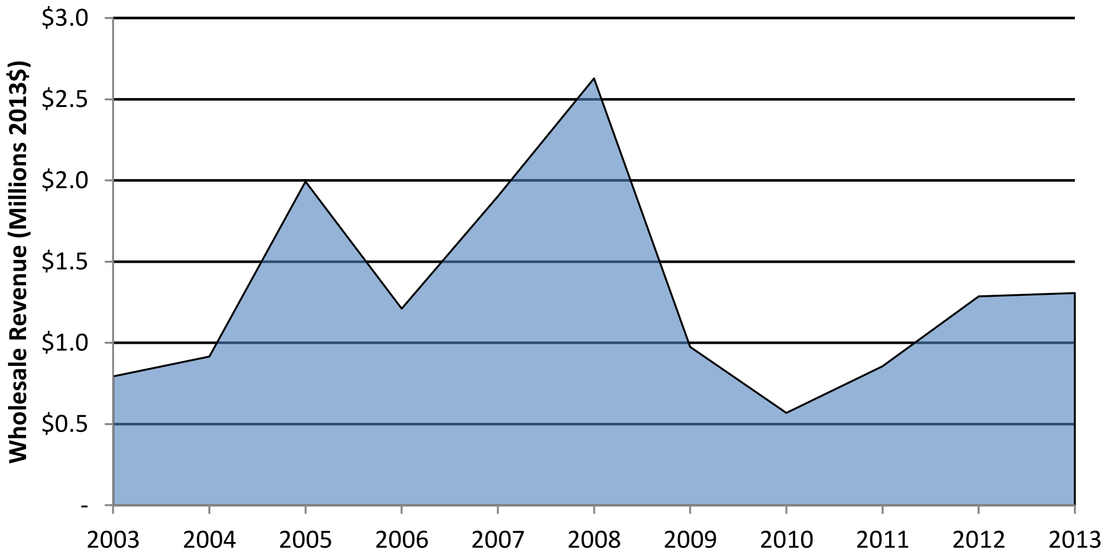
Table 5-44 Groundfish Harvest in Longline CV Pacific Cod Fishery, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Metric Tons of Groundfish Harvested in Pacific cod Target Fishery**						
Pacific Cod	1.29	0.69	0.36	0.48	0.75	1.03	4.60

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-33 and Table 5-45 summarize historic wholesale revenues in the longline CV fishery for Pacific cod. Overall, changes in wholesale revenue are largely correlated with changes in harvest between 2003 and 2013. Wholesale revenues peaked in 2008 at $2.5 million, followed with sharp declines in 2009 and 2010. Wholesale revenues recovered slightly to $1.29 million by 2012. In 2013, total wholesale revenue remained flat at $1.31 million, despite a 25 percent increase in harvest.

Figure 5-33 Wholesale Revenue in Longline CV Pacific Cod Target Fishery, 2003 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-45 Real Wholesale Revenue in Longline CV Pacific Cod Target Fishery, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	Wholesale Revenue (in millions of 2013 $)						
Pacific Cod	$2.63	$0.98	$0.57	$0.86	$1.29	$1.31	$7.62

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

5.5.4.3 Ex-Vessel Revenue, Wholesale Revenue and Processor Value Added

Longline CVs deliver their harvests to either shore plants, or inshore floating processors, and in making deliveries receive ex-vessel revenues. The processing facilities then turn the raw fish into products and sell them to generate wholesale revenues. The difference between ex-vessel value and wholesale value is the value added by the processor. Table 5-46, summarizes ex-vessel and wholesale revenues and calculates the value added by processors. In the table we combine processor types to protect confidential information.[29]

Total ex-vessel value in the fishery ranged from a high of 1.95 million in 2008 to a low of just 230,000 in 2010. On average, vessels in the longline CV Pacific cod target fisheries have generated about $60,000 in ex-vessel revenue per year. As seen in Table 5-46, changes in ex-vessel revenues from 2008 to 2013 have tracked closely with wholesale revenues, but processor value added has been much more stable than either of the two revenue measures. Over all six years, the average ex-vessel value generated has been about 56 percent of total revenue, but that figure is heavily influenced by 2008, where ex-vessel value generated was 74 percent of wholesale revenue. From 2009 to 2013, harvesters have received an average of 47 percent of the total value generated.

[29] If there were more vessels participating in the fishery, it would have been possible to discuss revenue impacts by region. But the very low number of participating vessels and confidentiality rules precludes that assessment.

Table 5-46 Ex-Vessel Revenues, Wholesale Revenue and Processor Value Added from the Longline CV Fishery

2008	2009	2010	2011	2012	2013	Average
			Ex-Vessel Value ($Millions 2013)			
$1.95	$0.47	$0.23	$0.37	$0.61	$0.67	$0.72
			Wholesale Value Generated by Processors ($Millions 2013)			
$2.63	$0.98	$0.57	$0.86	$1.29	$1.31	$1.27
			Processor Value Added ($Millions 2013)			
$0.67	$0.50	$0.34	$0.48	$0.68	$0.64	$0.55

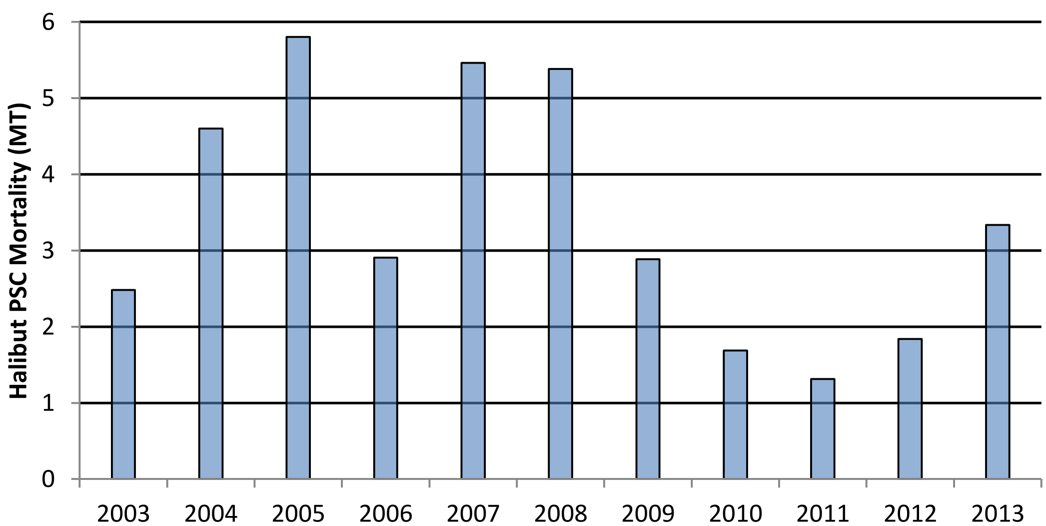
Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

5.5.4.4 Halibut PSC Limits and Halibut PSC Mortality in Longline CV Target Fishery

Halibut PSC limits for the longline CV Pacific cod target fishery have remained stable at 15 mt since 2008 (NMFS 2014f).

Figure 5-34 summarizes halibut PSC mortality in the longline CV fishery from 2003 to 2013. Actual halibut mortality data are shown in Table 5-47 for 2008 to 2013. Total halibut mortality in the longline CV Pacific cod target fishery has varied from a high of 5.8 mt in 2005 to low of 1.3 mt in 2011 during the 11-year period shown in Figure 5-34. Since 2008, the high has been 5.4 mt—just 36 percent of the 15 mt PSC limit for the fishery. Between 2008 and 2013, total halibut PSC mortality in the longline CV fishery averaged 2.7 mt. The decreases in halibut mortality from 2008 to 2011 largely correlates with overall participation in the longline CV fishery, with a few recent upticks in 2012 and 2013.

Figure 5-34 Halibut PSC Mortality in Longline CV Target Fishery, 2003 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

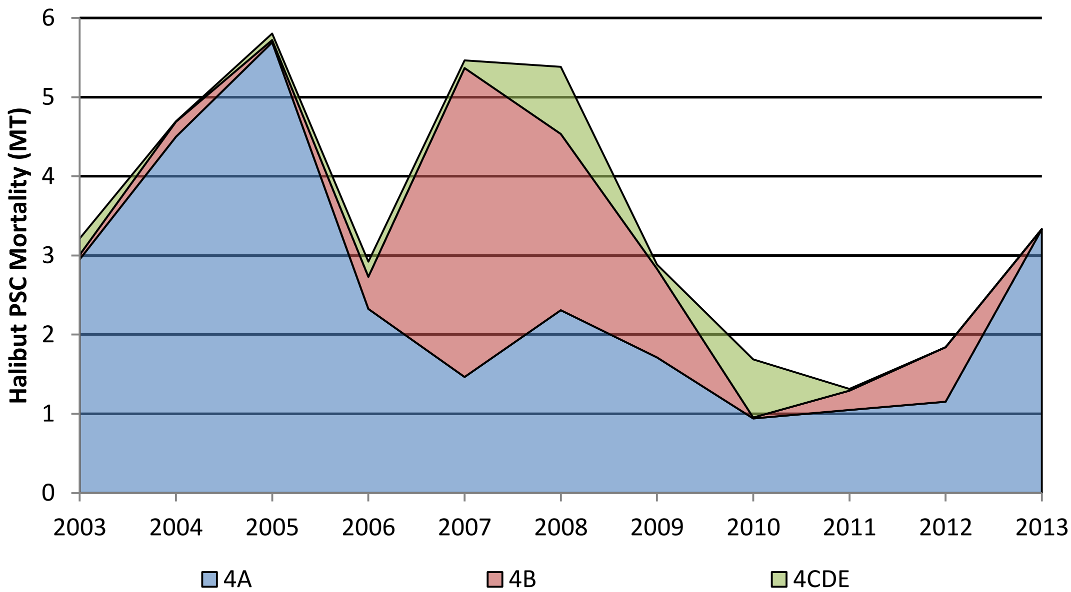
Table 5-47 Halibut PSC Mortality in Longline CV Target Fishery, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group				Halibut PSC Mortality (in round weight mt)			
Pacific Cod	5.4	2.9	1.7	1.3	1.8	3.3	16.4

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-35 and Table 5-48 summarize halibut mortality in longline CV fishery by IPHC area. Between 2008 and 2013, nearly two-thirds of halibut mortality occurred in IPHC Area 4A. This changed in 2007, when a large spike in halibut mortality occurred in Area 4B, pushing total halibut mortality back above 5 mt in 2007 and 2008—still less than half of the longline CV fishery's total halibut PSC limit. Halibut mortality decreased steadily between 2008 and 2011, where it reached a low of 1.3 mt. By 2013, halibut mortality returned to 3.3 mt, caught entirely in Area 4A.

Figure 5-35 Halibut PSC Mortality in Longline CV Fishery by IPHC Area, 2008 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

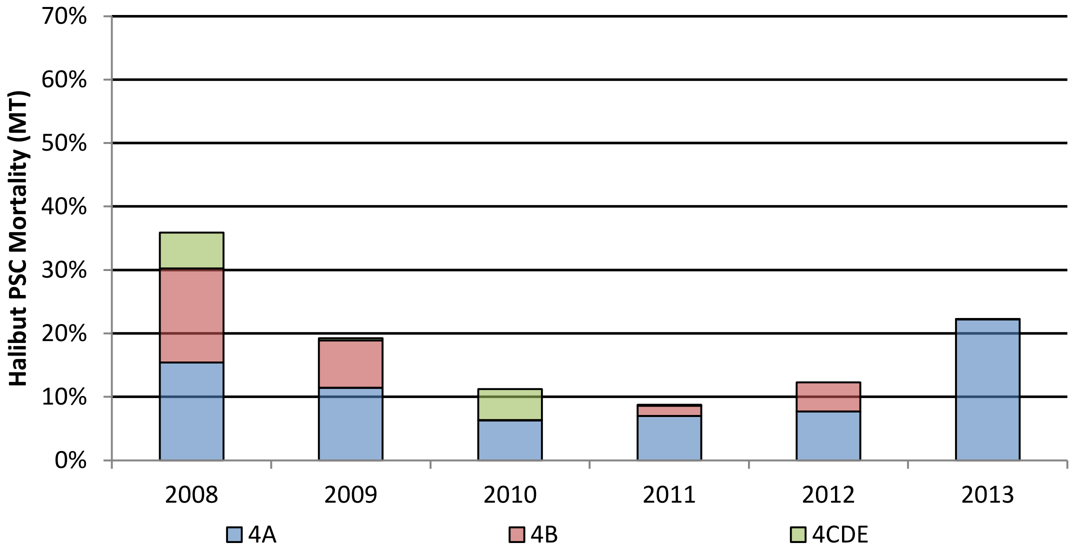
Table 5-48 Halibut PSC Mortality in Longline CV Fishery, by IPHC Area, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Halibut PSC Mortality (in round weight mt)**						
IPHC Area 4A	2.3	1.7	0.9	1.0	1.2	3.3	**10.5**
IPHC Area 4B	2.2	1.1	0.0	0.2	0.7	0.0	4.3
IPHC Areas 4CDE	0.8	0.1	0.7	0.0	-	0.0	1.7
All Areas	**5.4**	**2.9**	**1.7**	**1.3**	**1.8**	**3.3**	**16.4**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-36 summarizes the percent of the longline CV Pacific cod halibut PSC limit taken between 2008 and 2013. Within that time frame, the longline CV fishery, on average, harvested 18 percent of its 15 mt halibut PSC limit annually. In order for the longline CV fishery to be materially affected by a reduction, their limit would need to be cut by more than 60 percent. Because most of these vessels also participate in the commercial halibut fishery (see Table 5-50) they are more likely to gain from the reduced halibut PSC limits than they are to be harmed.

Figure 5-36 Percentage of 2014 Halibut PSC Limits taken by Longline CVs, 2008 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-49 summarizes the calculation of the wholesale revenue per ton of halibut PSC mortality in the longline CV Pacific cod fishery. This measure is an indication of how much wholesale revenue the participants (harvesters and processors combined) in the longline CV fishery would have to give up during an average trip if they were required to reduce halibut PSC mortality by one mt. The numbers shown in the table are calculated by summing the wholesale revenue by year and then dividing by the halibut PSC mortality taken in the year in the fishery. It should be noted that because there is significant variability in halibut PSC rates over the course of the year and across vessels, there is also significant variability in the wholesale value generated per ton of halibut PSC mortality in a given fishery.

Between 2008 and 2013, the longline CV Pacific cod fishery (including both harvesters and processors) generated an average of $0.46 million per ton of halibut PSC mortality. The years with the lowest averages of wholesale revenue per ton of halibut PSC mortality occurred in 2009 and 2010, both at $340,000 per ton of halibut PSC mortality, while in 2012, wholesale revenue generated per ton of halibut PSC mortality averaged $700,000.

Table 5-49 Wholesale Revenue per Ton of Halibut PSC Mortality in Longline CV Pacific Cod Fishery, 2008 to 2013

	2008	2009	2010	2011	2012	2013	All Years
Target Group	**Wholesale Revenue Per Ton (in millions of 2013 $ per mt)**						
Pacific Cod	$0.49	$0.34	$0.34	$0.65	$0.70	$0.39	$0.46

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

5.5.4.5 Reliance of Longline CVs on BSAI Groundfish and Diversification of Longline CVs into Other Fisheries

Table 5-50 summarizes the participation and amount of ex-vessel revenues earned in other fisheries by vessels that also participated in the longline CV Pacific cod fishery in the BSAI, between 2008 and 2013. There is a noticeable drop-off beginning in 2011 of activity of longline CVs in other fisheries. In 2009 there were 13 active longline CVs targeting Pacific cod in the BSAI. Of these, 9 also participated in the Alaska halibut fisheries, 10 participated in IFQ sablefish fisheries and 4 were active in GOA groundfish fisheries. Similar levels of participation in other fisheries were seen in 2010. In 2011, longline CVs active in the BSAI Pacific cod fishery dropped by two, but the number that also participated in halibut fisheries fell by four vessels, and the number in sablefish fell by five. Similar declines were seen in 2012. The reasons for this apparent shift are not known.

In the bottom part of the table we summarize the diversity of ex-vessel revenue earned by the longline CVs active the BSAI Pacific cod fishery. Of the other fisheries in which vessels participate, halibut is clearly the most important, and in every year shown, revenues in the halibut fishery have been much higher than revenues in the BSAI Pacific cod fishery. Revenue in the BSAI Pacific cod fishery as a percent of revenue in all fisheries is summarized in the bottom row of the table. In 2008 and 2009, Pacific cod accounted for an average of 10 percent of overall earning. In 2010 and 2011, the average dropped to 5 percent. Then in 2012 and 2013, the relative importance of the BSAI Pacific cod fishery jumped up to an average of 25 percent of total revenue.

Table 5-50 Number of Longline CVs Participating in Other Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013
Number Longline CVs Participating in BSAI Pacific Cod Fishery						
BSAI Longline CV Pacific Cod	20	13	11	9	9	11
Number Longline CVs Participating Other Fisheries						
BSAI Pot Groundfish	-	1	-	-	1	2
CDQ Groundfish	-	-	-	-	-	-
All Halibut	18	9	10	6	5	7
All Fixed Gear Sablefish	13	10	11	6	4	2
GOA Groundfish	14	4	5	3	1	-
AK Salmon	3	3	1	1	1	1
All Other AK Fisheries	2	1	1	-	-	1
West Coast Fisheries	1	-	-	1	-	-
Ex-Vessel Revenue ($2013 Millions)						
Halibut Fisheries	$8.54	$2.36	$5.27	$4.46	$1.67	$1.32
All Other Fisheries	$4.06	$1.35	$2.80	$0.50	$0.44	$0.29
Halibut & Other Fishery Total	**$12.61**	**$3.71**	**$8.08**	**$4.95**	**$2.11**	**$1.61**
BSAI Longline CV Pacific Cod	$1.96	$0.47	$0.23	$0.37	$0.61	$0.67
All Fisheries	**$14.57**	**$4.19**	**$8.31**	**$5.33**	**$2.72**	**$2.28**
BSAI Longline CV Pacific Cod % of Total Ex-vessel revenue	13%	11%	3%	7%	22%	29%

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

5.5.5 Longline Catcher Processors

Longline CPs operating in the BSAI groundfish fishery primarily participate in the Pacific cod fishery and are apportioned 48.7 percent of the BSAI Pacific cod TAC, after subtraction of the CDQ reserve. In addition to Pacific cod, few other target species exist, with the exception of the IFQ sablefish fishery.[30] The longline CPs produce relatively higher-value products that compensate for the lower catch volumes compared to trawl vessels.

Each year a BSAI Pacific cod allocation is made to the longline CP sector through the annual harvest specifications process. A sector-specific allocation, in combination with a closed class of license holders, created an opportunity for these license holders to form a voluntary fishing cooperative to divide the

[30] Because the halibut bycatch in the IFQ Sablefish fishery is exempt from PSC limits, this analysis treats the participation in the sablefish fishery differently than participation in the Greenland turbot fishery, for example.

sector's allocation of Pacific cod among members of the cooperative through private contractual agreements. The Freezer Longline Conservation Cooperative (FLCC) was incorporated on February 26, 2004. By June 2010, through private negotiations and a federally funded license buyback loan, the owners of all longline CPs endorsed for BSAI Pacific cod had become members of the FLCC (NPFMC 2012, 2013b). It is important to note that FLCC is not regulated by NMFS, with allocations being apportioned to the sector, and not the cooperative. Further details regarding the FLCC are provided in Section 5.5.5.6.

5.5.5.1 Description of Participants in the Longline CP Fisheries

Longline CP Harvesting Vessels in Longline CP Target Fisheries

Table 5-51 summarizes the number of unique vessels fishing in the longline CP fishery. Between 2008 and 2013, 43 unique longline CPs participated in the BSAI Groundfish fishery. To determine unique vessel counts, the study team counted each active vessel in a year once. The number of unique vessels participating in the longline CP fishery has steadily declined from 39 in 2008, to 31 by 2013. A large reduction in the number of participating longline CPs occurred in 2011 across both target species, likely due to the full implementation of the FLCC, and the rationalization that the cooperative enabled.

Table 5-51 Types and Numbers of Vessels Participating in BSAI Target Fisheries of Longline CPs, 2008 to 2013

	2008	2009	2010	2011	2012	2013	2008–2013
Pacific Cod	39	38	36	30	31	29	42
All other targets but Sablefish	7	10	13	10	7	7	20
All Targets	**39**	**38**	**38**	**32**	**31**	**31**	**43**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-52 summarizes the longline CP ownership by region. Of the 43 unique vessels participating in the longline CP fishery between 2008 and 2013, 9 were registered to owners in Alaska. Alaskan-owned longline CPs tend to also participate for Pacific cod in the CDQ cod fishery.

Table 5-52 Longline CP Vessel Owner's Place of Residence, 2008 to 2013

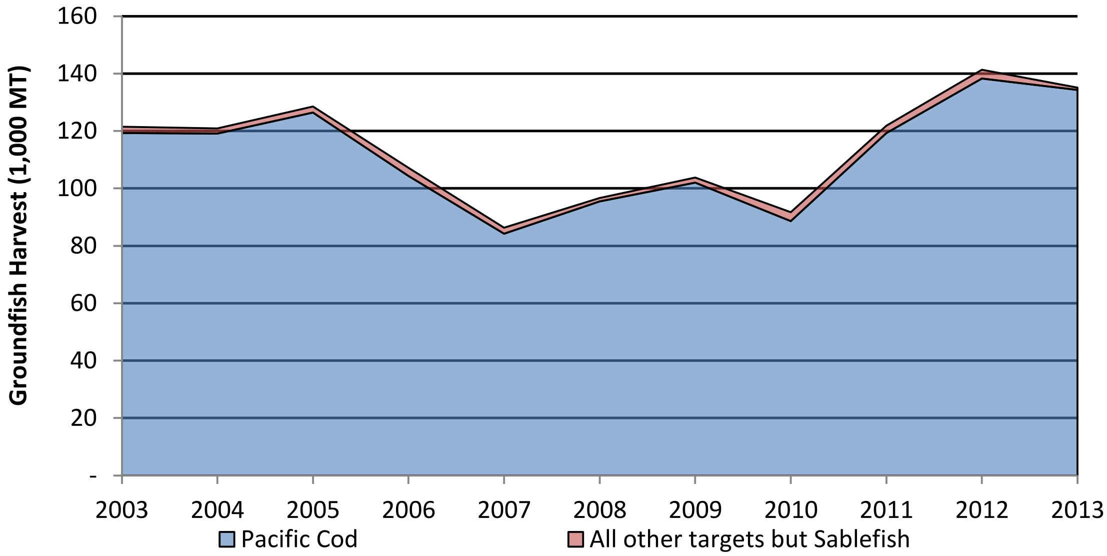
	2008	2009	2010	2011	2012	2013	Unique Vessels
Region	Number of Participating Vessels						
NW Alaska	-	-	-	-	-	-	-
SW Alaska	-	-	-	-	-	-	-
Other Alaska	3	3	8	8	7	7	9
Other U.S.	36	35	30	24	24	24	39
Total	39	38	38	32	31	31	43

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

5.5.5.2 Catch and Revenue in Longline CP Target Fisheries

Figure 5-37 and Table 5-53 summarize total harvest in the longline CP fishery. Within the fishery, Pacific cod was targeted 98 percent of the time, with the remaining 2 percent to All Other Targets but Sablefish. Greenland turbot was the primary focus of the "Other Targets", generating 94 percent of the revenue in that group of target fisheries. Total harvest decreased 30 percent in 2006 and 2007, then remained relatively flat until increasing again in 2011. In 2012, total harvest exceeded 140,000 mt. A five percent decrease in total harvest is seen in 2013. Between 2008 and 2013, the longline CP fishery harvested approximately 25 percent of all of the total non-pollock harvests by volume of all groups affected by the PSC limit reduction alternative.

Figure 5-37 Groundfish Harvests in Target Fisheries of Longline CPs, 2003 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-53 Groundfish Harvest in Longline CP Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Metric Tons of Groundfish (of All Species) Harvested in Longline CP Target Fisheries**						
Pacific Cod	95.46	102.00	88.60	119.26	138.26	134.29	$0.68
All other targets but Sablefish	1.19	1.77	3.10	2.57	3.07	0.82	$0.01
All Targets	**96.66**	**103.78**	**91.70**	**121.83**	**141.33**	**135.11**	**690.41**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

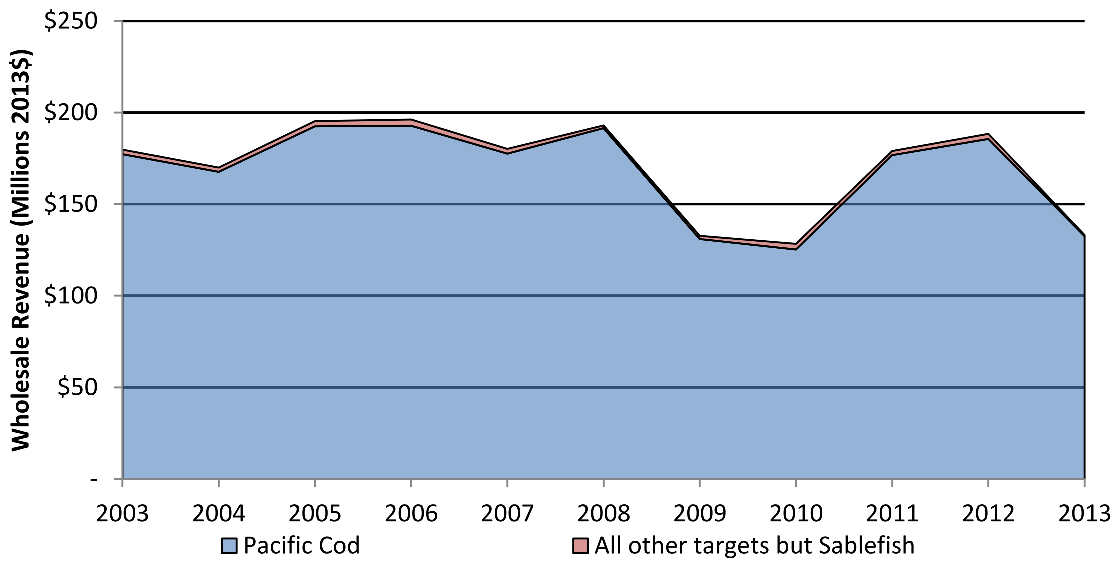
Table 5-54 and Figure 5-38 summarize total wholesale revenues in the longline CP fishery. As can be seen in the figure, wholesale revenues remained stable from 2005 through 2007, despite declines in total harvest. Wholesale revenues dropped below $130 million in 2009 and 2010, likely due to effects from global recession. Wholesale revenues recovered in 2011 and 2012 before declining 30 percent in 2013. It is not entirely clear at this point what is causing the sudden drop in wholesale revenues in 2013. We note similar declines have occurred in other fisheries, not just in the longline CP fishery, and not just for Pacific cod.

Table 5-54 Real Wholesale Revenue in Target Fisheries of Longline CPs, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Wholesale Revenue (in millions of 2013 $)**						
Pacific Cod	$191.45	$130.93	$125.20	$176.72	$185.55	$132.50	$942.36
All other targets but Sablefish	$1.47	$1.74	$3.10	$2.25	$2.78	$0.62	$11.95
All Targets	**$192.92**	**$132.67**	**$128.30**	**$178.97**	**$188.33**	**$133.11**	**$954.31**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-38 Wholesale Revenue in Target Fisheries of Longline CPs, 2003 to 2013



5.5.5.3 Regional Impacts of Longline CPs

Table 5-55 summarizes the distribution of wholesale revenues generated by longline CPs between Alaska and other states. These data assign revenue to states based on the vessel owner's address on record in the ADF&G vessel files. In general, the proportion of the amount of Alaska-based revenue has increased. In 2008 and 2009, Alaska-based vessels generated 7.3 percent of the fleet's wholesale revenue, but from 2010 to 2013 Alaska's share jumped to 18.4 percent.

Table 5-55 Distribution of Wholesale Revenue from Longline CP Fisheries

	2008	2009	2010	2011	2012	2013	Average
	Wholesale Value by Vessel Owner's Region ($Millions 2013)						
Other States	$179.61	$122.06	$106.71	$145.68	$150.73	$109.77	$135.76
Alaska	$13.31	$10.61	$21.60	$33.29	$37.60	$23.34	$23.29
Total	**$192.92**	**$132.67**	**$128.30**	**$178.97**	**$188.33**	**$133.11**	**$159.05**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

5.5.5.4 Halibut PSC Limits and Halibut PSC Mortality in Target Fisheries of Longline CPs

Halibut PSC limits in the longline CP fisheries are apportioned to the sector as a whole. This differs from apportionment to A80 cooperatives, which are regulated by NMFS. Under NMFS regulation, apportionment of halibut PSC is directly assigned to each cooperative by NMFS. However, the creation of FLCC allowed for the sector-wide apportionment of halibut PSC mortality to be distributed similarly to A80 cooperatives, in that halibut PSC mortality is apportioned based on the groundfish catch histories of the member vessels. This type of organizational structure potentially presents efficiency gains in managing halibut PSC.

Halibut PSC limits for the longline CP target fisheries are shown in Table 5-56. The PSC limit for the Pacific cod fishery is allocated exclusively to longline CPs, while the PSC limit for all other target fisheries (excluding sablefish) is shared with the longlines CP. While longline CPs have some level of participation in these other target fisheries, longline CVs have no recent participation in other target fisheries. PSC limits have remained unchanged since 2008.

Table 5-56 Halibut PSC Limits and Apportionment to Longline CP Target Fisheries, 2008 to 2013

Target Group	2008	2009	2010	2011	2012	2013
	Halibut PSC Limit (in Round Weight mt)					
Pacific Cod	760	760	760	760	760	760
All other Hook and Line Target Fisheries excluding Sablefish	58	58	58	58	58	58

Note: Technically, the PSC limit for all other longline fisheries except sablefish applies to both longline CPs and longline CVs. However, longline CVs have had no recorded activity in these other fisheries from 2008 to 2013.

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-39 and Table 5-57 summarize total halibut mortality in the longline CP target fisheries. Between 2008 and 2013, total halibut mortality remained relatively stable, averaging just over 500 tons annually. Between 2008 and 2013, the longline CP fisheries had 3,100 tons of halibut PSC mortality, almost entirely in the Pacific cod target fishery, as shown in Table 5-57. As aforementioned, the present analysis of halibut mortality excludes participants in the IFQ and CDQ fixed gear fisheries for sablefish, as they are exempt from the PSC limits.

Figure 5-39 Halibut PSC Mortality in Longline CP Target Fisheries, 2003 to 2013

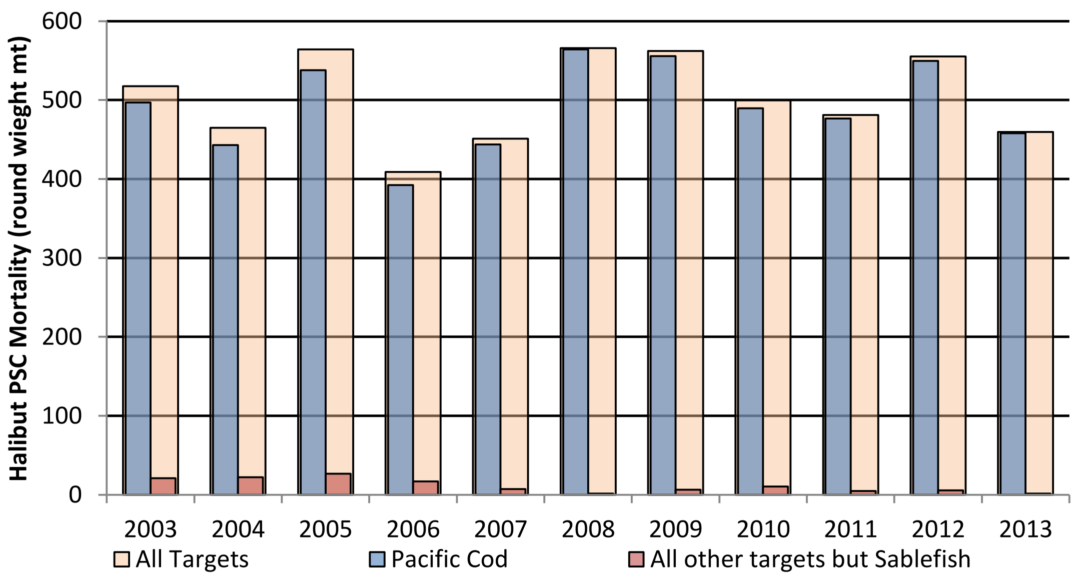


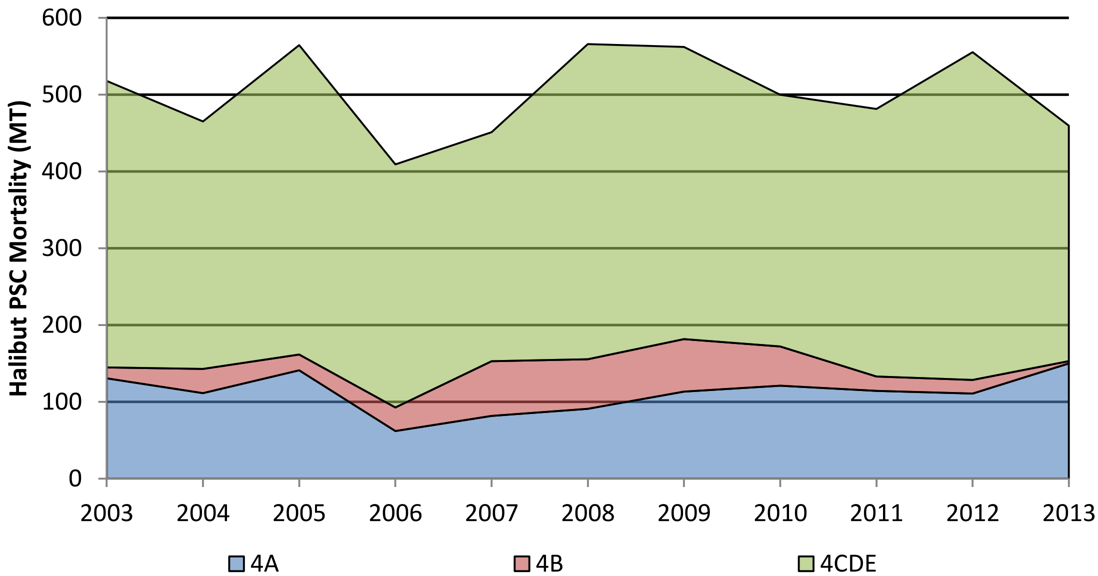
Table 5-57 Halibut PSC Mortality in Longline CP Target Fisheries, 2008 to 2013

Target Group	2008	2009	2010	2011	2012	2013	Total
	Halibut PSC Mortality (in Round Weight mt)						
Pacific Cod	564.3	555.6	489.4	476.7	549.5	458.1	3,093.7
All other targets but Sablefish	1.3	6.4	10.3	4.5	5.7	1.4	29.6
All Targets	**565.7**	**562.0**	**499.7**	**481.2**	**555.2**	**459.5**	**3,123.2**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-40 and Table 5-58 summarize halibut PSC mortality taken in the longline CP fishery. Between 2008 and 2013, halibut PSC mortality averaged 520 mt—approximately 15 percent of total halibut PSC mortality taken in the all of the fisheries for which reductions in PSC limits are being considered. Over the same time period, 70 percent of halibut PSC mortality was taken from IPHC Area 4CDE, 23 percent from 4A, and 7 percent from 4B. As shown in the figure below, halibut mortality in the longline CP fishery remained relatively constant among IPHC areas.

Figure 5-40 Halibut PSC Mortality in Longline CP Fisheries by IPHC Area



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

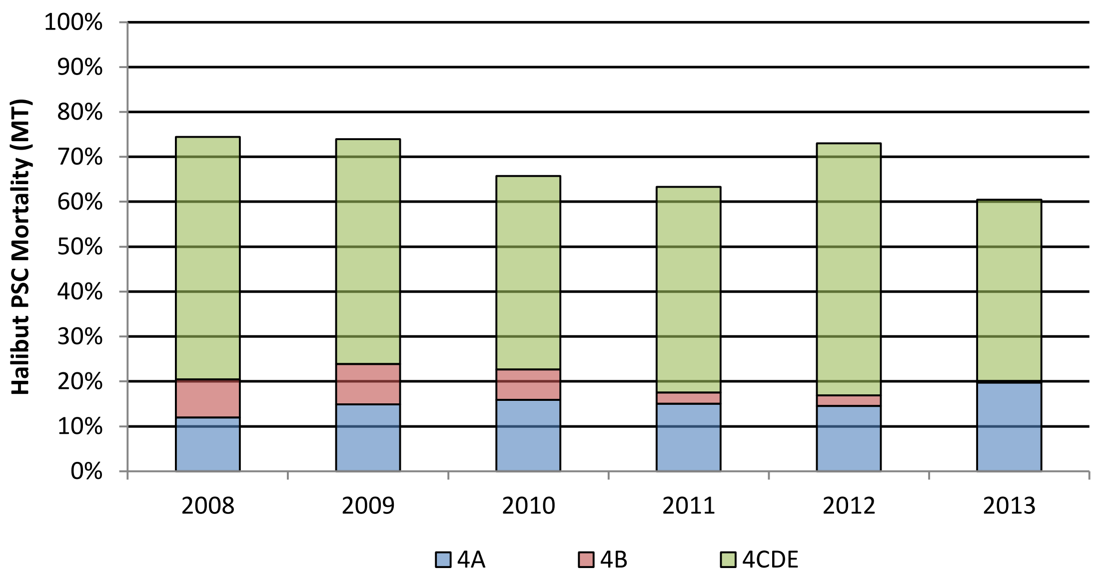
Table 5-58 Halibut PSC Mortality in Longline CP Fisheries, by IPHC Area, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
IPHC Area	**Halibut PSC Mortality (in Round Weight mt)**						
IPHC Area 4A	90.8	113.2	121.0	114.2	110.7	149.9	699.9
IPHC Area 4B	64.6	68.4	51.0	18.7	17.7	3.0	223.4
IPHC Areas 4CDE	410.3	380.4	327.7	348.3	426.7	306.5	2,199.9
All Areas	**565.7**	**562.0**	**499.7**	**481.2**	**555.2**	**459.5**	**3,123.2**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

The percentage of the halibut PSC limit for the Pacific cod fishery (760 mt) taken from 2008 to 2013 by longline CPs is shown in Figure 5-41. Since 2008, the longline CP fishery has taken an average of 68 percent of its halibut PSC limit. In three of the years (2008, 2009, and 2012) halibut PSC mortality exceeded 70 percent of the limit, while in two of the years, less than 65 percent was taken (2011 and 2013). Reductions in halibut PSC mortality in IPHC areas 4B and 4CDE helped push the percent of halibut taken in 2013 down to just over 61 percent. Any potential halibut PSC limit reductions in the BSAI Groundfish fishery would need to be large to impact the longline CP fishery as their halibut PSC mortality has been consistently well below the fishery's halibut PSC mortality apportionment. While not shown in the figure, longline CP halibut PSC mortality in all other target fisheries (excluding sablefish) has been less than 10 percent of the 58 mt PSC limit, with the exception of 2010 when 17.5 percent was taken.

Figure 5-41 Percentage of 2014 Halibut PSC Limits for Pacific Cod Taken by Longline CP, 2008 to 2013



Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-59 summarizes wholesale revenue per ton of halibut PSC mortality in the longline CP fishery between 2008 and 2013. This measure is an indication of how much wholesale revenue the average participant in the longline CP fishery would have to give up during an average trip if they were required to reduce their halibut PSC mortality by a single mt. The numbers shown in the table are calculated by summing the wholesale revenue for the target group and year and then dividing by the halibut PSC mortality for the same target group and year. It should be noted that because there is significant variability in halibut PSC mortality rates over the course of the year and across vessels, there is also significant variability in the wholesale value generated per ton of halibut mortality in a given fishery.

Wholesale revenue per ton of halibut mortality in the longline CP target fishery for Pacific cod averaged $300,000 between 2008 and 2013, as shown in Table 5-59. Small amounts of halibut PSC mortality taken in the “All other targets but sablefish” group in 2008 resulted in a wholesale revenue per ton of halibut reaching $1.10 million. However, the overwhelming majority of participation takes place in the Pacific cod target fishery, which drives the average revenue per ton. The lowest average wholesale revenues per ton of halibut PSC mortality occurred in 2009 ($240,000) and 2010 ($260,000), primarily due to decreases in wholesale revenues as a result of a global recession.

Table 5-59 Wholesale Revenue per Ton of Halibut PSC Mortality in Longline CP Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Wholesale Revenue Per Ton (in millions of 2013 $ per mt)**						
Pacific Cod	$0.34	$0.24	$0.26	$0.37	$0.34	$0.29	$0.30
All other targets but Sablefish	$1.10	$0.27	$0.30	$0.50	$0.49	$0.45	$0.40
All Targets	**$0.34**	**$0.24**	**$0.26**	**$0.37**	**$0.34**	**$0.29**	**$0.31**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

5.5.5.5 Reliance of Longline CPs on BSAI Groundfish and Diversification of Longline CPs into Other Fisheries

Table 5-60 summarizes participation and wholesale revenues of longline CPs that participate in fisheries outside of the BSAI groundfish fisheries for Pacific cod and "other groundfish targets excluding sablefish." These other fisheries include the CDQ groundfish fisheries, the pot-gear fishery for Pacific cod, the sablefish and halibut fisheries, and longline groundfish fisheries in GOA. On average, more than a third of vessels participating in the longline CP BSAI Groundfish fisheries between 2008 and 2013 also participated in the CDQ groundfish fishery, GOA groundfish fishery, and fixed gear sablefish fishery. Vessels participating in the longline CP fishery that also participated in the "other fisheries" generated, on average, $52 million in wholesale revenue per year—or approximately 33 percent of wholesale revenue generated in the BSAI longline CP groundfish fisheries.

Table 5-60 Number of Longline CPs Participating in Other Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013
Number of Longline CPs Participating in Other Fisheries						
BSAI Pot Groundfish	3	1	3	2	1	-
CDQ Groundfish	17	17	15	13	11	13
All Halibut	5	5	5	5	1	1
All fixed Gear Sablefish	12	13	16	13	10	6
GOA Groundfish	18	17	18	13	7	3
AK Salmon	-	1	-	-	-	-
All other AK Fisheries	2	2	2	1	2	2
West Coast Fisheries	-	-	-	-	-	-
Longline CP Wholesale Revenue ($2013 Millions)						
Halibut Fisheries	$0.3	$0.4	$0.6	$1.5	NA	NA
All Other Fisheries	$63.7	$42.2	$55.7	$67.3	$48.3	$35.0
BSAI Longline Groundfish Total	$192.92	$132.67	$128.30	$178.97	$188.33	$133.11
Total Revenue by Longline CPs (excludes halibut)	$256.62	$174.87	$184.00	$246.27	$236.63	$168.11
BSAI Longline Groundfish as a Percent of Total	75.2%	75.9%	69.7%	72.7%	79.6%	79.2%

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

5.5.5.6 Longline CP Cooperative

Since 2003, longline CPs have been required to have a Pacific cod longline catcher processor endorsement on their LLP license to target BSAI Pacific cod with longline gear and process it onboard. The Consolidated Appropriations Act of 2005 defined eligibility in the longline CP sector as the holder of an LLP license that is transferable, or becomes transferable, and that is endorsed for BS or AI catcher processor fishing activity, Pacific cod, and longline gear (NPFMC 2012).

Each year a BSAI Pacific cod allocation is made to the longline CP sector through the annual harvest specifications process. A sector-specific allocation, in combination with a closed-class of license holders, created an opportunity for these license holders to form a voluntary fishing cooperative to divide the sector's allocation of Pacific cod among members of the cooperative through private contractual agreements. The Freezer Longline Conservation Cooperative (FLCC) was incorporated on February 26, 2004. By June 2010, through private negotiations and a federally funded license buyback loan, the owners of all longline CPs endorsed for BSAI Pacific cod had become members of the FLCC (NPFMC 2012, 2013b). In December 2010, Congress passed the Longline Catcher Processor Subsector Single Fishery Cooperative Act (Pub. L. 111-335), which established a statutory framework for the formation of the cooperative. Under this Act, NMFS must implement a single, mandatory cooperative with exclusive catch privileges for each LLP license holder if requested to do so by persons holding at least 80 percent of the LLP licenses held by longline CPs eligible to participate in the BSAI Pacific cod fishery. A cooperative implemented under the Act would be authorized by NMFS to collectively harvest the total amount of BSAI Pacific cod allocated to the longline CP sector and utilize the sector's halibut PSC mortality allocation, less any TAC amount and PSC mortality amount allocated to longline CPs not in the cooperative. The allocation to vessels not in the cooperative would be based on vessel history from 2006 to 2008 (NPFMC 2012). The federal legislation specifies that the cooperative must prohibit any eligible member from harvesting a total of more than 20 percent of the Pacific cod available to be harvested by the longline CP sector.

In addition, the Longline Catcher Processor Subsector Single Fishery Cooperative Act authorizes NMFS to recover reasonable costs related to the implementation and administration of a cooperative approved under the Act, consistent with section 304(d)(2) of the MSA. However, NMFS reports that, to date, it has not received any request from LLP license holders to implement a cooperative under the Act (78 FR 63951 (October 25, 2013)). Moreover, the members of FLCC have argued that their cooperative was not formed under the Act. Nevertheless, NMFS maintains that FLCC members are subject to cost recovery because the Council has limited the longline CP portion of the BSAI Pacific cod fishery to only persons holding an LLP with specific endorsements, those LLP holders have formed a voluntary cooperative, those LLP holders have taken a federal loan as part of a license buyback program, and the Council has set aside a percentage of the TAC for those vessels (NMFS 2013).

In any case, the formation of the FLCC has created a de facto catch share program for the longline CP portion of the BSAI Pacific cod fishery (NMFS 2013). The FLCC apportions the sector's share of the available Pacific cod TAC among its members to eliminate the race for fish that arises under limited access management. FLCC members subdivide the TAC with each receiving a share for harvest; shares are issued in proportion to historical BSAI Pacific cod fishing activity. FLCC members are free to exchange their shares among themselves, and to stack shares on individual vessels (NPFMC 2013b) Compliance with the agreement is monitored by SeaState, Inc., and the contract, signed by the members, imposes heavy financial penalties for noncompliance. Under the terms of the contract, dissolution of the cooperative requires the agreement of an 85 percent supermajority of LLP license holders (NPFMC 2013b).

In the GOA, the allocation of Pacific cod and apportionment of halibut PSC mortality available to the longline catcher processor sector is at times too small to allow NMFS to open the fishery in the absence of some control of harvest by members of the sector. Consequently, for several years, FLCC members have also organized their GOA Pacific cod harvests, working with participants in the GOA Pacific cod fishery that are not cooperative members. The GOA constituents have not come to an agreement on the terms for a GOA cooperative. This coordination has resulted in sufficient commitments regarding Pacific cod harvests and halibut PSC mortality avoidance to allow NMFS to open the fishery (NPFMC 2013b).

5.5.6 Community Development Quota Fisheries for Groundfish

The CDQ Program was established by the Council in 1992, and in 1996, the program was incorporated into the MSA. The CDQ Program consists of six different CDQ groups representing different geographical regions in Alaska. The CDQ Program receives annual apportionments of TACs for a variety of commercially valuable species in the BSAI Groundfish fishery, which are in turn allocated among six different non-profit managing organizations representing different affiliations of communities (CDQ groups).

The final rule to implement Amendment 80 in 2008 increased the percentage of TAC for directed fisheries (with the exception of pollock and sablefish) that are allocated to the CDQ Program from 7.5 percent to 10.7 percent, modified the percentage of halibut, crab, and non-Chinook salmon PSC mortality allocated to the CDQ Program as PSC mortality quota, and included other provisions necessary to bring A80 and the CDQ Program into compliance with applicable law.

The CDQ groups are provided exclusive access to the CDQ target fisheries and PSC limits. Like allocations made to the two A80 cooperatives, apportionments of halibut PSC mortality are made to each CDQ group, allowing the CDQ group to optimize the distribution of halibut PSC mortality among its groundfish target fisheries. For the purpose of this study, CDQ data were analyzed as a single multi-vessel, multi-gear gear, multi-target sector and does not delve into internal apportionment or harvests across the various CDQ groups.

5.5.6.1 Description of Participants in the CDQ Fisheries

CDQ Harvesting Vessels in CDQ Target Fisheries

Table 5-61 summarizes the number of unique vessels operating in the CDQ fisheries between 2008 and 2013. Sixty unique vessels participated in the CDQ fishery between 2008 and 2013, with nearly 60 percent of vessels operating in the Pollock|Atka Mackerel|Other Species and Pacific cod target fisheries.

Vessels operating in the CDQ fisheries are not regulated by gear type. For this reason, Table 5-61 summarizes participation only by target fisheries. To determine unique vessel counts, the study team counted each active vessel in a year once. However, within each harvest sector, the columns do not sum to the "All Target" total. This is due to the fact that some vessels participate in more than one target fishery.

Table 5-61 Types and Numbers of Vessels Participating in CDQ Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	2008–2013
Pollock|Atka Mackerel|Other Species	24	21	18	22	22	21	35
Pacific Cod	19	20	17	16	16	23	35
Yellowfin Sole	5	3	5	11	9	8	13
All other targets	7	5	7	10	10	10	16
All Targets	**40**	**40**	**36**	**38**	**36**	**42**	**56**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-62 below summarizes unique vessel participation in CDQ fisheries by vessel type and region of owner residence. Catcher processors represent the majority of vessels participating in CDQ fisheries; largely consisting of longline CPs, AFA-CPs, and A80-CPs. Between 2008 and 2013, 25 percent of vessels operating in the CDQ fishery were Alaskan owned.

Some individual CDQ groups invest in ownership interest in both the at-sea processing sector and in catcher vessels that directly catch the CDQ group's various species allocation. Other CDQ groups lease quota to various harvesting partners, receiving royalty payments on each allocation harvested. It is important to note that some vessels owned in part by Alaskan CDQ groups may be registered with non-Alaskan addresses, thereby underestimating Alaskan ownership.

Table 5-62 CDQ Vessel Owner's Place of Residence, 2008 to 2013

	2008	2009	2010	2011	2012	2013	2008–2013
AFA-CPs			**Number of Unique Vessels**				
NW Alaska	-	-	-	-	-	-	-
SW Alaska	-	-	-	-	-	-	-
Other Alaska	-	-	-	1	1	1	1
Other U.S.	12	12	12	14	14	14	15
Total Unique Vessels	12	12	12	15	15	15	15
AFA-CVs			**Number of Unique Vessels**				
NW Alaska	-	-	-	-	-	-	-
SW Alaska	1	1	-	-	-	-	1
Other Alaska	-	-	-	-	-	-	-
Other U.S.	5	3	-	-	-	-	5
Total Unique Vessels	6	4	-	-	-	-	6
Non-AFA Trawl CVs			**Number of Unique Vessels**				
NW Alaska	-	-	-	-	-	-	-
SW Alaska	-	-	-	-	-	-	-
Other Alaska	-	-	-	-	-	-	-
Other U.S.	1	1	2	2	3	3	4
Total Unique Vessels	1	1	2	2	3	3	4
A80-CP			**Number of Unique Vessels**				
NW Alaska	-	-	-	-	-	-	-
SW Alaska	-	-	-	-	-	-	-
Other Alaska	-	-	-	-	-	-	-
Other U.S.	4	5	7	8	7	6	10
Total Unique Vessels	4	5	7	8	7	6	10
Longline CPs			**Number of Unique Vessels**				
NW Alaska	-	-	-	-	-	-	-
SW Alaska	-	-	-	-	-	-	-
Other Alaska	3	3	5	5	6	5	6
Other U.S.	14	14	10	8	5	8	16
Total Unique Vessels	17	17	15	13	11	13	19
Longline CVs			**Number of Unique Vessels**				
NW Alaska	-	1	-	-	-	5	6
SW Alaska	-	-	-	-	-	-	-
Other Alaska	-	-	-	-	-	-	-
Other U.S.	-	-	-	-	-	-	-
Total Unique Vessels	-	1	-	-	-	5	6
All Types			**Number of Unique Vessels**				
NW Alaska	-	1	-	-	-	5	6
SW Alaska	1	1	-	-	-	-	1
Other Alaska	3	3	5	6	7	6	7
Other U.S.	36	35	31	32	29	31	50
Total Unique Vessels	40	40	36	38	36	42	56

Note: There were a total of six vessels whose owners lived in multiple regions over the six-year period. Also note that shaded cells indicate that catch and revenue data for that sub-set of vessels in that year for that target fishery cannot be disclosed due to confidentiality rules.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

5.5.6.2 Catch and Revenue in CDQ Target Fisheries

Figure 5-42 shows total harvest of CDQ fisheries between 2003 and 2013, while Table 5-63 provides actual numbers from 2008 to 2013. Because of reductions in the pollock ABC and TACs, groundfish harvests in CDQ target fisheries declined dramatically in 2008 and again in 2009. CDQ pollock harvests fell nearly 43 percent to 91 mt by 2009. Overall groundfish catch rose again in 2011, largely due to increases in the pollock TACs and an emerging yellowfin sole fishery. Total harvest in the CDQ fishery has increased gradually each year since 2011.

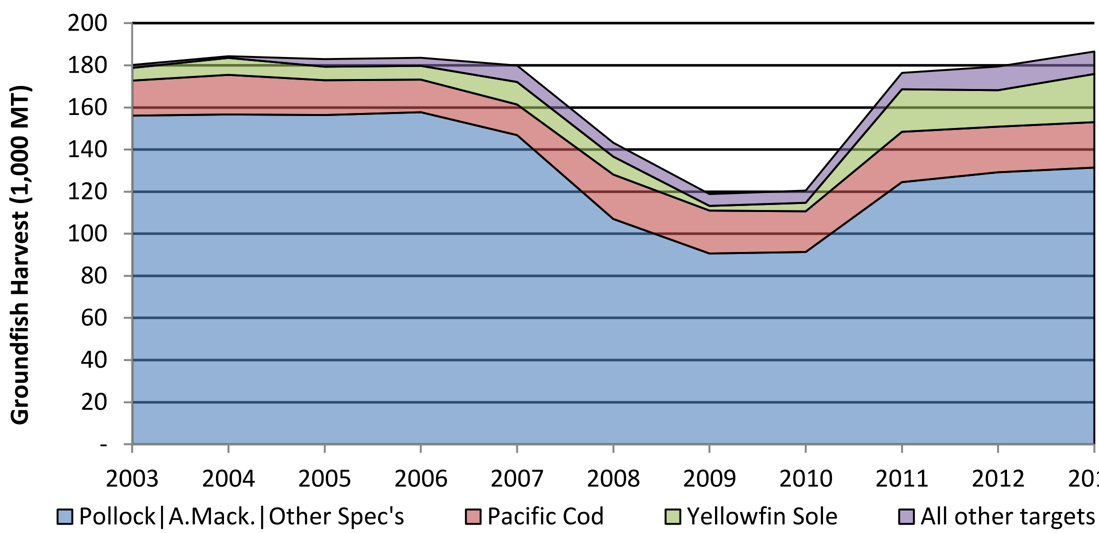
Harvests in the Pollock|Atka Mackerel|Other Species target group are almost entirely driven by pollock, although since 2003, 4 percent of the 1.44 million tons in this target group were assigned as Atka mackerel or "other species" target fisheries. From 2008 to 2013, the pollock fishery accounted for 73 percent of the total harvest in the CDQ fishery. Because pollock is so overwhelming within the CDQ fishery, Figure 5-43 on the following page, displays total harvest in the CDQ fishery, excluding pollock. In that figure, the increasing importance of the yellowfin sole target fishery can readily be seen. From this "non-pollock" perspective, CDQ harvests increased between 2003 and 2013. A 400 percent year-over-year increase in the harvest of yellowfin sole occurred in 2011, pushing the total non-pollock harvest above 50 mt. In 2013, yellowfin sole harvest reached nearly 23 mt, overtaking Pacific cod as the second largest target fishery (Table 5-63). Note that harvests of "all other targets" include CDQ target fisheries for rock sole (52 percent), rockfish (30 percent), arrowtooth flounder (5 percent), flathead sole (5 percent) and Greenland turbot (>1 percent).

Table 5-63 Groundfish Harvest in CDQ Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Metric Tons (1,000s) of Groundfish (of All Species) Harvested in CDQ Target Fisheries**						
Pollock|Atka Mackerel|Other Species	107.01	90.62	91.33	124.52	129.21	131.43	674.12
Pacific Cod	21.11	20.38	19.32	23.91	21.66	21.57	127.95
Yellowfin Sole	8.50	2.22	4.04	20.20	17.31	22.90	75.17
All other targets	6.62	5.64	5.80	7.79	11.26	10.66	47.78
All Targets	**143.24**	**118.85**	**120.50**	**176.41**	**179.44**	**186.56**	**925.01**

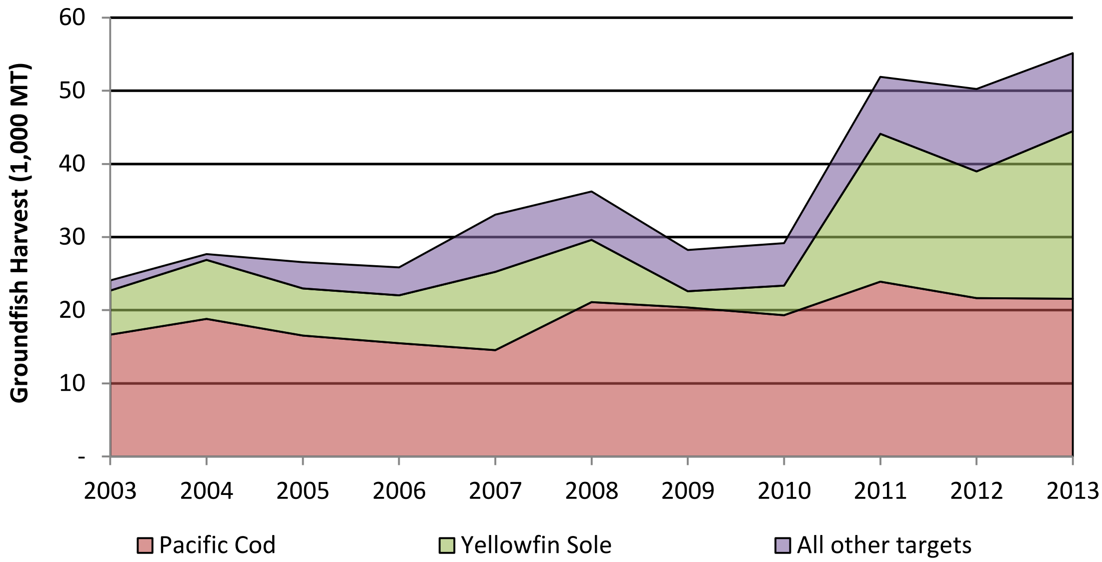
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-42 Groundfish Harvests in Target Fisheries of CDQ Vessels, 2003 to 2013



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

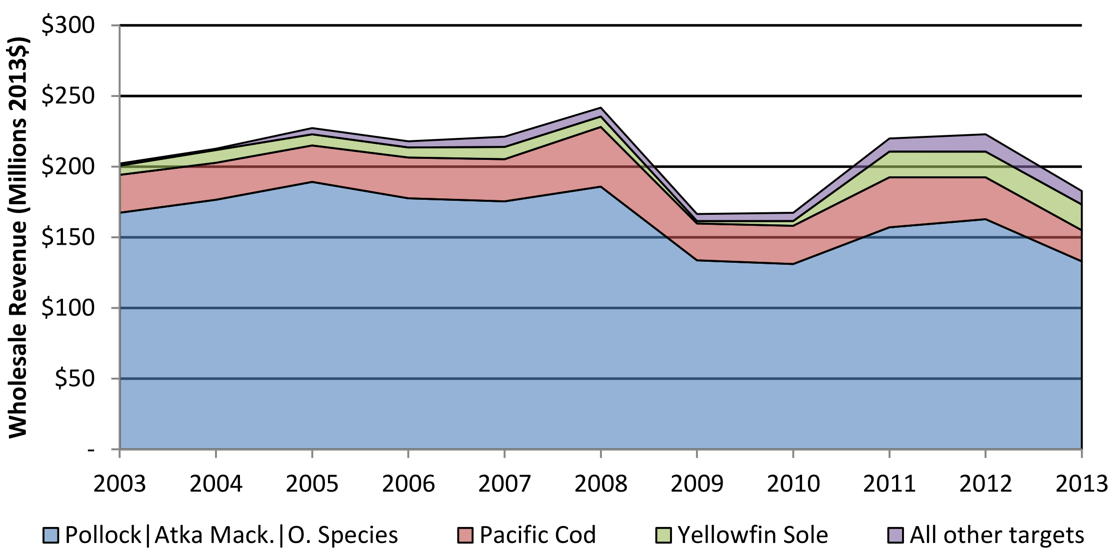
Figure 5-43 Non-pollock Groundfish Harvests in CDQ Target Fisheries, 2003 to 2013



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-44 and Table 5-64 summarize wholesale revenues in the CDQ groundfish fisheries from 2003 to 2008. As shown, wholesale revenues gradually increased from 2003 through 2008 in spite of a decline in pollock harvest. The sharp decline in 2009 is attributed to primarily to the global recession. Overall groundfish revenues rose again in 2011, largely due to increases in the pollock TACs and an emerging yellowfin sole fishery. In 2013, an 18 percent decrease in total wholesale revenue occurred, despite a gradual increase in total harvest—a phenomenon seen in almost all other fisheries. The decline is a function of lower revenues per ton across all major species in 2013 as discussed in earlier sections.

Figure 5-44 Wholesale Revenue in CDQ Target Fisheries, 2003 to 2013



Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

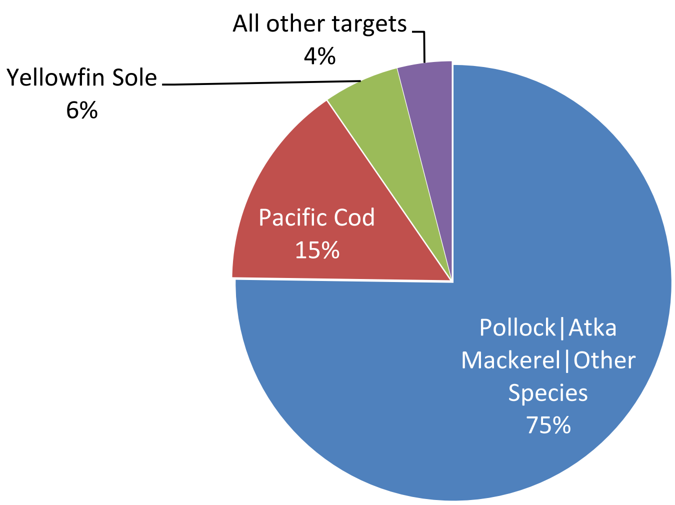
Table 5-64 Real Wholesale Revenue in CDQ Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Wholesale Revenue (in millions of 2013 $)**						
Pollock|Atka Mackerel|Other Species	$185.80	$133.68	$131.07	$157.03	$162.77	$132.95	$903.29
Pacific Cod	$42.21	$26.06	$27.02	$35.38	$29.62	$21.98	$182.27
Yellowfin Sole	$7.39	$1.70	$3.38	$18.20	$18.18	$18.22	$67.07
All other targets	$6.27	$5.02	$5.85	$9.26	$12.26	$9.53	$48.19
All Targets	**$241.67**	**$166.45**	**$167.32**	**$219.87**	**$222.84**	**$182.68**	**$1,200.83**

Note: All other targets include CDQ target fisheries for rock sole, rockfish, arrowtooth flounder, Greenland turbot, and flathead sole.
Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-45 summarizes wholesale revenue generated by species in the CDQ fisheries. As shown, the pollock fishery accounts for three-quarters of the wholesale revenue generated. Pollock and Pacific cod combined accounted for 90 percent of wholesale revenues in the CDQ fishery between 2008 and 2013.

Figure 5-45 Average Percentage of Wholesale Revenue by CDQ Target Fisheries, 2008 to 2013



Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

5.5.6.3 Regional Impacts of CDQ Groundfish Fisheries

In Table 5-65 we compare the distribution of wholesale revenue between two groups: 1) CPs that are owned by residents of other states and 2) shore plants in Alaska combined with CPs that are registered to Alaska owners. We note that due to confidentiality restrictions, we cannot provide a similar breakdown for ex-vessel revenues generated by CVs. The share of wholesale revenue from the CDQ groundfish fishery that is attributed to Alaska jumped considerably in 2011, when one of the AFA-CPs switched to Alaska ownership. We also note the full economic impact of the CDQ groundfish fishery in Alaska is beyond the scope of this analysis, but it is almost certainly greater than the split of wholesale revenues depicted here.

Table 5-65 Distribution of Wholesale Revenue from the BSAI CDQ Fisheries

	2008	2009	2010	2011	2012	2013	Average
	Wholesale Value by Region ($Millions 2013)						
Other States	$235.36	$162.29	$157.29	$170.13	$186.70	$154.93	$177.78
Alaska	$6.31	$4.15	$10.03	$49.74	$36.14	$27.75	$22.35
Total	$241.67	$166.45	$167.32	$219.87	$222.84	$182.68	$200.14

Note: Wholesale value generated by shore plants in Alaska is combined with Alaska-owned CPs.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

5.5.6.4 Halibut PSC Limits and Halibut PSC Mortality in Target Fisheries of CDQ Vessels

Table 5-66 summarizes halibut PSC limits for the CDQ fishery between 2008 and 2013. Halibut PSC mortality is allocated to CDQ groups initially, allocating 326 mt from the total trawl halibut PSC limit, plus 7.5 percent, or 67 mt, of the non-trawl halibut PSC limit. The increase in the halibut PSC limit in 2010 was a part of the Amendment 80 reapportionment of PSC mortality. Halibut PSC limits have remained at 393 mt since 2010.

Table 5-66 Halibut PSC Limits and Apportionment to CDQ Target Fisheries, 2008 to 2013

Target Group	2008	2009	2010	2011	2012	2013
	Halibut PSC Limit (in Round Weight mt)					
All targets combined	343	343	393	393	393	393

Source: Developed by NEI using data from NMFS' Alaska Groundfish Specification Tables (NMFS 2014f).

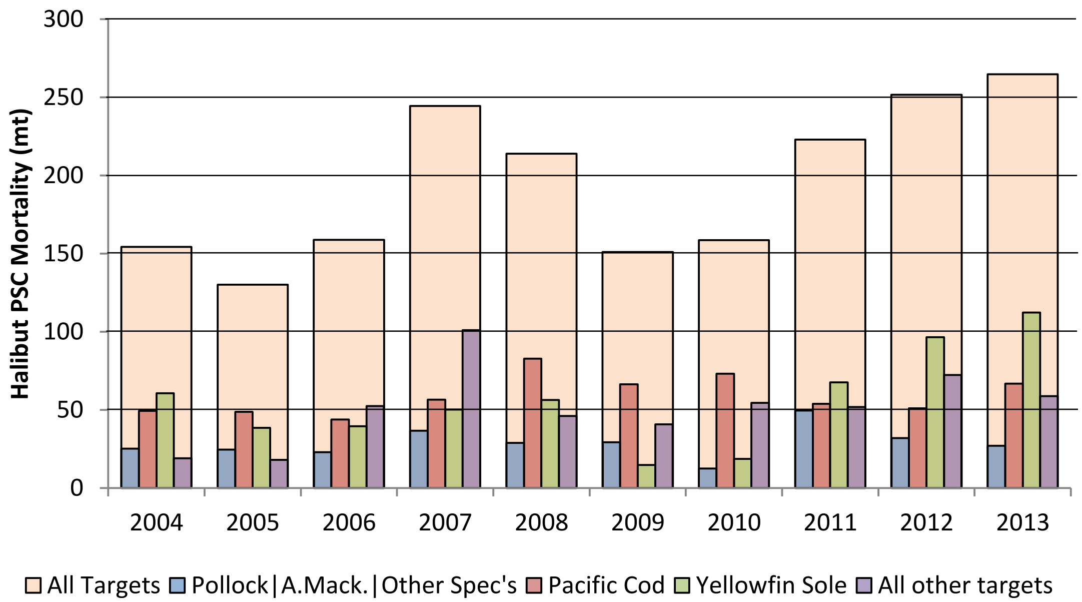
Table 5-67 and Figure 5-46 on the following page summarize halibut mortality in the CDQ target fisheries. Halibut mortality occurs primarily in the non-pollock fisheries, which accounted for 86 percent of halibut PSC mortality in the CDQ fishery (see Figure 5-47). Between 2004 and 2013, halibut PSC mortality in CDQ fisheries closely tracked total harvest of non-pollock harvest, increasing during years of increased harvest in non-pollock fisheries. Halibut PSC mortality fell 29 percent in 2009 and 2010, during which time there was a decrease in total yellowfin sole harvest. Halibut PSC mortality peaked in 2013 at 265 mt, roughly 67 percent of the CDQ Program's total halibut PSC limit. Recent increases in halibut PSC mortality are due primarily to increased CDQ participation in the yellowfin sole fishery.

Table 5-67 Halibut PSC Mortality in CDQ Target Fisheries, 2008 to 2013

Target Group	2008	2009	2010	2011	2012	2013	Total
	Halibut PSC Mortality (in Round Weight mt)						
Pollock|Atka Mackerel|Other Species	28.8	29.3	12.4	49.6	31.9	27.0	179.0
Pacific Cod	82.7	66.3	73.1	53.8	50.9	66.8	393.6
Yellowfin Sole	56.3	14.7	18.7	67.6	96.6	112.3	366.3
All other targets	46.2	40.7	54.4	51.9	72.3	58.7	324.3
All Targets	**214.0**	**151.0**	**158.6**	**223.0**	**251.7**	**264.8**	**1,263.2**

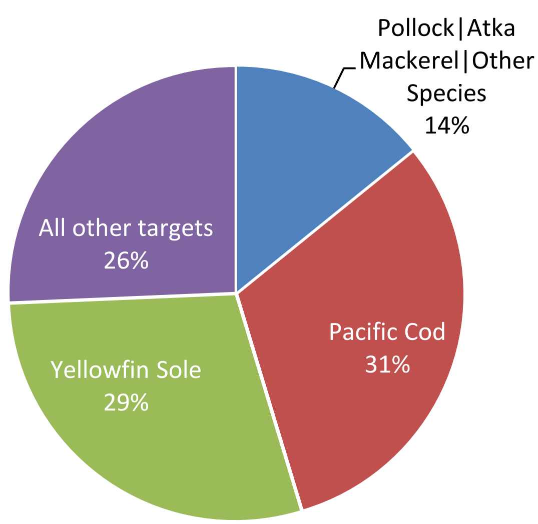
Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-46 Halibut PSC Mortality in CDQ Target Fisheries, 2004 to 2013



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

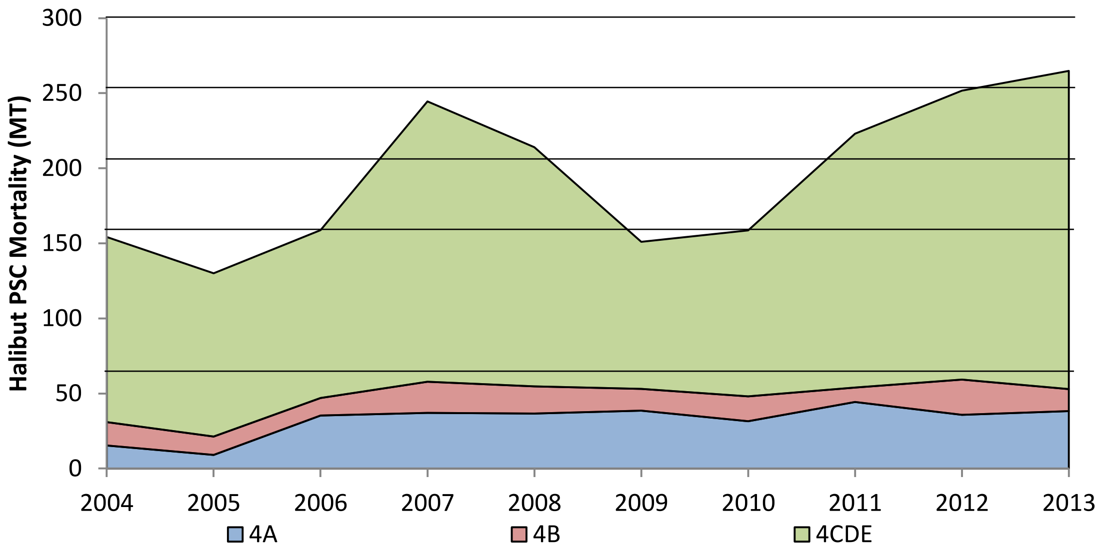
Figure 5-47 Average Percentage of Total Halibut PSC Mortality by CDQ Target Fisheries, 2008 to 2013



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-48 and Table 5-68 summarize halibut mortality in CDQ fisheries by IPHC area. Halibut PSC primarily occurs in IPHC Area 4CDE—75 percent of CDQ halibut PSC mortality 2008 to 2013 was taken in IPHC Area 4CDE.

Figure 5-48 Halibut PSC Mortality in CDQ Fisheries by IPHC Area, 2004 to 2013



Note: Data by IPHC Area were unavailable for CDQ fisheries prior to 2004.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

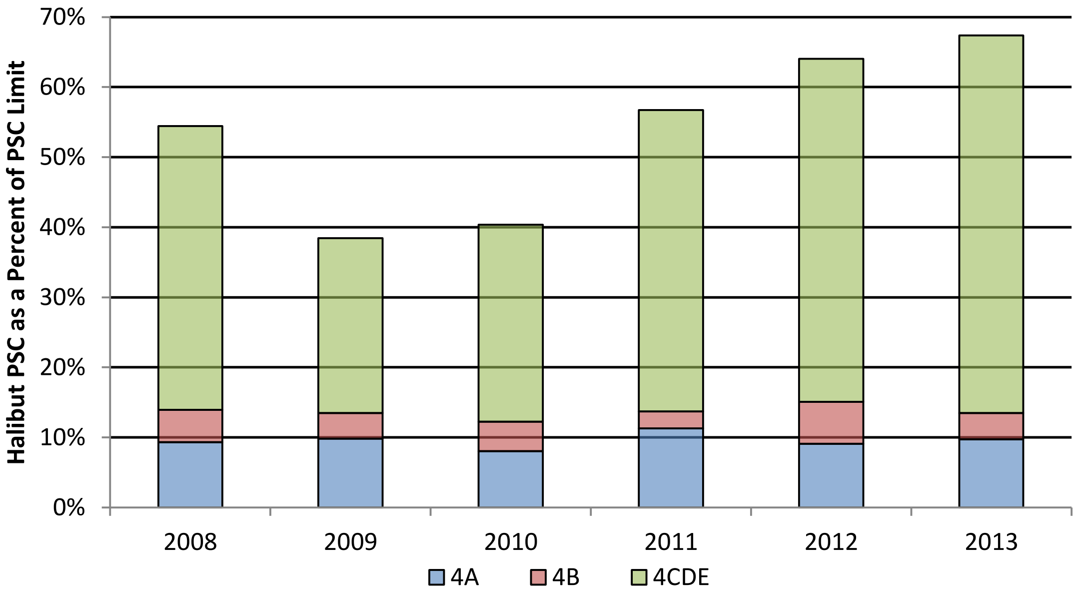
Table 5-68 Halibut PSC Mortality in CDQ Fisheries by IPHC Area, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Halibut PSC Mortality (in Round Weight mt)**						
IPHC Area 4A	36.6	38.6	31.5	44.3	35.8	38.3	225.1
IPHC Area 4B	18.1	14.5	16.6	9.6	23.5	14.7	96.9
IPHC Areas 4CDE	159.3	97.9	110.5	169.1	192.4	211.9	941.2
All Areas	**214.0**	**151.0**	**158.6**	**223.0**	**251.7**	**264.8**	**1,263.2**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 5-49 summarizes the percentage of halibut PSC limits harvested in the CDQ fishery by IPHC area. Between 2008 and 2013, the CDQ fishery harvested 54 percent of its halibut PSC limit, on average. Since 2010, annual percentages of halibut PSC limits harvested has gradually increased in IPHC Area 4CDE, reaching 67 percent of the total halibut PSC limit in 2013. As seen in Table 5-67, there were relatively big increases in halibut mortality in the yellowfin sole target fisheries.

Figure 5-49 Percentage of Current Halibut PSC Limits Harvested in CDQ Fisheries by IPHC, 2008 to 2013



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Table 5-69 summarizes calculation of the wholesale revenue generated per ton of halibut PSC mortality in each of the CDQ fisheries. This measure is an indication of how much wholesale revenue the average participant in the CDQ fishery would have to give up during an average trip if they were required to reduce halibut PSC mortality by one mt. The numbers shown in the table are calculated by summing the wholesale revenue for the target group and year and then dividing by the halibut PSC mortality for the same target group and year. It should be noted that because there is significant variability in halibut PSC mortality rates over the course of the year and across vessels, there is also significant variability in the wholesale value generated per ton of halibut PSC mortality in a given fishery.

Wholesale revenues per ton of halibut PSC mortality have gradually decreased from $1.13 million in 2008 to $0.69 million in 2013. This is likely due to the combination of decreased wholesale revenues from pollock in 2009 and 2010, and increases in halibut PSC mortality in non-pollock fisheries. It is clear that the wholesale revenue generated per ton of halibut PSC mortality in the pollock fisheries (averaging $5.05 million per ton from 2008 to 2013) is significantly higher than the values generated in the other CDQ target fisheries. This is due to the relatively low levels of halibut PSC mortality taken in the pollock target fishery. Wholesale revenue per ton of halibut PSC mortality in the CDQ Pacific cod fishery averaged $460,000 from 2008 to 2013, while the yellowfin sole fishery averaged a relatively low $18,000 per ton of halibut PSC mortality.

Table 5-69 Wholesale Revenue per Ton of Halibut PSC Mortality in CDQ Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Average
Target Group	**Wholesale Revenue Per Halibut PSC Mortality (in millions of 2013 $ per mt)**						
Pollock|Atka Mackerel|Other Species	$6.45	$4.56	$10.58	$3.17	$5.11	$4.92	$5.05
Pacific Cod	$0.51	$0.39	$0.37	$0.66	$0.58	$0.33	$0.46
Yellowfin Sole	$0.13	$0.12	$0.18	$0.27	$0.19	$0.16	$0.18
All other targets	$0.14	$0.12	$0.11	$0.18	$0.17	$0.16	$0.15
All Targets	**$1.13**	**$1.10**	**$1.05**	**$0.99**	**$0.89**	**$0.69**	**$0.95**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

5.5.6.5 Reliance on BSAI Groundfish and Diversification of CDQ Vessels into Other Fisheries

Vessels participating in the CDQ fisheries are primarily dependent on the other non-CDQ BSAI groundfish fisheries and most participate in the CDQ fisheries on a part-time basis. These vessels also generate revenues in other fisheries throughout the state and on the West Coast. The level of participation in other fisheries is important because it provides context regarding the relative importance of the groundfish fisheries that are affected by the proposed alternatives to reduce halibut PSC Limits. Table 5-70 summarizes activities in fisheries other than CDQ fisheries in which these vessels are active.

Table 5-70 Total CDQ Vessels Participating Other Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013
Number of CDQ Vessels Participating Other Fisheries						
BSAI Pot Groundfish	-	-	-	-	-	-
Non-CDQ BSAI Groundfish	40	39	34	37	35	37
All Halibut	-	1	-	-	-	-
All Fixed Gear Sablefish	4	5	3	2	2	1
GOA Groundfish	13	14	11	10	7	4
AK Salmon	-	-	-	-	1	-
All Other AK Fisheries	1	1	1	1	1	1
West Coast Fisheries	10	3	4	9	9	9
Additional Revenue of Vessels Participating CDQ Fisheries in All Other Fisheries ($2013 millions)						
Non-CDQ BSAI Groundfish	$551.5	$476.1	$531.0	$749.4	$732.3	$678.8
All Other Fisheries	$14.9	$14.1	$15.0	$14.7	$17.5	$13.8

Note: Table developed by Northern Economics using AKFIN data (Fey 2014).

5.6 Pacific Halibut Fisheries in IPHC Area 4

This section provides an overview of the commercial halibut fisheries in Area 4. Within this overview we generally combine the IFQ fishery and the CDQ fishery when discussing IFQ and CDQ harvests and revenue. This is done in part because data precision has not been consistent over all of the years, and also because the proposed reductions in halibut PSC limit will create proportional benefits for both fisheries. In other words, if PSC limit reductions lead to a million pound increase in the FCEY, the two fishery components will share the benefit in direct proportions to their allocations.

5.6.1 Catch and Revenue in the Commercial Fisheries for Pacific Halibut in the BSAI

Over the past ten years there have been substantial reductions in the net weight pounds of halibut IFQ and CDQ harvests in Alaska. Between 2003 and 2013 there was a 60 percent decrease in the reported net weight pounds of halibut harvested in Alaska according to AKFIN data. Roughly 19 percent of the net weight pounds of harvested by IFQs and CDQs in Alaska were harvested in the Area 4 in 2013, a proportion that has stayed relatively stable over the past decade. Between 2012 and 2013 there was a 24 percent decrease in the reported net weight of IFQ and CDQ halibut harvests in Area 4. Harvests within the three regulatory subareas defined by the IPHC (4A, 4B, and 4CDE) are broken out in Table 5-71 below. In 2013 IPHC regulatory Area 4A accounted for 29 percent, Area 4B accounted for 29 percent and Area 4CDE accounted for 42 percent of the total reported net weight pounds of halibut harvested in the BSAI.

Table 5-71 IFQ and CDQ Harvests of Halibut in Alaska Based on AKFIN Data

Year	GOA (2C–3B)	4A	4B	4CDE	BSAI (4A–4E)	Alaska Total
	Harvests Reported in Net Weight Pounds (1,000s)					
2003	45,428.1	4,899.4	3,836.3	3,023.2	11,758.9	57,188.2
2004	47,992.7	3,372.7	2,631.1	2,810.6	8,814.3	56,807.1
2005	46,192.9	3,291.4	1,884.8	3,384.4	8,560.6	54,753.5
2006	44,412.3	3,230.5	1,577.4	3,145.2	7,953.0	52,365.3
2007	41,951.8	2,760.0	1,403.0	3,758.3	7,921.4	49,873.2
2008	39,655.3	3,011.7	1,725.3	3,777.4	8,514.3	48,169.6
2009	37,188.9	2,536.4	1,536.8	3,306.6	7,379.7	44,568.6
2010	35,598.7	2,350.2	1,818.3	3,296.1	7,464.7	43,063.4
2011	24,580.6	2,275.6	2,027.9	3,497.6	7,801.1	32,381.7
2012	19,720.3	1,596.5	1,717.1	2,322.3	5,636.0	25,356.2
2013	18,242.7	1,247.9	1,221.7	1,779.5	4,249.0	22,491.7
Total	**400,964.2**	**30,572.1**	**21,379.6**	**34,101.3**	**86,053.1**	**487,018.6**

Note: The AKFIN data contained several records that did not report a harvest subarea—with the exception of 1,320 lb, harvests with "Unknown" areas were assigned to IPHC Areas based on processor locations.
Source: Table developed by Northern Economics from data provided by AKFIN (Fey 2014).

This study uses data from AKFIN for analysis, but it should be noted that IPHC also collects and publishes data on the commercial harvest of halibut in Alaska. The IPHC data displayed in Table 5-72 below vary slightly from the harvests reported in Table 5-71 prepared with AKFIN data, because IPHC also includes halibut harvests made for scientific purposes and funding. Although the numbers differ slightly, the IPHC data show a similar reduction in reported net weight pounds of halibut harvested between 2003 and 2013, about 63 percent.

Table 5-72 Commercial Harvests of Halibut in Alaska from IPHC Data

Year	GOA (2C–3B)	4A	4B	4CDE	BSAI (4A-4E)	Grand Total
	Harvests Reported in Net Weight Pounds (1,000s)					
2003	48,389.0	5,024.0	3,863.0	3,258.0	12,145.0	60,534.0
2004	50,861.0	3,562.0	2,719.0	2,923.0	9,204.0	60,065.0
2005	49,829.0	3,404.0	1,975.0	3,481.0	8,860.0	58,689.0
2006	46,998.0	3,332.0	1,590.0	3,227.0	8,149.0	55,147.0
2007	44,215.0	2,828.0	1,416.0	3,850.0	8,094.0	52,309.0
2008	41,475.0	3,015.0	1,763.0	3,876.0	8,654.0	50,129.0
2009	37,491.0	2,528.0	1,593.0	3,310.0	7,431.0	44,922.0
2010	35,102.0	2,325.0	1,829.0	3,315.0	7,469.0	42,571.0
2011	24,444.0	2,351.0	2,054.0	3,429.0	7,834.0	32,278.0
2012	19,771.0	1,583.0	1,738.0	2,341.0	5,662.0	25,433.0
2013	18,203.0	1,233.0	1,237.0	1,775.0	4,245.0	22,448.0
Total	**416,778.0**	**31,185.0**	**21,777.0**	**34,785.0**	**87,747.0**	**504,525.0**

Note: IPHC Commercial Harvest data includes harvests undertaken by IPHC for scientific purposes. All IPHC data are reported in 1,000 of lb.
Source: Table developed by Northern Economics from IPHC Reports (IPHC RARA, 2014).

Table 5-73 displays IFQ and CDQ halibut harvests in thousands of net weight pounds between 2003 and 2013 in Area 4 by subarea. IFQ harvests accounted for over 74 percent of the total net weight pounds of halibut harvested in 2013. The majority of CDQ halibut harvests in the BSAI are reported in regulatory Area 4CDE, and in 2013 about 78 percent of the total harvested net weight pounds of halibut were harvested in this area. Area 4CDE surrounds the western coast of Alaska, within which the majority of

CDQ communities are found. The remainder of the CDQs are harvested in Area 4B; there are no CDQ allocations in Area 4A. IFQ harvests are more equally distributed across the three regulatory areas being analyzed in this study, with 39 percent of the 2013 IFQ harvest in Area 4A, 32 percent in Area 4B, and 29 percent in Area 4CDE.

Table 5-73 IFQ and CDQ Harvests of Halibut in the BSAI

	4A	4B	4CDE	IFQ Total	4A	4B	4CDE	CDQ Total
Year	IFQ Fishery in Net Weight Pounds (1,000s)				CDQ Fishery in Net Weight Pounds (1,000s)			
2003	4,899.4	3,836.3	3,023.1	11,758.8	-	-	0.2	0.2
2004	3,372.7	2,631.1	2,810.6	8,814.3	-	-	-	-
2005	3,291.4	1,884.8	3,384.2	8,560.4	-	-	0.1	0.1
2006	3,230.5	1,577.4	3,144.7	7,952.5	-	-	0.5	0.5
2007	2,760.0	1,403.0	3,758.0	7,921.1	-	-	0.3	0.3
2008	3,011.7	1,725.0	3,776.9	8,513.5	-	0.3	0.5	0.8
2009	2,526.5	1,443.8	1,753.7	5,724.0	-	102.8	1,552.9	1,655.7
2010	2,315.3	1,397.7	1,879.4	5,592.4	-	420.6	1,451.6	1,872.2
2011	2,275.6	1,594.9	1,875.3	5,745.8	-	433.0	1,622.4	2,055.3
2012	1,587.1	1,376.4	1,172.9	4,136.4	-	350.1	1,149.5	1,499.6
2013	1,230.2	999.0	930.3	3,159.6	-	222.6	849.2	1,089.5
Total	**30,500.4**	**19,869.5**	**27,509.0**	**77,878.8**	**-**	**1,529.4**	**6,627.2**	**8,174.2**

Note: Prior to 2009, the distinction between CDQ and IFQ harvests were less precise than they are currently.
Source: Table developed by Northern Economics from data provided by AKFIN (Fey 2014)

The net weight pounds of halibut allocated to the BSAI IFQ and CDQ fisheries has steadily declined since 2003. Table 5-74 displays the allocations for the BSAI IFQ and CDQ fisheries broken down by IPHC regulatory area. Since 2003, the total net weight pounds of halibut allocated to IFQ fisheries in the BSAI have declined by 67 percent and CDQ allocations have declined by 56 percent. The IFQ fishery in regulatory Area 4A has historically received the highest allocation—about 38 percent of the total BSAI IFQ allocation in 2013. Area 4CDE typically receives the highest of the CDQ allocation, in 2013 accounting for over 76 percent of the total BSAI CDQ allocations. If IFQ and CDQ allocations were combined, 4A gets 33.3 percent, 4B 25.0 percent and 4CDE gest 41.7 percent.

Table 5-74 IFQ and CDQ Allocations of Halibut in the BSAI (Net Weight Pounds)

	4A	4B	4CDE	IFQ Total	4A	4B	4CDE	CDQ Total
Year	IFQ Fishery in Net Weight Pounds				CDQ Fishery in Net Weight Pounds			
2003	4,970.0	3,344.0	2,436.0	10,750.0	-	836.0	2,014.0	2,850.0
2004	3,470.0	2,248.0	2,064.0	7,782.0	-	562.0	1,721.0	2,283.0
2005	3,440.0	1,808.0	2,178.0	7,426.0	-	452.0	1,811.0	2,263.0
2006	3,350.0	1,336.0	1,932.0	6,618.0	-	334.0	1,618.0	1,952.0
2007	2,890.0	1,152.0	2,239.8	6,281.8	-	288.0	1,860.2	2,148.2
2008	3,100.0	1,488.0	2,122.8	6,710.8	-	372.0	1,767.2	2,139.2
2009	2,550.0	1,496.0	1,882.8	5,928.8	-	374.0	1,577.2	1,951.2
2010	2,330.0	1,728.0	1,950.0	6,008.0	-	432.0	1,630.0	2,062.0
2011	2,410.0	1,744.0	2,028.0	6,182.0	-	436.0	1,692.0	2,128.0
2012	1,567.0	1,495.2	1,328.8	4,391.0	-	373.8	1,136.2	1,510.0
2013	1,330.0	1,160.0	1,030.8	3,520.8	-	290.0	950.7	1,240.7
Total	**31,407.0**	**18,999.2**	**21,193.0**	**71,599.2**	**-**	**4,749.8**	**17,777.5**	**22,527.3**

Source: Table developed by Northern Economics from NMFS data (NMFS 2014f).

Using the information displayed in Table 5-73 and Table 5-74, Table 5-75 below displays the combined IFQ and CDQ harvest as a percentage of the combined BSAI halibut allocation. With the exception of harvests in Area 4A in 2010 and 2012, the combined CDQ and IFQ harvest historically have stayed well under the total allocated amount. In 2013 only 89 percent of the total BSAI halibut allocation was harvested leaving a total of 714,225 pounds of allocated halibut unharvested.

Table 5-75 IFQ and CDQ Allocations of Halibut in the BSAI (Percent of Allocation)

	4A	4B	4CDE	BSAI Total
Year	Combined IFQ and CDQ Harvests as percent of Allocation			
2003	99%	92%	68%	86%
2004	97%	94%	74%	88%
2005	96%	83%	85%	88%
2006	96%	94%	89%	93%
2007	96%	97%	92%	94%
2008	97%	93%	97%	96%
2009	99%	82%	96%	94%
2010	101%	84%	92%	92%
2011	94%	93%	94%	94%
2012	102%	92%	94%	96%
2013	94%	84%	90%	89%
Total	**97%**	**90%**	**88%**	**91%**

Source: Table developed by Northern Economics from data AKFIN (Fey 2014) and NMFS (2014f).

Table 5-76 below displays the estimated real ex-vessel value of IFQ and CDQ halibut harvest. The estimated real ex-vessel value is the amount that processors paid fishermen for their harvests and has been adjusted for inflation (2013$). Since 2003, the estimated real ex-vessel value of Alaskan IFQ and CDQ halibut harvests has decreased by 55 percent. IFQ and CDQ halibut harvests in the BSAI have decreased by 61 percent and regulatory Area 4A experienced the largest decrease with a 74 percent reduction in real ex-vessel value since 2003.

Table 5-76 Estimated Real Ex-vessel Revenue of IFQ and CDQ Harvests of Halibut in Alaska

	GOA (2C–3B)	4A	4B	4CDE	BSAI (4A–4E)	Alaska Total
Year	Ex-Vessel Value of Harvests (in Millions of 2013 $)					
2003	$202.98	$21.57	$14.90	$10.93	$47.39	$250.37
2004	$210.76	$14.15	$9.99	$10.98	$35.12	$245.88
2005	$191.16	$12.93	$6.61	$11.80	$31.34	$222.50
2006	$212.48	$15.21	$6.85	$14.20	$36.26	$248.74
2007	$227.85	$14.57	$6.75	$18.22	$39.54	$267.39
2008	$204.61	$14.14	$7.38	$16.68	$38.20	$242.81
2009	$140.26	$8.25	$4.92	$9.87	$23.04	$163.30
2010	$188.16	$11.81	$8.50	$15.14	$35.46	$223.62
2011	$165.22	$15.36	$12.76	$21.72	$49.84	$215.06
2012	$120.29	$8.88	$9.02	$12.49	$30.39	$150.69
2013	$94.04	$5.52	$5.15	$7.80	$18.47	$112.52
Total	**$1,957.82**	**$142.39**	**$92.83**	**$149.83**	**$385.05**	**$2,342.87**

Source: Table developed by Northern Economics from data provided by AKFIN (Fey 2014).

One of the factors contributing to the decline in real ex-vessel values of IFQ and CDQ harvests displayed in Table 5-76 is the decrease in harvest pounds discussed earlier (Table 5-73), but falling prices have also contributed. Table 5-77 displays the estimated real ex-vessel value per net weight pound for IFQ and CDQ halibut harvests in Alaska, which has actually increased by 14 percent since 2003. Starting from the peak in 2011, however, there has been a relatively large price decline across all areas—prices were down 11.8 percent in 2012 and 18.8 percent in 2013. Over the two years, prices have declined by a total of 30.5 percent.

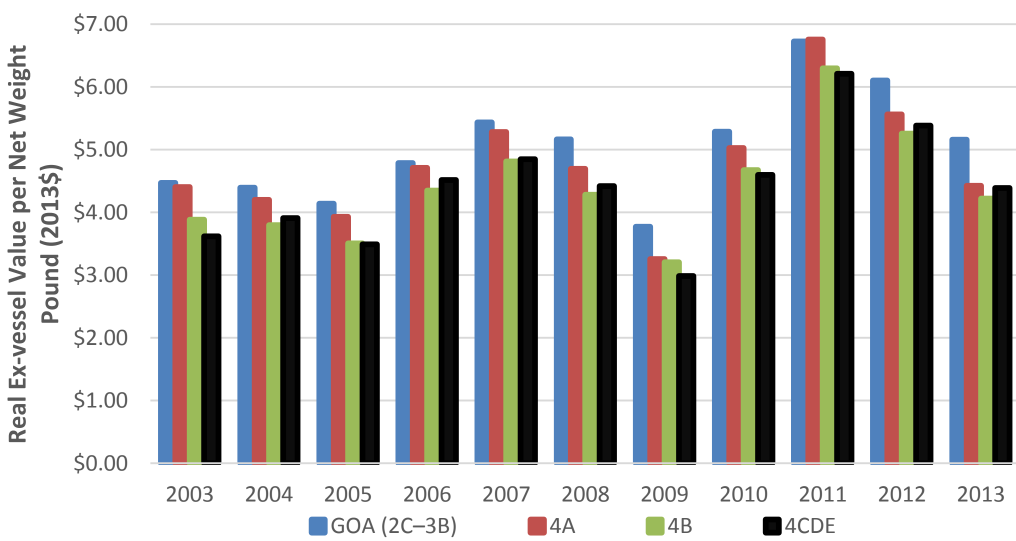
Table 5-77 Estimated Real Ex-vessel Price per Net Weight Pound Harvested

	GOA (2C–3B)	4A	4B	4CDE	BSAI (4A–4E)	Alaska Total
Year	Ex-Vessel Value per Net Weight Pound (2013$)					
2003	$4.47	$4.40	$3.88	$3.61	$4.03	$4.38
2004	$4.39	$4.20	$3.80	$3.91	$3.98	$4.33
2005	$4.14	$3.93	$3.51	$3.49	$3.66	$4.06
2006	$4.78	$4.71	$4.34	$4.52	$4.56	$4.75
2007	$5.43	$5.28	$4.81	$4.85	$4.99	$5.36
2008	$5.16	$4.69	$4.28	$4.42	$4.49	$5.04
2009	$3.77	$3.25	$3.20	$2.99	$3.12	$3.66
2010	$5.29	$5.03	$4.67	$4.59	$4.75	$5.19
2011	$6.72	$6.75	$6.29	$6.21	$6.39	$6.64
2012	$6.10	$5.56	$5.26	$5.38	$5.39	$5.94
2013	$5.16	$4.42	$4.22	$4.39	$4.35	$5.00
Total	**$4.88**	**$4.66**	**$4.34**	**$4.39**	**$4.47**	**$4.81**

Note: Estimates of ex-vessel prices are calculated from the summary data.
Source: Table developed by Northern Economics from data provided by AKFIN (Fey 2014).

Real ex-vessel value of halibut harvests per net pound have followed similar trends in both the BSAI and GOA since 2003. As displayed in Figure 5-50, areas 2C-3B (GOA), 4A, 4B and 4CDE all reported the lowest real ex-vessel value per net weight pound in 2009 and the highest real ex-vessel value per net weight pound in 2011. Since 2011, all four of the areas analyzed have experienced decreases in the real ex-vessel value per net weight pound for CDQ and IFQ halibut harvests.

Figure 5-50 Estimated Real Ex-Vessel Value per Net Weight Pound Harvested



Source: Figure developed by Northern Economics from data provided by AKFIN (Fey 2014)

Table 5-78 displays the real wholesale value of IFQ and CDQ halibut harvest in Alaska between 2003 and 2013. The real wholesale value is the value that processors generated from selling processed product to the consumer market, and has been adjusted for inflation (2013$). The real wholesale value of harvests in Alaska has decreased by almost 40 percent since 2003. Real wholesale value of harvests from Area 4 has decreased by over 60 percent, with harvests and products from 4A seeing the largest reductions—a 72 percent decline since 2003.

Table 5-78 Estimated Real Wholesale Value of IFQ and CDQ Harvest of Halibut in Alaska

	GOA (2C–3B)	4A	4B	4CDE	BSAI (4A–4E)	Alaska Total
Year	Wholesale Value of Harvests (in Millions of 2013 $)					
2003	$379.59	$41.22	$32.28	$25.44	$98.94	$478.53
2004	$405.77	$37.07	$28.92	$30.90	$96.89	$502.67
2005	$482.11	$34.23	$19.60	$35.20	$89.04	$571.15
2006	$480.38	$38.61	$18.85	$37.59	$95.05	$575.44
2007	$476.68	$38.59	$19.62	$52.54	$110.74	$587.42
2008	$483.38	$42.15	$24.15	$52.87	$119.17	$602.55
2009	$416.41	$25.75	$15.60	$33.57	$74.92	$491.33
2010	$448.06	$38.00	$29.40	$53.30	$120.71	$568.76
2011	$281.05	$35.99	$32.07	$55.31	$123.37	$404.42
2012	$271.64	$24.75	$26.62	$36.00	$87.38	$359.01
2013	$248.28	$11.44	$11.20	$16.31	$38.94	$287.21
Total	**$4,373.35**	**$367.81**	**$258.31**	**$429.03**	**$1,055.15**	**$5,428.50**

Note: Estimated wholesale values include revenues from ancillary products.
Source: Table developed by Northern Economics from COAR data provided by AKFIN (Fey 2014).

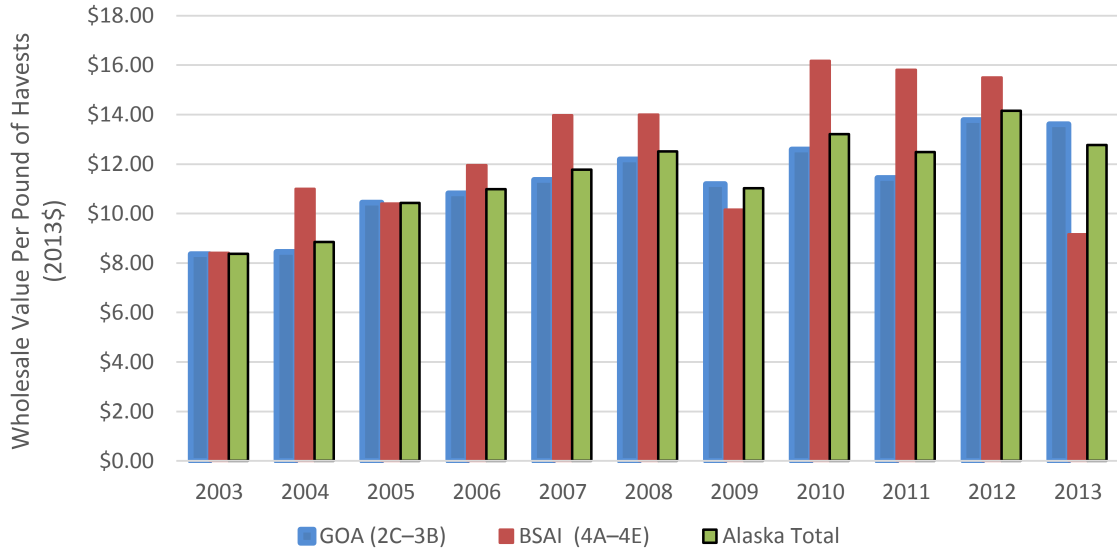
Overall, the real wholesale value generated per net weight pound of IFQ and CDQ halibut harvests in Alaska (displayed in Table 5-79 and Figure 5-51 below) has increased by 52 percent since 2003. Through 2011, real wholesale values per harvested pound in Area 4 increased at a faster rate than increases in the GOA and Alaska as whole. Prices fell across the board in 2009 due primarily to the global recession, then rebounded in 2010. In Area 4, real wholesale values generated per harvested pound were at their highest levels that year, before seeing relatively small declines in 2011 and 2013. Real wholesale prices for the GOA and Alaska as whole hit their high point in the 11-year period in 2012. In 2013, real wholesale value generated per pound for Area 4 halibut fell sharply, while prices in the GOA were flat. The drop in wholesale value per in Area 4 amounted to 69.2 percent year-over-year decline. Unusually large and unexplained declines in imputed wholesale prices were also seen in the BSAI groundfish fisheries.

Table 5-79 Estimated Real Wholesale Value per Net Weight Pound Harvested

	GOA (2C–3B)	BSAI (4A–4E)	Alaska Total
Year	Wholesale Value Per Pound of Harvests (2013$)		
2003	$8.36	$8.41	$8.37
2004	$8.45	$10.99	$8.85
2005	$10.44	$10.40	$10.43
2006	$10.82	$11.95	$10.99
2007	$11.36	$13.98	$11.78
2008	$12.19	$14.00	$12.51
2009	$11.20	$10.15	$11.02
2010	$12.59	$16.17	$13.21
2011	$11.43	$15.81	$12.49
2012	$13.77	$15.50	$14.16
2013	$13.61	$9.16	$12.77
Total	**$10.91**	**$12.26**	**$11.15**

Note: Estimates of wholesale values per pound are calculated from the COAR data.
Source: Table developed by Northern Economics from data provided by AKFIN (Fey 2014).

Figure 5-51 Estimated Real Wholesale Value per Net Weight Pound Harvested



Source: Figure developed by Northern Economics from data provided by AKFIN (Fey 2014).

5.6.2 Distribution of Revenue in the BSAI Commercial Halibut Fisheries

Table 5-80 displays the real ex-vessel value of halibut of participants in Area 4 halibut fisheries by the vessel owner's region of residence. The table also includes ex-vessel revenues generated by those same participants in the GOA halibut fishery. In order to be included in the table, the vessel had to have participated in Area 4 in that year. The regions of residence displayed in this table are:

- Northwest Alaska (NW AK), which includes coastal areas north of Bristol Bay;
- Southwest Alaska (SW AK), including the Bristol Bay region, the AK Peninsula, Aleutian Islands, and Kodiak;
- Other Alaska (Other AK) which covers the all other regions in Alaska;
- Other U.S. (Other US) which includes all other U.S. participants.

Table 5-80 Ex-vessel Value of Halibut from Area 4 by Owner Region of Residence, 2008 to 2013

		2008	2009	2010	2011	2012	2013	Average
Region	Area	Ex-Vessel Value (2013 $ Millions)						
NW AK	4A	-	-	-	-	-	-	-
NW AK	4B	-	-	-	-	-	-	-
NW AK	4CDE	$2.39	$1.43	$1.62	$2.19	$1.61	$1.34	$1.77
NW AK	Area 4	$2.39	$1.43	$1.62	$2.19	$1.61	$1.34	$1.77
NW AK	GOA	-	-	-	-	-	-	-
NW AK	**Halibut Total**	**$2.39**	**$1.43**	**$1.62**	**$2.19**	**$1.61**	**$1.34**	**$1.77**
SW AK	4A	$4.88	$2.48	$3.95	$4.99	$2.88	$1.95	$3.52
SW AK	4B	$2.12	$1.42	$2.70	$3.30	$2.02	$1.51	$2.18
SW AK	4CDE	$6.79	$2.42	$4.81	$5.22	$3.69	$2.82	$4.29
SW AK	Area 4	$13.79	$6.32	$11.46	$13.50	$8.59	$6.28	$9.99
SW AK	GOA	$10.51	$6.30	$8.57	$6.66	$3.89	$3.09	$6.50
SW AK	**Halibut Total**	**$24.30**	**$12.62**	**$20.03**	**$20.16**	**$12.48**	**$9.37**	**$16.49**
Other AK	4A	$2.87	$2.29	$3.72	$5.11	$2.95	$1.58	$3.09
Other AK	4B	$2.02	$1.65	$2.99	$3.79	$2.99	$1.28	$2.45
Other AK	4CDE	$1.45	$1.84	$2.75	$8.35	$3.29	$1.54	$3.20
Other AK	Area 4	$6.34	$5.77	$9.46	$17.25	$9.22	$4.40	$8.74
Other AK	GOA	$9.53	$6.59	$10.30	$8.93	$5.04	$3.24	$7.27
Other AK	**Halibut Total**	**$15.87**	**$12.37**	**$19.76**	**$26.18**	**$14.26**	**$7.64**	**$16.01**
Other US	4A	$6.30	$3.43	$4.12	$5.23	$3.03	$1.96	$4.01
Other US	4B	$3.22	$1.85	$2.80	$5.67	$4.01	$2.35	$3.32
Other US	4CDE	$6.03	$4.18	$5.96	$5.95	$3.89	$1.89	$4.65
Other US	Area 4	$15.55	$9.46	$12.87	$16.85	$10.93	$6.20	$11.98
Other US	GOA	$19.08	$13.50	$17.80	$15.05	$9.35	$7.29	$13.68
Other US	**Halibut Total**	**$34.62**	**$22.96**	**$30.67**	**$31.90**	**$20.28**	**$13.49**	**$25.65**
All Regions	4A	$14.04	$8.20	$11.79	$15.33	$8.86	$5.49	$10.62
All Regions	4B	$7.36	$4.91	$8.49	$12.76	$9.01	$5.15	$7.95
All Regions	4CDE	$16.67	$9.87	$15.14	$21.71	$12.49	$7.59	$13.91
All Regions	Area 4	$38.07	$22.99	$35.42	$49.80	$30.36	$18.23	$32.48
All Regions	GOA	$39.12	$26.39	$36.66	$30.63	$18.28	$13.62	$27.45
All Regions	**Halibut Total**	**$77.19**	**$49.38**	**$72.08**	**$80.43**	**$48.63**	**$31.85**	**$59.93**

Note: Only vessels that participated in at least one sub-area in IPHC Area 4 in the year are included in the table.
Source: Developed by Northern Economics based on data from AKFIN (Fey 2014)

As seen in Table 5-80 above, between 2008 and 2013 all of the vessel owners residing in NW AK fished for halibut exclusively in Area 4CDE and generated an average annual real ex-vessel value of $1.77 million. Vessel owners from the SW AK Region fished in all Area 4 subareas as well as in the GOA. Approximately 60 percent of the total real ex-vessel value by SW AK owners came from Area 4, with Area 4CDE generating more than 40 percent of their Area 4 total. Vessel owners from other areas of AK (Other AK) who fished Area 4 generated just over 54 percent of their halibut value from Area 4 subareas, and the remaining 45 percent from GOA subareas. On average, vessel owners from other regions of the U.S. (Other US) that fished in Area 4, had the largest share of ex-vessel value of the four regions analyzed, however the majority of their revenues (53 percent) came from the GOA.

The following two table more detailed information about participants in the Alaska halibut fisheries from Western Alaska whose communities are on the Bering Sea or Aleutian Island Coast.

Information in the tables comes from the Commercial Fisheries Entry Commission (CFEC) database of “Permit Activity Fishing Activity by Year, State, Census Area, or City” (CFEC 2013). The database provides fishery participation data at the community level, though community-level landings and revenues data are often confidential due to a limit number of permits being fished. Northern Economics uses a proprietary algorithm to produce landings and revenues estimates wherever the actual data are limited due to confidentiality. The algorithm uses average landings and revenues per active permit holder to fill in missing information, using locations and historical information in the process. These estimates are produced in a way such that the communities properly add up to the boroughs and census areas, and so that those areas add up to the state totals.

The information for 2012 in the table should be considered preliminary, due to a lag in updating halibut information in the CFEC database. Updated 2012 and preliminary 2013 data can be added to this table if requested.

The table shows information only for those communities anticipated to participate exclusively in the Area 4 halibut fishery. Since halibut permits are statewide, the source data doesn't specify whether all landings came from Area 4. To improve the estimates, the analysis omits certain communities to that have greater likelihood in Area 3A or 3B. For communities in and north of Bristol Bay Borough, the analysis assumes all permit holders fish only in the Bering Sea (Area 4). Along the Alaska Peninsula the communities of Chignik, Chignik Lagoon, King Cove, Perryville, and Sand Point were excluded. In addition communities in the Kodiak Island Borough were also excluded, even though some of these residents have participated in Area 4 halibut fisheries.

Table 5-81 shows participation in the Bering Sea halibut fishery by borough or census area for 2008 to 2012. Since the halibut permits are statewide, the analysis assumes that only residents in western or southwestern Alaska with direct access to the Bering Sea would fish in that area. Residents of Kodiak Island Borough and communities with direct access to the Gulf of Alaska are omitted from the table. The table also shows estimates of the landings and ex-vessel value of catch by area.

More detailed participation information is given in Table 5-82 which shows the number of persons fishing in each of the boroughs and census areas by year.

Table 5-81 Commercial Halibut Fishery Participation of Residents of the Bering Sea Coast by Borough or Census Area, 2008 to 2012

Borough / Census Area	Year 2008	2009	2010	2011	2012
Number of Permits Held					
Aleutians East Borough	10	11	10	12	12
Aleutians West Census Area	54	59	52	58	52
Bethel Census Area	228	230	214	228	206
Bristol Bay Borough	5	4	4	5	5
Dillingham Census Area	44	31	28	24	46
Lake and Peninsula Borough	3	2	2	4	2
Wade Hampton Census Area	25	19	13	22	22
Total Number of Permits Held	**369**	**356**	**323**	**353**	**345**
Number of Permits Fished					
Aleutians East Borough	8	9	10	11	11
Aleutians West Census Area	51	45	48	52	47
Bethel Census Area	178	170	155	176	140
Bristol Bay Borough	0	1	2	0	1
Dillingham Census Area	22	13	9	13	20
Lake and Peninsula Borough	1	1	0	0	0
Wade Hampton Census Area	11	12	9	14	15
Total Number of Permits Fished	**271**	**251**	**233**	**266**	**234**
Number of Persons Fishing					
Aleutians East Borough	8	9	10	11	11
Aleutians West Census Area	51	45	48	52	47
Bethel Census Area	178	170	155	176	140
Bristol Bay Borough	0	1	2	0	1
Dillingham Census Area	22	13	9	13	20
Lake and Peninsula Borough	1	1	0	0	0
Wade Hampton Census Area	11	12	9	14	15
Total Number of Persons Fishing	**271**	**251**	**233**	**266**	**234**
Total Pounds					
Aleutians East Borough	102,989	123,803	122,914	104,921	91,480
Aleutians West Census Area	1,724,762	1,735,302	2,255,639	2,202,811	1,501,449
Bethel Census Area	434,385	469,656	471,975	494,241	354,996
Bristol Bay Borough	0	20,610	36,923	0	395
Dillingham Census Area	29,918	15,603	41,054	48,595	53,382
Lake and Peninsula Borough	11,450	13,609	0	0	0
Wade Hampton Census Area	16,222	66,283	60,235	16,854	9,448
Total Pounds	**2,319,725**	**2,444,865**	**2,988,740**	**2,867,421**	**2,011,149**
Total Revenues					
Aleutians East Borough	438,710	247,578	423,002	516,387	381,143
Aleutians West Census Area	6,190,416	3,158,206	7,331,362	10,041,953	5,670,546
Bethel Census Area	1,564,704	898,784	1,237,342	1,348,518	1,077,006
Bristol Bay Borough	0	41,079	126,720	0	1,152
Dillingham Census Area	91,639	31,417	94,618	198,814	180,523
Lake and Peninsula Borough	46,414	27,883	0	0	0
Wade Hampton Census Area	69,404	133,180	204,518	68,832	28,031
Total Revenues	**8,401,286**	**4,538,127**	**9,417,561**	**12,174,503**	**7,338,402**

Source: Developed by Northern Economics based on data from CFEC (CFEC 2013).

Table 5-82 Participation by Residents of Communities on the Bering Sea Coast, 2008 to 2012

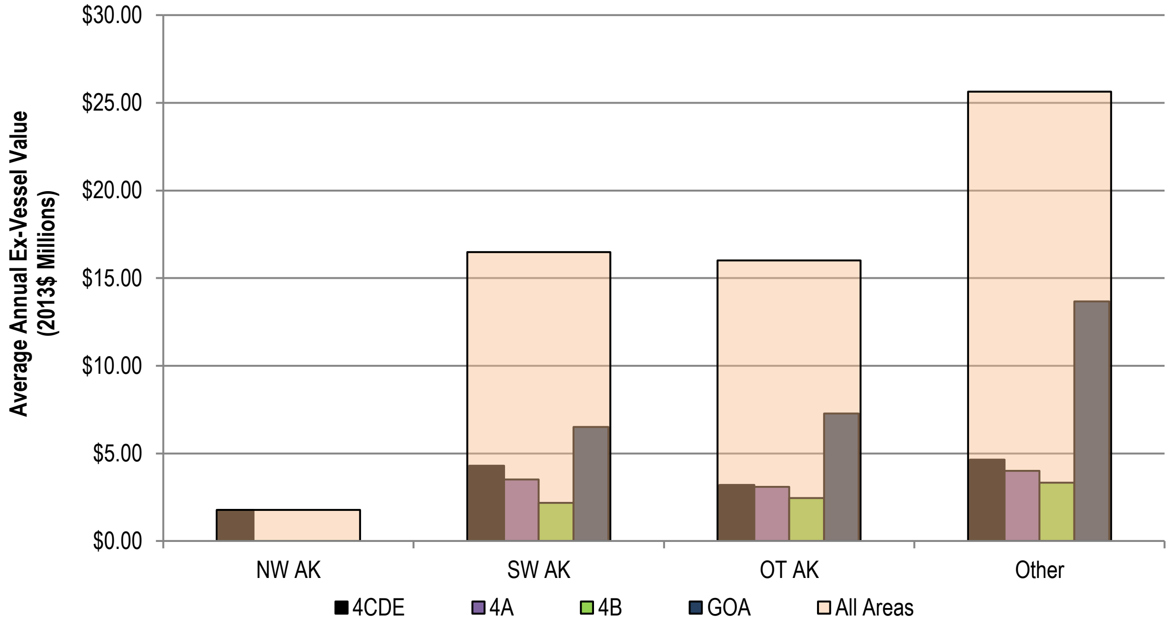
		Year				
Borough / Census Area	**Community**	**2008**	**2009**	**2010**	**2011**	**2012**
Aleutians East Borough	Akutan	5	6	7	8	8
	Cold Bay	1	1	1	1	1
	False Pass	2	2	2	2	2
	Total	**8**	**9**	**10**	**11**	**11**
Aleutians West Census Area	Adak	2	2	1	2	1
	Atka	4	1	4	4	5
	Dutch Harbor	6	6	8	6	5
	Nikolski	1	0	0	0	0
	Saint George Island	6	6	5	7	7
	Saint Paul Island	22	21	21	23	20
	Unalaska	10	9	9	10	9
	Total	**51**	**45**	**48**	**52**	**47**
Bethel Census Area	Akiachak	1	0	0	0	0
	Bethel	0	0	0	0	0
	Chefornak	29	23	25	23	9
	Goodnews Bay	0	4	2	1	2
	Kipnuk	21	24	21	24	19
	Kongiganak	1	0	0	0	1
	Kwigillingok	0	0	0	0	1
	Mekoryuk	32	31	30	31	27
	Newtok	12	8	9	9	10
	Nightmute	8	7	5	9	7
	Platinum	0	1	0	0	0
	Quinhagak	10	7	2	8	9
	Toksook Bay	36	36	33	41	30
	Tuluksak	0	0	0	0	0
	Tuntutuliak	0	1	0	0	0
	Tununak	28	28	28	30	25
	Total	**178**	**170**	**155**	**176**	**140**
Bristol Bay Borough	King Salmon	0	1	1	0	0
	Naknek	0	0	1	0	1
	Total	**0**	**1**	**2**	**0**	**1**
Dillingham Census Area	Clarks Point	0	0	0	0	1
	Dillingham	12	4	0	1	2
	Manokotak	0	0	1	0	0
	Togiak	9	8	8	12	17
	Twin Hills	1	1	0	0	0
	Total	**22**	**13**	**9**	**13**	**20**
Lake and Peninsula Borough	Egegik	0	0	0	0	0
	Pilot Point	0	0	0	0	0
	Port Heiden	1	1	0	0	0
	Total	**1**	**1**	**0**	**0**	**0**
Wade Hampton Census Area	Chevak	2	1	2	5	6
	Hooper Bay	5	10	7	9	9
	Scammon Bay	4	1	0	0	0
	Total	**11**	**12**	**9**	**14**	**15**
Total Number of Persons Fishing		**271**	**251**	**233**	**266**	**234**

Source: Developed by Northern Economics based on data from CFEC (CFEC 2013).

Figure 5-52 displays the average ex-vessel value of halibut harvested by active vessels in Area 4 between 2008 and 2013, by the vessel owners' regions of residence. Vessel owners in the SW AK, Other AK and

Other US regions who were active in Area 4 halibut fishery were also active in the GOA, whereas vessel owners in the NW AK region did not actively fish outside of Area 4CDE. Areas 4C, 4D and 4E are geographically close to the NW AK region, and it should also be noted that a large percent of the vessel owners residing in NW AK participate in CDQ harvest and Area 4E is home to an exclusive CDQ fishery.

Figure 5-52 Average Ex-vessel Value of Halibut of Active Vessels in Area 4 by Owner Region of Residence



Notes: 1) OT AK = Other Alaska; Other = Other U.S.
2) Only vessels that participated in at least one sub-area in IPHC Area 4 in the year are included in the table.
Source: Developed by Northern Economics based on data from AKFIN (Fey 2014)

Table 5-83 displays the number of vessels with halibut landings in at least one sub-area of Area 4 (BSAI) by the vessel owner's region of residence. In regions where vessel owners fished in multiple areas in the BSAI and GOA, the total unique vessels row will not add up to the sum of vessels, since vessels will be counted in each of the areas in which they harvested halibut. The unique vessel column will also not add up to the sum of the unique vessel row due to entry and exit of active vessel owners throughout the time period being considered. The amount that the unique vessel column is bigger than its corresponding rows from 2008 to 2013 is an indication of the variability in vessel owner participation through the study period. For example, the unique number of active fishing vessels from 2008 to 2013 from NW AK (373) is much higher than the average unique vessels recorded each year (189). The difference between the total unique vessels (54) and the average annual count of unique vessels (37) from the Other US region is much closer in value, indicating that there is much less turnover and varied participation among vessel owners in this region.

Table 5-83 Number of Vessels with Halibut Landings in at least One Subarea of Area 4, 2008 to 2013

		2008	2009	2010	2011	2012	2013	Unique
Region	**Area**	**Number of Active Vessels in IPHC Area 4**						**Vessels**
NW AK	4A	-	-	-	-	-	-	-
NW AK	4B	-	-	-	-	-	-	-
NW AK	4CDE	199	192	177	199	173	194	373
NW AK	GOA & Area 4	-	-	-	-	-	-	-
NW AK	**Unique Vessels**	**199**	**192**	**177**	**199**	**173**	**194**	**373**
SW AK	4A	34	30	32	24	26	25	59
SW AK	4B	14	11	17	12	15	16	31
SW AK	4CDE	47	36	35	40	48	37	81
SW AK	GOA & Area 4	17	14	15	12	12	11	31
SW AK	**Unique Vessels**	**79**	**66**	**66**	**66**	**78**	**62**	**137**
Other AK	4A	25	27	28	34	29	22	51
Other AK	4B	11	10	11	13	13	10	28
Other AK	4CDE	11	10	10	15	13	9	31
Other AK	GOA & Area 4	22	22	26	28	23	19	40
Other AK	**Unique Vessels**	**37**	**32**	**34**	**39**	**36**	**29**	**67**
Other US	4A	36	33	32	28	25	27	45
Other US	4B	17	15	16	19	17	17	29
Other US	4CDE	19	19	17	18	17	17	26
Other US	GOA & Area 4	32	30	27	26	24	22	38
Other US	**Unique Vessels**	**42**	**39**	**39**	**37**	**32**	**35**	**54**
All Regions	4A	95	90	92	86	80	74	143
All Regions	4B	42	36	44	44	45	43	80
All Regions	4CDE	276	257	239	272	251	257	504
All Regions	GOA & Area 4	71	66	68	66	59	52	103
All Regions	**Unique Vessels**	**357**	**329**	**316**	**341**	**319**	**320**	**615**

Note: Only vessels that participated in at least one sub-area in IPHC Area 4 in the year are included in the table.
Source: Developed by Northern Economics based on data from AKFIN (Fey 2014)

Table 5-84 displays the ex-vessel revenues from Area 4 Halibut fisheries along with ex-vessel revenues of all other fisheries in which active Area 4 vessels participated, by the region of residence of the vessel owner. Vessel owners from the NW AK region tend to focus their fishing on BSAI halibut, whereas vessel owners in the SW AK, Other AK and Other US regions tend to have a much more diverse array of targeted fisheries.

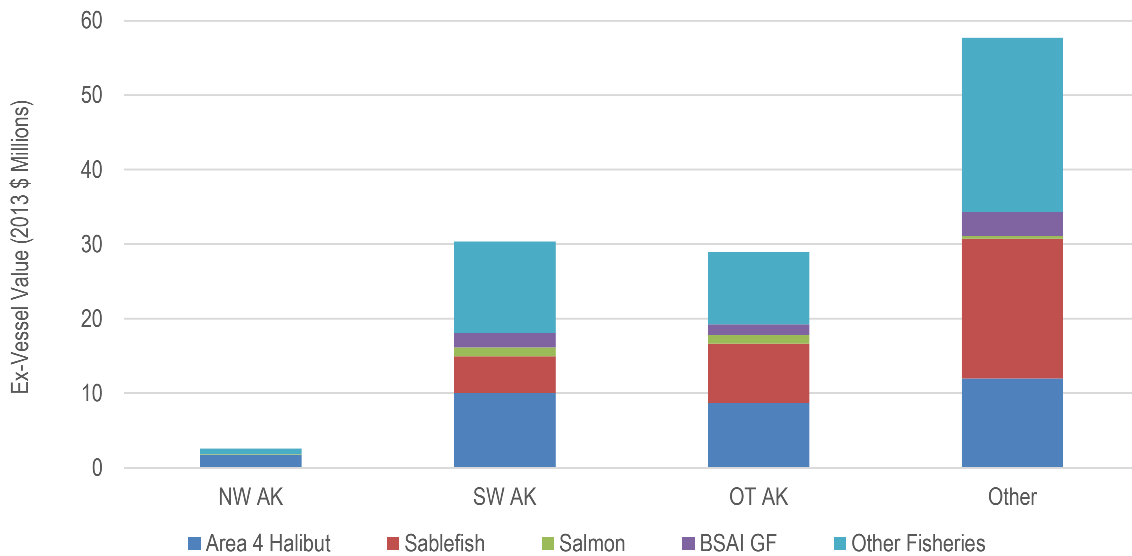
Table 5-84 Ex-Vessel Value in All Fisheries of Active Area 4 Vessels by the Vessel Owner's Region

Region	Fishery	2008	2009	2010	2011	2012	2013	Average 2008–2013
		Ex-Vessel Value (2013 $ Millions)						
NW AK	Area 4 Halibut	$2.39	$1.43	$1.62	$2.19	$1.61	$1.34	$1.77
NW AK	Sablefish	-	-	-	-	-	-	-
NW AK	Salmon	$0.04	$0.03	$0.02	$0.01	$0.00	$0.02	$0.02
NW AK	BSAI GF	$0.00	$0.00	$0.00	-	$0.00	$0.00	$0.00
NW AK	Other Fisheries	$0.77	$0.69	$0.92	$0.80	$0.92	$0.62	$0.79
NW AK	**All Fisheries**	**$3.21**	**$2.16**	**$2.57**	**$3.00**	**$2.54**	**$1.99**	**$2.58**
SW AK	Area 4 Halibut	$13.79	$6.32	$11.46	$13.50	$8.59	$6.28	$9.99
SW AK	Sablefish	$4.83	$4.48	$5.36	$7.12	$4.47	$3.42	$4.95
SW AK	Salmon	$1.34	$1.15	$0.90	$1.11	$1.94	$0.84	$1.21
SW AK	BSAI GF	$1.60	$0.77	$1.68	$2.43	$2.51	$2.62	$1.94
SW AK	Other Fisheries	$18.60	$10.33	$14.04	$12.21	$11.51	$6.90	$12.27
SW AK	**All Fisheries**	**$40.17**	**$23.05**	**$33.45**	**$36.37**	**$29.02**	**$20.07**	**$30.36**
Other AK	Area 4 Halibut	$6.34	$5.77	$9.46	$17.25	$9.22	$4.40	$8.74
Other AK	Sablefish	$7.78	$6.30	$7.19	$11.92	$8.89	$5.53	$7.93
Other AK	Salmon	$0.85	$1.14	$1.79	$1.57	$0.59	$0.95	$1.15
Other AK	BSAI GF	$0.38	$0.05	$0.60	$1.00	$4.50	$1.84	$1.40
Other AK	Other Fisheries	$11.87	$8.37	$12.55	$11.55	$9.05	$5.05	$9.74
Other AK	**All Fisheries**	**$27.23**	**$21.63**	**$31.59**	**$43.29**	**$32.25**	**$17.78**	**$28.96**
Other US	Area 4 Halibut	$15.55	$9.46	$12.87	$16.85	$10.93	$6.20	$11.98
Other US	Sablefish	$18.83	$16.64	$17.31	$25.92	$19.96	$13.85	$18.75
Other US	Salmon	$0.40	$0.31	$0.70	$0.31	$0.36	$0.29	$0.39
Other US	BSAI GF	$5.67	$3.22	$3.84	$3.86	$1.90	$0.65	$3.19
Other US	Other Fisheries	$32.97	$23.47	$25.03	$24.51	$18.36	$15.96	$23.38
Other US	**All Fisheries**	**$73.40**	**$53.10**	**$59.75**	**$71.46**	**$51.51**	**$36.95**	**$57.70**
All Regions	Area 4 Halibut	$38.07	$22.99	$35.42	$49.80	$30.36	$18.23	$32.48
All Regions	Sablefish	$31.44	$27.41	$29.86	$44.96	$33.32	$22.79	$31.63
All Regions	Salmon	$2.63	$2.64	$3.41	$3.01	$2.89	$2.11	$2.78
All Regions	BSAI GF	$7.65	$4.05	$6.12	$7.30	$8.91	$5.12	$6.52
All Regions	Other Fisheries	$64.21	$42.86	$52.55	$49.07	$39.84	$28.54	$46.18
All Regions	**All Fisheries**	**$144.01**	**$99.94**	**$127.36**	**$154.13**	**$115.32**	**$76.78**	**$119.59**

Note: Only vessels that participated in at least one sub-area in IPHC Area 4 in the year are included in the table.
Source: Developed by Northern Economics based on data from AKFIN (Fey 2014)

Figure 5-53 takes the average ex-vessel values by fishery from 2008 to 2013 displayed in Table 5-84 and organizes them by vessel owner region. Vessel owners in the Other US and SW AK regions who actively harvested Area 4 halibut had both the highest average ex-vessel value in the Area 4 halibut fishery as well as the highest average total ex-vessel value in all of the fisheries combined.

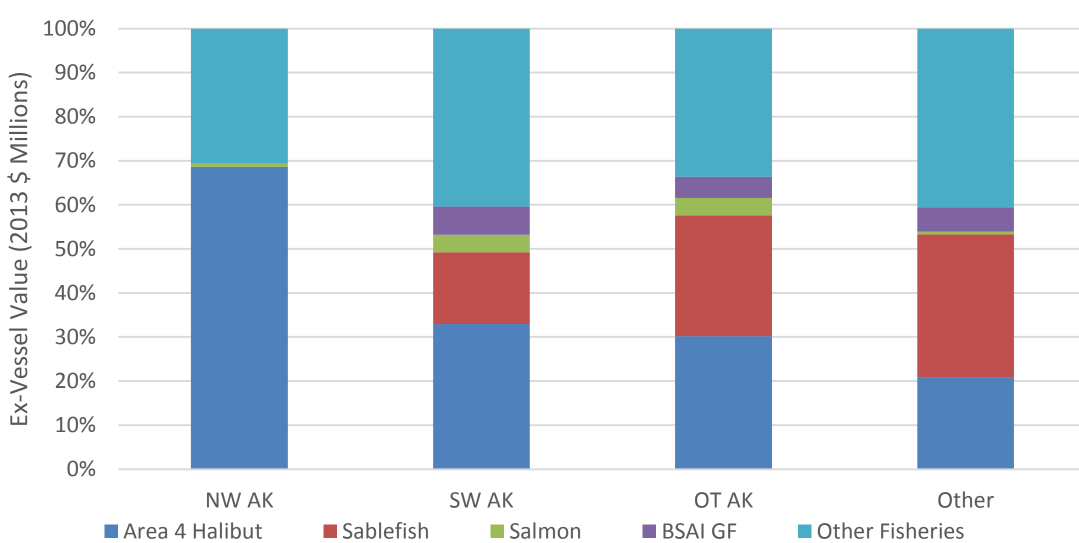
Figure 5-53 Average Ex-vessel of All Fisheries of Active Vessels in Area 4 by Owner Region of Residence



Note: Only vessels that participated in at least one sub-area in IPHC Area 4 in the year are included in the table.
Source: Developed by Northern Economics based on data from AKFIN (Fey 2014).

Figure 5-54 displays the percent of the total average ex-vessel value that each fishery accounts for active vessels in the Area 4 halibut fishery by the region of the vessel owner's residence. Area 4 halibut accounts for almost 70 percent the average total ex-vessel value of NW AK vessel owners, but is closer to 30 percent of the average total ex-vessel value for SW AK and Other AK vessel owners and only about 20 percent of the average total ex-vessel value for vessel owners in the Other US region. Sablefish the single species with the largest or second largest percent of average ex-vessel value for vessel owners in the SW AK, Other AK and Other US regions. The gear used to catch sablefish can also be used for halibut, so it is not surprising that these two species make up the majority of the ex-vessel value of vessel owners who participate in the Area 4 halibut fishery.

Figure 5-54 Average Ex-vessel of All Fisheries of Active Vessels in Area 4 by Owner Region of Residence



Source: Developed by Northern Economics based on data from AKFIN (Fey 2014)

Using the information displayed in Table 5-84, Table 5-85 was created to display the ex-vessel revenue by fishery as a percent of the Area 4 halibut revenue by vessel owner region. This information displays the portion of ex-vessel revenues that the other fisheries make up for active vessels in the Area 4 halibut fishery

Table 5-85 Ex-Vessel Revenue by Fishery as a Percent of Area 4 Halibut Revenue, by Owner's Region

		2008	2009	2010	2011	2012	2013	Average 2008–2013
Region	**Fishery**	**Other Fishery Revenue as a Percent of Area 4 Halibut Revenue**						
NW AK	Area 4 Halibut	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
NW AK	Sablefish	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
NW AK	Salmon	1.8%	2.4%	1.2%	0.5%	0.3%	1.7%	1.3%
NW AK	BSAI GF	0.0%	0.1%	0.0%	0.0%	0.1%	0.2%	0.1%
NW AK	Other Fisheries	32.2%	48.4%	57.0%	36.6%	57.1%	46.6%	44.7%
NW AK	**All Fisheries**	**134.0%**	**150.9%**	**158.3%**	**137.1%**	**157.5%**	**148.5%**	**146.0%**
SW AK	Area 4 Halibut	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
SW AK	Sablefish	35.0%	70.8%	46.8%	52.7%	52.0%	54.4%	49.5%
SW AK	Salmon	9.7%	18.2%	7.9%	8.2%	22.6%	13.4%	12.2%
SW AK	BSAI GF	11.6%	12.2%	14.7%	18.0%	29.2%	41.7%	19.4%
SW AK	Other Fisheries	134.9%	163.4%	122.5%	90.4%	133.9%	109.9%	122.7%
SW AK	**All Fisheries**	**291.3%**	**364.7%**	**291.8%**	**269.3%**	**337.7%**	**319.4%**	**303.8%**
Other AK	Area 4 Halibut	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Other AK	Sablefish	122.8%	109.1%	75.9%	69.1%	96.4%	125.6%	90.7%
Other AK	Salmon	13.5%	19.8%	18.9%	9.1%	6.4%	21.7%	13.2%
Other AK	BSAI GF	6.0%	0.9%	6.3%	5.8%	48.8%	41.9%	16.0%
Other AK	Other Fisheries	187.2%	145.0%	132.6%	66.9%	98.2%	114.8%	111.4%
Other AK	**All Fisheries**	**429.4%**	**374.7%**	**333.9%**	**250.9%**	**349.7%**	**403.9%**	**331.3%**
Other US	Area 4 Halibut	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Other US	Sablefish	121.1%	175.8%	134.5%	153.8%	182.7%	223.3%	156.6%
Other US	Salmon	2.5%	3.3%	5.4%	1.8%	3.3%	4.7%	3.3%
Other US	BSAI GF	36.5%	34.1%	29.8%	22.9%	17.4%	10.5%	26.6%
Other US	Other Fisheries	212.1%	248.0%	194.5%	145.5%	167.9%	257.3%	195.2%
Other US	**All Fisheries**	**472.1%**	**561.2%**	**464.3%**	**424.0%**	**471.3%**	**595.7%**	**481.7%**
All Regions	Area 4 Halibut	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
All Regions	Sablefish	82.6%	119.2%	84.3%	90.3%	109.8%	125.0%	97.4%
All Regions	Salmon	6.9%	11.5%	9.6%	6.0%	9.5%	11.6%	8.6%
All Regions	BSAI GF	20.1%	17.6%	17.3%	14.7%	29.4%	28.1%	20.1%
All Regions	Other Fisheries	168.7%	186.4%	148.4%	98.5%	131.2%	156.5%	142.2%
All Regions	**All Fisheries**	**378.2%**	**434.8%**	**359.6%**	**309.5%**	**379.9%**	**421.2%**	**368.2%**

Note: Only vessels that participated in at least one sub-area in IPHC Area 4 in the year are included in the table.
Source: Developed by Northern Economics based on data from AKFIN (Fey 2014)

5.7 Analysis of Options to Reduce Halibut PSC Limits

In this section we examine and summarize the impacts of the Alternative 2, which would reduce halibut PSC limits of non-exempt groundfish fisheries in the BSAI. Including the status quo option, there are seven proposed options to reduce PSC limits. The analysis starts with an overview of the status quo and then goes on to assess the impacts of options relative to the status quo. The change options are organized by six different participant groups. All seven options are listed below.

- Option 1 keeps the PSC limits the same as they currently exist.
- Option 2 focuses on the PSC Limits for vessels in the Bering Sea Trawl Limited Access fisheries (BSAI TLA).
- Option 3 focuses on the PSC Limits for Amendment 80 Catcher Processors (A80-CPs).
- Option 4 focuses on the PSC Limits for catcher vessels using hook and line gear (i.e. longline CVs) in their target fishery for Pacific cod.
- Option 5 focuses on the PSC Limits for CPs using hook and line gear (i.e. longline CPs) in their target fishery for Pacific cod.
- Option 6 focuses on PSC Limits for vessels participating in CDQ groundfish fisheries.
- Option 7 focuses on PSC Limits for hook and line vessels that target species other than Pacific cod and sablefish. Technically, this PSC Limit would constrain both longline CVs and longline CPs, but since 2008 there have been no NMFS catch records that document participation by longline CVs in target fisheries for groundfish species other than for Pacific cod or sablefish. Therefore, in practice this option focuses on longline CPs that participate in target fisheries for groundfish species other than Pacific cod or sablefish.

Within each of the change options, there are four suboptions:

1) Reduce the halibut PSC limit by 10 percent, to 90 percent of status quo;
2) Reduce the halibut PSC limit by 20 percent, to 80 percent of status quo;
3) Reduce the halibut PSC limit by 30 percent, to 70 percent of status quo;
4) Reduce the halibut PSC limit by 35 percent, to 65 percent of status quo.

Table 5-86 Summary of Options and Suboptions under Alternative 2

			Status Quo	Suboption 1	Suboption 2	Suboption 3	Suboption 4
		Percent of Status Quo	100%	90%	80%	70%	65%
		Reduction Percent	0%	10%	20%	30%	35%
Option	Affected Sector or Fishery Group	Affected Target	Halibut PSC Limit (mt)				
Option 2	BSAI TLA	All Targets	875.0	787.5	700.0	612.5	568.8
Option 3	A80-CPs	All Targets	2,325.0	2,092.5	1,860.0	1,627.5	1,511.3
Option 4	Longline CVs	Pacific cod	15.0	13.5	12.0	10.5	9.8
Option 5	Longline CPs	Pacific cod	760.0	684.0	608.0	532.0	494.0
Option 6	CDQs	All Targets	393.0	353.7	314.4	275.1	255.5
Option 7	Longline CPs & CVs	All Other Targets (non-IFQ)	58.0	52.2	46.4	40.6	37.7

Note: The halibut PSC limit for the BSAI TLA fisheries is sub-divided into separate and distinct target fishery apportionments. These will be discussed in more detail in Section 0.

The assessment of the impacts of these options are described in terms of changes from the status quo over a 10-year period in the future—specifically, from 2014 to 2023. The impact of each option will be estimated through the use of the IMS Model which, as described in Section 5.4.3, is a model that simulates the groundfish and halibut fishery over the 10-year future period. In each iteration of the 10,000 iterations of model, each future year will be represented by one of the years between 2008 and 2013. These Basis Years will be chosen at random, and there is no limit set on the number of times within an iteration that a given Basis Year may be selected. The focus of the impacts assessment and the primary output of the IMS Model are four key measures:

1) The annual average change, relative to the status quo, in halibut PSC mortality (HMT in round weight mt) by IPHC area over the 10-year period by affected groundfish fisheries;
2) The annual average change, relative to the status quo, in halibut harvests (in net weight mt) of the commercial halibut fishery by IPHC area over the 10-year period;
3) The average change relative to the status quo in the net present value (NPV) of wholesale revenues over the 10-year period for the affected groundfish fisheries;
4) The average change relative to the status quo in the net present value (NPV) of wholesale revenues over the 10-year period for the commercial halibut fisheries.

We define each of these measures in more detail below.

Annual Average Change in Halibut Mortality in Groundfish Fisheries over the 10-Year Future Period

Each Basis Year selected will bring with it the halibut PSC pattern from the affected groundfish fishery within that year by vessel, month, area, and target. Under the status quo, the pattern is unchanged. Under the option being assessed, halibut PSC mortality is cut on a record-by-record basis until the halibut PSC mortality falls below the new PSC limit that is set by the option. The order in which records are cut is defined by the "Scenario" being run. The difference in halibut PSC mortality for that Basis Year between the status quo and under the option is calculated for each IPHC Area (Status Quo PSC – Option PSC = PSC Difference). In each iteration of the simulation, these calculations are repeated and reported over all ten of the Basis Years for each IPHC Area. The IMS Model is run for 10,000 iterations for each Scenario, so there are a total of 100,000 estimates of PSC Difference for each IPHC Area and Scenario. The average of these differences is the "Annual Average Change in PSC" in the groundfish fishery over the 10-year future period.

Annual Average Change in Harvests in the Commercial Halibut Fishery over the 10-Year Future Period

The amount of halibut available for harvest changes over time with differences in halibut PSC mortality, but with a lag of over two years. The algorithm used to determine the change in halibut harvest that results from a change in halibut PSC mortality was described in the Section 5.4.2. From the perspective of the algorithm if halibut PSC is reduced in Y_1 then then the difference in O26 halibut PSC mortality from the status quo case for Y_1 becomes available in O26 halibut PSC mortality because available in Y_2. The difference in O26 halibut PSC mortality is a function of the observed O26 to U26 ratio, which varies by sector (BSAI TLA, A80-CP, longline CP) but can be approximated at 60 percent. In addition, round weight halibut PSC mortality must be converted to net weight (multiply round weight by 0.75) and the average exploitation rate of harvest (calculated as harvested volume ÷ FCEY) must by applied—for Area 4 the average exploitation rate of harvest = 95 percent. The IMS Model makes these calculations for each year and IPHC area during the 10-year simulation period using halibut PSC mortality from each Basis Year, as selected. For each iteration, there are 10 years of predicted harvests for each area under both the status quo and the option. The model reports the difference between the two (calculated as Harvest under the Option – Harvest under the Status Quo) each year. The IMS Model runs 10,000 iterations, so the Annual Average Change in Harvest is an average calculated over 100,000 data points for each IPHC area.

The Average Change from the Status Quo of Net Present Value of Wholesale Revenue over the 10-year Future Period for the Affected Groundfish Fisheries

Each groundfish record used in the analysis was supplied by AKFIN (Fey 2014) and reports the total weight of groundfish, the total halibut PSC mortality, the total estimated nominal ex-vessel value of the groundfish harvested and the total estimated nominal wholesale value of the groundfish harvested for each vessel in each month in each target fishery in each NMFS reporting area. Prior to undertaking the analysis we adjust all of the nominal ex-vessel and wholesale values for inflation to 2013$ using the Producer Price Index for Unprocessed and Packaged Fish (BLS 2014). The sum over all of the AKFIN records for all vessels in a given sector, for a given year equals the status quo estimate of groundfish harvest, halibut PSC mortality, ex-vessel value, and wholesale value. The sum of wholesale value of the records that were cut to get the sector under the PSC limit specified by the Option, equals the change in wholesale value from the status quo for that basis year.

Because we are looking out into the future, the "time value of money" becomes an issue, so we discount the change that was estimated for 2015 (Y_2) by multiplying by the assumed annual discount rate (r). In the IMS Model, **d** is assumed to equal 95 percent.[31] The change in wholesale values estimated for 2016 (Y_3) is multiplied by d^2 (d-squared) or 90.3 percent. The change in wholesale value in Y_4 is multiplied by d^3 (d× d × d) and so on until Y_{10} which is multiplied by r^9 or 63.0 percent. Table 5-87 shows the discount rates used to calculate NPVs in the IMS Model.

Table 5-87 Discount Rates for Future Year as Used in the IMS Model

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Year	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7	Y_8	Y_9	Y_{10}
discount = d	No discount	d (0.95)	d^2 (0.95 × 0.95)	d^3 (0.95 × 0.95 × 0.95)	d^4 0.95^4	d^5 0.95^5	d^6 0.95^5	d^7 0.95^5	d^8 0.95^5	d^9 0.95^9
Discount	1.00	0.950	0.903	0.857	0.815	0.774	0.735	0.698	0.663	0.630

Source: Developed by Northern Economics.

The discounted changes in wholesale values for each of the 10 years in the simulation are summed and the result is the NPV of the change from the status quo in wholesale revenue for that iteration. The IMS model is iterated 10,000 times for each Scenario, and the average of the 10,000 reported values is the average change from the status quo of net present value of wholesale revenue for the affected groundfish fishery for that Scenario under that option.

The Average Change from the Status Quo of Net Present Value of Wholesale Revenue over the 10-year Future Period for the Commercial Halibut Fisheries

Under the status quo for a given basis year, the wholesale revenue generated in the commercial halibut fishery is calculated by summing the wholesale value for each processor that was active during the fishing year. AKFIN provided these data to the analysts by processor and year. They estimate the wholesale values using Commercial Operator Annual Report data submitted by all of the processors each year. After adjusting for inflation to 2013$, we calculate the real wholesale value per harvested net ton for each year. These values were calculated in Table 5-79 on a net-weight pound basis and are reproduced below (Table 5-88) on a net weight mt basis as used in the IMS Model. These real values of wholesale of revenue per net weight ton were multiplied the by change from the status quo in halibut harvests for each of the 10 future years in the IMS Model iteration, and then discounted based on the discount rates in Table 5-87. The discounted change in wholesale values over all 10 years in the model are summed and the result is

[31] Technically, it is better to define the discount rate as the percent by which the value decreases each year. We are assuming a 5 percent discount rate per year where the rate = r. We multiply the value by (1 – r) for the second year, and $(1 – r)^2$ in the third year, and so on.

the net present value of the change in wholesale value for that iteration. Each run of the IMS Model comprises 10,000 iterations, and the average over all 10,000 iterations is the average change from the status quo of net present value of wholesale revenue over the 10-year future period for the commercial halibut fisheries.

Table 5-88 Real Wholesale Value per unit of Volume in the Commercial Halibut Fishery for the Basis Years

Units	2008	2009	2010	2011	2012	2013
Real Wholesale Revenue per net weight lb ($2013)	$14.00	$10.15	$16.17	$15.81	$15.50	$9.16
Real Wholesale Revenue per net weight mt ($2013	$30,857	$22,383	$35,650	$34,863	$34,179	$20,203

Source: Developed by Northern Economics based on data from AKFIN (Fey 2014).

A Caveat Regarding the Impact of U26 Halibut PSC Mortality in the IMS Model and the Assessment of Impacts

As mentioned in Section 5.4.2.3, under the current harvest policy U26 halibut that would be "saved" under PSC limit reduction options are assumed to become part of the TCEYs and FCEYs as they grow into mature fish that become part of the exploitable biomass. The IMS Model and the assessment of impacts rely on this assumption. We do not make any further adjustments to account for any savings of U26 fish. We also note that under proposed changes to the IPHC harvest poliscy, any savings of U26 that would be generated and potentially added to the FCEY would be distributed across all IPHC areas coastwide. Based on coastwide biomass percentages shown in Table 5-1, only 20 percent of any projected savings of U26 halibut would accrue to catch limits in Area 4.

5.7.1 An Assessment of the Status Quo and the Potential Impacts of Differing Levels of Halibut PSC

In this section we examine the Status Quo and develop the baseline estimates of the key measures described in the introduction above. For the groundfish fishery the key measures: 1) Average halibut PSC mortality in each area and in total, by sector during the each of the 10 years in the future years, and 2) Average Net Present Value of Wholesale Revenues, by sector, over the 10-year future period, can be estimated by using either the averages from the Basis Years or via the IMS Model. However, realistic estimates of the future halibut FCEYs, and thus harvests and revenues in the commercial halibut fishery, are much more difficult to estimate. This is because FCEY and harvests depend on the O26 halibut PSC mortality taken in the previous two years and changes in O26 halibut PSC mortality vary significantly from year to year. Therefore, we have run the IMS Model for the Status Quo Baseline In the remainder of this section we summarize the Status Quo Baseline and the provide the key measures against which changes to the Status Quo will be judged.

5.7.1.1 Summaries of Key Measures from the Status Quo Baseline

Annual Average Halibut PSC Mortality in Groundfish Fisheries under the Status Quo

Halibut PSC mortality for each of the affected groundfish fisheries and sectors during the Basis Years (2008 to 2013) is a key component of the status quo baseline for Alternative 2 and the assessment of impacts of the various options under Alternative 2. Table 5-89 below summarizes halibut PSC mortality as used for the Status Quo Baseline. We note that for the BSAI TLA, the amounts of halibut PSC mortality under the status quo have been reduced by a total of 51.9 mt from what was actually realized during the fishing years from 2008–2013. This is a result of the assumption that PSC Limits are strictly enforced. In the IMS Model Basis Years are randomly drawn to represent the 10 future years in the fishery. Over the 10,000 iterations in the IMS Model for the Status Quo Baseline, the average halibut PSC mortality over the 10-year future period is within $1/10^{th}$ of 1 percent of the amount shown in the table.

Table 5-89 Halibut PSC Mortality in the Basis Years, by Groundfish Fishery, 2008 to 2013

Basis Years	2008	2009	2010	2011	2012	2013	Status Quo Average
Groundfish Fishery			**Halibut PSC Mortality (round weight mt)**				
BSAI TLA in all target fisheries	735.3	726.5	484.2	636.7	936.3	682.9	**700.3**
A80-CPs in all target fisheries	1,969.0	2,073.7	2,253.6	1,810.2	1,945.4	2,168.3	**2,036.7**
Longline CVs in Pacific cod fisheries	5.4	2.9	1.7	1.3	1.8	3.3	**2.7**
Longline CPs in Pacific cod fisheries	564.3	555.6	489.4	476.7	549.5	458.1	**515.6**
CDQs in all groundfish fisheries	214.0	151.0	158.6	223.0	251.7	264.8	**210.5**
Longline CVs & CPs in Other Target Fisheries	1.3	6.4	10.3	4.5	5.7	1.4	**4.9**
All Affected Groundfish Fisheries	**3,489.4**	**3,516.0**	**3,397.9**	**3,152.4**	**3,690.5**	**3,578.8**	**3,470.8**

Source: Developed by Northern Economics based on data from AKFIN (2014) and NMFS (2014f)

Table 5-90 shows halibut PSC mortality taken during the Basis Years in the Status Quo Baseline (in 1,000s of net weight pounds). As in the previous table, these numbers have been adjusted to remove PSC Limit overages.

Table 5-90 Halibut PSC Mortality in the Basis Years by IPHC Area, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Status Quo Average
IPHC Area			**Total Halibut PSC Mortality (round weight mt)**				
4A	723.1	923.4	621.9	662.9	1,052.0	756.8	790.0
4B	191.2	252.7	285.4	274.6	332.3	250.1	264.4
4CDE	2,575.1	2,339.9	2,490.6	2,214.9	2,306.2	2,571.9	2,416.4
Area 4 Total	3,489.4	3,516.0	3,397.9	3,152.4	3,690.5	3,578.8	3,470.8

Source: Developed by Northern Economics from the IMS Model.

Net Present Value of Wholesale Revenues in the Groundfish Fisheries over the 10-year Future Period

Table 5-91 and Table 5-92 summarize wholesale revenues in the Basis Year and in the IMS Model Run for the Status Quo Baseline. Table 5-91 summarizes real wholesale revenues (in 2013$ millions) generated by each of the affected groundfish fisheries during the Basis Years. On average, the groundfish fisheries have generated $1.958 billion in wholesale revenues from 2008 to 2013. Table 5-92 shows IMS Model results for the Status Quo Baseline. The first row of data shows the nominal (pre-discounted) average wholesale values for each of the 10 future years. The average nominal wholesale value in the model over 10,000 iterations was $1,957.97 million, which is within 1/10th of 1 percent of the average value shown in Table 5-91. In the second row of Table 5-92, the discounted average values for the future years are shown. The sum of these discounted future values equals the net present value of the groundfish fisheries in the Status Quo Baseline—the net present value over the 10-year period modelled is $15.714 billion.

Table 5-91 Wholesale Value of Groundfish Fisheries in the Status Quo Basis Year

Groundfish Fishery	2008	2009	2010	2011	2012	2013	Status Quo Average
	Wholesale Value (2013$ Millions)						
BSAI TLA in all target fisheries	$1,475.22	$1,134.72	$1,083.98	$1,363.58	$1,399.22	$1,179.86	**$1,272.76**
A80-CPs in all target fisheries	$320.65	$284.78	$323.90	$357.31	$375.56	$289.04	**$325.21**
Longline CVs in Pacific cod fisheries	$2.63	$0.98	$0.57	$0.86	$1.29	$1.31	**$1.27**
Longline CPs in Pacific cod fisheries	$192.92	$132.67	$128.30	$178.97	$188.33	$133.11	**$159.05**
CDQs in all groundfish fisheries	$241.67	$166.45	$167.32	$219.87	$222.84	$182.68	**$200.14**
Longline CVs & CPs in Other Target Fisheries	$1.47	$1.74	$3.10	$2.25	$2.78	$0.62	$1.99
All Affected Groundfish Fisheries	**$2,233.09**	**$1,719.59**	**$1,704.07**	**$2,120.58**	**$2,187.24**	**$1,786.00**	**$1,958.43**

Note: Wholesale Revenue for the BSAI TLA under the Status Quo baseline has been reduced by $11.2 million from amounts actually generated in the fishery from 2008 to 2013. The reduction is necessary there were some PSC overages found in the data, and in the Status Quo Baseline and the IMS Model we assume that PSC Limits are strictly enforced.

Source: Developed by Northern Economics based on data from AKFIN (2014) and NMFS (2014f)

Table 5-92 Nominal and Discounted Future Wholesale Revenue in Groundfish Fisheries under the Status Quo Baseline Model

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	NPV
	Average Groundfish Wholesale Revenue ($ Millions) over 10,000 iterations of the IMS Model										
Nominal Value ($ 2013)	$1,957	$1,959	$1,959	$1,962	$1,959	$1,956	$1,958	$1,956	$1,958	$1,955	**#N/A**
Discounted Value	$1,957	$1,861	$1,768	$1,682	$1,595	$1,514	$1,439	$1,366	$1,299	$1,232	**$15,714**

NPV = Net Present Value

Source: Developed by Northern Economics from the IMS Model.

Annual Average Halibut Harvests in the Commercial Halibut Fishery under the Status Quo

Table 5-93 summarizes commercial halibut harvests in Area 4 for the Status Quo Baseline from the IMS model. The IMS Model assumes that harvested pounds are 95 percent of the FCEY in each Area. The IMS Model also assumes that the 6.96 million pound (net weight) TCEY imputed by the analysts for 2014 for Area 4 using the algorithm described in Section 5.4.2 is unchanged during the 10-year future period. The IMS Model also assumes that "other removals" are constant at 2013 levels. The assumed distribution of 6.96 million pound TCEY for each IPHC area is shown in the bulleted list.

- TCEY for IPHC Area 4A is 1,302.3 (1,000s, net weight lb) in 2014 and 1,522.7 (1,000s, net weight lb) from 2015 to 2023
- TCEY for IPHC Area 4B is 1,339.1 (1,000s, net weight lb) in 2014 and 1,118.7 (1,000s, net weight lb) from 2015 to 2023
- TCEY for IPHC Area 4CDE is 4,185.9 (1,000s, net weight lb) each year from 2014 to 2023

We note that the TCEY in Area 4A was bumped up by 220,460 pounds (100 mt) from the imputed value that was used in later years. The TCEY was "borrowed" from Area 4B. The one-year bump was necessary to "keep the fishery" open in 2014. This type of adjustment is similar to the types of adjustments that appear to have been made by the IPHC in the past.

The numbers in the table are derived using the TCEY indicated above and then by working through the FCEY setting algorithm using the halibut PSC amount from the Basis Years as they are selected in the IMS Model. The average over 10,000 iterations of the Status Quo Baseline IMS Model run indicate an average of 2.941 million pounds landed from 2014 to 2023.

Table 5-93 Commercial Halibut Harvests as Modelled in the Status Quo Baseline

IPHC Area	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Status Quo Average
	Average Landed Halibut (1,000s of net weight lb) over 10,000 iterations of the IMS Model										
4A	807.5	583.2	672.6	660.8	666.9	661.7	666.2	668.5	664.4	671.6	672.3
4B	1,083.0	752.0	769.8	768.1	769.0	768.5	767.3	769.2	767.9	769.6	798.4
4CDE	1,220.7	1,582.2	1,492.9	1,487.5	1,486.0	1,486.2	1,486.6	1,489.1	1,483.2	1,486.6	1,470.1
Area 4 Total	3,111.2	2,917.4	2,935.3	2,916.5	2,921.8	2,916.4	2,920.1	2,926.9	2,915.4	2,927.8	2,940.9

Source: Developed by Northern Economics from the IMS Model.

Net Present Value of Wholesale Revenues in the Commercial Halibut Fishery over the 10-year Future Period

Table 5-94 shows the nominal and discounted average wholesale revenues for the commercial halibut fishery by IPHC Area resulting from the 10,000 iterations of the Status Quo Baseline IMS Model. Nominal revenues are not discounted and all represent wholesale revenues in 2013 dollars. The average nominal wholesale revenue was $37.57 million, with 50 percent coming from Area 4CDE, 27 percent coming from Area 4B and 23 percent coming from Area 4A.

The second part of Table 5-94 shows the discounted averages of the wholesale revenues generated in each of the future years over the 10,000 iterations of the IMS Model. The IMS Model assumes a 5 percent discount rate (95 percent of the original value remains after each year). The sum of the discounted values over the 10-year period equals the estimated Net Present Value of the commercial halibut fishery for the Status Quo Baseline.

Table 5-94 Commercial Halibut Harvests as Modelled in the Status Quo Baseline

IPHC Area	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Status Quo Average
	Average Nominal Wholesale Revenues (2013$ millions) over 10,000 iterations of the IMS Model										
4A	$10.31	$7.45	$8.59	$8.43	$8.51	$8.44	$8.53	$8.55	$8.49	$8.60	$8.59
4B	$13.83	$9.62	$9.82	$9.80	$9.81	$9.82	$9.82	$9.83	$9.82	$9.85	$10.20
4CDE	$15.58	$20.25	$19.04	$18.98	$18.95	$18.98	$19.02	$19.03	$18.97	$19.02	$18.78
Area 4 Total	$39.72	$37.32	$37.44	$37.21	$37.27	$37.24	$37.36	$37.40	$37.28	$37.47	$37.57
	Average Discounted (@ 95%/year) Wholesale Revenues over 10,000 iterations of the IMS Model										**NPV over 10-Year Future**
4A	$10.31	$7.08	$7.75	$7.23	$6.93	$6.53	$6.27	$5.97	$5.63	$5.42	$69.13
4B	$13.83	$9.14	$8.86	$8.40	$7.99	$7.60	$7.22	$6.86	$6.51	$6.21	$82.62
4CDE	$15.58	$19.23	$17.18	$16.27	$15.44	$14.68	$13.98	$13.29	$12.59	$11.99	$150.23
Area 4 Total	$39.72	$35.45	$33.79	$31.90	$30.36	$28.82	$27.47	$26.12	$24.73	$23.62	$301.98

NPV = net present value
Source: Developed by Northern Economics from the IMS Model.

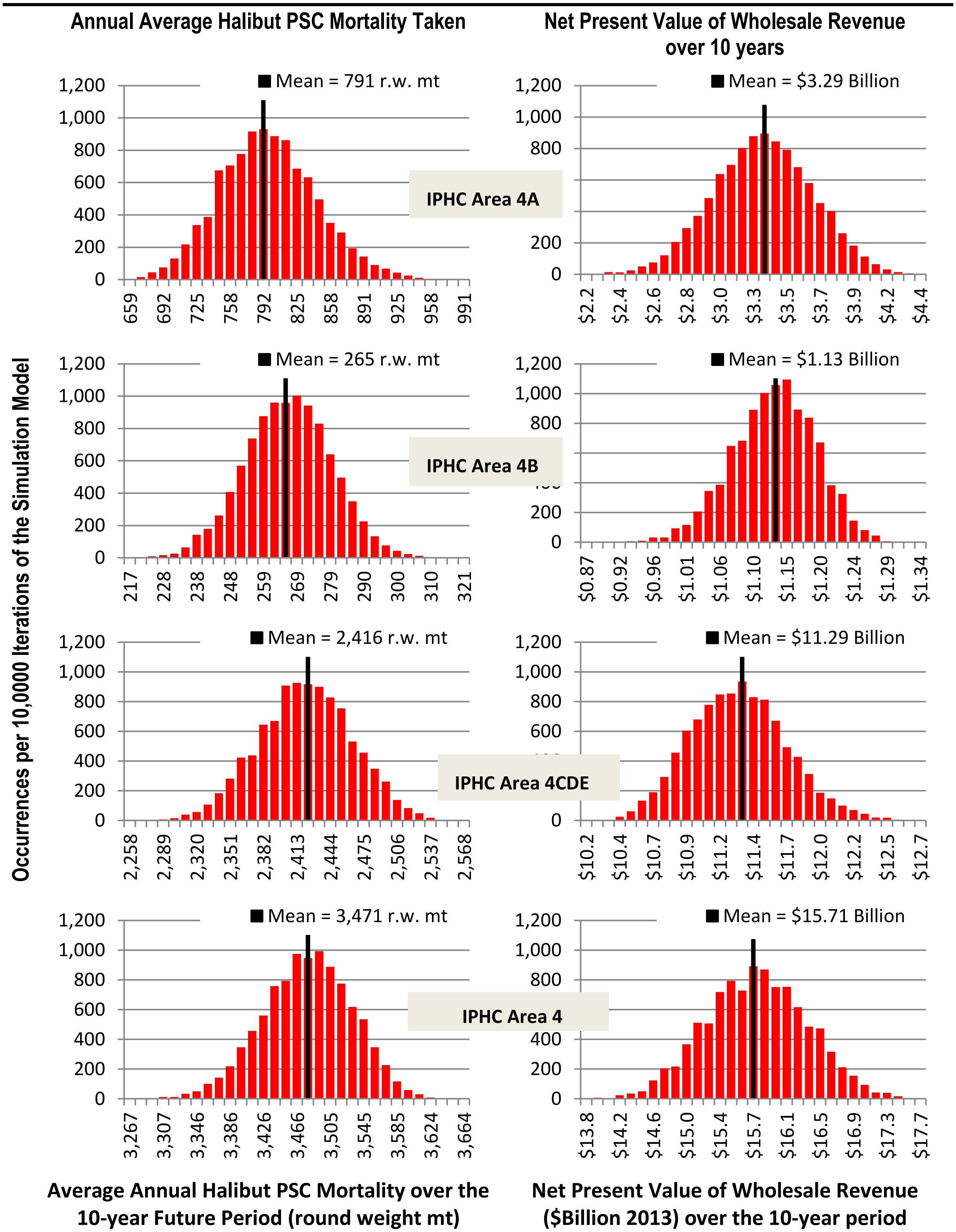
Distributions of Halibut PSC and Harvests, and Distributions of Net Present Values in the Groundfish and Halibut Fisheries

On the following pages are two figures showing the distributions, in the form of histograms, of the four key measures from the IMS Model Runs.

- The left-side of Figure 5-55 shows halibut PSC mortality in the groundfish fisheries, by IPHC area.
- The right-side shows the net present value of wholesale revenue in the groundfish fisheries.
- The left-side of Figure 5-56 shows harvests in the halibut fishery, by IPHC area.

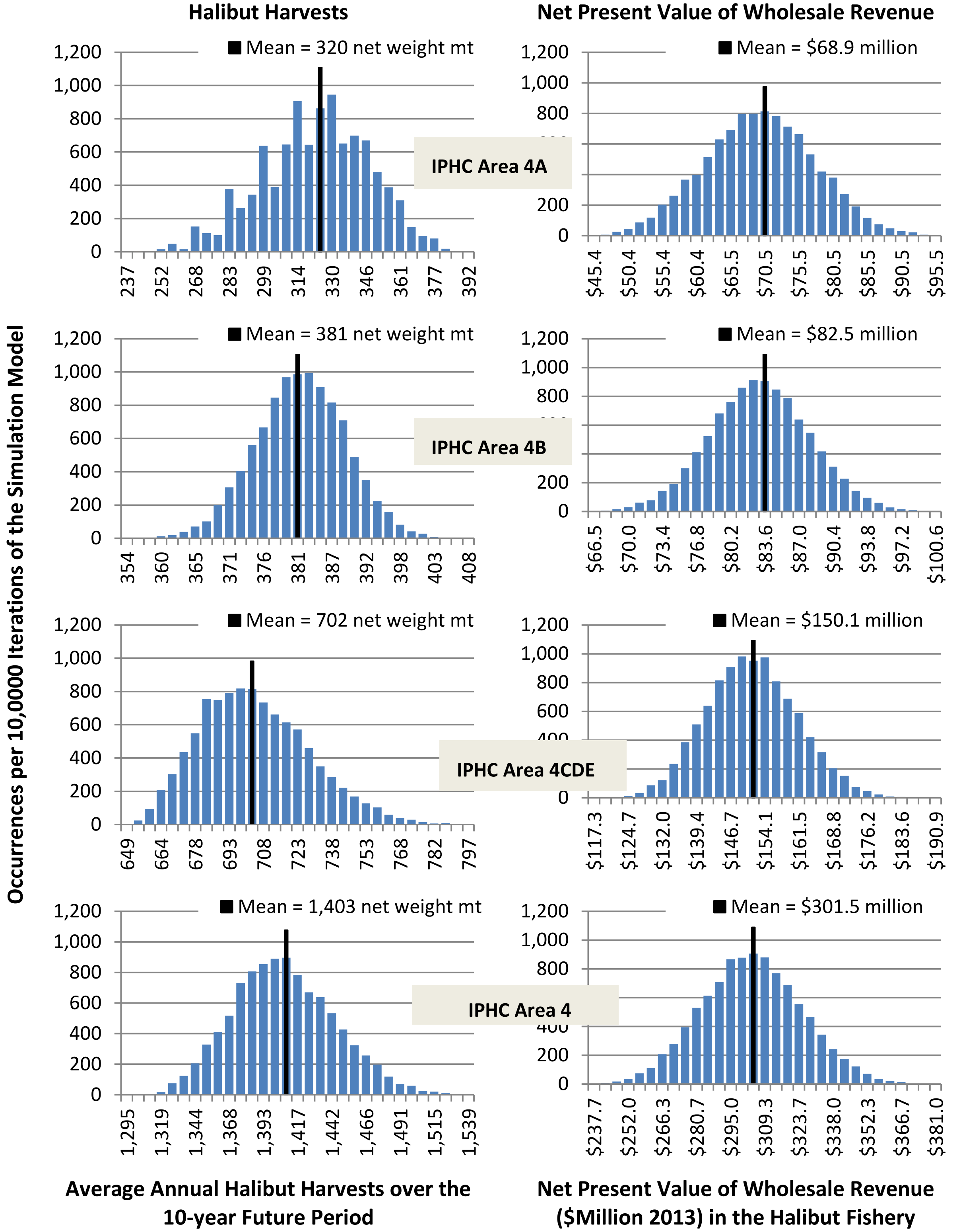
- The right-side shows the net present value of wholesale revenue in the halibut fishery.

Figure 5-55 Distributions of Halibut PSC Mortality and the Net Present Value of Revenue in Groundfish Fisheries, under the Status Quo Baseline



Source: Developed by Northern Economics from the IMS Model.

Figure 5-56 Distributions of Halibut Catch and the Net Present Value of Revenue in the Commercial Halibut Fisheries, under the Status Quo Baseline



Source: Developed by Northern Economics from the IMS Model.

5.7.1.2 A Qualitative Assessment of Behavior Changes Possible under the Status Quo

<u>**Impacts if Current PSC Limits were Fully Taken**</u>

The specter of increases in halibut PSC mortality in the BSAI groundfish fishery has long been a concern, not only for participants and managers in the halibut fishery, but also for members of the groundfish industry, consumers of halibut, and many other stakeholders. These concerns are exacerbated by the relatively low levels of halibut biomass in recent years, and by the fact that there currently exists a significant amount of slack between the existing PSC limits and the recent amounts of halibut PSC mortality that have been taken by the groundfish fishery.

In this section, we examine the issue from an analytical perspective, and ask the question: what would happen to the FCEYs and halibut harvests if the BSAI groundfish fishery, for some unexplained reason, increased the amount of PSC they take, up to the maximum allowed by their combined PSC limits.

This was primarily an exercise in working through the FCEY-setting algorithm that has been used extensively in this analysis, and in making assumptions about the areas in which halibut PSC increases would occur. Our simplistic approach assumes that the TCEYs from 2014 for each IPHC Area remain constant at 2014 levels. We also assume that each sector's PSC increases proportionally in the Basis Years, in IPHC areas in which they participate, up to that sector's existing PSC limit. In cases where halibut PSC in the BSAI TLA pollock fishery pushed the BSAI TLA over its 875 mt limit for a Basis Year, no additional increases were made.

We found, with this approach, that IPHC Area 4A was the most vulnerable of the three Area 4 subareas, at least with the 2014 imputed TCEYs. This is because the variability in halibut PSC mortality in the groundfish fisheries in Area 4A, during the Basis Years, is very pronounced, ranging from a low in 2010 of 621.9 mt (round weight) to a high in 2012 of 1,052 mt. With these kinds of swings, and a relatively low FCEY—the FCEY was 386 mt (net weight) in 2014—significant increases in halibut mortality in Area 4A could push the FCEY to zero.

Hypothetical increases in halibut PSC mortality up to the PSC limits for all groundfish sectors would undoubtedly have significant impacts on all Area 4 fisheries, but only Area 4A appeared vulnerable (with the assumptions used) to seeing a "zeroing" out of the FCEY. In our very cursory examination, we found that halibut harvests and revenues in the commercial halibut fishery over all of Area 4 could fall by 25 to 33 percent relative to 2014 levels.

<u>**Behavior Changes, Innovation and Flexibility in Reducing PSC Mortality**</u>

While it is possible that halibut mortality could increase in the future, it is also possible that, under the status quo, halibut mortality could decrease.

In general, the groundfish fisheries in the BSAI can be characterized as having become more rationalized over time. The A80-CP fishery was rationalized with the implementation of Amendment 80 in 2008, and the formation of cooperatives. Similarly, the longline CP fishery has become rationalized with its cooperative. The following discussion, excerpted from the "Five- year Review of the Effects of Amendment 80", (Northern Economics 2014), summarizes the increased flexibility that participants in rationalized fisheries are experiencing.

> Although not entirely unexpected, rationalization under A80 appears to have led to behavioral changes, innovation and increased flexibility on the part of A80 operators as they work to optimize revenues under the constraints of halibut and crab PSCs…

During interviews with A80 vessel owners and operators it was noted several times that the fleet is no longer trying to maximize revenue per day, and instead is trying to maximize total catch and revenue per pound while staying within their PSC apportionments and other constraints. This change in their primary motivation means they are much less averse to trying new gear configurations, to moving when they hit high levels of bycatch and reducing night-time trawling when halibut are abundant. They are also more willing to test bycatch reduction tools and methods like experimental halibut excluder devices, and to push for deck sorting of halibut to reduce mortality rates.

The following discussion, which summarizes the findings of Abbott, Haynie, and Reimer in their paper, *Hidden Flexibilities: Institutions, Incentives, and the Margins of Selectivity in Fishing*" (Abbot et al. 2014), provides some insights into the theoretical underpinning of these changes.

In their analysis of the BSAI non-pollock groundfish trawl fishery, Abbott et al. conclude that behavioral—rather than strictly technical—considerations are significant in explaining changes in catch composition in the fishery following implementation in 2008 of A80. The authors apply multiple statistical measures and econometric modeling techniques to two primary data sources to estimate the significance of various factors in predicting pre- and post-A80 bycatch. These data sources include: confidential observer data on the location and catch of each vessel from the North Pacific Groundfish Observer Program (NPGOP); and vessel-level data on the production weight of final products for each target species, as well as estimates of the initial catch weight embodied in the final products. The authors focus their analysis on three margins of behavioral change, concluding that each has proved significant in explaining reduced bycatch rates: large-scale adjustments to fishing grounds away from areas with traditionally high rates of halibut and cod bycatch; smaller-scale movements away from bycatch hotspots; and reductions in night fishing, particularly during the first third of the year.

The authors also point out that A80 represented a major policy shift away from a system under which the catch of all species, including bycatch species, was regulated by the common-pool assignment of multiple TACs for each species to one under which individual vessels operate under a multispecies catch share system with individual accountability for catch of both target and bycatch species. In addition to granting a defined share of the total A80 TAC for the six primary target species to each vessel in the previous limited-entry program according to its catch history, A80 allows vessels to vest their shares in either a cooperative formed by participating members, or in the limited-access common pool fishery. The regulations afford cooperatives considerable flexibility with regard to the internal allocation of catch entitlements. The authors point out that groups of A80 CPs operating under cooperatives have avoided reaching their collective halibut and cod allocations every year since A80 implementation. The authors also point out that halibut bycatch rates in the non-cooperative portion of the A80 fishery remained unchanged in 2008 and reached historically high levels in 2009 and 2010.

5.7.2 Analysis of Impacts of Options Affecting the BSAI Trawl Limited Access Fisheries

In this section we summarize the impacts of proposed reductions of halibut PSC limits for the BSAI TLA target fisheries as specified under Option 2. Four suboptions are specified as follows.

- Option 2.1: Reduce the BSAI TLA PSC limit by 10 percent.
- Option 2.2: Reduce the BSAI TLA PSC limit by 20 percent.
- Option 2.3: Reduce the BSAI TLA PSC limit by 30 percent.
- Option 2.4: Reduce the BSAI TLA PSC limit by 35 percent

The PSC Limit for BSAI TLA fisheries is currently apportioned in the annual specification process to four targets groups : 1) yellowfin sole, rockfish, Pacific cod, and the Pollock|Atka Mackerel|Other Species target group, which we will shorten to Pollock|Atka Mackerel|Other Species throughout the remainder of the document. The Pollock|Atka Mackerel|Other Species apportionment is unique, because it is not a fully binding constraint. If the PSC limit is reached, fishing for Atka mackerel and "Other species" is prohibited, but vessels may continue to fish for mid-water pollock. Since 2008, less than $22 million has been generated in the BSAI TLA fisheries for Atka mackerel compared to over $7 billion in pollock.

The assessment of impacts of Alternative 2 is accomplished through the use of the Iterated Multiyear Simulation (IMS) Model that was introduced and described in Section 5.4.3. The results of the IMS Model show the net present value (NPV) of differences in wholesale revenue between the status quo (as modelled) and the projected outcomes if the PSC limit reductions had been imposed. In general, the IMS Model looks out at the next 10 years under both the status quo and for the suboption, and assumes that any one of the years from 2008 to 2013 will serve as the Basis Year for future years from 2014 to 2023.

In the IMS Model, halibut PSC mortality taken in a randomly drawn Basis Year by IPHC area, as well as the groundfish revenue generated in that Basis Year, are placed into the model. The model then compares catch, halibut PSC, and wholesale revenue over the 10-year future period under PSC limits in the status quo against the PSC limits under the suboption for the same set of Basis Years. In order to be reasonably certain that the selection and order of Basis Years do not unnecessarily bias the outcome of the model, the draws of Basis Years and the calculation of results are repeated (iterated) 10,000 times.

It should be noted that the status quo PSC limits are set equal to the apportionment for the target fishery identified in the Basis Year's harvest specifications process by the Council and NMFS. In other words, if 2008 is drawn as the Basis Year, the PSC limit for yellowfin sole, Pacific cod, rockfish and Pollock|Atka Mackerel|Other Species from that Basis Year will be used in the IMS Model. It should also be noted that the IMS Model uses the imputed TCEYs by IPHC area from 2014 for the commercial halibut fishery under both the status quo and the suboptions. It is also assumed that the amounts of other removals (subsistence, recreation, wastage in the commercial fishery) are held constant at estimates from the 2013 fishing year, and that commercial harvests as a percent of FCEY are fixed at weighted average rate from 2008 to 2013. The wholesale revenues per ton generated in the commercial halibut fishery during the Basis Years are used in the model.

In the IMS Model for the BSAI TLA, the target fishery specific PSC limits are strictly enforced. By this we mean that we do not model within-year transfers of the PSC limits from one target fishery to another if it appears that there is a need for such transfers. For example, we do not allow NMFS to transfer "surplus" amounts of the halibut PSC limits from the BSAI TLA Pacific cod fishery to the BSAI TLA yellowfin sole fishery during the fishing year. Similarly, the IMS Model does not allow NMFS to transfer halibut PSC limits to into or out of the BSAI TLA to or from other sectors. In other words, again for purposes of the analysis only, the IMS Model would not transfer surplus halibut PSC mortality that had been apportioned from the BSAI TLA yellowfin sole fishery to the A80 fishery. While the IMS Model strictly enforces the target-specific apportionments and doesn't permit internal transfers, mid-water pollock fishery to continue even after Pollock|Atka Mackerel|Other Species PSC limit has been taken.

It must also be noted that there are weeks when harvests of a BSAI TLA vessel are designated as participating in target fisheries for which there are no halibut PSC mortality apportionments. For example, the catch of a BSAI TLA vessel for a given week may be assigned to the Greenland turbot target fishery via NMFS' target fishery assignment algorithm, even though there is no specific PSC mortality apportionment to which the halibut PSC mortality taken during that week should be assigned. When this happens during the fishing year, NMFS in-season managers assign the halibut PSC mortality manually to the apportionment they think is most appropriate (Furuness, 2014). In the IMS Model, all halibut PSC mortality assigned to targets for which there are no halibut PSC mortality apportionments have been assigned to the Pacific cod PSC mortality apportionment.[32]

The strict enforcement of the PSC limits extends to the assessment of the fishery under the status quo, as well as under the proposed suboptions. From the perspective of the IMS Model under the status quo, strict enforcement means that if, under the actual fisheries as they took place during the Basis Years, NMFS had moved halibut originally apportioned to Pacific cod to the yellowfin sole fishery, or if NMFS had allowed an overage in yellowfin sole fishery or any other fishery in excess of its specific PSC mortality apportionment, those transfers and allowances are disallowed in the IMS Model. Thus total halibut PSC mortality, total catch and total revenue under the status quo for a particular Basis Year may be less than it actually was during the fishing year. Table 5-95 summarizes PSC limits for BSAI TLA target fisheries under each Basis Year as they were applied to future years under the IMS Model. The table also includes halibut PSC mortality amounts that were actually taken and allowed under the IMS Model for the status quo, as well as the halibut PSC mortality amounts that were actually taken but dis-allowed under the IMS Model for the status quo.

[32] An exception is that 2.01 mt of halibut PSC mortality taken in BSAI TLA fisheries from 2008–2013, which NMFS assigned to the flathead sole target fishery were designated to the yellowfin sole apportionment in the IMS Model.

Table 5-95 Target-Specific Halibut PSC Limits in the BSAI TLA, as Modelled for Status Quo Basis Years 2008 to 2013

	2008	2009	2010	2011	2012	2013
Target Fishery/Target Group	**Target Fishery Apportionments (mt) of the 875 mt Halibut PSC Limit for the BSAI TLA**					
Yellowfin Sole	162.0	187.0	167.0	167.0	167.0	167.0
Rockfish	3.0	5.0	5.0	5.0	5.0	5.0
Pollock|Atka Mackerel|Other Species	125.0	175.0	250.0	250.0	250.0	250.0
Pacific Cod	585.0	508.0	453.0	453.0	453.0	453.0
Total for All BSAI TLA Fisheries	**875.0**	**875.0**	**875.0**	**875.0**	**875.0**	**875.0**
	Halibut PSC mortality (mt) modelled under the Status Quo for the Basis Years					
Yellowfin Sole	156.7	98.9	28.5	81.0	143.2	161.3
Rockfish	2.0	2.0	0.4	3.5	0.5	3.4
Pollock|Atka Mackerel|Other Species	272.4	395.5	198.0	291.3	345.8	204.6
Pacific Cod	304.2	230.0	257.4	260.8	446.8	313.5
Total for All BSAI TLA Fisheries	**735.3**	**726.5**	**484.2**	**636.7**	**936.3**	**682.9**
	Halibut PSC mortality (mt) for the Basis Years that were Disallowed under the IMS Model for Status Quo					
Yellowfin Sole	-	-	-	-	-	23.9
Rockfish	-	-	-	-	-	-
Pollock|Atka Mackerel|Other Species	3.3	0.4	-	0.6	23.7	-
Pacific Cod	-	-	-	-	-	-
Total for All BSAI TLA Fisheries	**3.3**	**0.4**	**-**	**0.6**	**23.7**	**23.9**

Source: Developed by Northern Economics from AKFIN data (Fey 2014) and NMFS (2014f).

For each suboption, the IMS Model is run under two different scenarios that represent a lower impact case (Scenario A) and a higher impact case (Scenario B). The two scenarios assessed under each of the four suboptions for Option 2 are described below:

- Scenario A: Under Scenario A, the PSC limits for all four of the BSAI TLA target fishery apportionments are reduced by the suboption reduction percentage including the apportionment for Pollock|AtkaM|Other.
- Scenario B: Under Scenario B, the PSC limit for Pollock|Atka Mackerel|Other Species is held constant at 2014 levels, and PSC mortality apportionments for the three other target fisheries are reduced by an amount greater than the suboption reduction percentage such that the overall reduction for the sector equals the suboption reduction percentage.

Scenario A will have lower overall impacts because the pollock fishery will continue to be unconstrained even though the PSC limits on the Pollock|Atka Mackerel|Other Species target group fishery have been reduced. Table 5-96 shows an example of the PSC mortality Apportionments to BSAI TLA fisheries under the two Scenarios and the four suboptions that would be applied when fishing year 2013 is selected for inclusion in the model. The target fishery apportionments for all six Basis Years are provided in the introduction to the assessment for each suboption.

Table 5-96 PSC Limits by Target Fishery Under Scenarios A & B, for Option 2.1–2.4 and Fishing Year 2013

Target Fishery	Status Quo—2013 Fishing Year	Suboption 2.1 10% Reduction	Suboption 2.2 20% Reduction	Suboption 2.3 30% Reduction	Suboption 2.4 35% Reduction
	Halibut PSC mortality Apportionments (mt) Assumed under Scenario A				
Yellowfin Sole	167.0	150.3	133.6	116.9	108.6
Rockfish	5.0	4.5	4.0	3.5	3.3
Pollock|Atka Mackerel|Other Species	250.0	225.0	200.0	175.0	162.5
Pacific Cod	453.0	407.7	362.4	317.1	294.5
Total Limit	**875.0**	**787.5**	**700.0**	**612.5**	**568.8**
	Halibut PSC mortality Apportionments (mt) Assumed under Scenario B				
Yellowfin Sole	167.0	143.6	120.2	96.9	85.2
Rockfish	5.0	4.3	3.6	2.9	2.6
Pollock|Atka Mackerel|Other Species	250.0	250.0	250.0	250.0	250.0
Pacific Cod	453.0	389.6	326.2	262.7	231.0
Total Limit	**875.0**	**787.5**	**700.0**	**612.5**	**568.8**

Source: Developed by Northern Economics based on Harvest Specifications (NMFS 2014f).

For the BSAI TLA fisheries, the IMS Model uses a "Last-Caught First-Cut" algorithm to identify records that must be dropped from each target fishery in the Basis Year if the halibut PSC mortality for the target fishery has been reached. The process is relatively straightforward and can be summarized as follows:

- Assign a unique and random number to each record in the BSAI TLA fishery during each Basis Year. Note that each record shows the fishery data for an individual vessel in a month, in a three digit management area, and a particular a target fishery.[33]
- Sort the records in the BSAI TLA from low to high by year, by month, by the PSC mortality Apportionment fishery, and finally by the unique random number.
- Calculate the running total of halibut PSC mortality from the beginning of the year to the end within each PSC mortality Apportionment fishery.
- Drop all records in the PSC mortality Apportionment fishery where the running total of halibut PSC mortality exceeds the PSC limit for the fishery.
- Add back in all dropped records that were specifically assigned to the "pollock" target fishery, but keep as dropped any records that were specifically assigned to the Atka mackerel target fishery or to the "Other Species" target fishery. Records in pollock targets as initially assigned by NMFS are exempted.

Table 5-97 provides a demonstration of the process used to drop and exempt particular BSAI TLA records within the 2012 Basis Year in the IMS Model. The table shows an excerpt of individual records from the AKFIN data. The records have been sorted by year, month, the PSC mortality Apportionment Target, and finally, by the random record number. The PSC limit for the Pollock|Atka Mackerel|Other Species when 2012 is the Basis Year is 250 mt. The column labeled "Running PSC mortality Total" shows halibut PSC mortality getting closer to the limit and finally surpassing it. All records where the running halibut PSC mortality total has been surpassed are marked to be dropped. But since records for which the initial target assigned by NMFS is pollock are exempt from the PSC limit, those are marked as exempt and not dropped in the end. The same process is used for the other PSC mortality Apportionment Target, except the last step is unnecessary. In the IMS Model, the dropped records are selected in advance

[33]Counting arrowtooth and Kamchatka flounder as one, there are 12 target fisheries to which vessels are assigned. In addition to the targets for which there are PSC mortality apportionments, vessels in the BSAI TLA have participated in the following: arrowtooth and Kamchatka flounder, flathead sole, rock sole, and Alaska plaice.

for each suboption and they are dropped every time that particular Basis Year is chosen in one of the IMS Model iterations.

Table 5-97 Hypothetical Example of the Process Used to Drop or Exempt Records

NMFS Area	Year	Month	Random Record #	Initial Target	PSC Apportionment Target	PSC	Running PSC Total	Initial Check	Exempt Pollock
518	2012	9	0.7569	Pollock	Pollock|AtkaM|Other	0.38	248.30	Keep	Keep
521	2012	9	0.7589	Pollock	Pollock|AtkaM|Other	-	248.30	Keep	Keep
518	2012	9	0.7958	Atka Mackerel	Pollock|AtkaM|Other	1.32	249.62	Keep	Keep
521	2012	9	0.8362	Pollock	Pollock|AtkaM|Other	0.66	250.28	Drop	Exempt
518	2012	9	0.8478	Pollock	Pollock|AtkaM|Other	-	250.28	Drop	Exempt
543	**2012**	**9**	**0.8657**	**Atka Mackerel**	**Pollock|AtkaM|Other**	**0.92**	**251.20**	**Drop**	**Drop**
521	2012	9	0.9157	Pollock	Pollock|AtkaM|Other	-	251.20	Drop	Exempt
541	**2012**	**9**	**0.9604**	**Atka Mackerel**	**Pollock|AtkaM|Other**	**3.10**	**254.30**	**Drop**	**Drop**

Source: Developed by Northern Economics

Once the IMS Model is run for both Scenarios, the model results are developed. For each suboption, we present a relatively high-level summary of impacts. For the commercial halibut fishery, each assessment will present the results in the form of eight histograms showing the Net Present Value of the total change in wholesale revenues relative to the status quo over the 10-year period modelled, for each IPHC Area (Area 4A, 4B and 4CDE) and for Area 4 overall. In other words, four histograms are provided for each impact scenario (A & B). Each histogram is a bell-shaped (more or less) distribution of outcomes in terms of wholesale revenue increases under the suboption. In each histogram, there are 30 bins, starting at zero impact and extending up to the estimated maximum impacts seen in any of the 10,000 iterations.

The impact of the proposed PSC limit reductions on the BSAI TLA groundfish fishery will also be summarized using histograms showing the distribution of the net present value of changes in wholesale revenue over the 10-year future period relative to the status quo. Two histograms are provided, one for each impact scenario (A & B). A third summary figure is provided showing overall changes and changes in each of the four BSAI TLA target fisheries relative to the status quo.

5.7.2.1 Option 2–Suboption 1: Reduce Halibut PSC Limits for the BSAI TLA Fisheries by 10 Percent

This section summarizes the expected impacts to the BSAI TLA groundfish fisheries and to the Area 4 commercial halibut fisheries of Option 2.1. Under this option, the halibut PSC limit for BSAI TLA fisheries will be reduced to 787.5 mt, or 90 percent of the 875 mt halibut PSC limit under the status quo.

The halibut PSC limit for the BSAI TLA is apportioned each year by the Council and NMFS into target fishery-specific limits. Under the status quo, the total limit is apportioned to four specific target fisheries: 1) yellowfin sole, 2) rockfish, 3) Pollock|Atka Mackerel|Other Species, and 4) Pacific cod. The Council and NMFS have the ability to change these apportionments in their annual specification process as they see fit, and even to assign halibut PSC limits to different target fishery definitions.

As described in the introduction to Option 2 above, the IMS Model assesses the impact of the sup-option for two different Scenarios. Under Scenario A, all four of the target fishery-specific apportionments are set at levels equal to 90 percent of the level set under the status quo. Under Scenario B, the apportionment to the Pollock|Atka Mackerel|Other Species fishery is held constant at status quo levels, and apportionments to the remaining three target fishery groups are proportionally adjusted downward so that the total to all four target groups equals 787.5 mt. The upper portion of Table 5-98 shows the target fishery apportionments included in the IMS Model for Scenario A and Scenario B.

The bottom portion of the table shows the minimum halibut PSC mortality reduction amount for each Basis Year, noting that minimums cannot be estimated for Pollock|Atka Mackerel|Other Species apportionment because pollock is exempt. Based on the lower portion of the table the BSAI TLA yellowfin sole fishery will be constrained under the new limits, but only when 2008 or 2013 are selected as Basis Years. The BSAI TLA Pacific cod fishery will be constrained when 2012 is selected as a Basis Year. When 2009, 2010, or 2011 are place selected into the model there no impact generated for that year.

Table 5-98 Target Fishery Apportionments for Basis Year under Scenario A and Scenario B for Option 2.1

	2008		2009		2010		2011		2012		2013	
Scenario	A	B	A	B	A	B	A	B	A	B	A	B
Target Fishery	**Target Fishery Apportionments (mt) for Basis Years under Scenario A and Scenario B**											
Yellowfin Sole	145.8	143.1	168.3	163.6	150.3	143.6	150.3	143.6	150.3	143.6	150.3	143.6
Rockfish	2.7	2.7	4.5	4.4	4.5	4.3	4.5	4.3	4.5	4.3	4.5	4.3
Pollock|AtkaM|Other	112.5	125.0	157.5	175.0	225.0	250.0	225.0	250.0	225.0	250.0	225.0	250.0
Pacific Cod	526.5	516.8	457.2	444.5	407.7	389.6	407.7	389.6	407.7	389.6	407.7	389.6
	Minimum Changes in Halibut PSC Mortality (mt) from Status Quo, Assuming Strict Enforcement of PSC Apportionments											
Yellowfin Sole	10.9	13.6	-	-	-	-	-	-	-	-	11.0	17.7
Rockfish	-	-	-	-	-	-	-	-	-	-	-	-
Pollock|AtkaM|Other	Because pollock is exempt the minimum halibut PSC reduction cannot be estimated without the IMS Model											
Pacific Cod	-	-	-	-	-	-	-	-	39.1	57.3	-	-
All Fisheries except Pollock|AtkaM|Other	**10.9**	**13.6**	**-**	**-**	**-**	**-**	**-**	**-**	**39.1**	**57.3**	**11.0**	**17.7**

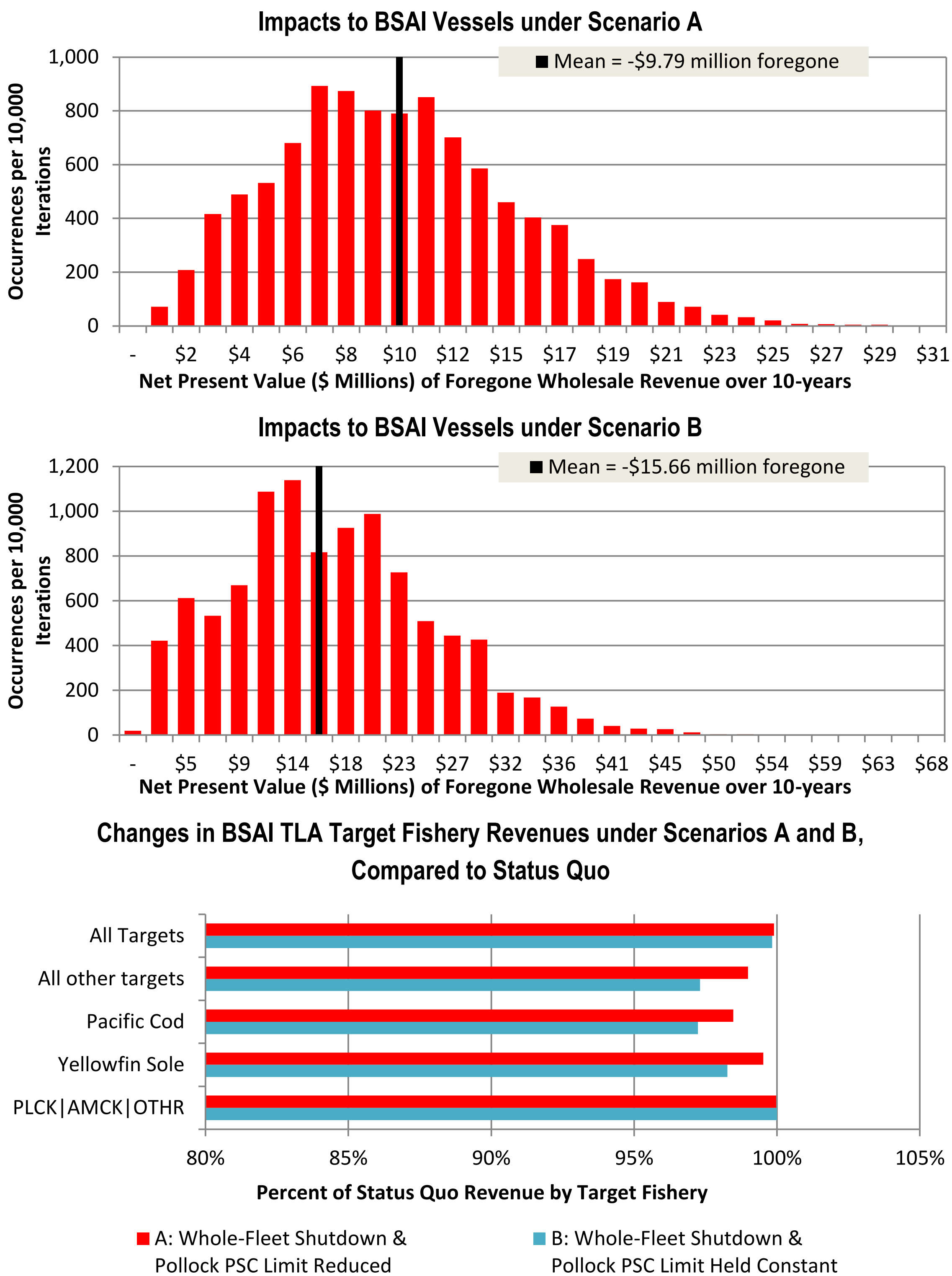
Source: Developed by Northern Economics based on NMFS (2014f).

Figure 5-57 on page 230 summarizes the impact of the PSC limit reduction on vessel and processors participating in the BSAI TLA groundfish fisheries. Under Scenario A, vessels and processors in the BSAI TLA are expected to forego an average of $9.79 million in net present value of wholesale revenues over the 10-year period modelled. Under Scenario B, the negative impact to the BSAI TLA participants jumps to an average net present value of $15.66 in foregone wholesale revenues over the 10-year period.

Figure 5-58 on page 231 summarizes the impacts of Option 2.1 on the commercial halibut fishery under Scenario A and Scenario B. The IMS Model results indicate that on average, over the 10,000 iterations ran for Scenario A, the net present value of changes from the status quo in terms of additional wholesale revenue generated from the commercial halibut fishery is $1.05 million of the 10-year period modelled. Under Scenario B, the average net present value over all 10,000 iterations is 34 percent higher at $1.41 million (in 2013$). It is important to emphasize that all of the result show the change estimated in the IMS Model for each variable. For example the <u>change in net present value</u> from the status quo equals the net present value of wholesale revenue under Option 2.1 <u>minus</u> the net present value of wholesale revenue in the status quo.

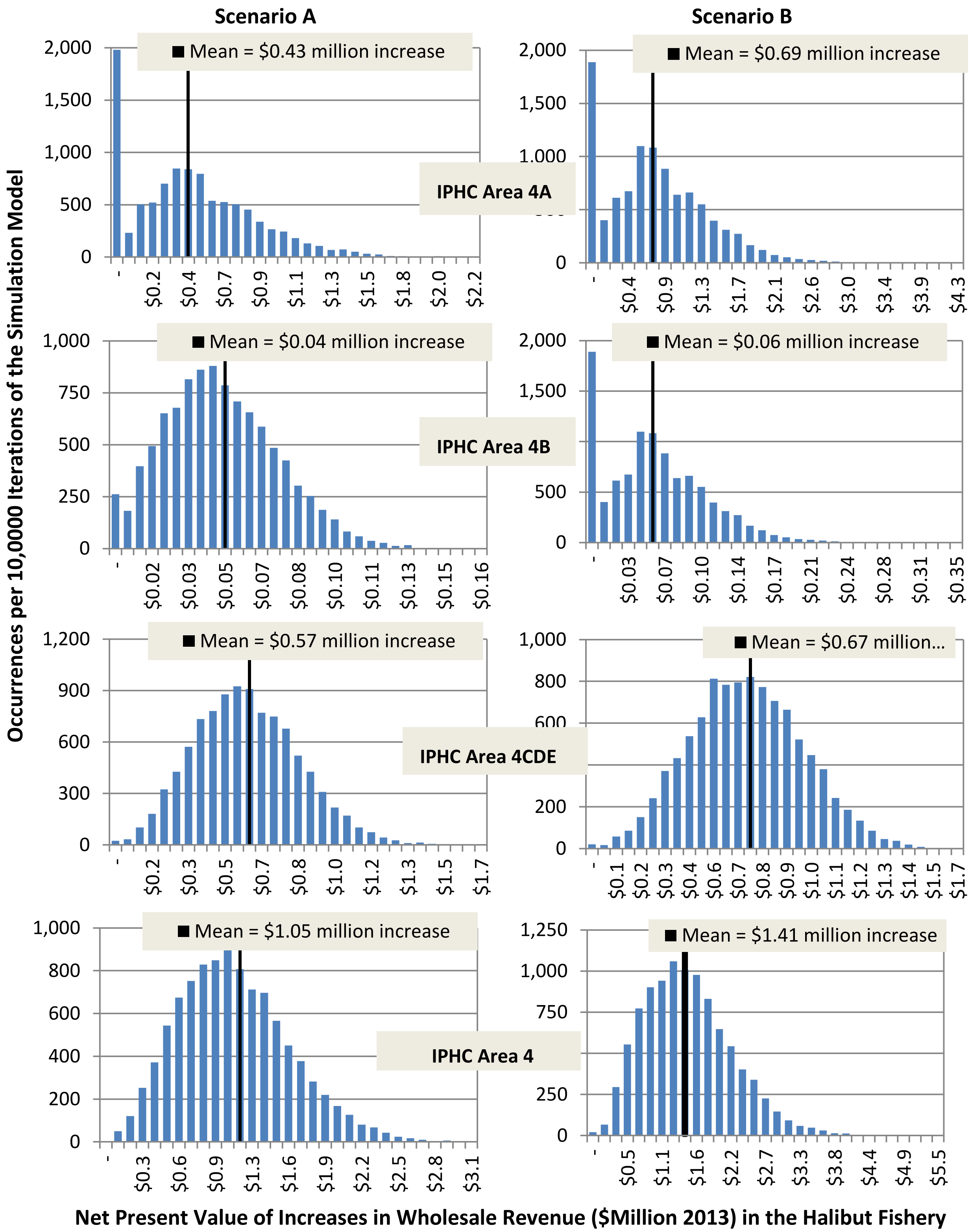
It is important to note that the values depicted in the histograms showing the distribution of the 10-year net present value of changes in wholesale revenue compared to the status quo for both the commercial halibut fishery and for the BSAI TLA cover 10,000 iterations, and that there is a fairly meaningful amount of variation within those iterations. The figures indicate that more of the iterations occur to the left of the mean than the right, indicating that the distribution is skewed toward smaller impacts (from an absolute value sense).

Figure 5-57 Impacts to BSAI TLA Vessels under Option 2.1—10% Reductions in Halibut PSC Limits



Scenario A assumes that pollock caps are reduced in the same proportion as all other caps.
Scenario B assumes that pollock caps are not reduced, but that caps for other targets are reduced to meet the PSC reduction goal.
Source: Developed by Northern Economics Using IMS Model Results for Option 2.1.

Figure 5-58 10-year Net Present Value of Revenue Impacts to Commercial Halibut Fisheries of Option 2.1



Note: Scenario A assumes that all caps including pollock caps are reduced, while Scenario B assumes that pollock caps are not reduced, but that caps for other targets are reduced to meet the PSC reduction goal.

Source: Developed by Northern Economics Using IMS Model Results for Option 2.1.

Table 5-99 summarizes additional details regarding the distributions of the net present values of changes in wholesale revenue from the status quo under the two scenarios for Option 2.1.

The table provides the following:

- Number of iterations by IPHC area in which the IMS model estimates no change from the Status Quo—occurs if the Basis Year generates no change in halibut in an area for the year.
- Minimum and Maximum Changes in the Magnitude of Net Present Value from the status quo. Because of all of the iterations with zero impacts, the minimum impacts seen in any iteration are also close to zero. The maximum change indicates the iteration with the largest magnitude of change.
- Mean changes in the Net Present Value from status quo were provided in the figures and are provided again here. On average, about 4 percent of impacts accrue to Area 4B, while 4A and 4CDE split the rest.
- Standard Deviation Changes in Net Present Value. If the distribution is normal, the rule of thumb is that 95 percent of all of the iterations will fall within a standard deviation on either side of the mean.
- The median change in the Net Present Value of changes from status quo: half of the iterations result in changes that are less than the median, and half are greater than the median. Under this suboption the median is smaller than the mean, indicating the distribution is skewed to the left.
- Mean Change in Halibut PSC Mortality (Round Weight): This is the average annual reduction in halibut PSC mortality by Area.
- Mean Change in Commercial Catch: This is the average annual increase in commercial halibut catch in net-weight tons (mt) by IPHC Area.
- Mean Change in Net Present Value per annual average change in halibut (mt): The denominator depends on whether the change is for the commercial halibut fishery or for the groundfish fishery.

Table 5-99 Statistical Details of the IMS Model Runs for Option 2.1

	Directed Halibut Fishery Impacts								Groundfish	
	Scenario A				Scenario B				Scenario A	Scenario B
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4	All Areas	
Iterations with No Change in Net Present Value (NPV)	1,980	262	23	-	1,888	1,888	20	20	-	20
Change in the Net Present Value of Wholesale Revenue from the Status Quo, Over All Iterations ($2013 Millions)										
Minimum Change in Magnitude of NPV	-	-	-	$0.00	-	-	-	-	($0.23)	-
Maximum Change in Magnitude of NPV	$2.13	$0.16	$1.60	$3.02	$4.15	$0.34	$1.60	$5.29	($30.10)	($65.35)
Mean Change in NPV	$0.43	$0.04	$0.57	$1.05	$0.69	$0.06	$0.67	$1.41	($9.79)	($15.66)
Standard Deviation of Changes in NPV	$0.37	$0.03	$0.24	$0.48	$0.57	$0.05	$0.26	$0.70	$4.75	$8.83
Median Change in NPV	$0.38	$0.04	$0.55	$1.00	$0.61	$0.05	$0.67	$1.35	($9.38)	($14.77)
Change in Average Annual Halibut (mt) from the Status Quo										
Mean Annual Change in Halibut PSC Mortality (Round Weight mt)	-5.00	-0.49	-6.57	-12.06	-7.94	-0.64	-7.95	-16.53	-12.06	-16.53
Mean Annual Change in Commercial Halibut Catch (Net Weight mt)	1.83	0.19	2.40	4.41	2.91	0.23	2.85	5.99	-	-
Mean Change in NPV (2013$ million) per annual change in halibut (mt)	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$1.08	$1.26

Source: Developed by Northern Economics Using IMS Model Results for Option 2.1.

5.7.2.2 Option 2–Suboption 2: Reduce Halibut PSC Limits for the BSAI TLA Fisheries by 20 Percent

This section summarizes the expected impacts to the BSAI TLA groundfish fisheries and to the Area 4 commercial halibut fisheries of Option 2.2. Under this option, the halibut PSC limit for BSAI TLA fisheries will be set at 80 percent of the status quo levels, or 700 mt, down from 875 mt.

As with Option 2.1, two Scenarios will be used to describe the potential impact of this reduction. Under Scenario A, all four of the target fishery-specific apportionments are set at levels equal to 80 percent of the level set under the status quo. Under Scenario B, the apportionment to the Pollock|Atka Mackerel|Other Species fishery is held constant at status quo levels, and apportionments to the remaining three target fishery groups are proportionally adjusted downward so that the total to all four target groups equals 700 mt. Table 5-100 shows the target fishery apportionments included in the IMS Model for Scenario A and Scenario B.

The lower portion of the table shows the minimum reduction in halibut PSC mortality (mt) from the status quo that would be expected for each Basis Year under the lower PSC mortality Apportionments under Option 2.2. The numbers in this part of the table are calculated by subtracting the new PSC mortality apportionment from the status quo halibut PSC mortality. The estimates can't be created without the IMS Model for the Pollock|Atka Mackerel|Other Species because of the exemption for the pollock target fisheries. From the lower part of the table we see that only when 2008, 2012 or 2013 are selected as Basis Years will there be any impact of the PSC reductions. Further, only when 2012 as a Basis Year will there be in impacts in the Pacific cod fishery.

Table 5-100 Target Fishery Apportionments for Basis Year under Scenario A and Scenario B for Option 2.2

	2008		2009		2010		2011		2012		2013	
Scenario	A	B	A	B	A	B	A	B	A	B	A	B
Target Fishery	**Target Fishery Apportionments (mt) for Basis Years under Scenario A and Scenario B**											
Yellowfin Sole	129.6	124.2	149.6	140.3	133.6	120.2	133.6	120.2	133.6	120.2	133.6	120.2
Rockfish	2.4	2.3	4.0	3.8	4.0	3.6	4.0	3.6	4.0	3.6	4.0	3.6
Pollock|AtkaM|Other	100.0	125.0	140.0	175.0	200.0	250.0	200.0	250.0	200.0	250.0	200.0	250.0
Pacific Cod	468.0	448.5	406.4	381.0	362.4	326.2	362.4	326.2	362.4	326.2	362.4	326.2
	Minimum Reduction in Halibut PSC Mortality (mt) from the Status Quo, Assuming Strict Enforcement of PSC Apportionments											
Yellowfin Sole	27.1	32.5	-	-	-	-	-	-	9.6	23.0	27.7	41.1
Rockfish	-	-	-	-	-	-	-	-	-	-	-	-
Pollock|AtkaM|Other	Because pollock is exempt the minimum halibut PSC reduction cannot be estimated without the IMS Model											
Pacific Cod	-	-	-	-	-	-	-	-	84.4	120.7	-	-
All Fisheries except Pollock|AtkaM|Other	**27.1**	**32.5**	**-**	**-**	**-**	**-**	**-**	**-**	**94.1**	**143.7**	**27.7**	**41.1**

Source: Developed by Northern Economics based on data from AKFIN (Fey 2014) and NMFS (2014f).

Figure 5-59 on page 236 summarizes the impact of the PSC limit reduction on vessel and processors participating in the BSAI TLA groundfish fisheries. Under Scenario A, vessels and processors in the BSAI TLA are expected to forego an average of $30.47 million in net present value of wholesale revenues over the 10-year period modelled. Under Scenario B, the negative impact to the BSAI TLA participants jumps to an average net present value of $50.35 in foregone wholesale revenues over the 10-year period.

Figure 5-60 on page 237 summarizes the impacts of Option 2.2 on the commercial halibut fishery under Scenario A and Scenario B. The IMS Model results indicate that on average, over the 10,000 iterations run for Scenario A, the net present value of changes from the status quo in terms of additional wholesale revenue generated from the commercial halibut fishery is $2.33 million over the 10-year period modelled—an increase of 111 percent over option 2.1. Under Scenario B, the average net present value over all 10,000 iterations is 136 percent higher at $3.33 million (in 2013$).

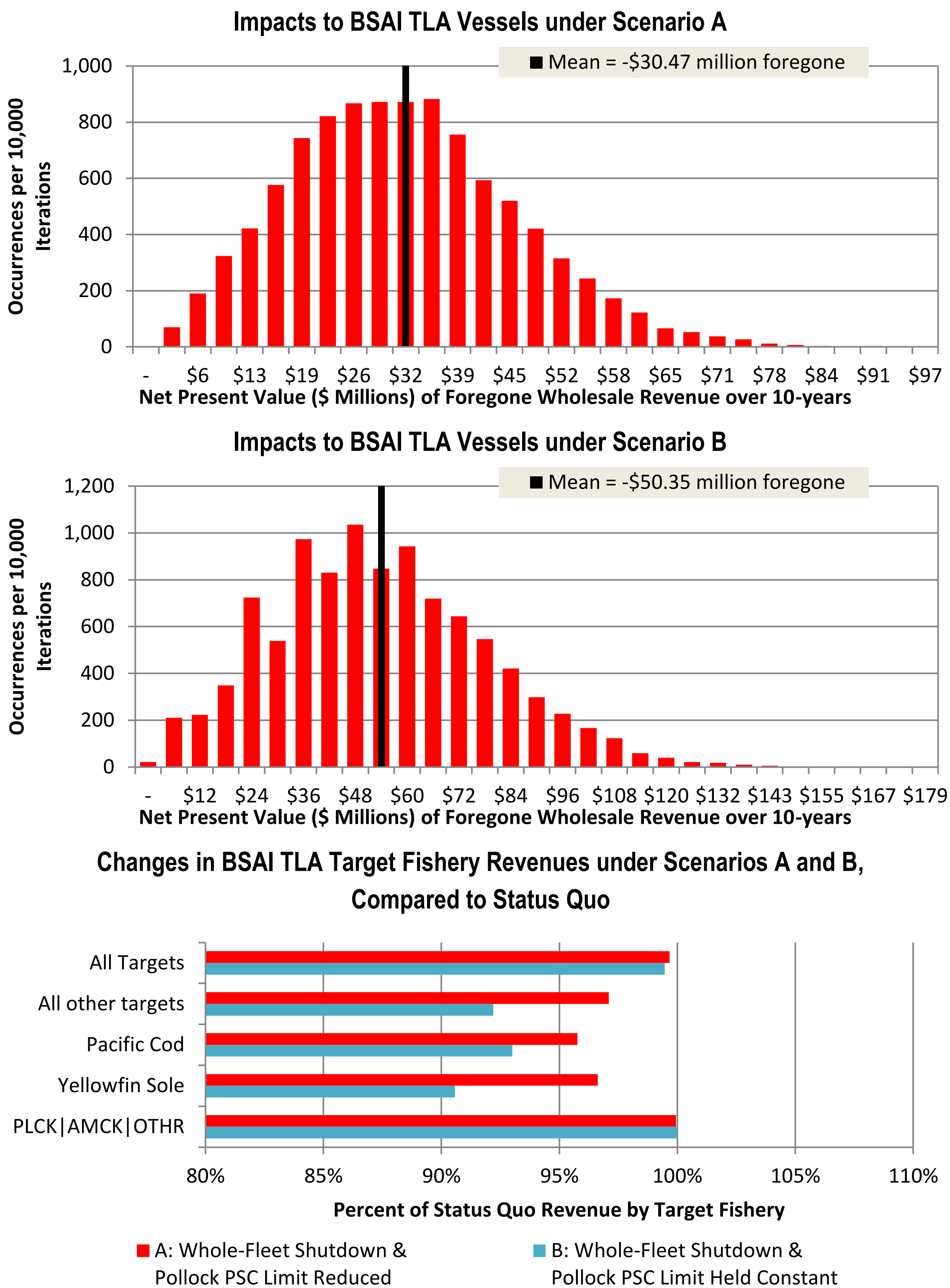
Table 5-101 provides additional statistical details from the IMS Model runs for Option 2.2. Once again impacts to 4A and 4CDE are split fairly evenly with 4B impacts increasing to about 8 percent of total.

Table 5-101 Statistical Details of the IMS Model Runs for Option 2.2

	Directed Halibut Fishery Impacts								Groundfish	
	Scenario A				Scenario B				Scenario A	Scenario B
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4	All Areas	
Iterations with No Change in Net Present Value (NPV)	271	12	10	0	1,895	1,895	21	21	0	21
Net Change in the Net Present Value of Wholesale Revenue from the Status Quo, Over All Iterations ($2013 Millions)										
Minimum Change in Magnitude of NPV	-	-	-	$0.01	-	-	-	-	($0.15)	-
Maximum Change in Magnitude of NPV	$4.38	$0.57	$2.66	$7.43	$7.76	$1.59	$4.25	$13.59	($94.04)	($173.38)
Mean Change in NPV	$0.95	$0.18	$1.20	$2.33	$1.28	$0.26	$1.79	$3.33	($30.47)	($50.35)
Standard Deviation of Changes in NPV	$0.79	$0.09	$0.43	$1.12	$1.07	$0.22	$0.66	$1.73	$14.05	$24.66
Median Change in NPV	$0.85	$0.17	$1.19	$2.21	$1.12	$0.23	$1.78	$3.12	($29.62)	($48.37)
Change in Average Annual Halibut (mt) from the Status Quo										
Mean Annual Change in Halibut PSC mortality (Round Weight (mt))	-11.00	-2.09	-14.23	-27.33	-14.67	-3.00	-21.01	-38.69	-27.33	-38.69
Mean Annual Change in Directed Catch (Net Weight mt)	4.03	0.74	5.06	9.83	5.40	1.11	7.56	14.06	-	-
Mean Change in NPV ($2013 million) per annual change in halibut (mt)	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$1.49	$1.74

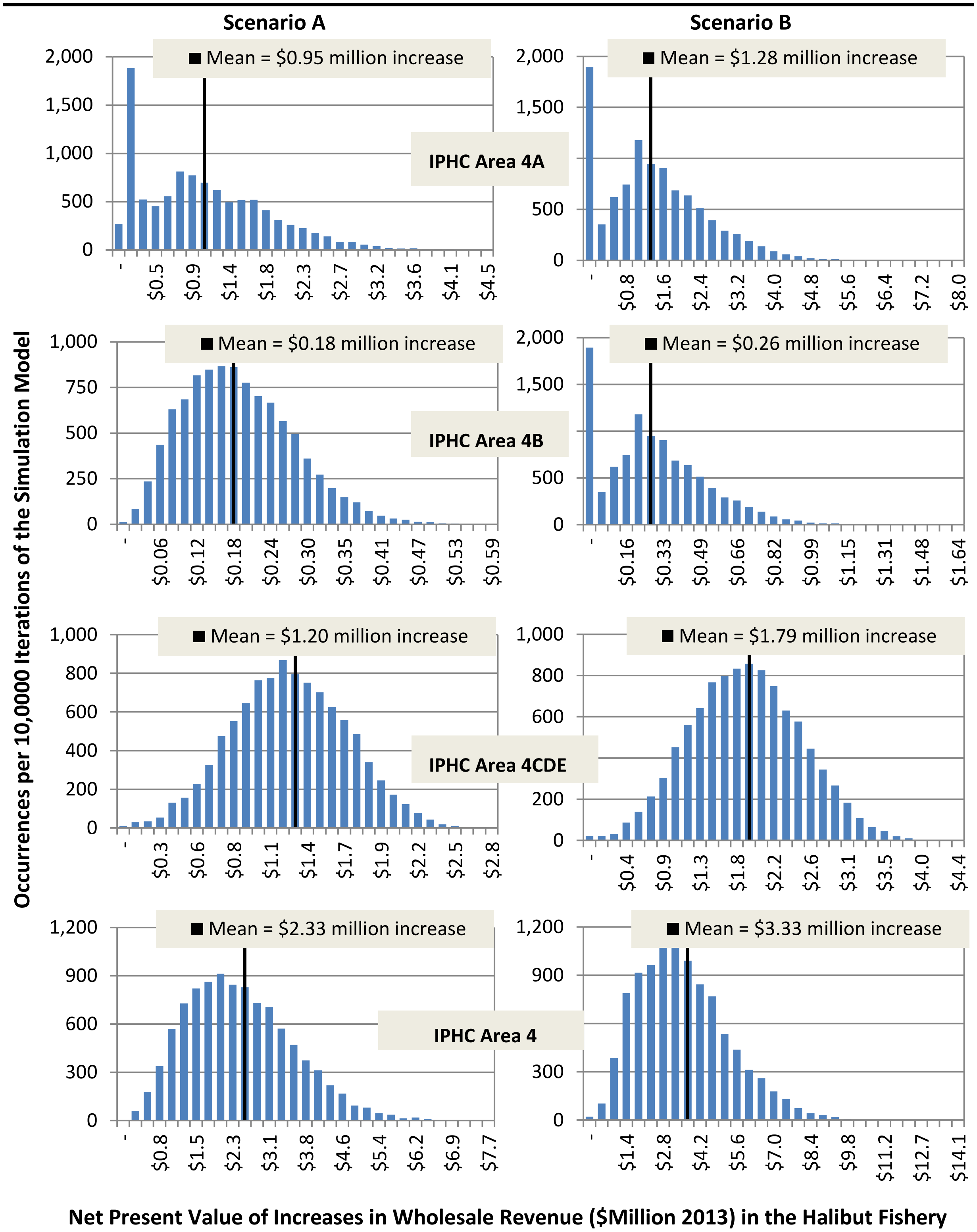
Source: Developed by Northern Economics Using IMS Model Results for Option 2.2.

Figure 5-59 Impacts to BSAI TLA Vessels under Option 2.2—20% Reductions in Halibut PSC Limits



Scenario A assumes that pollock caps are reduced in the same proportion as all other caps.
Scenario B assumes that pollock caps are not reduced, but that caps for other targets are reduced to meet the PSC reduction goal.
Source: Developed by Northern Economics Using IMS Model Results for Option 2.2.

Figure 5-60 Net Present Value of Revenue Impacts to Commercial Halibut Fisheries of Option 2.2



Note: Scenario A assumes that all caps including pollock caps are reduced, while Scenario B assumes that pollock caps are not reduced, but that caps for other targets are reduced to meet the PSC reduction goal.

Source: Developed by Northern Economics Using IMS Model Results for Option 2.2.

One of important findings for Option 2.2 that was not discussed for Option 2.1 is that fact that for the BSAI TLA participants, the net present value of the change in wholesale revenues increased from Option 2.1 by a much greater percentage than the net present value of the change for the commercial halibut fishery.

Under Option 2.1 for Scenario A, the commercial halibut fishery is expected to see an increase in the net present value relative to the status quo of $1.05 million over the 10-year in the model. For Scenario A under Option 2.2, the commercial halibut fishery gains $2.33 million in net present value, an increase of 122 percent over Option 2.1. A slightly greater percentage change (136 percent) is seen under Scenario B. The negative change to BSAI TLA from Option 2.1 to Option 2.2 increases by 211 percent under Scenario A and 222 percent under Scenario B. In other words, setting the limits at 80 percent of the status quo as opposed to setting them at 90 percent of the status quo limits more than doubles the positive increase in net present value for the commercial halibut fleet. However, the same change from (from Option 2.1 to Option 2.2) triples the amount of foregone wholesale revenues for the BSAI TLA participants.

The differences in the relative change percentages for the two fisheries can be explained by looking at the bottom row of Table 5-101 and comparing it to Table 5-99 for Option 2.1. The bottom row shows the change in net present value over the 10-year period divided by the annual average change in tons. For the commercial fishery we divide by net weight tons of increased harvest, and for the groundfish fishery we divide by the annual average of halibut PSC reductions.

For the commercial halibut fishery, the number is constant at $240,000 per net weight ton. This is logical because we would not expect the revenues generated per ton of harvest to change substantially within a given year with a relatively marginal increase in volume. For the BSAI TLA participants, however, the cost of reducing halibut PSC tends to increase with each additional ton. Under Option 2.1, Scenario A, the annual average of halibut PSC mortality is reduced by 9.0 mt at an average net present value change $1.08 million per mt; for Scenario B, in which annual average halibut PSC mortality fell by 12.4 mt, the net present value change was $1.26 million per mt. Under Option 2.2, average halibut PSC mortality reductions increased to 20.5 mt and 29.0 mt under Scenarios A and B, while the change in foregone net present value per ton jumped to $1.49 million and $1.74 respectively.

5.7.2.3 Option 2–Suboption 3: Reduce Halibut PSC Limits for the BSAI TLA Fisheries by 30 Percent

This section summarizes the expected impacts to the BSAI TLA groundfish fisheries and to the Area 4 commercial halibut fisheries of Option 2.3. Under this option, the halibut PSC limit for BSAI TLA fisheries will be set at 70 percent of the status quo levels, or 612.5 mt down from 875 mt.

Table 5-102 shows the target fishery apportionments included in the IMS Model for Scenario A and Scenario B for Option 2.3. The lower portion of the table shows the minimum reductions in halibut PSC mortality (mt) from the status quo that would be expected for each Basis Year under the lower PSC mortality Apportionments under Option 2.3. As in previous tables, estimates can’t be created without the IMS Model for the Pollock|Atka Mackerel|Other Species because of the exemption for the pollock target fisheries. With the increased reductions in PSC limits, the BSAI TLA rockfish fisheries will be affected for the time, and for the first time selection of 2012 as Basis Year will increase the impacts of the iterations.

Table 5-102 Target Fishery Apportionments for Basis Year under Scenario A and Scenario B for Option 2.3

	2008		2009		2010		2011		2012		2013	
Scenario	A	B	A	B	A	B	A	B	A	B	A	B
Target Fishery	**Target Fishery Apportionments (mt) for Basis Years under Scenario A and Scenario B**											
Yellowfin Sole	129.6	124.2	149.6	140.3	133.6	120.2	133.6	120.2	133.6	120.2	133.6	120.2
Rockfish	2.4	2.3	4.0	3.8	4.0	3.6	4.0	3.6	4.0	3.6	4.0	3.6
Pollock|AtkaM|Other	100.0	125.0	140.0	175.0	200.0	250.0	200.0	250.0	200.0	250.0	200.0	250.0
Pacific Cod	468.0	448.5	406.4	381.0	362.4	326.2	362.4	326.2	362.4	326.2	362.4	326.2
	Minimum Reduction in Halibut PSC Mortality (mt) from Status Quo, Assuming Strict Enforcement of PSC Apportionments											
Yellowfin Sole	43.3	51.4	-	-	-	-	-	-	26.3	46.4	44.4	64.5
Rockfish	-	0.1	-	-	-	-	0.0	0.6	-	-	-	0.5
Pollock|AtkaM|Other	Because pollock is exempt the minimum halibut PSC reduction cannot be estimated without the IMS Model											
Pacific Cod	-	-	-	-	-	-	-	-	129.7	184.1	-	50.8
All Fisheries except Pollock|AtkaM|Other	**43.3**	**51.4**	**-**	**-**	**-**	**-**	**0.0**	**0.6**	**156.1**	**230.5**	**44.4**	**115.7**

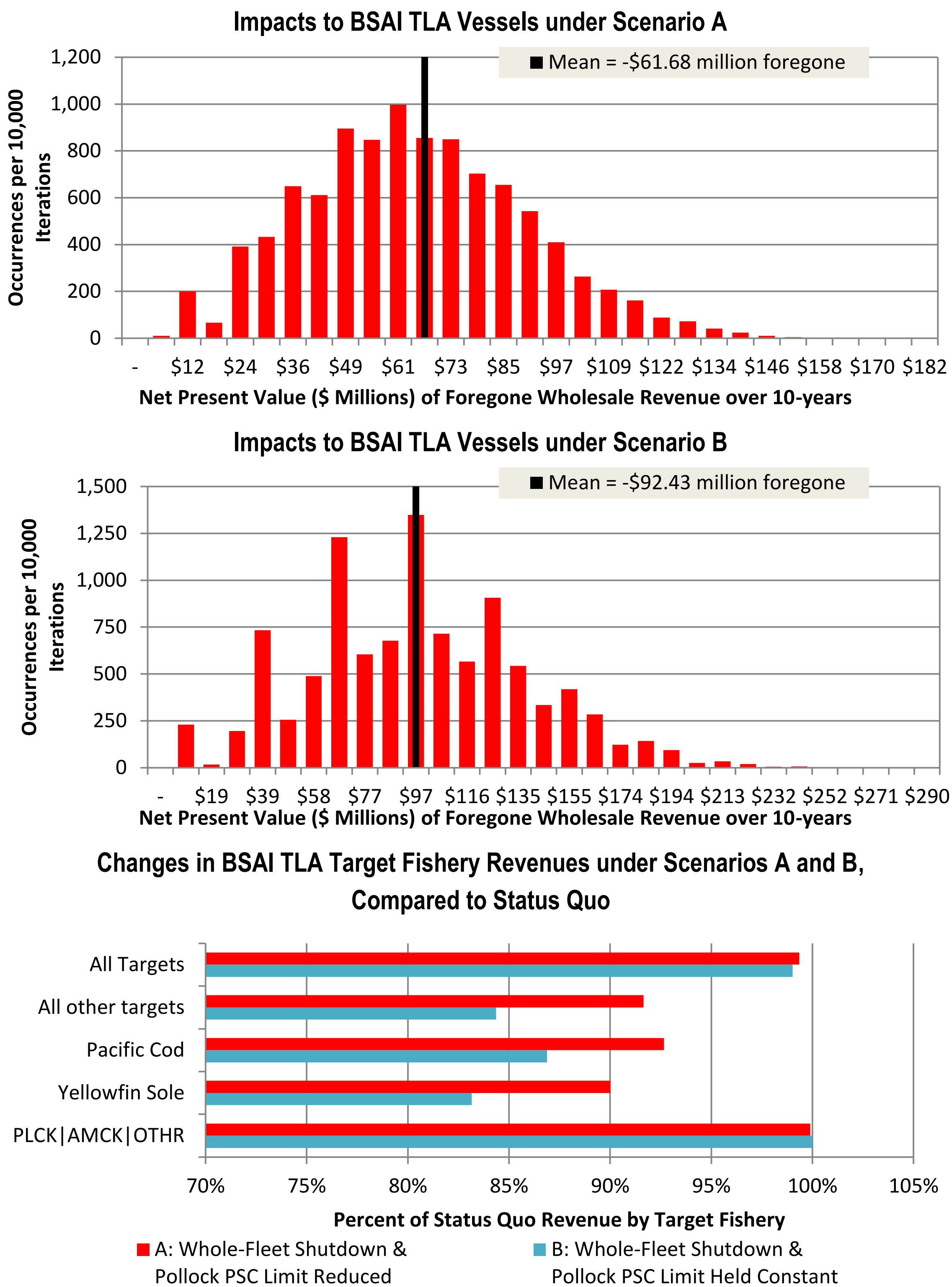
Source: Developed by Northern Economics based on data from AKFIN (Fey 2014) and NMFS (2014f).

Figure 5-61 on page 240 summarizes the impact of the PSC limit reduction on vessel and processors participating in the BSAI TLA groundfish fisheries. Under Scenario A, vessels and processors in the BSAI TLA are expected to forego an average of $61.67 million in net present value of wholesale revenues over the 10-year period modelled. Under Scenario B, the negative impact to the BSAI TLA participants increases to an average net present value of $92.44 in foregone wholesale revenues over the 10-year period—an increase of 84 percent over Option 2.2.

Figure 5-62 on page 241 summarizes the impacts of Option 2.3 on the commercial halibut fishery under Scenario A and Scenario B. The IMS Model results indicate that on average, over the 10,000 iterations ran for Scenario A, the net present value of changes from the status quo in terms of additional wholesale revenue generated from the commercial halibut fishery is $3.79 million over the 10-year period modelled—an increase of 63 percent over option 2.3. Under Scenario B, the average net present value over all 10,000 iterations is 76 percent higher at $5.85 million (in 2013$).

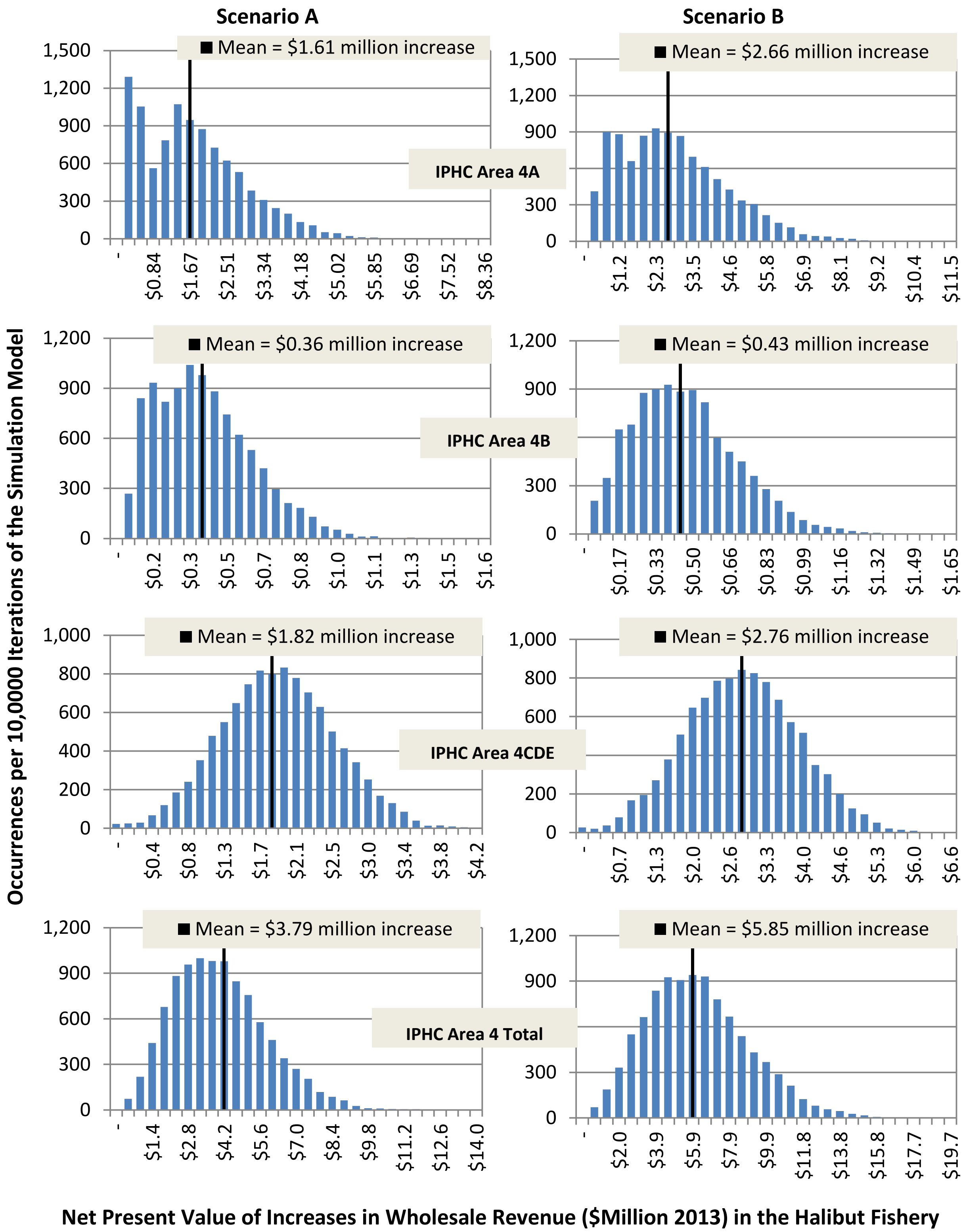
With Scenario A under Option 2.3, Area 4A generates 46 percent of the change in net present value for the commercial fishery with 47 percent going to Area 4CDE. With Scenario B, Area 4CDE generates 48 percent of the change in net present value over the 10-year period, while Area 4A realizes 42 percent.

Figure 5-61 Impacts to BSAI TLA Vessels under Option 2.3—30% Reductions in Halibut PSC Limits



Scenario A assumes that pollock caps are reduced in the same proportion as all other caps.
Scenario B assumes that pollock caps are not reduced, but that caps for other targets are reduced to meet the PSC reduction goal.
Source: Developed by Northern Economics Using IMS Model Results for Option 2.3.

Figure 5-62 Net Present Value of Revenue Impacts to Commercial Halibut Fisheries of Option 2.3



Note: Scenario A assumes that all caps including pollock caps are reduced, while Scenario B assumes that pollock caps are not reduced, but that caps for other targets are reduced to meet the PSC reduction goal.

Source: Developed by Northern Economics Using IMS Model Results for Option 2.3.

Details regarding the results of Option 2.3 are provided in Table 5-103. In general, the same pattern seen for Option 2.1 and Option 2.2 emerges for Option 2.3. The magnitude of net present value impacts increases for both the commercial halibut fishery (positive impacts) and for the BSAI TLA fishery (negative impacts). Once again, the bottom line of the table indicates that the BSAI TLA participants will need to forego even higher levels of net present value for each additional ton of PSC mortality reductions, while the commercial halibut fishery continues at a flat rate of increase per net weight ton gained.

Table 5-103 Statistical Details of the IMS Model Runs for Option 2.3

	Directed Halibut Fishery Impacts								Groundfish	
	Scenario A				Scenario B				Scenario A	Scenario B
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4	All Areas	
Iterations with No Change in Net Present Value (NPV)	0	1	22	0	2	2	26	2	0	2
Net Change in the Net Prseent Value of Wholesale Revenue from the Status Quo Over All Iterations ($2013 Millions)										
Minimum Change in Magnitude of NPV	$0.01	-	-	$0.03	-	-	-	-	($2.99)	-
Maximum Change in Magnitude of NPV	$8.08	$1.58	$4.08	$13.53	$11.15	$1.60	$6.40	$19.05	($176.29)	($280.59)
Mean Change in NPV	$1.61	$0.36	$1.82	$3.79	$2.66	$0.43	$2.76	$5.85	($61.67)	($92.44)
Standard Deviation of Changes in NPV	$1.14	$0.22	$0.66	$1.81	$1.67	$0.23	$1.01	$2.74	$25.69	$41.48
Median Change in NPV	$1.46	$0.34	$1.82	$3.62	$2.46	$0.41	$2.75	$5.62	($78.93)	($120.78)
Change in Average Annual Halibut (MT) from the Status Quo										
Mean Annual Change in Halibut PSC mortality (Round Weight MT)	-18.63	-4.30	-21.45	-44.38	-31.43	-5.20	-33.03	-69.66	-44.38	-69.66
Mean Annual Change in Directed Catch (Net Weight MT)	6.80	1.54	7.71	16.05	11.23	1.83	11.62	24.69	-	-
Mean Change in NPV (2013$ million) per annual change in halibut (mt)	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$1.85	$1.77

Source: Developed by Northern Economics Using IMS Model Results for Option 2.3.

5.7.2.4 Option 2–Suboption 4: Reduce Halibut PSC Limits for the BSAI TLA Fisheries by 35 Percent

Table 5-104 summarizes the target fishery apportionments for Option 2.5, which sets the BSAI TLA halibut PSC Limit at 568.8 mt. Figure 5-63 and Figure 5-64 on the following pages summarize the IMS Model results for BSAI TLA participants and the commercial halibut fishery respectively. Table 5-105 on page 243 provides additional statistical details of the IMS Model for the Option.

Table 5-104 Target Fishery Apportionments for Basis Year under Scenario A and Scenario B for Option 2.4

	2008		2009		2010		2011		2012		2013	
Scenario	A	B	A	B	A	B	A	B	A	B	A	B
Target Fishery	**Target Fishery Apportionments (mt) for Basis Years under Scenario A and Scenario B**											
Yellowfin Sole	129.6	124.2	149.6	140.3	133.6	120.2	133.6	120.2	133.6	120.2	133.6	120.2
Rockfish	2.4	2.3	4.0	3.8	4.0	3.6	4.0	3.6	4.0	3.6	4.0	3.6
Pollock|AtkaM|Other	100.0	125.0	140.0	175.0	200.0	250.0	200.0	250.0	200.0	250.0	200.0	250.0
Pacific Cod	468.0	448.5	406.4	381.0	362.4	326.2	362.4	326.2	362.4	326.2	362.4	326.2
	Minimum Reduction in Halibut PSC mortality (mt) from Status Quo, Assuming Strict Enforcement of PSC Apportionments											
Yellowfin Sole	51.4	60.8	-	-	-	-	-	-	34.7	58.1	52.8	76.1
Rockfish	0.1	0.2	-	-	-	-	0.3	1.0	-	-	0.1	0.8
Pollock|AtkaM|Other	Because pollock is exempt the minimum halibut PSC reduction cannot be estimated without the IMS Model											
Pacific Cod	-	-	-	-	-	26.3	-	29.8	152.4	215.8	19.1	82.5
All Fisheries except Pollock|AtkaM|Other	**51.4**	**61.1**	**-**	**-**	**-**	**26.3**	**0.3**	**30.8**	**187.1**	**273.9**	**72.0**	**159.5**

Source: Developed by Northern Economics based on data from AKFIN (Fey 2014) and NMFS (2014f).

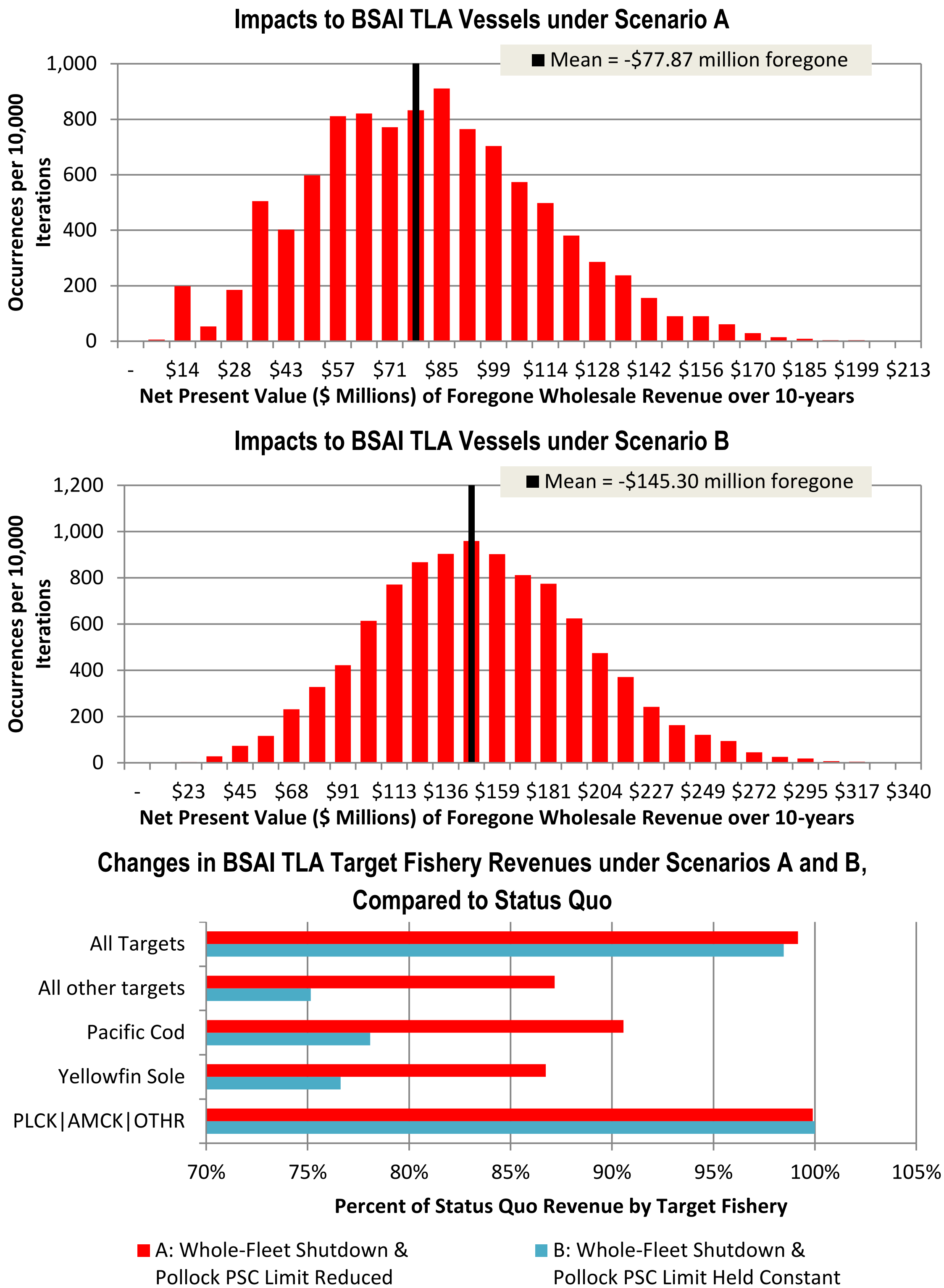
Details regarding the results of Option 2.4 are provided in Table 5-105. The magnitude of net present value impacts increase relative to the status quo and earlier options for both the commercial halibut fishery (positive impacts) and to the BSAI TLA fishery (negative impacts). The bottom line of the table shows that the BSAI TLA that the mean estimate foregone net present value over the ten year period ranges between $1.88 million and $1.97 million for each additional ton in annual PSC mortality reductions. The commercial halibut fishery gains net present value, but at the same rate of $240,000 over the 10-year period per net weight ton of annual harvests.

Table 5-105 Statistical Details of the IMS Model Runs for Option 2.4

	Directed Halibut Fishery Impacts								Groundfish	
	Scenario A				Scenario B				Scenario A	Scenario B
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4	All Areas	
Iterations with No Change in Net Present Value (NPV)	1	0	19	0	0	0	0	0	0	0
	Net Change in the Net Present Value of Wholesale Revenue from the Status Quo Over All Iterations ($2013 Millions)									
Minimum Change in Magnitude of NPV	-	$0.01	-	$0.01	$0.25	$0.03	$0.49	$0.77	($2.70)	($18.06)
Maximum Change in Magnitude of NPV	$8.47	$1.54	$5.37	$14.73	$12.78	$1.71	$8.23	$22.73	($206.01)	($328.54)
Mean Change in NPV	$1.87	$0.45	$2.37	$4.69	$4.00	$0.56	$3.85	$8.41	($77.87)	($145.30)
Standard Deviation of Changes in NPV	$1.30	$0.23	$0.87	$2.21	$1.92	$0.25	$1.11	$3.21	$32.11	$47.07
Median Change in NPV	$1.71	$0.42	$2.36	$4.48	$3.77	$0.53	$3.83	$8.11	($76.66)	($143.30)
	Change in Average Annual Halibut (MT) from the Status Quo									
Mean Annual Change in Halibut PSC mortality (Round Weight MT)	-21.73	-5.32	-28.17	-55.23	-46.86	-6.64	-45.02	-98.52	-55.23	-98.52
Mean Annual Change in Directed Catch (Net Weight MT)	7.89	1.88	9.99	19.77	16.88	2.36	16.28	35.53	-	-
Mean Change in NPV (2013$ million) per annual change in halibut (mt)	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$1.88	$1.97

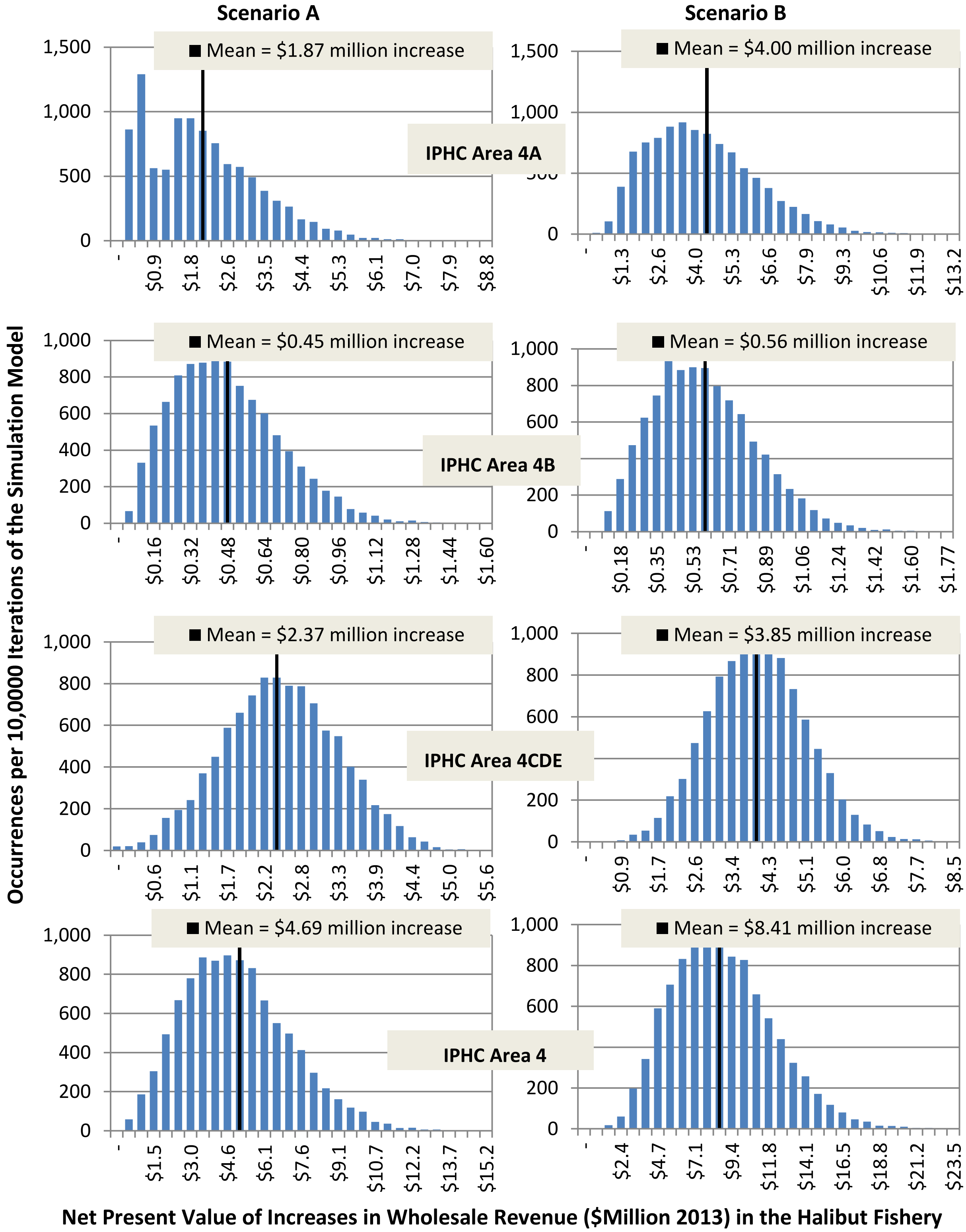
Source: Developed by Northern Economics Using IMS Model Results for Option 2.4.

Figure 5-63 Impacts to BSAI TLA Vessels under Option 2.4—35% Reductions in Halibut PSC Limits



Scenario A assumes that pollock caps are reduced in the same proportion as all other caps.
Scenario B assumes that pollock caps are not reduced, but that caps for other targets are reduced to meet the PSC reduction goal.
Source: Developed by Northern Economics Using IMS Model Results for Option 2.4.

Figure 5-64 Net Present Value of Revenue Impacts to Commercial Halibut Fisheries of Option 2.4



Note: Scenario A assumes that all caps including pollock caps are reduced, while Scenario B assumes that pollock caps are not reduced, but that caps for other targets are reduced to meet the PSC reduction goal.

Source: Developed by Northern Economics Using IMS Model Results for Option 2.4.

5.7.2.5 Summary of Impacts of Options Affecting Vessels Participants in the BSAI TLA

This section contains three tables that summarize the impacts of proposed options to reduce halibut PSC limits in the BSAI TLA fisheries, and with those reductions generate increased harvests in the commercial halibut fishery in Area 4.

- Table 5-106 summarizes the average changes in the net present value of wholesale revenue over the 10-year period simulated in the IMS Model. Net Present Value Changes for the BSAI TLA fishery are negative, while the net present value changes for the commercial halibut fishery are positive. Under Option 2.1, the ratio of impacts averaged over the two scenarios is -10.4 to 1. Under Option 2.4 the ratio of impacts averaged over Scenario A and B is -17.0 to 1.
- Table 5-107 shows, in the upper section, the average annual reduction in halibut PSC mortality (in round weight mt) in each IPHC subarea and for Area 4 as a whole. The lower portion of the table shows projected annual increases in commercial halibut harvests (in net weight mt). For each round weight ton that halibut PSC mortality is reduced, the commercial halibut fishery gains 0.36 tons (net weight). The difference is caused by three factors, which when multiplied equals 0.36.
    a) O26 halibut PSC mortality accounted for only 50 percent of BSAI TLA halibut PSC mortality during the Basis Years.
    b) The Area 4A halibut fleet on average catches only about 95 percent of the FCEY.
    c) The conversion factor moving from round weight to net weight is 75 percent.
- Table 5-108 shows the estimated 10-year change in net present value from the status quo per the annual average change in tons of halibut used. For the BSAI TLA fisheries, we divide the estimated mean of net present value of changes in wholesale revenue by the annual average reduction in halibut PSC mortality (in round weight tons). For the commercial halibut fishery, the mean of net present value of changes in wholesale revenue is divided by the annual average increase in catch (in net weight tons). For the BSAI TLA fishery, the foregone net present value of revenue per ton increases with increasing reduction amounts. For the commercial halibut fishery, the increased net present value of revenue per ton generates a constant return regardless of the amount of increase.

Table 5-106 Average Estimated Changes in the Net Present Value of Wholesale Revenue over 10 Years from Options 2.1–2.4

	BSAI TLA Groundfish Fishery Impacts			Commercial Halibut Fishery Impacts							
	PSC Limit	Scenario A	Scenario B	Scenario A				Scenario B			
Option	All Areas	All Areas		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	MT	Net Present Value of Change in Wholesale Revenues ($2013 Millions)									
2.1: -10%	788	($9.79)	($15.66)	$0.43	$0.04	$0.57	$1.05	$0.69	$0.06	$0.67	$1.41
2.2: -20%	700	($30.47)	($50.35)	$0.95	$0.18	$1.20	$2.33	$1.28	$0.26	$1.79	$3.33
2.3: -30%	613	($61.67)	($92.44)	$1.61	$0.36	$1.82	$3.79	$2.66	$0.43	$2.76	$5.85
2.4: -35%	569	($77.87)	($145.30)	$1.87	$0.45	$2.37	$4.69	$4.00	$0.56	$3.85	$8.41

Source: Developed by Northern Economics using IMS Model Results.

Table 5-107 Annual Average Change in Halibut PSC Mortality and Halibut Harvest for Options 2.1–2.4

	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Option	Average Annual Change in Groundfish Halibut PSC mortality (Round Weight MT) of BSAI TLA Vessels							
2.1: -10%	-5.00	-0.49	-6.57	-12.06	-7.94	-0.64	-7.95	-16.53
2.2: -20%	-11.00	-2.09	-14.23	-27.33	-14.67	-3.00	-21.01	-38.69
2.3: -30%	-18.63	-4.30	-21.45	-44.38	-31.43	-5.20	-33.03	-69.66
2.4: -35%	-21.73	-5.32	-28.17	-55.23	-46.86	-6.64	-45.02	-98.52
	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Option	Average Annual Change in Commercial Halibut Catch (Net Weight MT)							
2.1: -10%	1.83	0.19	2.40	4.41	2.91	0.23	2.85	5.99
2.2: -20%	4.03	0.74	5.06	9.83	5.40	1.11	7.56	14.06
2.3: -30%	6.80	1.54	7.71	16.05	11.23	1.83	11.62	24.69
2.4: -35%	7.89	1.88	9.99	19.77	16.88	2.36	16.28	35.53

Source: Developed by Northern Economics using IMS Model Results.

Table 5-108 10-year Net Present Value Change per Ton of Change in Halibut PSC mortality or Harvest, Options 2.1–2.4

	BSAI TLA Groundfish Fishery Impacts			Commercial Halibut Fishery Impacts							
	PSC Limit	Scenario A	Scenario B	Scenario A				Scenario B			
Option	All Areas	All Areas		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	MT	Net Present Value of Change in Wholesale Revenues ($2013 Millions) per Annual Change in Tons from the Status Quo									
2.1: -10%	788	$1.08	$1.26	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24
2.2: -20%	700	$1.49	$1.74	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24
2.3: -30%	613	$1.85	$1.77	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24
2.4: -35%	569	$1.88	$1.97	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24

Source: Developed by Northern Economics using IMS Model results.

5.7.3 Analysis of Impacts of Options Affecting the Amendment 80 Catcher Processors

In this section we summarize the impacts of proposed reductions of halibut PSC limits for the A80-CPs as proposed under Option 3. Four suboptions are specified as follows.

- Option 3.1: Reduce A80-CP Halibut PSC Limits by 10%
- Option 3.2: Reduce A80-CP Halibut PSC Limits by 20%
- Option 3.3: Reduce A80-CP Halibut PSC Limits by 30%
- Option 3.4: Reduce A80-CP Halibut PSC Limits by 35%

The PSC limit for the A80 fisheries is allocated to two A80 cooperative based on the catch histories of the A80-CPs included as members. Within each cooperative, the PSC mortality is apportioned to owner companies according to the internal rules of each cooperative, and then to vessels within each company based each firm's priorities. Within each cooperative PSC mortality may be transferred from company to company, and of course each company can re-assign PSC mortality however it wishes during the year. In addition, halibut PSC mortality may be transferred from one cooperative to another. Unlike the target fishery-specific PSC Limits in the BSAI TLA fishery, the halibut PSC limit for A80-CPs is not subdivided by target fishery—each company may use its halibut PSC mortality in whichever target fishery they choose.

The assessment of impacts of the proposed reductions in PSC limits is accomplished through the use of the IMS Model that is described in considerable detail in Section 5.4.3. In general, the IMS Model looks out at the next 10 years under each suboption, and assumes that any one of the years between 2008 and 2013 repeats itself one or more times as a Basis Year for 2014 to 2023. The halibut PSC mortality taken in each Basis Year by IPHC area, as well as the groundfish revenue generated in that year, are placed into the model after the Basis Years are drawn at random. Basis Year estimates of wholesale revenue per net weight ton of halibut harvested in the Area 4 halibut fishery are also used in the model.

The IMS Model compares catch, halibut PSC mortality, and wholesale revenue of the 10-year period under the status quo PSC limit against the same randomly assigned 10-year period assuming that the reduced PSC limit is imposed. The PSC limit reduction, if it is binding, results in reductions in groundfish harvests and reductions in ex-vessel and wholesale revenues that are generated. The model also calculates changes in the directed halibut fishery FCEY based on the changes in the PSC mortality halibut mortality from previous years. If the reduction in the PSC limit is binding, then the FCEY for the directed fishery increases and therefore catch and revenues also increase. In order to be reasonably certain that the selection of Basis Years and the order of those years do not unnecessarily bias the outcome, the IMS Model runs 10,000 iterations, and the results over each of those 10,000 iterations are compiled and summarized.

For each suboption, IMS Model is run under two different scenarios that represent a low impact case (Scenario A) and a high impact case (Scenario B) as described below:

- Scenario A: Under Scenario A it is assumed that operators of A80-CPs, using sector-wide fishery data for the years 2008 to 2013, determine the particular months and target fisheries that generate the lowest wholesale revenue per ton of halibut mortality. They then avoid fishing for those targets in those months. For analytical purposes it is assumed that operators know in advance how much halibut savings will be created by dropping these target months from their repertoire.
- Scenario B: Under Scenario B it is assumed that each A80 company is assigned its own halibut cap by the cooperative in which it operates. Companies that have excess PSC mortality are assumed to transfer PSC mortality to companies that don't have enough PSC mortality. It is also

assumed, however, that each company with excess PSC mortality holds back 5 percent of their halibut in case they need it later in the year. Finally, it is assumed that if transfers of halibut are not available, then companies with a PSC mortality shortfall will reduce the length of time that its least “efficient” vessel operates.

Scenario A ends up having a lower impact than Scenario B, in part because of the assumption that the A80 fleet knows in advance how many “target months” in low-value fisheries they need to avoid to stay under the fleet-wide cap, and in part because of the assumed stickiness in the transfers in Scenario B.

For each suboption the analysis will present a relatively high-level summary of impacts. For the halibut fishery, each assessment will present the IMS Model results in the form of eight histograms showing the net present value of the total change in wholesale revenues relative to the status quo over the 10-year period modelled, for each IPHC area (Area 4A, 4B and 4CDE) and for Area 4 overall.

The impact of the proposed PSC limit reductions on the A80 groundfish fisheries will also be summarized using histograms. The histograms will show the distribution of the net present value of changes from the status quo in wholesale revenue over the 10-year period. Two histograms are provided, one for each impact scenario (A & B). Finally, a third summary figure is provided showing overall changes under each scenario in the major A80 target fisheries relative to the status quo.

Table 5-109 summarizes PSC limits and halibut PSC mortality (mortality) for 2008 to 2013. The first set of two rows shows the limits and halibut PSC mortality as they actually were during the Basis Years. The second set of rows shows the PSC limits and halibut PSC mortality for the Basis Years as modelled under the status quo, noting that the status quo PSC limits for 2008 to 2010 are lower than the historic levels, and also noting that A80-CP halibut PSC mortality in every year from 2008 to 2013 was lower than the PSC limit. Each of the remaining sets of three rows summarize the PSC Limit and halibut PSC mortality amount that are input in the IMS Model for the option under each of the Basis Years. The lightly shaded cells indicate that the PSC Limit is not binding for that year and the halibut PSC mortality amounts were unchanged. In general, the modelled halibut PSC mortality amounts under Scenario A are between 3 to 5 mt of the PSC limit. Under Scenario B, halibut PSC mortality amounts generally range from 20 to 60 mt less than under Scenario A, with a few exceptions.

Table 5-109 Historical and Modelled Halibut PSC Limits and PSC mortality for A80-CPs

	2008	2009	2010	2011	2012	2013	Average
Historical Halibut PSC Limits and Actual Halibut PSC mortality (mt)							
PSC Limit	2,525.0	2,475.0	2,425.0	2,375.0	2,325.0	2,325.0	2,408.3
Actual PSC	1,969.0	2,073.7	2,253.6	1,810.2	1,945.4	2,168.3	2,036.7
Modelled Halibut PSC Limit and Halibut PSC mortality under the Status Quo							
PSC Limit	2,325.0	2,325.0	2,325.0	2,325.0	2,325.0	2,325.0	2,325.0
PSC Scenarios A & B	1,969.0	2,073.7	2,253.6	1,810.2	1,945.4	2,168.3	2,036.7
Modelled Halibut PSC Limit and Halibut PSC mortality under Option 3.1 (Reduce PSC Limit by 10%)							
PSC Limit	2,092.5	2,092.5	2,092.5	2,092.5	2,092.5	2,092.5	2,092.5
PSC Scenario A	1,969.0	2,073.7	2,088.9	1,810.2	1,945.4	2,092.4	1,996.6
PSC Scenario B	1,969.0	2,073.7	2,052.3	1,810.2	1,945.4	2,030.5	1,980.2
Modelled Halibut PSC Limit and Halibut PSC mortality under Option 3.2 (Reduce PSC Limit by 20%)							
PSC Limit	1,860.0	1,860.0	1,860.0	1,860.0	1,860.0	1,860.0	1,860.0
PSC Scenario A	1,854.6	1,858.7	1,858.6	1,810.2	1,850.5	1,841.7	1,845.7
PSC Scenario B	1,805.1	1,807.3	1,855.6	1,810.2	1,819.4	1,847.6	1,824.2
Modelled Halibut PSC Limit and Halibut PSC mortality under Option 3.3 (Reduce PSC Limit by 30%)							
PSC Limit	1,627.5	1,627.5	1,627.5	1,627.5	1,627.5	1,627.5	1,627.5
PSC Scenario A	1,622.8	1,623.2	1,622.7	1,622.7	1,625.2	1,622.7	1,623.2
PSC Scenario B	1,587.5	1,583.9	1,586.6	1,606.4	1,604.6	1,601.8	1,595.1
Modelled Halibut PSC Limit and Halibut PSC mortality under Option 3.4 (Reduce PSC Limit by 35%)							
PSC Limit	1,511.3	1,511.3	1,511.3	1,511.3	1,511.3	1,511.3	1,511.3
PSC Scenario A	1,508.3	1,508.4	1,510.9	1,482.6	1,509.7	1,509.7	1,504.9
PSC Scenario B	1,476.4	1,456.1	1,497.2	1,490.6	1,494.2	1,474.9	1,481.6

Source: Developed by Northern Economics based on AKFIN data (Fey 2014).

5.7.3.1 Option 3–Suboption 1: Reduce Halibut PSC Limits for the A80-CP Fisheries by 10 Percent

Based on Table 5-109 above, the 10 percent reduction in PSC Limits from status quo as proposed under Option 1 will only generate impacts when 2009 or 2013 are selected as the Basis Year in the IMS Model. The Model results for Option 3.1 are summarized in the two sets of figures on the following pages. Figure 5-65 on page 252 summarizes the distribution of changes in net present value of wholesale value for A80-CPs. Figure 5-66 on page 253 summarizes the distribution of changes in net present value of wholesale value over the 10-year period for the commercial halibut fishery in Areas 4A, 4B, 4CDE and Area 4 as a whole. Table 5-110 below presents the statistical details of the IMS Model runs for Scenarios A and B.

On average over the 10,000 iteration in the IMS Model, the commercial halibut fishery would realize a $4.21 million increase in the net present value of wholesale revenue over a 10-year period under Scenario A. Under the same Scenario, the A80-CPs would see an average decrease in their net present value of wholesale revenue of 9.94 million. This is change ratio -2.36 to 1 favoring the commercial halibut fishery. Under Scenario B the change ratio is -3.24 to 1.

Under both Scenarios, over 90 percent of the reduction in halibut PSC mortality and over 90 percent of the increases in commercial harvests accrue to Area 4CDE, while very little, if any, change is seen in Area 4B. In general for every round weight ton of halibut PSC mortality cut by the A80-CPs, the commercial halibut fishery gains 0.47 net weight tons of commercial harvest. This difference is attributed to the 0.75 factor to convert round weight to net weight, the 95 percent historical catch to FECY ratio in Area 4, and the 65.5 to 34.5 percent O26 to U26 ratio for A80-CP halibut PSC mortality during the Basis Years.

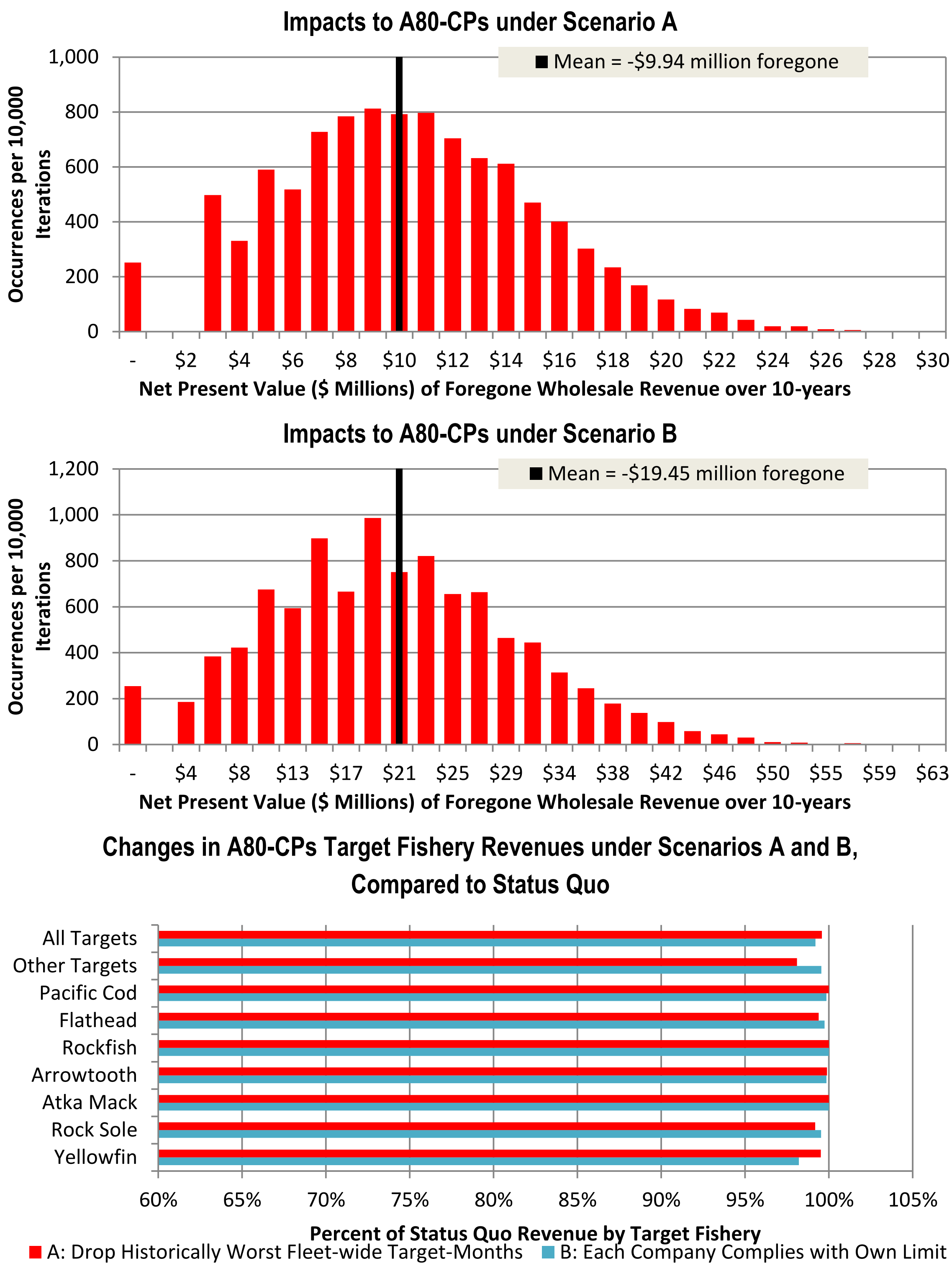
The bottom line of Table 5-110 shows that the commercial halibut fishery generated a $240,000 increase in their net present value of wholesale revenue (over the 10-year period) for every additional net weight ton they harvested annually. This value remains constant for all areas under both scenarios. Under Scenario A, A80-CPs had to forego $250,000 of net present value over the 10-year period for each halibut PSC mortality mt cut on an annual basis—an amount only slightly higher than gains/annual ton in the commercial halibut fishery. Under Scenario B, the foregone net present value per ton of annual halibut PSC mortality reduction for A80-CPs jumps to $340,000. The increase results because the mechanics of Scenario B mean that the A80 fleet may be forced to cut back on trips that generate relatively high levels of revenue per ton of halibut PSC mortality.

Table 5-110 Statistical Details of the IMS Model Runs for Option 3.1

	Directed Halibut Fishery Impacts								Groundfish	
	Scenario A				Scenario B				Scenario A	Scenario B
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4	All Areas	
Iterations with No Change in Net Present Value (NPV)	252	1,900	252	252	1,943	10,000	254	254	252	254
Net Change in the Net Present Value of Wholesale Revenue from the Status Quo Over All Iterations ($2013 Millions)										
Minimum Change in Magnitude of NPV	-	-	-	-	-	-	-	-	-	-
Maximum Change in Magnitude of NPV	$1.53	$0.03	$14.33	$15.87	$0.92	-	$17.33	$18.10	($29.22)	($60.91)
Mean Change in NPV	$0.32	$0.01	$3.88	$4.21	$0.18	-	$5.83	$6.00	($9.94)	($19.45)
Standard Deviation of Changes in NPV	$0.24	$0.01	$2.17	$2.39	$0.15	-	$3.03	$3.14	$4.86	$9.73
Median Change in NPV	$0.28	$0.01	$3.67	$3.97	$0.16	-	$5.60	$5.74	($9.66)	($18.79)
25th Percentile of NPV Changes	$0.12	$0.00	$2.28	$2.42	$0.05	-	$3.66	$3.75	($6.55)	($12.58)
75th Percentile of NPV Changes	$0.47	$0.01	$5.26	$5.73	$0.27	-	$7.79	$8.02	($13.21)	($25.87)
Change in Average Annual Halibut (MT) from the Status Quo										
Mean Annual Change in Halibut PSC mortality (Round Weight MT)	-3.08	-0.06	-36.88	-40.03	-1.72	-	-55.25	-56.97	-40.03	-56.97
Mean Annual Change in Directed Catch (Net Weight MT)	1.36	0.03	16.43	17.81	0.74	-	24.64	25.39	-	-
Mean Change in NPV (2013$ million) per annual change in halibut (mt)	$0.24	$0.24	$0.24	$0.24	$0.24	-	$0.24	$0.24	$0.25	$0.34

Source: Developed by Northern Economics Using IMS Model Results for Option 3.1.

Figure 5-65 Impacts to A80-CPs under Option 3.1—10% Reductions in Halibut PSC Limits

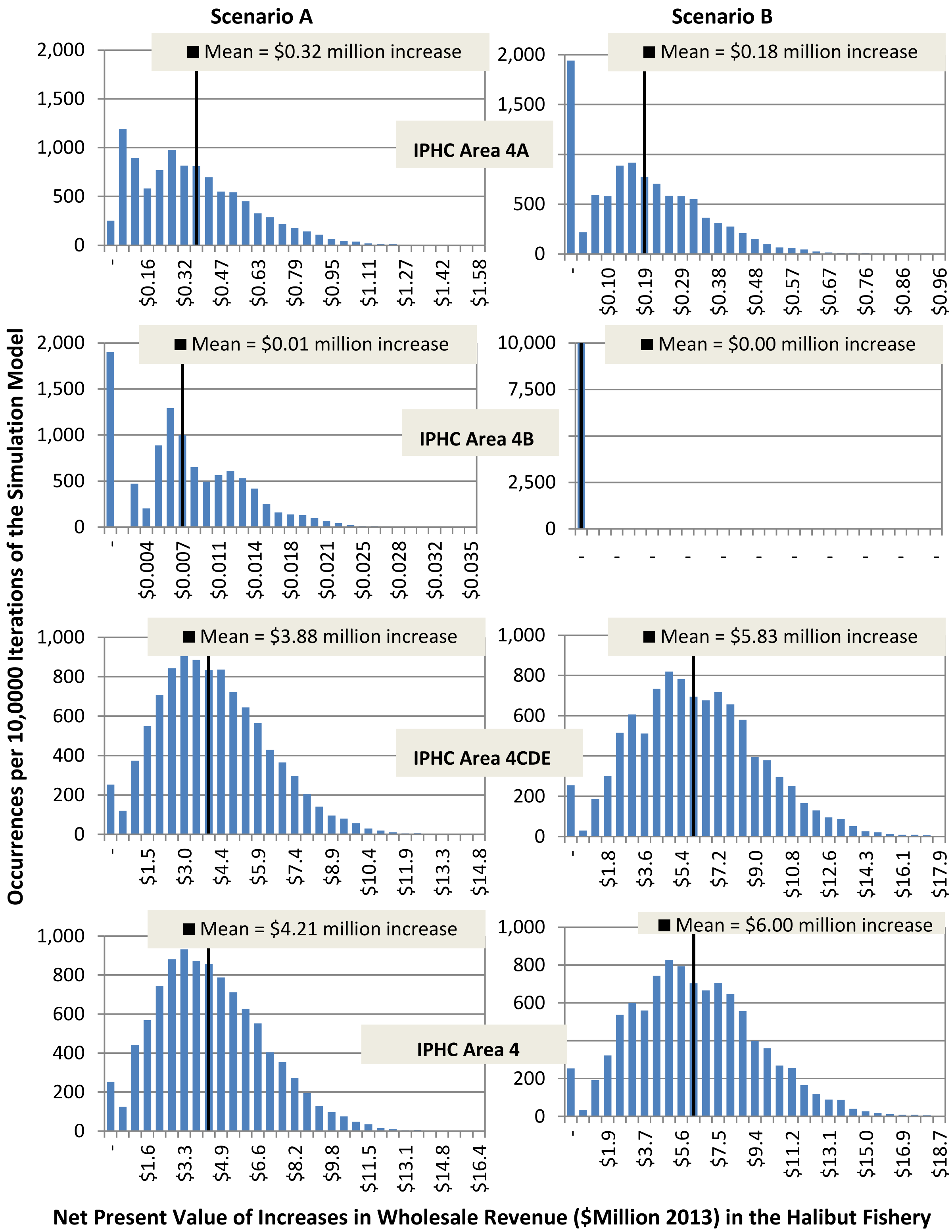


Scenario A assumes that A80-CPs choose to drop target fisheries in months that have historically produced the least wholesale revenue per ton of halibut mortality.

Scenario B assumes each A80 company has its own limit and they drop target months at the end of the year of vessels that have lower wholesale revenues per ton of halibut mortality.

Source: Developed by Northern Economics Using IMS Model Results for Option 3.1.

Figure 5-66 Net Present Value of Revenue Impacts to Commercial Halibut Fisheries of Option 3.1



Note: Scenario A assumes that A80-CPs drop target fisheries in months that have historically produced the least wholesale revenue per ton of halibut mortality. Scenario B assumes each A80 company has its own limit and they drop end-of-year target months of vessels that have the least annual wholesale revenues per ton of halibut.

5.7.3.2 Option 3–Suboption 2: Reduce Halibut PSC Limits for the A80-CP Fisheries by 20 Percent

Figure 5-67 on page 256 summarizes the results of Option 3.2 for the A80-CPs. Figure 5-68 on page 257 summarizes the IMS Model results for the commercial halibut fishery under Option 3.2 for Scenarios A and B. Table 5-111 below presents the statistical details of the model runs for the Option, which reduces halibut PSC limit for A80-CPs to 1,860 mt—80 percent of status quo PSC limit. As seen in Table 5-109 on page 250, Option 3.2 will reduce halibut PSC mortality in all the Basis Years with the exception of 2011. This contrasts with Option 3.1, which would have only reduced halibut PSC mortality when 2010 or 2013 were selected as Basis Years in the IMS Model.

On average the IMS Model results indicate that commercial halibut fishery will realize a $20.21 million increase in the net present value of wholesale revenue under Scenario A. Under the same Scenario, the A80-CPs are expected to realize an average decrease in the net present value of wholesale revenue of over $52 million. This is a change ratio -2.58 to 1 favoring the commercial halibut fishery. Under Scenario B, the change ratio was estimated at -5.12 to 1 with the A80-CPs seeing a $114 million loss in net present value compared to a gain in net present value of $22.39 million for the commercial halibut fishery.

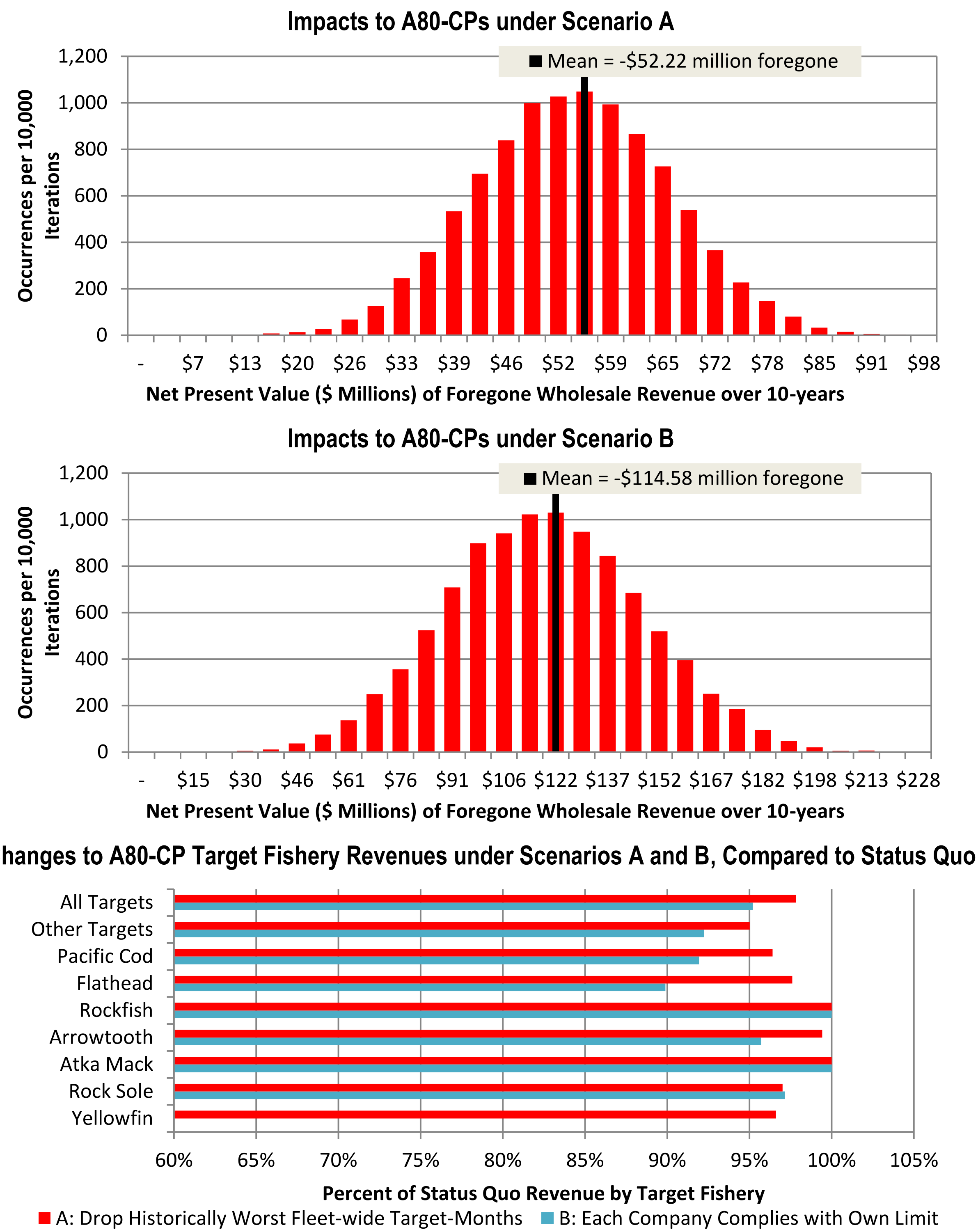
Under both Scenarios, between 86 and 89 percent of the changes are projected to accrue to Area 4CDE, with the remainder attributed to Area 4A. As under Option 3.1, for every round weight ton of halibut PSC mortality reductions by the A80-CPs, the commercial halibut fishery gains 0.47 net weight tons of commercial harvest.

The bottom line of Table 5-111 shows that the commercial halibut fishery generated a $240,000 increase in their net present value of wholesale revenue (over the 10-year period) for every additional net weight ton they harvested on an annual basis—the same amount generated under Option 3.1 and under Options 2.1–2.4. Under Scenario A, A80-CPs had to forego $270,000 of net present value over the 10-year period for each ton of halibut PSC mortality they cut on an annual basis. Under Scenario B, the foregone net present value per ton of annual halibut PSC mortality reduction for A80-CPs jumps to $540,000. The increase results because the mechanics of Scenario B mean that the A80 fleet may be forced to cut back on trips that generate relatively high levels of revenue per ton of halibut PSC mortality.

Table 5-111 Statistical Details of the IMS Model Runs for Option 3.2

	Directed Halibut Fishery Impacts								Groundfish	
	Scenario A				Scenario B				Scenario A	Scenario B
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4	All Areas	
Iterations with No Change in Net Present Value (NPV)	0	1,933	0	0	0	10,000	0	0	0	0
Net Change in the Net Present Value of Wholesale Revenue from the Status Quo Over All Iterations ($2013 Millions)										
Minimum Change in Magnitude of NPV	$0.62	-	$4.26	$5.01	$0.23	-	$3.06	$3.71	($9.40)	($12.72)
Maximum Change in Magnitude of NPV	$7.76	$0.03	$33.49	$39.80	$5.82	-	$41.72	$44.26	($94.38)	($220.31)
Mean Change in NPV	$2.76	$0.01	$17.44	$20.21	$2.57	-	$19.82	$22.39	($52.22)	($114.58)
Standard Deviation of Changes in NPV	$1.08	$0.01	$4.22	$5.00	$0.83	-	$4.58	$4.79	$11.90	$28.61
Median Change in NPV	$2.63	$0.01	$17.26	$19.98	$2.52	-	$19.54	$22.18	($52.23)	($114.23)
25th Percentile of NPV Changes	$1.93	$0.00	$14.47	$16.72	$1.97	-	$16.61	$19.12	($43.97)	($94.69)
75th Percentile of NPV Changes	$3.45	$0.01	$20.27	$23.47	$3.11	-	$22.80	$25.55	($60.47)	($134.22)
Change in Average Annual Halibut (MT) from the Status Quo										
Mean Annual Change in Halibut PSC mortality (Round Weight MT)	-26.38	-0.06	-164.78	-191.23	-24.42	-	-187.49	-211.91	-191.23	-211.91
Mean Annual Change in Directed Catch (Net Weight MT)	11.66	0.03	73.74	85.43	10.84	-	83.75	94.59	-	-
Mean Change in NPV (2013$ million) per annual change in halibut (mt)	$0.24	$0.24	$0.24	$0.24	$0.24	-	$0.24	$0.24	$0.27	$0.54

Figure 5-67 Impacts to A80-CPs under Option 3.2—20% Reductions in Halibut PSC Limits

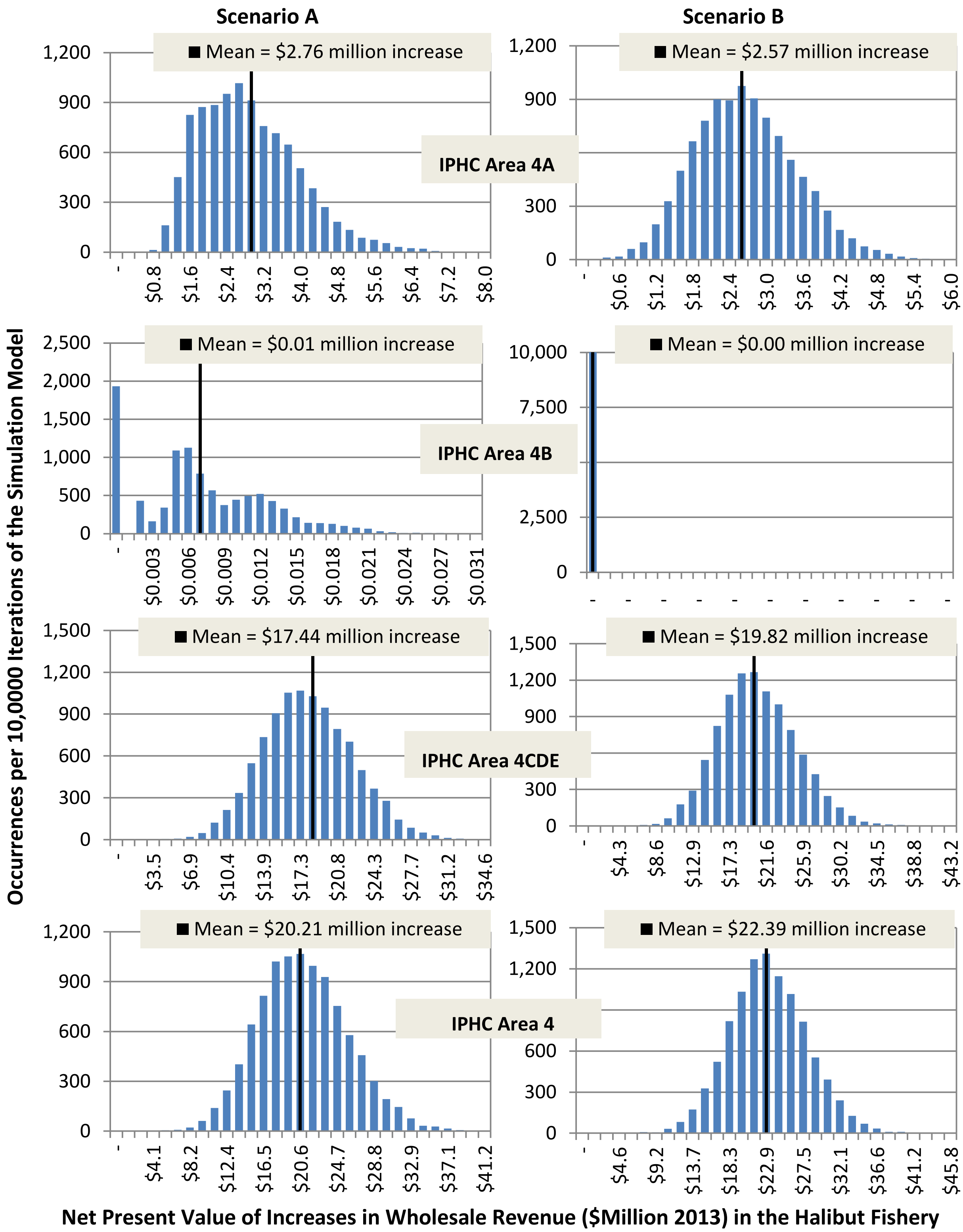


Scenario A assumes that A80-CPs choose to drop target fisheries in months that have historically produced the least wholesale revenue per ton of halibut mortality.

Scenario B assumes each A80 company has its own limit and they drop target months at the end of the year of vessels that have lower wholesale revenues per ton of halibut mortality.

Source: Developed by Northern Economics based on IMS Model runs for Option 3.2.

Figure 5-68 Net Present Value of Revenue Impacts to Commercial Halibut Fisheries of Option 3.2



Note: Scenario A assumes that A80-CPs drop target fisheries in months that have historically produced the least wholesale revenue per ton of halibut mortality. Scenario B assumes each A80 company has its own limit and they drop end-of-year target months of vessels that have the least annual wholesale revenues per ton of halibut.

5.7.3.3 Option 3–Suboption 3: Reduce Halibut PSC Limits for the A80-CP Fisheries by 30 Percent

Figure 5-69 on page 260 summarizes the results for the A80-CPs. Figure 5-70 on page 261 summarizes the IMS Model results for the commercial halibut fishery for Scenarios A and B for Option 3.3, which reduces halibut PSC mortality for A80-CPs down to 1,627.5 mt. Table 5-112 below presents the statistical details of the IMS Model runs for the Option. As seen in Table 5-109 on page 250, Option 3.3 is the first of the reduction options for the A80 fishery that will reduce halibut PSC mortality in all the Basis Years.

Results from the IMS Model indicate that the commercial halibut fishery will realize a $43.57 million increase in the net present value of wholesale revenue under Scenario A, while the A80-CPs are expected see an average decrease of over $161.21 million. This is a change ratio of -3.7 to 1 favoring the commercial halibut fishery. Under Scenario B, the change ratio is estimated at -6.2 to 1 with the A80-CPs expected on average to realize a $285.27 million net present value loss, while the commercial increases by only $2.7 million in net present value to $46.26 million.

It should be noted again that differences between Scenario A and B are found in the process to reduce their halibut PSC mortality. Under Scenario A, we essentially ignored the imperfections in the PSC mortality target market within and across cooperatives, and assume that the fleet as a whole would determine the best target fishery months to drop on average using fishery data from the Basis Years. Under Scenario B, we assumed a more realistic PSC mortality transfer market with some imperfections and imposed company-level PSC limits. After all potential transfers were undertaken, we assumed that vessels reduce halibut PSC mortality by cutting trips from their least efficient vessel on a last-caught first-cut basis.

Under both Scenarios, halibut PSC mortality reductions by subarea are expected to accrue roughly as follows: 15 percent to 4A, 4 percent to 4B and 81 percent to Area 4CDE.

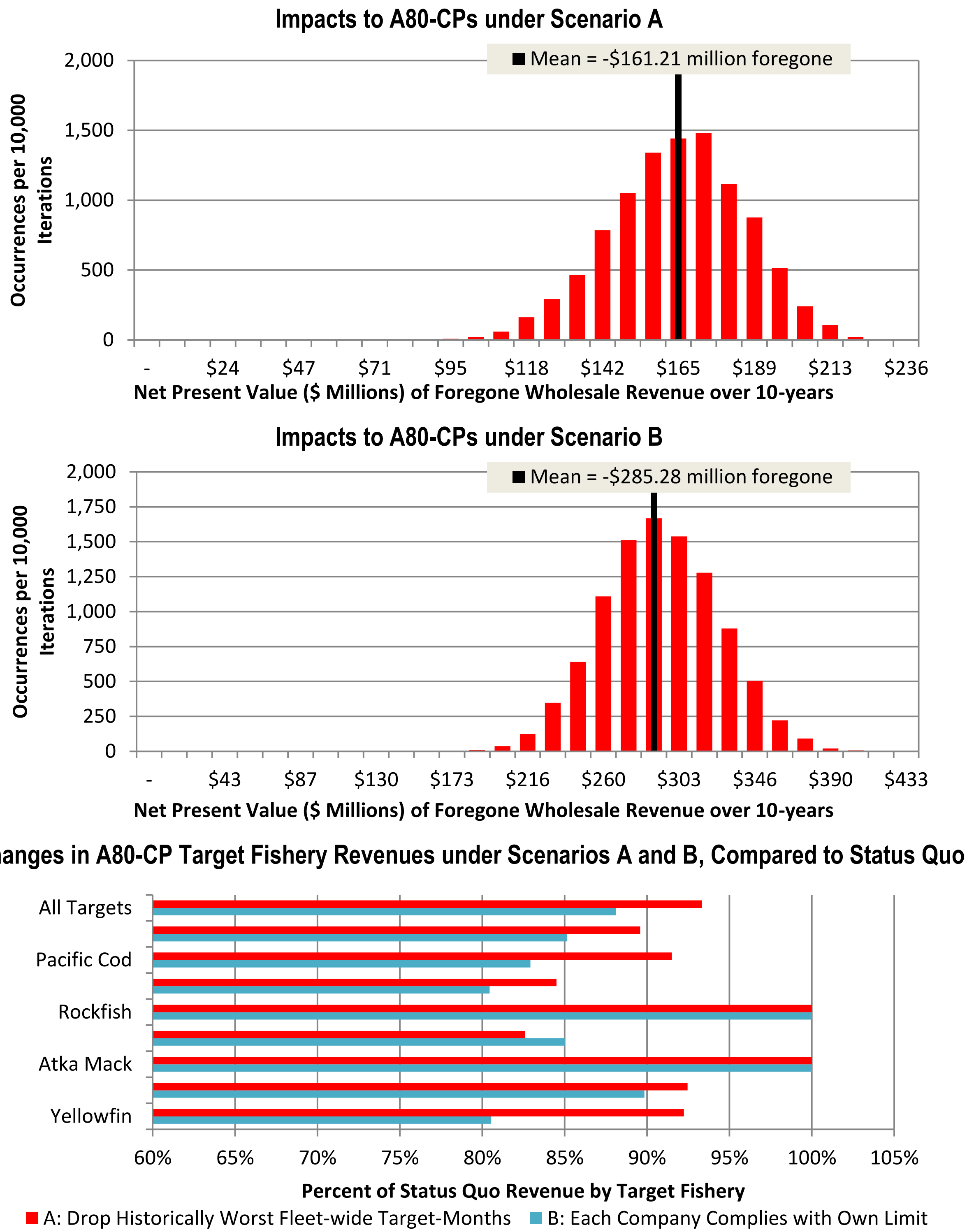
The bottom line of Table 5-112 shows that the commercial halibut fishery continues to generate a $240,000 increase in net present value per annual ton of net weight halibut gained. Under Scenario A, A80-CPs would forego $390,000 in net present value for each ton of halibut PSC mortality they cut on an annual basis. The net present value loss per annual ton of halibut PSC mortality reduction jumps to $650,000 under Scenario B.

Table 5-112 Statistical Details of the IMS Model Runs for Option 3.3

	Directed Halibut Fishery Impacts								Groundfish	
	Scenario A				Scenario B				Scenario A	Scenario B
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4	All Areas	
Iterations with No Change in Net Present Value (NPV)	0	19	0	0	0	18	0	0	0	0
Net Change in the Net Present Value of Wholesale Revenue from the Status Quo Over All Iterations ($2013 Millions)										
Minimum Change in Magnitude of NPV	$1.51	-	$21.59	$26.94	$2.59	-	$24.02	$28.64	($84.26)	($166.17)
Maximum Change in Magnitude of NPV	$13.19	$5.57	$54.60	$72.15	$11.41	$3.01	$63.44	$73.36	($228.45)	($418.53)
Mean Change in NPV	$6.36	$2.01	$35.20	$43.57	$7.15	$1.24	$37.86	$46.26	($161.21)	($285.27)
Standard Deviation of Changes in NPV	$1.78	$0.76	$4.54	$5.82	$1.26	$0.48	$5.41	$5.96	$21.00	$33.59
Median Change in NPV	$6.29	$1.96	$34.91	$43.06	$7.12	$1.23	$37.32	$45.88	($161.90)	($284.93)
Change in Average Annual Halibut (MT) from the Status Quo										
Mean Annual Change in Halibut PSC mortality (Round Weight MT)	-60.75	-19.06	-334.50	-414.31	-68.13	-11.51	-361.29	-440.94	-414.31	-440.94
Mean Annual Change in Directed Catch (Net Weight MT)	26.90	8.48	148.56	183.94	30.21	5.26	160.01	195.47	-	-
Mean Change in NPV (2013$ million) per annual change in halibut (mt)	$0.24	$0.24	$0.24	$0.24	$0.24	-	$0.24	$0.24	$0.39	$0.65

Source: Developed by Northern Economics based on IMS Model runs for Option 3.3.

Figure 5-69 Impacts to A80-CPs under Option 3.3—30% Reductions in Halibut PSC Limits

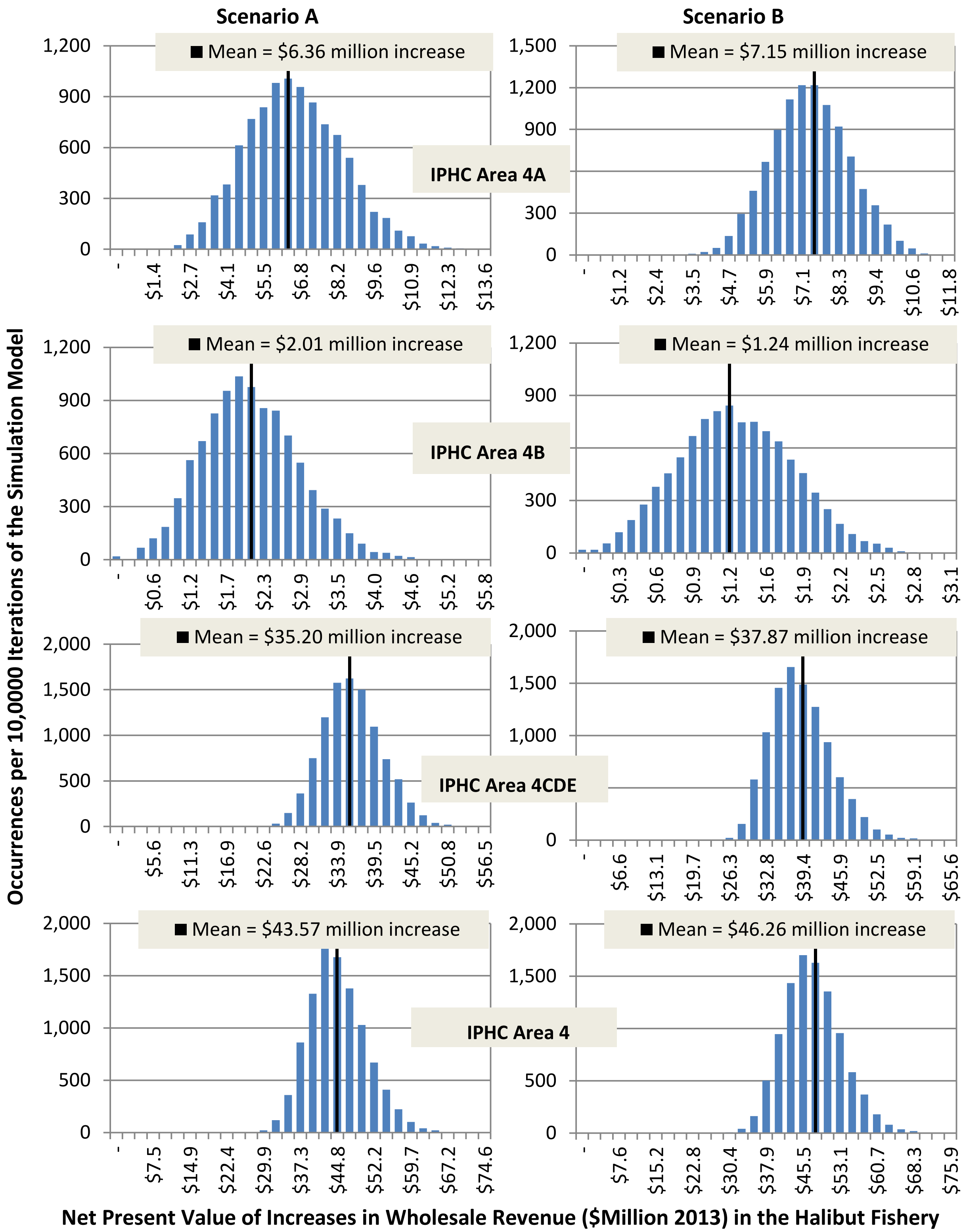


Scenario A assumes that A80-CPs choose to drop target fisheries in months that have historically produced the least wholesale revenue per ton of halibut mortality.

Scenario B assumes each A80 company has its own limit and they drop target months at the end of the year of vessels that have lower wholesale revenues per ton of halibut mortality.

Source: Developed by Northern Economics based on IMS Model runs for Option 3.3.

Figure 5-70 Net Present Value of Revenue Impacts to Commercial Halibut Fisheries of Option 3.3



Note: Scenario A assumes that A80-CPs drop target fisheries in months that have historically produced the least wholesale revenue per ton of halibut mortality. Scenario B assumes each A80 company has its own limit and they drop end-of-year target months of vessels that have the least annual wholesale revenues per ton of halibut.

5.7.3.4 Option 3–Suboption 4: Reduce Halibut PSC Limits for the A80-CP by 35 Percent

Figure 5-71 on page 263 summarizes the results of Option 3.4 for the A80-CPs. Figure 5-72 on page 264 summarizes the IMS Model results for the commercial halibut fishery under Option 3.3 for Scenarios A and B. This Option sets the A80-CP limit at 1,511.3 mt, or 65 percent of the status quo limit. Table 5-113 below presents the statistical details of the IMS Model runs.

Results from the IMS Model indicate that the commercial halibut fishery will realize a $55.68 million increase in the net present value of wholesale revenue under Scenario A, while the A80-CPs are expected see an average decrease of over $223.91 million. This is a change ratio of -4.2 to 1 favoring the commercial halibut fishery. Under Scenario B, the change ratio is estimated at -6.6 to 1 with the A80-CPs expected on average to realize a $367.51 million net present value loss.

Under the two Scenarios, halibut PSC mortality reductions by subarea are expected to accrue as follows: 15–16 percent to 4A, 3–6 percent to 4B and 78–81 percent to Area 4CDE. The annual average increase in halibut harvest in 4CDE under Scenario A is expected to be over 184.39 mt (net weight) with a reduction in halibut PSC mortality of 416.99 mt (round weight). Under Scenario B, Option 3.4 is expected to generate an annual average halibut PSC mortality reduction over all of Area 4 of 554.7 mt round weight. Under this option, every ton of halibut PSC mortality reduction is expected to generate 0.44 tons of net weight increases in commercial catch.

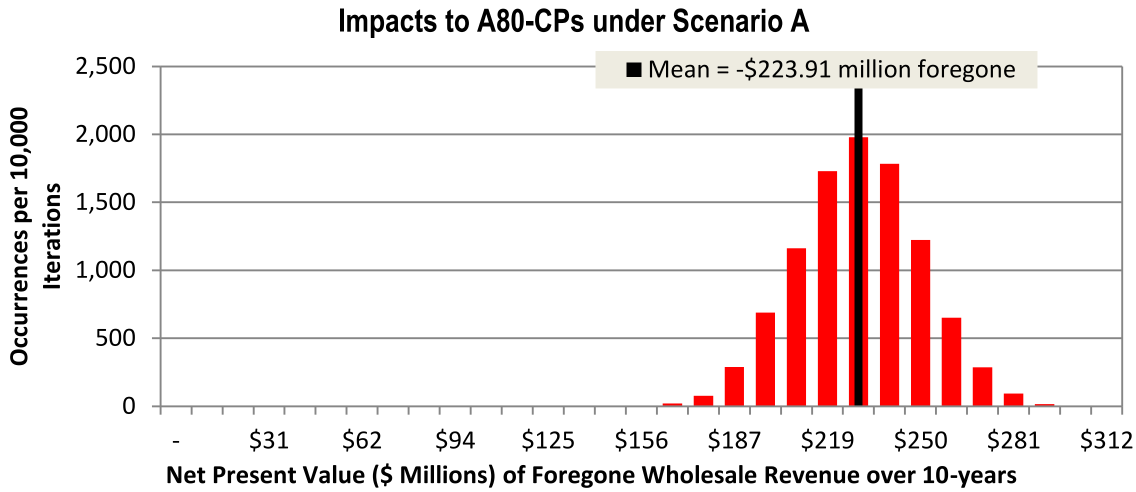
The bottom line of Table 5-112 shows that the commercial halibut fishery continues to generate a $240,000 increase in net present value per annual ton of net weight halibut gained. Under Scenario A, A80-CPs would forego $420,000 in net present value for each ton of halibut PSC mortality they cut on an annual basis. The net present value loss per annual ton of halibut PSC mortality reduction jumps to $660,000 under Scenario B.

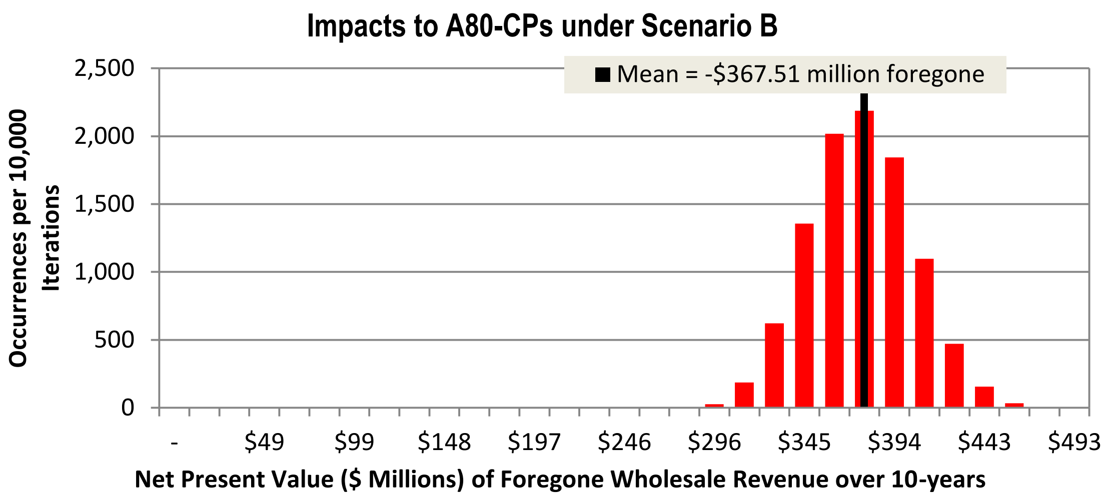
Table 5-113 Statistical Details of the IMS Model Runs for Option 3.4

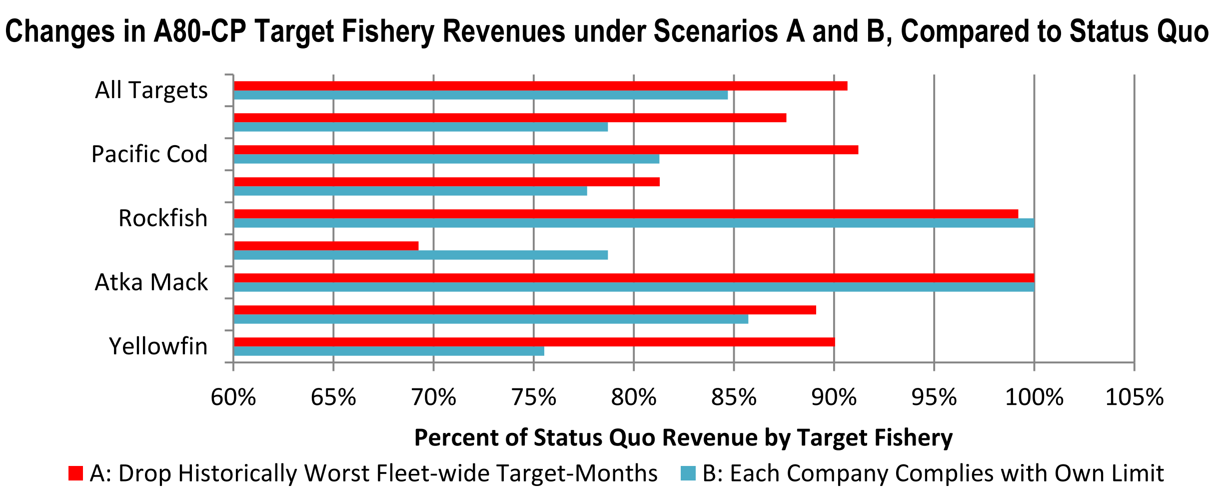
	Directed Halibut Fishery Impacts								Groundfish	
	Scenario A				Scenario B				Scenario A	Scenario B
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4	All Areas	
Iterations with No Change in Net Present Value (NPV)	-	1	-	-	-	-	-	-	-	-
Net Change in the Net Present Value of Wholesale Revenue from the Status Quo Over All Iterations ($2013 Millions)										
Minimum Change in Magnitude of NPV	$1.96	-	$27.84	$39.56	$5.31	$0.08	$32.53	$41.45	($152.88)	($281.39)
Maximum Change in Magnitude of NPV	$17.55	$8.53	$62.02	$83.44	$15.09	$3.79	$73.07	$84.87	($301.83)	($476.33)
Mean Change in NPV	$8.54	$3.48	$43.66	$55.68	$9.45	$1.53	$47.24	$58.22	($223.91)	($367.51)
Standard Deviation of Changes in NPV	$2.29	$1.18	$4.63	$5.91	$1.58	$0.54	$5.75	$5.97	$20.60	$28.33
Median Change in NPV	$8.41	$3.40	$43.63	$55.38	$9.40	$1.51	$46.73	$57.85	($223.95)	($367.14)
Change in Average Annual Halibut (MT) from the Status Quo										
Mean Annual Change in Halibut PSC mortality (Round Weight MT)	-81.38	-33.07	-416.99	-531.44	-90.38	-14.25	-450.10	-554.73	-531.44	-554.73
Mean Annual Change in Directed Catch (Net Weight MT)	36.09	14.70	184.39	235.18	39.88	6.45	199.41	245.75	-	-
Mean Change in NPV (2013$ million) per annual change in halibut (mt)	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.42	$0.66

Source: Developed by Northern Economics based on IMS Model runs for Option 3.4.

Figure 5-71 Impacts to A80-CPs under Option 3.4—35% Reductions in Halibut PSC Limits





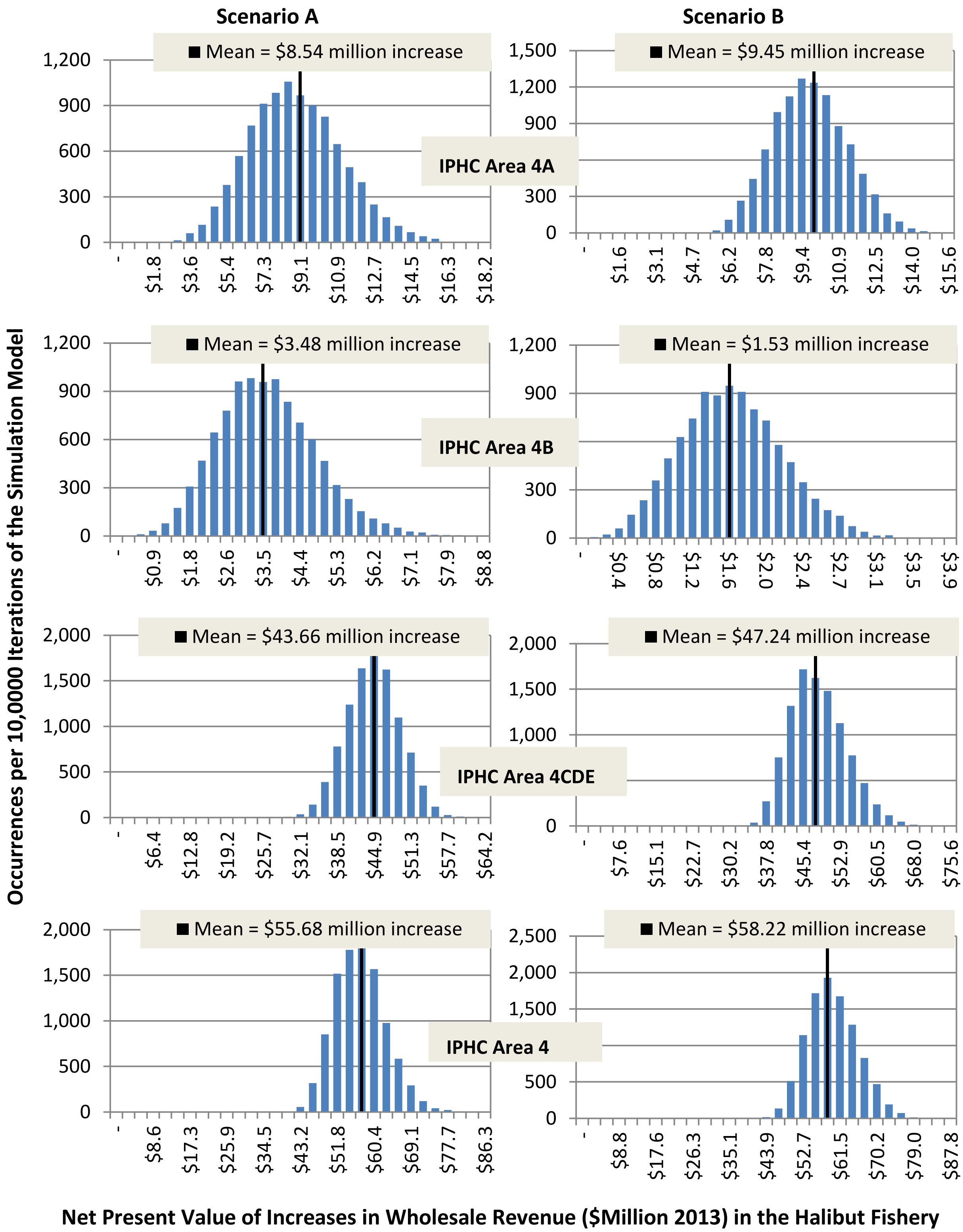


Scenario A assumes that A80-CPs choose to drop target fisheries in months that have historically produced the least wholesale revenue per ton of halibut mortality.

Scenario B assumes each A80 company has its own limit and they drop target months at the end of the year of vessels that have lower wholesale revenues per ton of halibut mortality.

Source: Developed by Northern Economics based on IMS Model runs for Option 3.4.

Figure 5-72 Net Present Value of Revenue Impacts to Commercial Halibut Fisheries of Option 3.4



Note: Scenario A assumes that A80-CPs drop target fisheries in months that have historically produced the least wholesale revenue per ton of halibut mortality. Scenario B assumes each A80 company has its own limit and they drop end-of-year target months of vessels that have the least annual wholesale revenues per ton of halibut.

5.7.3.5 Summary of Impacts of Options Affecting the Amendment 80 Catcher Processors

This section contains three tables that summarize the impacts of proposed options to reduce halibut PSC limits in the A80-CP fisheries, and with those reductions generate increased harvests in the commercial halibut fishery in Area 4.

- Table 5-114 summarizes the average changes in the net present value of wholesale revenue over the 10-year period simulated in the IMS Model. The table also shows Halibut PSC limits for the A80-CP fishery under each of the options. The net present value Changes from the status quo for the A80-CP fishery are negative, while the net present value changes from the Status Quo for the commercial halibut fishery are positive. Under Option 2.1, the ratio of impacts averaged over the two scenarios is -2.9 to 1. Under Option 2.4, the ratio of impacts averaged over Scenario A and B is -5.2 to 1.
- Table 5-115 shows, in the upper section, the average annual reduction in halibut PSC mortality (in round weight mt) in each IPHC subarea and for Area 4 as a whole. The lower portion of the table shows projected annual increases in commercial halibut harvests (in net weight mt). For each round weight ton that halibut PSC mortality is reduced, the commercial halibut fishery gains approximately 0.443 tons (net weight). The difference is caused by three factors, which when multiplied equals 0.443.
    - O26 halibut PSC mortality accounted for roughly 62.2 percent of A80-CP halibut PSC mortality during the Basis Years;
    - The Area 4A halibut fleet on average catches only about 95 percent of the FCEY;
    - The conversion factor moving from round weight to net weight is 75 percent.
- Table 5-116 shows the estimated 10-year change in net present value from the status quo per the annual average change in tons of halibut used. For the A80-CP, we divide the estimated mean of net present value of changes in wholesale revenue by the annual average reduction in halibut PSC mortality (in round weight tons). For the commercial halibut fishery, the mean of net present value of changes in wholesale revenue is divided by the annual average increase in catch (in net weight tons). For the A80-CP fishery, the foregone net present value of revenue per ton increases with increasing reduction amounts. For the commercial halibut fishery, the increased net present value of revenue per ton generates a constant return regardless of the amount of increase.

Table 5-114 Average Estimated Changes in the Net Present Value of Wholesale Revenue from Options 3.1–3.4

	Groundfish			Direct Halibut Fishery Impacts							
	PSC Limit	Scenario A	Scenario B	Scenario A				Scenario B			
Option	All Areas	All Areas		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	mt	Net Present Value of Change in Wholesale Revenues ($2013 Millions) from the Status Quo									
3.1: -10%	2,093	($9.94)	($19.45)	$0.32	$0.01	$3.88	$4.21	$0.18	-	$5.83	$6.00
3.2: -20%	1,860	($52.22)	($114.58)	$2.76	$0.01	$17.44	$20.21	$2.57	-	$19.82	$22.39
3.2: -30%	1,628	($161.21)	($285.27)	$6.36	$2.01	$35.20	$43.57	$7.15	$1.24	$37.86	$46.26
3.3: -35%	1,511	($223.91)	($367.51)	$8.54	$3.48	$43.66	$55.68	$9.45	$1.53	$47.24	$58.22

Source: Developed by Northern Economics using IMS Model results.

Table 5-115 Annual Average Change in Halibut Harvests and Halibut PSC Mortality under Options 3.1–3.4

	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Option	Average Change in Groundfish Halibut PSC mortality (Round Weight mt mortality) from the Status Quo							
3.1: -10%	-3.08	-0.06	-36.88	-40.03	-1.72	-	-55.25	-56.97
3.2: -2%	-26.38	-0.06	-164.78	-191.23	-24.42	-	-187.49	-211.91
3.3: -30%	-60.75	-19.06	-334.50	-414.31	-68.13	-11.51	-361.29	-440.94
3.4: -35%	-81.38	-33.07	-416.99	-531.44	-90.38	-14.25	-450.10	-554.73
	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Option	Average Change in Directed Halibut Catch (Net Weight mt) from the Status Quo							
3.1: -10%	1.36	0.03	16.43	17.81	0.74	-	24.64	25.39
3.2: -20%	11.66	0.03	73.74	85.43	10.84	-	83.75	94.59
3.3: -30%	26.90	8.48	148.56	183.94	30.21	5.26	160.01	195.47
3.4: -35%	36.09	14.70	184.39	235.18	39.88	6.45	199.41	245.75

Source: Developed by Northern Economics using IMS Model results.

Table 5-116 10-year Net Present Value Change per Ton of Change in Halibut PSC mortality or Harvest, Options 3.1–3.4

	A80-CP Groundfish Fishery Impacts			Commercial Halibut Fishery Impacts							
	PSC Limit	Scenario A	Scenario B	Scenario A				Scenario B			
Option	All Areas	All Areas		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	mt	Net Present Value of Change in Wholesale Revenues ($2013 Millions) per Annual Change in Tons from the Status Quo									
3.1: -10%	2,093	$0.25	$0.34	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24
3.2: -20%	1,860	$0.27	$0.54	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24
3.3: -30%	1,628	$0.39	$0.65	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24
3.4: -35%	1,511	$0.42	$0.66	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24

Source: Developed by Northern Economics using IMS Model results.

5.7.4 Analysis of Options Affecting the Longline Catcher Vessels

This section assesses the impacts of Option 4, and its suboptions, which would reduce the 15 mt halibut PSC limit for the Pacific cod fishery of longline catcher vessels (longline CVs), by a percentage ranging from 90 percent of the status quo down to 65 percent of the status quo. This section also includes a brief discussion of the impacts of Option 7, which would reduce the status quo halibut PSC limit for all hook and line vessels (which comprises both the longline CVs and the longline CPs) participating in target fisheries other than for Pacific cod or for IFQ sablefish (which is currently exempt from halibut PSC limits) from 58 mt to levels ranging from 90 percent of the status quo down to 65 percent of the status quo. The section will be quite short for two reasons:

1) Longline CVs have generated a maximum of 5.4 mt of halibut PSC mortality in any year from 2008 to 2013. This is only 36 percent of the status quo PSC limit, and therefore none of the proposed suboptions under Option 4 will have a material impact on longline CVs if they continue to operate in the Pacific cod fishery in the future at levels seen in the recent past.
2) There have been exactly zero weeks from 2008 to 2013 in which longline CVs have participated in a target fishery for any other species except Pacific cod or sablefish.

Table 5-117 summarizes the halibut PSC limits for the longline CV Pacific cod fishery under the status quo and under Options 4.1–4.4. The table also shows actual halibut PSC mortality taken in the fishery, and unused amounts that were left on the table under status quo. The table also estimates how much would have been left on the table under the proposed reductions. On the basis of this table, we conclude that longline CVs would not be materially affected by Option 4. We do note that reducing the PSC limits could curtail future expansion of the fishery, but given that the halibut PSC mortality in the fishery could more than double under all of the suboptions, there would be substantial room to expand the fishery even under Option 4.4.

The same general conclusion is reached with respect to Option 7 and reduced PSC Limits for all hook and line fisheries other than Pacific cod and sablefish. Longline CVs have not been involved in these fisheries and it appears they are very unlikely to be involved in these fisheries in the future.

Table 5-117 Halibut PSC Limits under Option 4, with Actual Halibut PSC mortality and Unused PSC mortality from 2008 to 2013 (round weight mt mortality)

	2008	2009	2010	2011	2012	2013	Average
	Historical Halibut PSC Limits in the Pacific Cod Fishery and Actual Halibut PSC mortality						
PSC Limit	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Actual PSC	5.4	2.9	1.7	1.3	1.8	3.3	2.7
	Modelled Halibut PSC Limit and Unused Halibut PSC mortality under the Status Quo						
PSC Limit	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Unused PSC	9.6	12.1	13.3	13.7	13.2	11.7	12.3
	Modelled Halibut PSC Limit and Unused Halibut PSC mortality under Option 4.1 (Reduce PSC Limit by 10%)						
Proposed PSC Limit	13.5	13.5	13.5	13.5	13.5	13.5	13.5
Unused PSC	8.1	10.6	11.8	12.2	11.7	10.2	10.8
	Modelled Halibut PSC Limit and Unused Halibut PSC mortality under Option 4.2 (Reduce PSC Limit by 20%)						
PSC Limit	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Unused PSC	6.6	9.1	10.3	10.7	10.2	8.7	9.3
	Modelled Halibut PSC Limit and Unused Halibut PSC mortality under Option 4.3 (Reduce PSC Limit by 30%)						
PSC Limit	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Unused PSC	5.1	7.6	8.8	9.2	8.7	7.2	7.8
	Modelled Halibut PSC Limit Unused Halibut PSC mortality under Option 4.4 (Reduce PSC Limit by 35%)						
PSC Limit	9.8	9.8	9.8	9.8	9.8	9.8	9.8
Unused PSC	4.4	6.9	8.1	8.5	8.0	6.5	7.1

Source: Developed by Northern Economics from AKFIN data (Fey 2014) and NMFS (2014f).

5.7.5 Analysis of Option 5 and Option 7 Affecting Longline Catcher Processors

In this section we summarize the impacts of proposed reductions of halibut PSC limits for the Pacific cod fishery of the longline CPs as specified under Option 5. This section also includes an assessment of the proposed reductions of halibut PSC limits under Option 7 for the hook and line fisheries for all target other than Pacific cod (which is addressed in Options 5.1–5.4) or IFQ sablefish (which is exempt from PSC limits). Longline CPs have been the only participants in target fisheries affected by Option 7. Four suboptions are specified for both PSC Limit reduction options as follows:

- Suboption 1: Reduce status quo longline CP Halibut PSC Limits by 10%
- Suboption 2: Reduce status quo longline CP Halibut PSC Limits by 20%
- Suboption 3: Reduce status quo longline CP Halibut PSC Limits by 30%
- Suboption 4: Reduce status quo longline CP Halibut PSC Limits by 35%

Before the analysis delves into the assessment of impacts from reducing halibut PSC limits in the longline CP target fishery for Pacific cod, we examine the potential impact of Option 7.[34] As shown in Table 5-118, the PSC limit under the status quo for hook and line fisheries other than for Pacific cod or sablefish has been established at 58 mt. The longline CPs are the only group that participates in these fisheries and are focusing almost exclusively on Greenland turbot when this apportionment is used. From 2008 to 2013, an average of 4.9 mt of halibut PSC mortality have been taken, with a maximum of 10.3 mt taken in 2010. On average, 53.1 mt of potential halibut mortality has been left unused. Under Option 7.4, the PSC limit would be reduced to 37.7 mt. Under this option there would have been 27.4 mt of halibut PSC mortality left on the table in 2010. The longline CP fleet could have expanded their efforts three-fold in these fisheries and still not hit the reduced cap. From this we conclude that there would be no material impact to the longline CP fleet if this PSC limit were reduced as proposed under option 7.4.

Table 5-118 Halibut PSC Limits under the Status Quo and Option 7.4, with Halibut PSC mortality and Unused PSC mortality from 2008 to 2013 (round weight mt)

	2008	2009	2010	2011	2012	2013	Average
Historical Halibut PSC Limits in the Pacific Cod Fishery and Actual Halibut PSC mortality							
Status Quo PSC Limit	58.0	58.0	58.0	58.0	58.0	58.0	58.0
Actual Halibut PSC	1.3	6.4	10.3	4.5	5.7	1.4	4.9
Unused PSC	56.7	51.6	47.7	53.5	52.3	56.6	53.1
Modelled Halibut PSC Limit and Halibut PSC mortality under Option 7.4 (Reduce PSC Limit by 35%)							
Option 7.4 PSC Limit	37.7	37.7	37.7	37.7	37.7	37.7	37.7
Actual Halibut PSC	1.3	6.4	10.3	4.5	5.7	1.4	4.9
Unused PSC	36.4	31.3	27.4	33.2	32.0	36.3	32.8

Source: Developed by Northern Economics based on AKFIN data (Fey 2014).

We now focus on Options 5.1–5.4, which would reduce halibut PSC limits in the Pacific cod target fisheries for the longline CPs. The assessment of impacts to the longline CP Pacific cod fishery specifically acknowledges the fact that the fleet has formed its own cooperative that operates without specific regulation from NMFS. While the specific operating rules of the cooperative are not publically known, it is presumed to operate in a manner similar to the A80 cooperatives. Thus, it is presumed that within the cooperative, PSC mortality is apportioned to the companies that own participating vessels. In addition, it is presumed that halibut PSC mortality may be transferred from one owner to another.

[34] As noted in Section 5.3, longline CVs have not participated in fisheries other than for Pacific cod or sablefish.

As with other options assessed for the BSAI TLA and A80-CP fisheries, the assessment of impacts of the proposed reductions in PSC limits for the longline CP Pacific cod fishery is accomplished through the use of the IMS Model that is described in considerable detail in Section 5.4.3.

For each suboption (Option 5.1–5.4), the IMS Model is run with 10,000 iterations under two different scenarios that represent a low impact case (Scenario A) and a high impact case (Scenario B). The two scenarios are basically the same as those used in the assessment of impacts to longline CPs. The two scenarios are described below:

- Scenario A: Under Scenario A it is assumed that operators of longline CPs, using sector-wide fishery data for the years 2008 to 2013, determine the particular months and target fisheries that generate the lowest wholesale revenue per ton of halibut mortality. They then avoid fishing for those targets in those months. For analytical purposes, it is assumed that operators know in advance how much halibut savings will be created by dropping these target months from their repertoire.
- Scenario B: Under Scenario B it is assumed that each longline CP company is assigned its own halibut cap by the cooperative. Companies that have excess PSC mortality are assumed to transfer PSC mortality to companies that don't have enough PSC mortality. It is also assumed, however, that each company with excess PSC mortality holds back 5 percent of their halibut in case they need it later in the year. Finally, it is assumed that if transfers of halibut are not available, then companies with a PSC mortality shortfall will reduce the length of time that its least "efficient" vessel operates.

Scenario A ends up having a lower impact than Scenario B in part because of the assumption that the longline CP fleet knows in advance how many "target months" in low-value fisheries they need to avoid to stay under the fleet-wide cap.

For each suboption analyzed, we present a relatively high-level summary of impacts. For the commercial halibut fishery, each assessment will present the simulation model results in the form of eight histograms showing the change from the status quo of the NPV of wholesale revenues over the 10-year period modelled. The distribution of the model iterations of the change in net present value will be shown for each IPHC Area (Area 4A, 4B and 4CDE) and for Area 4 overall. In each histogram there are 30 bins starting at zero impact and extending up to the estimated maximum seen in any one of the iterations.

The impact of the proposed PSC limit reductions on the longline CP groundfish fisheries will also be summarized using histograms. The histograms will show the distribution of the net present value of changes in wholesale revenue over the 10-year period with and without the PSC reductions. Two histograms are provided, one for each impact scenario (A & B), summarizing the impact over all management areas. Finally, a third summary figure is provided showing overall changes under each scenario in each of the longline CP target fisheries relative to the status quo.

Table 5-119 summarizes PSC limits and halibut PSC mortality in the longline CP target fishery for Pacific cod for 2008 to 2013. The first set of two rows shows the limits and halibut PSC mortality as they actually existed during the Basis Years. These rows constitute the status quo PSC limits and halibut PSC mortality. Each of the remaining sets of three rows summarize the PSC Limit and halibut PSC mortality amount that are used as input into the IMS Model for the option under each of the Basis Years. The lightly shaded cells indicate that the PSC Limit is not binding for that year and the halibut PSC mortality amounts were unchanged from status quo. In other words, halibut PSC mortality in the longline CP fishery for Pacific cod is far enough below the current PSC limit that Option 5.1 and Option 5.2 would not materially affect the fishery. The proposed PSC limit reduction options become binding at 70 percent of the status quo limit—under Option 5.3 they would have reduced halibut PSC mortality taken in three of the six Basis Years (2008, 2009, and 2012). Option 5.3 would not have affected the longline CP fishery for Pacific cod in 2010, 2011, or 2013. Option 5.4, which reduces the PSC limit to 65 percent of the status quo, would not have affected the fishery in 2011 or 2013 under either scenario, but because of the assumed "stickiness" of PSC mortalitys transfers and the individual company limits built into Scenario B, the Option as modelled would have had a small impact in 2010.

In general, for Option 5.4 the modelled halibut PSC mortality amounts under Scenario A, when there is a change, average about 4.6 mt less than the PSC limit. Under Scenario B, the difference between the modelled halibut PSC mortality amounts is higher with an average difference in the affected Basis Year of 31.7 mt.

Table 5-119 Historical and Modelled Halibut PSC Limits and PSC mortality for Longline CPs

	2008	2009	2010	2011	2012	2013	Average
Historical Halibut PSC Limits in the Pacific Cod Fishery and Actual Halibut PSC mortality (Round Weight mt)							
PSC Limit	760.0	760.0	760.0	760.0	760.0	760.0	760.0
Actual PSC	564.3	555.6	489.4	476.7	549.5	458.1	515.6
Modelled Halibut PSC Limit and Halibut PSC mortality under Option 5.1 (Reduce PSC Limit by 10%) (Round Weight mt)							
PSC Limit	684.0	684.0	684.0	684.0	684.0	684.0	684.0
PSC Scenario A	564.3	555.6	489.4	476.7	549.5	458.1	515.6
PSC Scenario B	564.3	555.6	489.4	476.7	549.5	458.1	515.6
Modelled Halibut PSC Limit and Halibut PSC mortality under Option 5.2 (Reduce PSC Limit by 20%) (Round Weight mt)							
PSC Limit	608.0	608.0	608.0	608.0	608.0	608.0	608.0
PSC Scenario A	564.3	555.6	489.4	476.7	549.5	458.1	515.6
PSC Scenario B	564.3	555.6	489.4	476.7	549.5	458.1	515.6
Modelled Halibut PSC Limit and Halibut PSC mortality under Option 5.3 (Reduce PSC Limit by 30%) (Round Weight mt)							
PSC Limit	532.0	532.0	532.0	532.0	532.0	532.0	532.0
PSC Scenario A	529.9	529.5	489.4	476.7	530.8	458.1	502.4
PSC Scenario B	481.6	503.8	489.4	476.7	501.3	458.1	485.2
Modelled Halibut PSC Limit and Halibut PSC mortality under Option 5.4 (Reduce PSC Limit by 35%) (Round Weight mt)							
PSC Limit	494.0	494.0	494.0	494.0	494.0	494.0	494.0
PSC Scenario A	481.9	492.5	489.4	476.7	493.8	458.1	482.1
PSC Scenario B	453.9	464.6	463.0	476.7	467.7	458.1	464.0

Source: Developed by Northern Economics based on AKFIN data (Fey 2014).

5.7.5.1 Option 5–Suboptions 1 and 2: Reduce Halibut PSC Limits for the Longline CP Pacific Cod Fishery by 10 or 20 Percent

As indicated above, neither Option 5.1 or 5.2 would appear to affect the longline CP fishery materially.

5.7.5.2 Option 5–Suboption 3: Reduce Halibut PSC Limits for the Longline CP Pacific Cod Fishery by 30 Percent

Based on Table 5-119 above, the 30 percent reduction in PSC Limits from status quo as proposed under Option 5.3 will only generate impacts when 2008, 2009 or 2012 is selected as the Basis Year in the IMS Model. The Model results for Option 5.3 are summarized in the two sets of figures on the following pages. Figure 5-73 on page 272 summarizes the distribution of changes in net present value of wholesale value for longline CPs. Figure 5-74 on page 273 summarizes the distribution of changes in net present value of wholesale value over the 10-year period for the commercial halibut fishery in Areas 4A, 4B, 4CDE and Area 4 as a whole. Table 5-120, on the next page, presents the statistical details of the IMS Model runs for Option 5.3 under Scenarios A and B.

On average, over the 10,000 iterations in the IMS Model, the commercial halibut fishery would realize a $1.53 million increase in the net present value of wholesale revenue over a 10-year period under Scenario

A. Under the same Scenario, the longline CPs would see an average decrease in their net present value of wholesale revenue of $10.15 million. This translates to a change ratio -6.62 to 1 favoring the commercial halibut fishery. Under Scenario B, the change ratio is -6.88 to 1, with a loss in net present value over the 10-year period for the longline CPs estimated a $24.08 million and a gain in net present value for the commercial halibut fishery of $3.50 million.

Under Scenario A, 81 percent of the reduction in halibut PSC mortality is expected to occur in 4CDE, with 14 percent in 4A and 6 percent in 4B. Under Scenario B, a greater percentage of the reductions in halibut PSC mortality occur in 4A (17 percent) and 4B (13 percent), with just 71 percent of the reduction accruing to 4CDE. In general, for every round weight ton of halibut PSC mortality cut by the longline CPs, the commercial halibut fishery gains 0.485 net weight tons of commercial harvest. This difference is attributed to the 0.75 factor to convert round weight to net weight, the 95 percent historical catch to FECY ratio in Area 4, and the 68.0 to 32.0 percent average O26 to U26 ratio for longline CP halibut PSC mortality during the Basis Years.

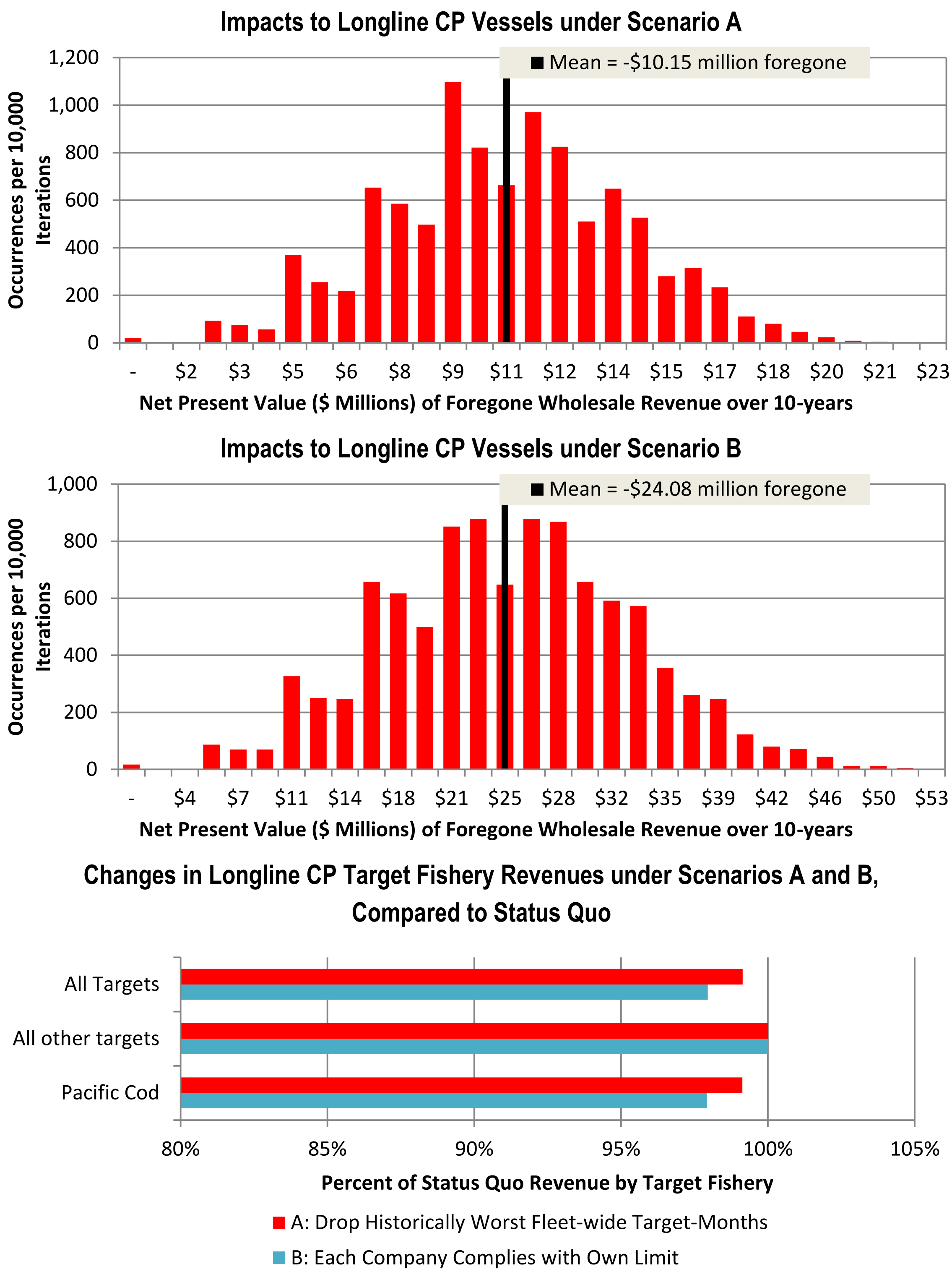
The bottom line of Table 5-120 shows that the commercial halibut fishery generated a $240,000 increase in their net present value of wholesale revenue (over the 10-year period) for every additional net weight ton they harvested annually. This value remains constant for all areas under both scenarios. Under Scenario A, longline CPs had to forego $770,000 of net present value over the 10-year period for each halibut PSC mortality mt cut on an annual basis. Under Scenario B, the foregone net present value per ton of annual halibut PSC limit reductions for longline CPs increases slightly jumps to $790,000.

Table 5-120 Statistical Details of the IMS Model Runs for Option 5.3

	Directed Halibut Fishery Impacts								Groundfish	
	Scenario A				Scenario B				Scenario A	Scenario B
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4	All Areas	
Iterations with No Change in Net Present Value (NPV)	20	1,958	20	20	17	282	17	17	20	17
	Net Change in the Net Present Value of Wholesale Revenue from the Status Quo Over All Iterations ($2013 Millions)									
Minimum Change in Magnitude of NPV	-	-	-	-	-	-	-	-	-	-
Maximum Change in Magnitude of NPV	$0.75	$0.34	$3.22	$3.52	$1.69	$1.98	$5.53	$8.14	($21.91)	($51.29)
Mean Change in NPV	$0.21	$0.08	$1.24	$1.53	$0.58	$0.45	$2.47	$3.50	($10.15)	($24.08)
Standard Deviation of Changes in NPV	$0.12	$0.06	$0.53	$0.58	$0.25	$0.33	$0.93	$1.36	$3.45	$8.23
Median Change in NPV	$0.20	$0.07	$1.22	$1.53	$0.57	$0.42	$2.47	$3.48	($10.15)	($24.20)
	Change in Average Annual Halibut (mt) from the Status Quo									
Mean Annual Change in Halibut PSC mortality (Round Weight mt)	-1.90	-0.60	-10.73	-13.23	-5.21	-3.94	-21.35	-30.50	-13.23	-30.50
Mean Annual Change in Directed Catch (Net Weight mt)	0.91	0.32	5.24	6.47	2.46	1.88	10.41	14.75	-	-
Mean Change in NPV (2013$ million) per annual change in halibut (mt)	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.77	$0.79

Source: Developed by Northern Economics based on IMS Model runs for Option 5.3.

Figure 5-73 Impacts to Longline CPs under Option 5.3—30% Reductions in Halibut PSC Limits

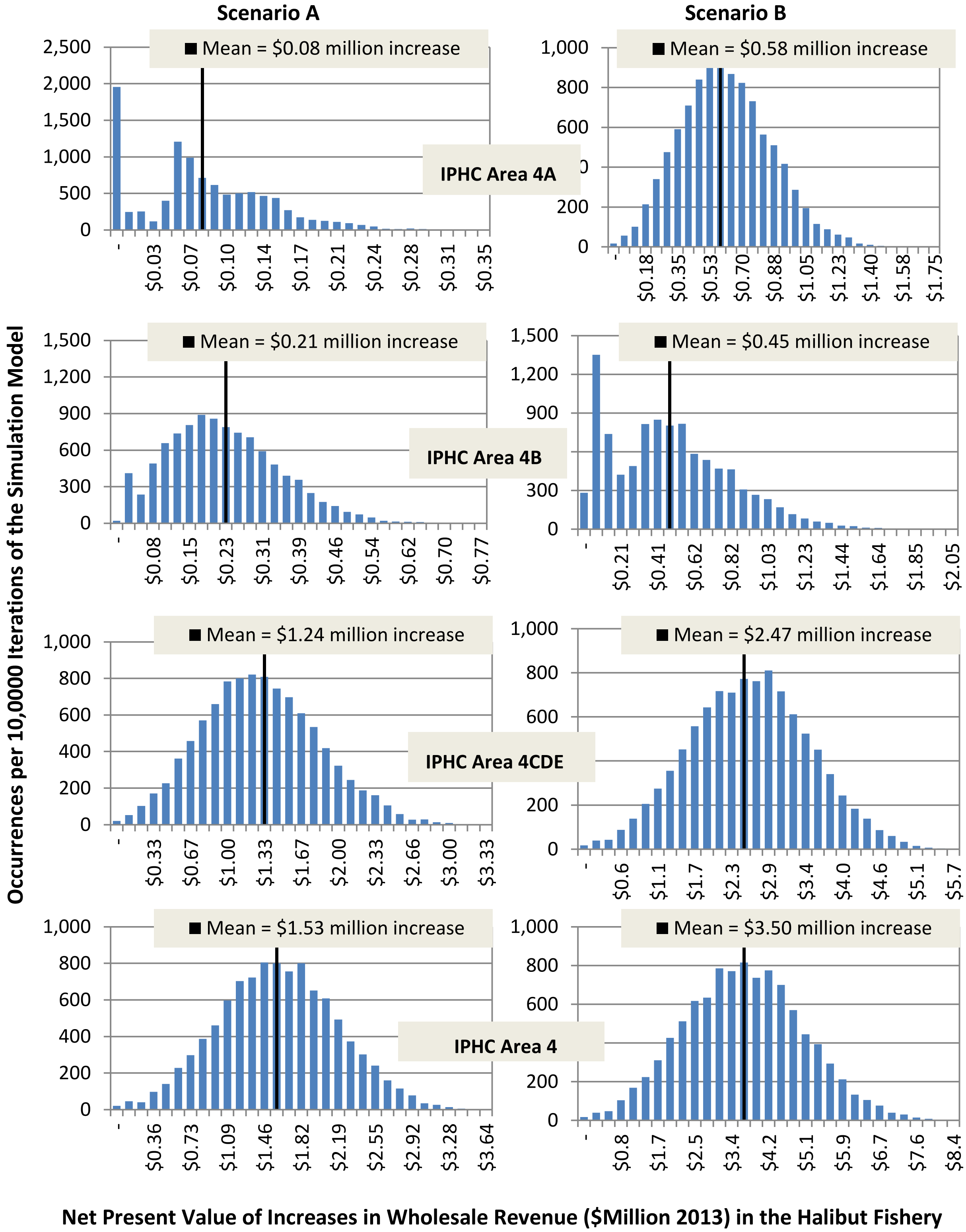


1) Scenario A assumes that longline CPs drop target fisheries in months that have historically produced the least wholesale revenue per ton of halibut mortality.

2) Scenario B assumes each longline CP company has its own limit and they drop end-of-year target months of vessels that have the least annual wholesale revenues per ton of halibut.

Source: Developed by Northern Economics based on IMS Model runs for Option 5.3.

Figure 5-74 Net Present Value of Revenue Impacts to Commercial Halibut Fisheries of Option 5.3



Note: Scenario A assumes that Longline CPs drop target fisheries in months that have historically produced the least wholesale revenue per ton of halibut mortality. Scenario B assumes each longline CP company has its own limit and they drop end-of-year target months of vessels that have the least annual wholesale revenues per ton of halibut.

5.7.5.3 Option 5–Suboption 4: Reduce Halibut PSC Limits for the Longline CP Pacific Cod Fishery by 35 Percent

Based on Table 5-119 on page 270, the 35 percent reduction in PSC Limits will only generate impacts for Scenario A when 2008, 2009 or 2012 is selected as the Basis Year in the model. Under Scenario B (because of the assumption of company level PSC limits and the stickiness of transfers between companies), impacts are also generated when 2010 is selected as a Basis Year. Figure 5-75 on page 276 summarizes the distribution of changes from status quo in net present value of wholesale value for longline CPs. The distributions of changes in net present value of wholesale value from the status quo for Option 5.4 for the commercial halibut fishery are summarized in Figure 5-76 on page 277. Table 5-121, on the next page, presents the statistical details of the IMS Model runs for Option 5.4.

Under Scenario A, the commercial halibut fishery would realize a $3.87 million increase in the net present value of wholesale revenue over a 10-year period. Under the same Scenario, the longline CPs would see, on average, a decrease in their net present value of wholesale revenue of $27.33 million. This translates to a change ratio of -7.07 to 1 favoring the commercial halibut fishery. Under Scenario B, the change ratio is -8.51 to 1, with a loss in net present value over the 10-year period for the longline CPs estimated a $50.41 million and a gain in net present value for the commercial halibut fishery of $5.92 million.

Under Scenario A, 74 percent of the reduction in halibut PSC mortality is expected to occur in 4CDE, with 9 percent in 4A and 16 percent in 4B. Under Scenario B, a greater percentage of the reductions in halibut PSC mortality occur in 4A (15 percent) and 4B (12 percent), with just 73 percent of the reduction accruing to 4CDE. In general, for every round weight ton of halibut PSC mortality cut by the longline CPs, the commercial halibut fishery gains 0.487 net weight tons of commercial harvest. This difference is attributed to the 0.75 factor to convert round weight to net weight, the 95 percent historical catch to FECY ratio in Area 4, and the 68.4 to 31.6 percent average O26 to U26 ratio for longline CP halibut PSC mortality during the Basis Years.

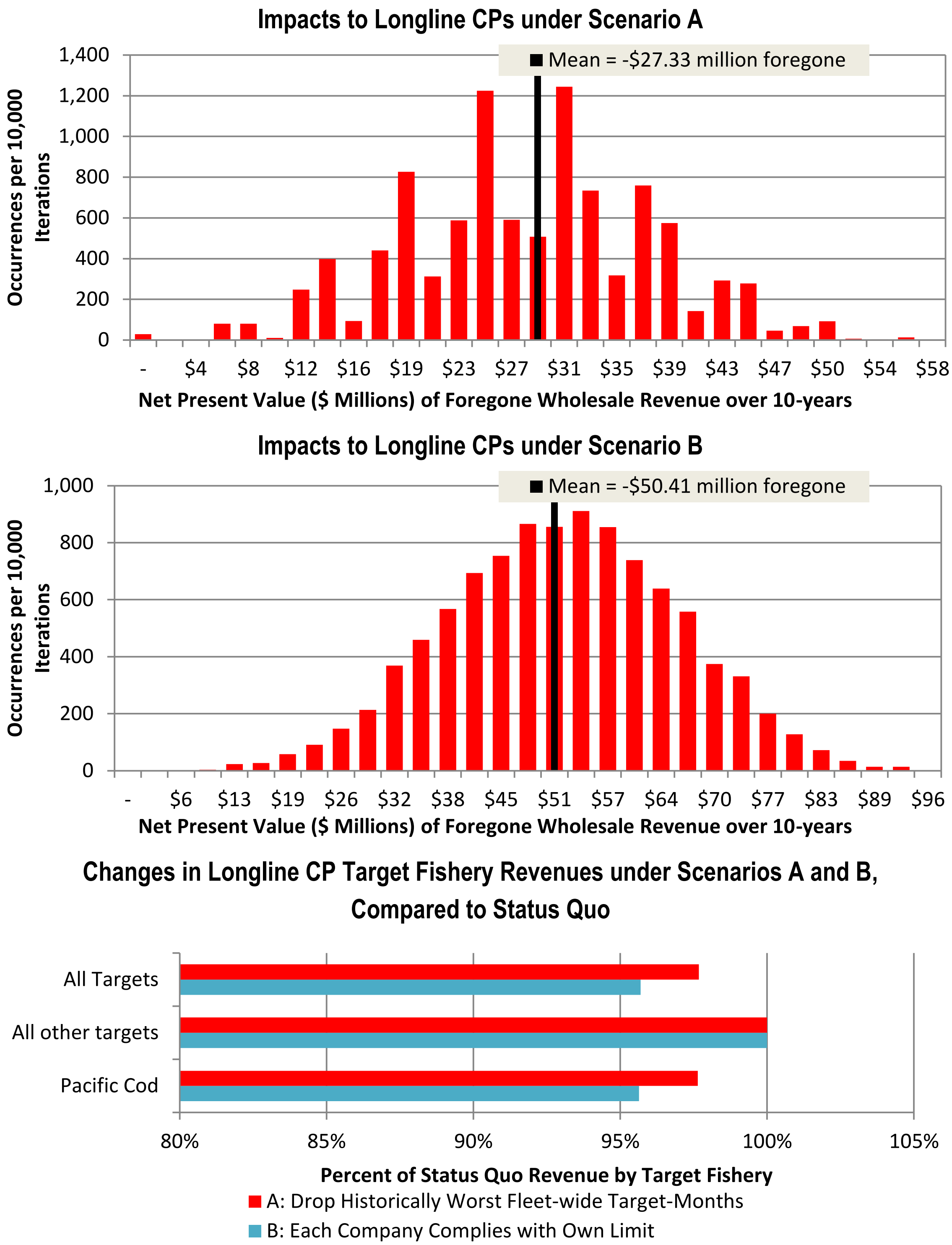
The bottom line of Table 5-121 shows that the commercial halibut fishery generated a $240,000 increase in their net present value of wholesale revenue (over the 10-year period) for every additional net weight ton they harvested annually. This value remains constant for all areas under both scenarios. Under Scenario A, longline CPs had to forego $820,000 of net present value over the 10-year period for each halibut PSC mortality mt cut on an annual basis. Under Scenario B, the foregone net present value per ton of annual halibut PSC limit reductions for longline CPs increases slightly jumps to $980,000.

Table 5-121 Statistical Details of the IMS Model Runs for Option 5.4

	Directed Halibut Fishery Impacts								Groundfish	
	Scenario A				Scenario B				Scenario A	Scenario B
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4	All Areas	
Iterations with No Change in Net Present Value (NPV)	29	267	29	29	1	26	1	1	29	1
	Net Change in the Net Present Value of Wholesale Revenue from the Status Quo Over All Iterations ($2013 Millions)									
Minimum Change in Magnitude of NPV	-	-	-	-	-	-	-	-	-	-
Maximum Change in Magnitude of NPV	$1.27	$1.76	$6.96	$9.13	$1.92	$2.00	$8.52	$11.82	($56.26)	($92.49)
Mean Change in NPV	$0.36	$0.64	$2.87	$3.87	$0.91	$0.69	$4.31	$5.92	($27.33)	($50.41)
Standard Deviation of Changes in NPV	$0.20	$0.32	$1.09	$1.45	$0.29	$0.33	$1.40	$1.90	$9.20	$13.78
Median Change in NPV	$0.33	$0.62	$2.87	$3.88	$0.91	$0.68	$4.33	$5.96	($27.64)	($50.57)
	Change in Average Annual Halibut (MT) from the Status Quo									
Mean Annual Change in Halibut PSC mortality (Round Weight MT)	-3.22	-5.33	-24.96	-33.51	-8.04	-5.96	-37.45	-51.45	-33.51	-51.45
Mean Annual Change in Directed Catch (Net Weight MT)	1.51	2.69	12.14	16.34	3.87	2.93	18.22	25.02	-	-
Mean Change in NPV (2013$ million) per annual change in halibut (mt)	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.82	$0.98

Source: Developed by Northern Economics based on IMS Model runs for Option 5.4.

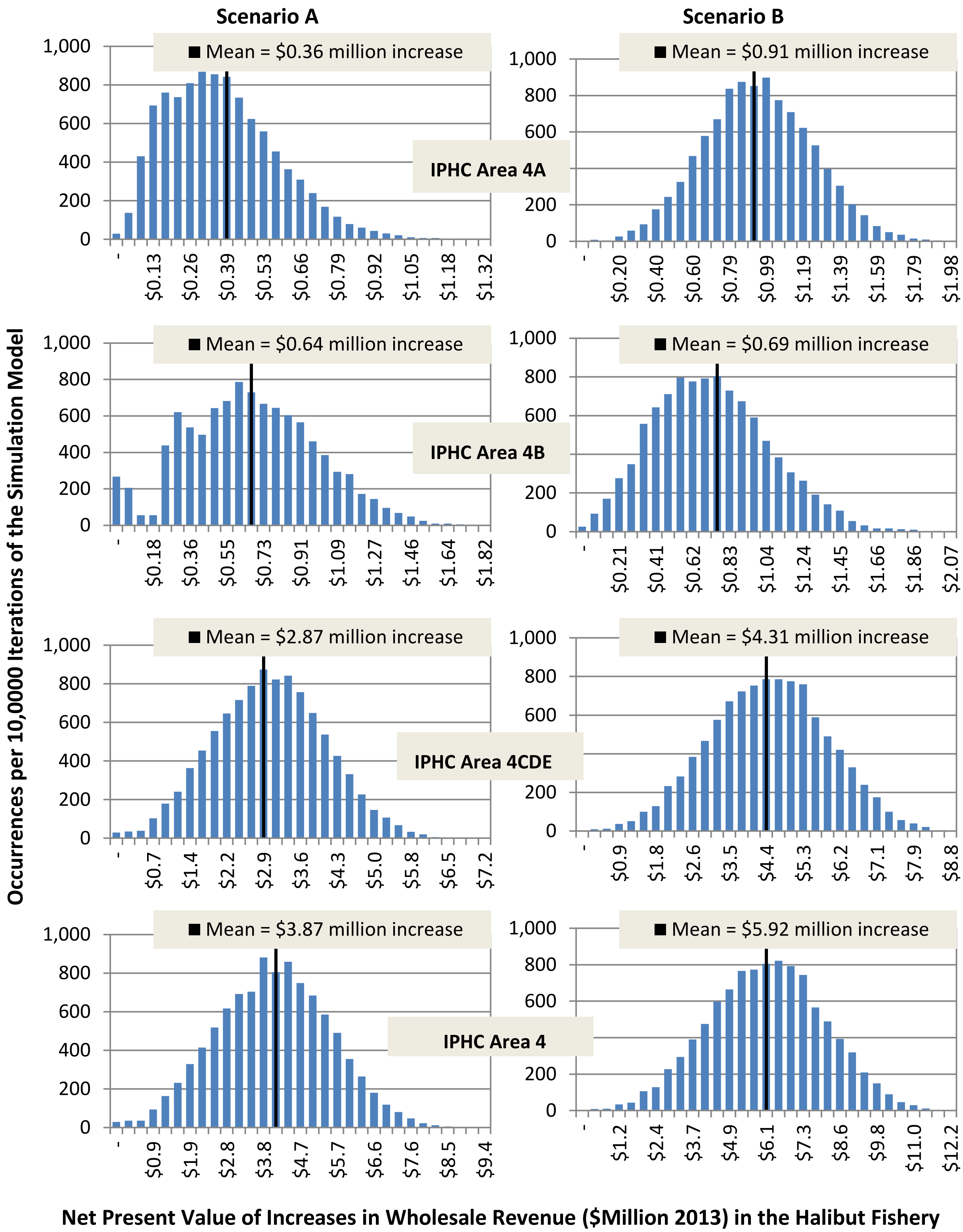
Figure 5-75 Impacts to BSAI TLA Vessels under Option 5.4—35% Reductions in Halibut PSC Limits



1) Scenario A assumes that longline CPs drop target fisheries in months that have historically produced the least wholesale revenue per ton of halibut mortality.
2) Scenario B assumes each longline CP company has its own limit and they drop end-of-year target months of vessels that have the least annual wholesale revenues per ton of halibut.

Source: Developed by Northern Economics based on IMS Model runs for Option 5.4.

Figure 5-76 Net Present Value of Revenue Impacts to Commercial Halibut Fisheries of Option 5.4



Note: Scenario A assumes that longline CPs drop target fisheries in months that have historically produced the least wholesale revenue per ton of halibut mortality. Scenario B assumes each longline CP company has its own limit and they drop end-of-year target months of vessels that have the least annual wholesale revenues per ton of halibut.

5.7.5.4 Summary of Options Affecting Longline Catcher Processors

This section contains three tables that summarize the impacts of proposed options to reduce halibut PSC limits in the longline CP fisheries, and with those reductions generate increased harvests in the commercial halibut fishery in Area 4. Options 5.1 and 5.2 had no material impacts to either the longline CPs or the commercial halibut fishery.

- Table 5-122 summarizes the average changes in the net present value of wholesale revenue over the 10-year period simulated in the IMS Model. Net Present Value Changes for the longline CP Pacific cod fishery are negative, while the net present value changes for the commercial halibut fishery are positive. Under Option 5.3, the ratio of impacts averaged over the two scenarios is -6.75 to 1. Under Option 5.4, the ratio of impacts averaged over Scenario A and B is -7.8 to 1.
- Table 5-123 shows, in the upper section, the average annual reduction in halibut PSC mortality (in round weight mt) in each IPHC subarea and for Area 4 as a whole. The lower portion of the table shows projected annual increases in commercial halibut harvests (in net weight mt). For each round weight ton that halibut PSC mortality is reduced, the commercial halibut fishery gains 0.48 tons (net weight). The difference is caused by three factors, which when multiplied equals 0.486.
    a) O26 halibut PSC mortality accounted for 68.25 percent of longline CP halibut PSC mortality during the Basis Years;
    b) The Area 4A halibut fleet on average catches only about 95 percent of the FCEY;
    c) The conversion factor moving from round weight to net weight is 75 percent.
- Table 5-124 shows the estimated 10-year change in net present value from the status quo per the annual average change in tons of halibut used. For the longline CP Pacific cod fishery, we divide the estimated mean of net present value of changes in wholesale revenue by the annual average reduction in halibut PSC mortality (in round weight tons). For the commercial halibut fishery, the mean of net present value of changes in wholesale revenue is divided by the annual average increase in catch (in net weight tons). For the longline CP Pacific cod fishery, the foregone net present value of revenue per ton increases with increasing reduction amounts. For the commercial halibut fishery, the increased net present value of revenue per ton generates a constant return regardless of the amount of increase.

Table 5-122 Average Estimated Changes in the Net Present Value of Wholesale Revenue from Options 5.1–5.4

	Longline CP Groundfish Impacts			Commercial Halibut Fishery Impacts							
	PSC Limit	Scenario A	Scenario B	Scenario A				Scenario B			
Option	All Areas	All Areas		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	mt	Net Present Value of Change in Wholesale Revenues ($2013 Millions) from the Status Quo									
5.1: -10%	684	-	-	-	-	-	-	-	-	-	-
5.2: -20%	608	-	-	-	-	-	-	-	-	-	-
5.3: -30%	532	($10.15)	($24.08)	$0.21	$0.08	$1.24	$1.53	$0.58	$0.45	$2.47	$3.50
5.4: -35%	494	($27.33)	($50.41)	$0.36	$0.64	$2.87	$3.87	$0.91	$0.69	$4.31	$5.92

Source: Developed by Northern Economics using IMS Model results.

Table 5-123 Annual Average Change in Halibut Harvests and Halibut PSC mortality under Options 5.1–5.4

	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Option	Average Change in Groundfish Halibut PSC mortality (Round Weight mt) from the Status Quo							
5.1: -10%	-	-	-	-	-	-	-	-
5.2: -20%	-	-	-	-	-	-	-	-
5.3: -30%	-1.90	-0.60	-10.73	-13.23	-5.21	-3.94	-21.35	-30.50
5.4: -35%	-3.22	-5.33	-24.96	-33.51	-8.04	-5.96	-37.45	-51.45
	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Option	Average Change in Directed Halibut Catch (Net Weight mt) from the Status Quo							
5.1: -10%	-	-	-	-	-	-	-	-
5.2: -20%	-	-	-	-	-	-	-	-
5.3: -30%	0.91	0.32	5.24	6.47	2.46	1.88	10.41	14.75
5.4: -35%	1.51	2.69	12.14	16.34	3.87	2.93	18.22	25.02

Source: Developed by Northern Economics using IMS Model results.

Table 5-124 10-year Net Present Value Change per Ton of Change in Halibut PSC mortality or Harvest, Options 5.1–5.4

	Longline CP Groundfish Fishery Impacts			Commercial Halibut Fishery Impacts							
	PSC Limit	Scenario A	Scenario B	Scenario A				Scenario B			
Option	All Areas	All Areas		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	mt	Net Present Value of Change in Wholesale Revenues ($2013 Millions) from the Status Quo									
5.1: -10%	684	-	-	-	-	-	-	-	-	-	-
5.2: -20%	608	-	-	-	-	-	-	-	-	-	-
5.3: -30%	532	$0.77	$0.79	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24
5.4: -35%	494	$0.82	$0.98	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24	$0.24

Source: Developed by Northern Economics using IMS Model results.

5.7.6 Analysis of Options Affecting the Groundfish CDQ Fisheries

In this section we summarize the impacts of proposed reductions of halibut PSC limits (technically, reductions to their halibut prohibited species quota (PSQ) reserve) for the CDQ groundfish fisheries as proposed under Option 6. Four suboptions are specified as follows.

- Option 6.1: Reduce Halibut PSC Limits for CDQ groundfish by 10%, from 393 mt to 353.7 mt
- Option 6.2: Reduce Halibut PSC Limits for CDQ groundfish by 20%, from 393 mt to 314.4 mt
- Option 6.3: Reduce Halibut PSC Limits for CDQ groundfish by 30%, from 393 mt to 275.1 mt
- Option 6.4: Reduce Halibut PSC Limits for CDQ groundfish by 35%, from 393 mt to 255.1 mt

Table 5-125 summarizes PSC limits and halibut PSC mortality in the CDQ groundfish target fishery for 2008 to 2013. The first set of two rows shows the limits and halibut PSC mortality as they actually existed during the Basis Years. These rows constitute the status quo PSC limits and halibut PSC mortality. The PSC Limits for Option 6.1–6.3 are not shown in the table because they would not be binding, and therefore would have no measurable impacts relative to historic levels of catch and halibut mortality.

The bottom three rows in Table 5-125 summarize the PSC Limit and halibut PSC mortality amounts that are used as input into the IMS Model for the Option 6.4 under each of the Basis Years. The lightly shaded cells indicate that the PSC Limit is not binding for that Basis Year and that the modelled halibut PSC mortality amounts will be unchanged from the status quo. In other words, Option 6.4 would only affect the CDQ groundfish fishery if halibut mortality in the CDQ fishery were as high as or higher than levels seen in 2013. Table 5-125 shows that under Scenario A for Option 6.4, when 2013 is drawn as the Basis Year, halibut PSC mortality will be approximately 9 mt less than it is under the status quo. Under Scenario B, when 2013 is drawn as the Basis Year, the modelled halibut PSC mortality will be about 14 mt less than under the status quo. When any other year is drawn as a Basis Year, there will no change in the halibut PSC mortality and therefore no measurable impact.

Table 5-125 Historical and Modelled Halibut PSC Limits and PSC mortality for CDQ Groundfish Fisheries

	2008	2009	2010	2011	2012	2013
Historical Halibut PSC Limits in the Pacific Cod Fishery and Actual Halibut PSC mortality (in round weight mt mortality)						
PSC Limit	343.0	343.0	393.0	393.0	393.0	393.0
Actual PSC	214.0	151.0	158.6	223.0	251.7	264.8
Modelled Halibut PSC Limit and Halibut PSC mortality (in round weight mt) under Option 2.4 (Reduce PSC Limit by 35%)						
PSC Limit	255.5	255.5	255.5	255.5	255.5	255.5
PSC Scenario A	214.0	151.0	158.6	223.0	251.7	255.0
PSC Scenario B	214.0	151.0	158.6	223.0	251.7	250.7

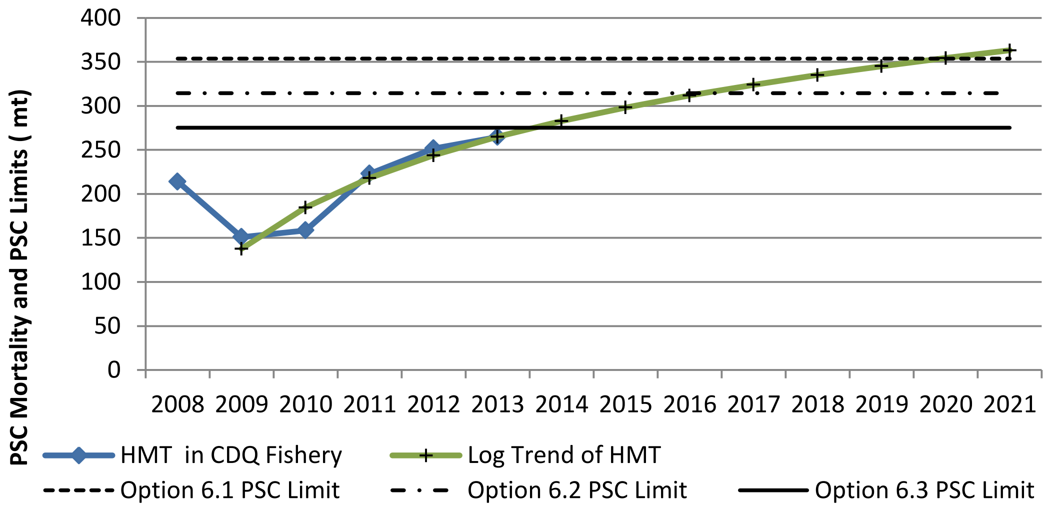
Source: Developed by Northern Economics based on AKFIN data (Fey 2014).

5.7.6.1 Option 6—Suboptions 1–3: Reduce Halibut PSC Limits for CDQ Fisheries 10, 20, or 30 Percent

When comparing the list of suboptions on page 280 with the historic amounts of halibut PSC mortality taken in the CDQ groundfish fishery (Table 5-125), it is clear that none of Options 6.1–6.3 would materially limit the CDQ fishery in any of the Basis Years; only Option 6.4 would.

This section contain a very brief examination of potential future impacts of Options 6.1–6.3 assuming that growth in the CDQ groundfish fishery continues and that halibut PSC mortality continues to growth as well. Figure 5-77 shows halibut PSC mortality from 2008 to 2013, along with a logarithmic growth trend using data from 2009 to 2013. Also shown in the chart are lines showing the PSC Limits for Options 6.1–6.3.

Figure 5-77 Halibut PSC mortality in CDQ Groundfish Fishery with a Log Growth Trend, and PSC Limits for Options 6.1–6.3



Note, HMT = halibut PSC mortality
Source: Developed by Northern Economics with halibut PSC mortality data from AKFin (Fey 2014).

Based on the growth trend in halibut PSC mortality in the CDQ groundfish fishery, it appears likely that the CDQ groundfish fishery would exceed the cap for Option 6.3 in the 2014 fishing year. The PSC limit for Option 6.2 would be hit by 2016 if growth continued at the rate shown in the growth trend. Assuming that halibut PSC mortality growth continued at the rate shown by the trend, the Option 6.1 PSC limit would be hit in 2020.

We note that this is a very simplistic analysis that serves only to demonstrate that if growth continues in the CDQ non-pollock groundfish fisheries, halibut PSC mortality is likely to continue to grow as well. If halibut PSC mortality grows at a logarithmic growth rate based on actual halibut PSC mortality from 2009 to 2013, then the currently less-constraining options would likely be binding in the not too distant future.

5.7.6.2 Option 6—Suboption 4: Reduce Halibut PSC Limits for CDQ Fisheries by 35 Percent

Option 6.4 would currently limit the CDQ groundfish fishery, but as was noted earlier, historical halibut PSC mortality exceeded the 255.1 mt halibut PSC limit under Option 6.4 for the first time in 2013. As with other binding options, the assessment of impacts of the proposed reduction in PSC limits for the CDQ groundfish fishery is accomplished through the use of the IMS Model, which is described in more detail in Section 5.4.2.

We note here that the IMS Model is not as effective for assessing the impacts of Option 6.4 as it appears to have been for Options assessed for other fisheries. One reason for this is that the CDQ groundfish fisheries have not yet fully matured, particularly with respect to the target fisheries other than pollock. As documented in Section 5.5.5, the portions of the CDQ groundfish fishery other than target fisheries for pollock and Pacific cod have grown steadily since 2009, as has the halibut PSC mortality in those fisheries. Because of this growth and the potential of these CDQ fisheries to continue to grow—at least until the CDQ apportionment of groundfish is more fully utilized—there are clearly better choices than the random draws of the Basis Year as inputs into the IMS Model. A better choice, for example, would simply be to use 2013 as the only Basis Year, or to use 2011 to 2013 and then create three additional Basis Years using growth rates from that period. However, since only the IMS Model was used for this version of the RIR, we will report the IMS Model results, but with the caveat that the model results are far less robust for this group than for other more mature fisheries.

The IMS Model was run with 10,000 iterations for the CDQ groundfish fisheries for Option 6.4 under two different scenarios that were supposed to represent a low impact case (Scenario A) and a high impact case (Scenario B). We also assume under both Scenarios that CDQ target fisheries for pollock are not exempt.[35] The two scenarios are described below:

- Scenario A: In this case it is assumed that CDQ Groups, using historic fishery data for 2008 to 2013 determine the particular months and target fisheries that generate the lowest wholesale revenue per ton of halibut mortality in CDQ fisheries. They then avoid fishing for those targets in those months. For analytical purposes it is assumed that operators know in advance how much halibut savings will be created by dropping these target months from their repertoire.
- Scenario B: Under this Scenario we use an open-access type closure protocol over all CDQ operations—this is the last-caught first-cut methodology. Once the CDQ PSC limit is hit, all CDQ fisheries that would have taken place later in the year are cut.

The Model results for Option 6.4 are summarized in the two sets of figures on the following pages. Figure 5-78 on page 284 summarizes the distribution of changes in net present value of wholesale value in the CDQ groundfish fishery. Figure 5-79 on page 285 summarizes the distribution of changes in net present value of wholesale value over the 10-year period for the commercial halibut fishery in Area 4 and its subareas. Table 5-120 below presents the statistical details of the IMS Model runs. We note that while Scenario A does, in fact, generate lower levels of impacts for the CDQ groundfish fishery than Scenario B, the impacts for the commercial halibut fishery are higher under Scenario A than under Scenario B.

On average, over the 10,000 iterations in the IMS Model, the commercial halibut fishery would realize a $0.23 million increase in the net present value of wholesale revenue over a 10-year period under Scenario A and $0.16 million increase under Scenario B. The CDQ groundfish fishery would see an average decrease in their net present value of wholesale revenue of $0.45 million under Scenario A and a $2.03 million decrease in changes in net present value under Scenario B. For Scenario A, the ratio of change is estimated at -1.94 to 1 favoring the commercial halibut fishery. Under Scenario B, the change ratio is -12.8 to 1.

Under Scenario A, 78 percent of the reduction in halibut PSC mortality is expected to occur in Area 4CDE, with the remaining 23 percent in 4A—no change is expected in Area 4B. Under Scenario B, the impact area flips, with a greater percentage of the reductions in halibut PSC mortality accruing to 4A (78 percent) and just 22 percent of the reduction accruing to 4CDE. In general, for every round weight ton of halibut PSC mortality cut by the CDQ groundfish fishery, the commercial halibut fishery gains 0.406 net weight tons of commercial harvest. This difference is attributed to the 0.75 factor to convert round weight to net weight, the 95 percent historical catch to FECY ratio in Area 4, and the 57.0 to 43.0 percent average O26 to U26 ratio for CDQ halibut PSC mortality during the Basis Years.

[35] It is not clear under the regulations whether or not CDQ pollock fisheries would be exempt from closures if the CDQ halibut PSC limit is reached. Under the BSAI TLA fishery, pollock is exempt, but that exemption appears to apply specifically to the BSAI TLA fishery. A second precedent is seen in the A80 fisheries. One of the A80-CPs is legally allowed to target BSAI pollock under the American Fisheries Act. But if that vessel's A80 cooperative were to reach its halibut PSC limit, it does not appear that the vessel would be allowed to continue to fish outside of the cooperative for pollock.

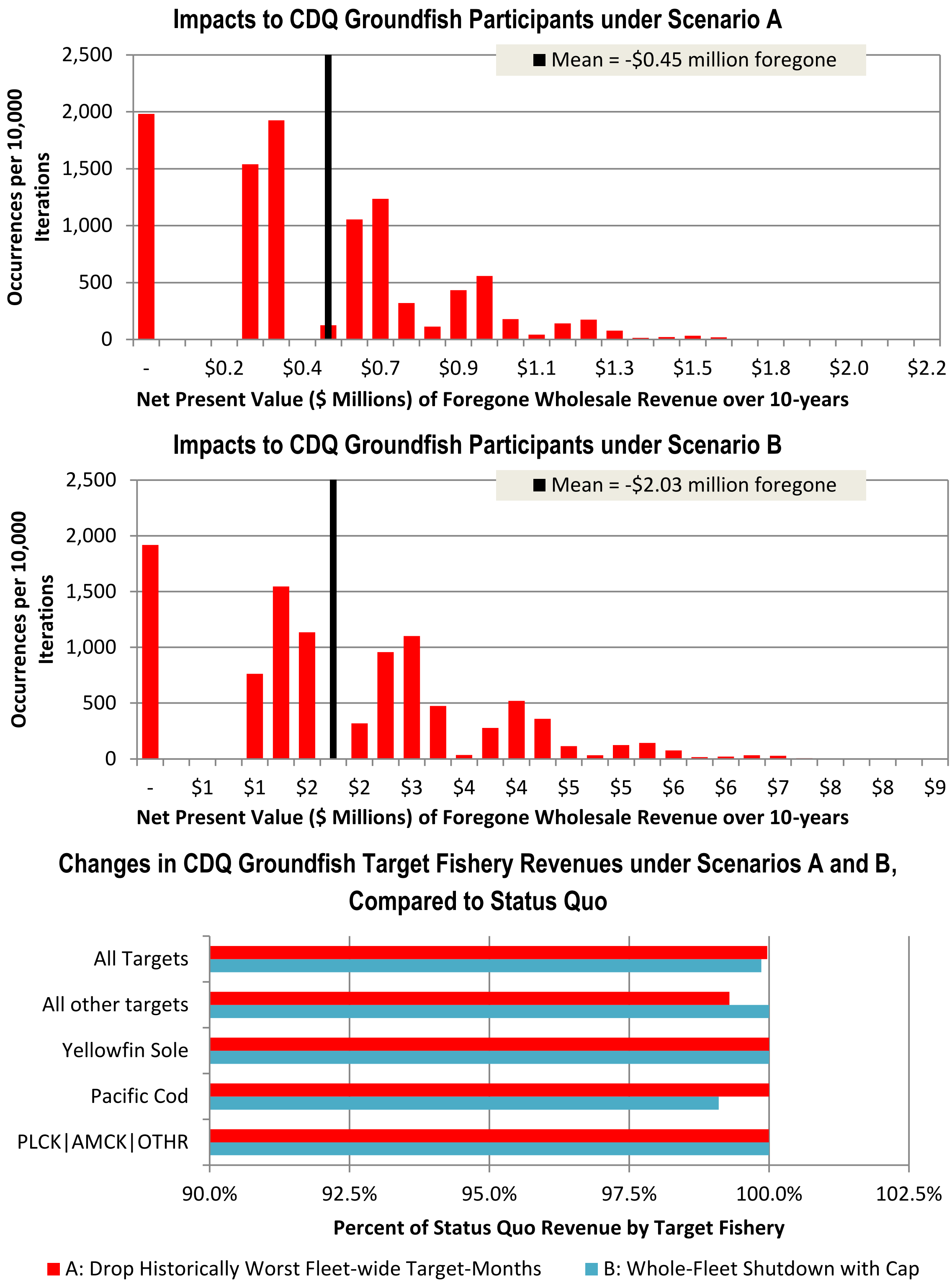
The bottom line of Table 5-126 shows that the commercial halibut fishery generated a $240,000 increase in their net present value of wholesale revenue (over the 10-year period) for every additional net weight ton they harvested annually. This value remains constant for all areas under both scenarios. Under Scenario A, the CDQ groundfish fishery had to forego $19,000 of net present value over the 10-year period for each halibut PSC mortality mt cut on an annual basis. Under Scenario B, the foregone net present value per ton of annual halibut PSC limit reductions for longline CPs increases slightly to $1.22 million for each ton of annual halibut PSC limit reductions.

Table 5-126 Statistical Details of the IMS Model Runs for Option 6.4

	Directed Halibut Fishery Impacts								Groundfish	
	Scenario A				Scenario B				Scenario A	Scenario B
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4	All Areas	
Iterations with No Change in Net Present Value (NPV)	1,980	10,000	1,980	1,980	1,918	10,000	1,918	1,918	1,980	1,918
	Net Change in the Net Present Value of Wholesale Revenue from the Status Quo Over All Iterations ($2013 Millions)									
Minimum Change in Magnitude of NPV	-	-	-	-	-	-	-	-	-	-
Maximum Change in Magnitude of NPV	$0.21	-	$0.77	$0.99	$0.52	-	$0.14	$0.66	($2.12)	($8.53)
Mean Change in NPV	$0.05	-	$0.18	$0.23	$0.12	-	$0.03	$0.16	($0.45)	($2.03)
Standard Deviation of Changes in NPV	$0.04	-	$0.14	$0.18	$0.10	-	$0.03	$0.12	$0.34	$1.51
Median Change in NPV	$0.04	-	$0.16	$0.20	$0.11	-	$0.03	$0.14	($0.34)	($1.64)
	Change in Average Annual Halibut (MT) from the Status Quo									
Mean Annual Change in Halibut PSC mortality (Round Weight MT)	-0.51	-	-1.86	-2.37	-1.30	-	-0.36	-1.66	-2.37	-1.66
Mean Annual Change in Directed Catch (Net Weight MT)	0.21	-	0.76	0.97	0.53	-	0.15	0.67	-	-
Mean Change in NPV (2013$ million) per annual change in halibut (mt)	$0.24	# N/A	$0.24	$0.24	$0.24	# N/A	$0.24	$0.24	$0.19	$1.22

Source: Developed by Northern Economics based on IMS Model runs for Option 6.4.

Figure 5-78 Impacts to CDQ Participants under Option 6.4—35% Reductions in Halibut PSC Limits

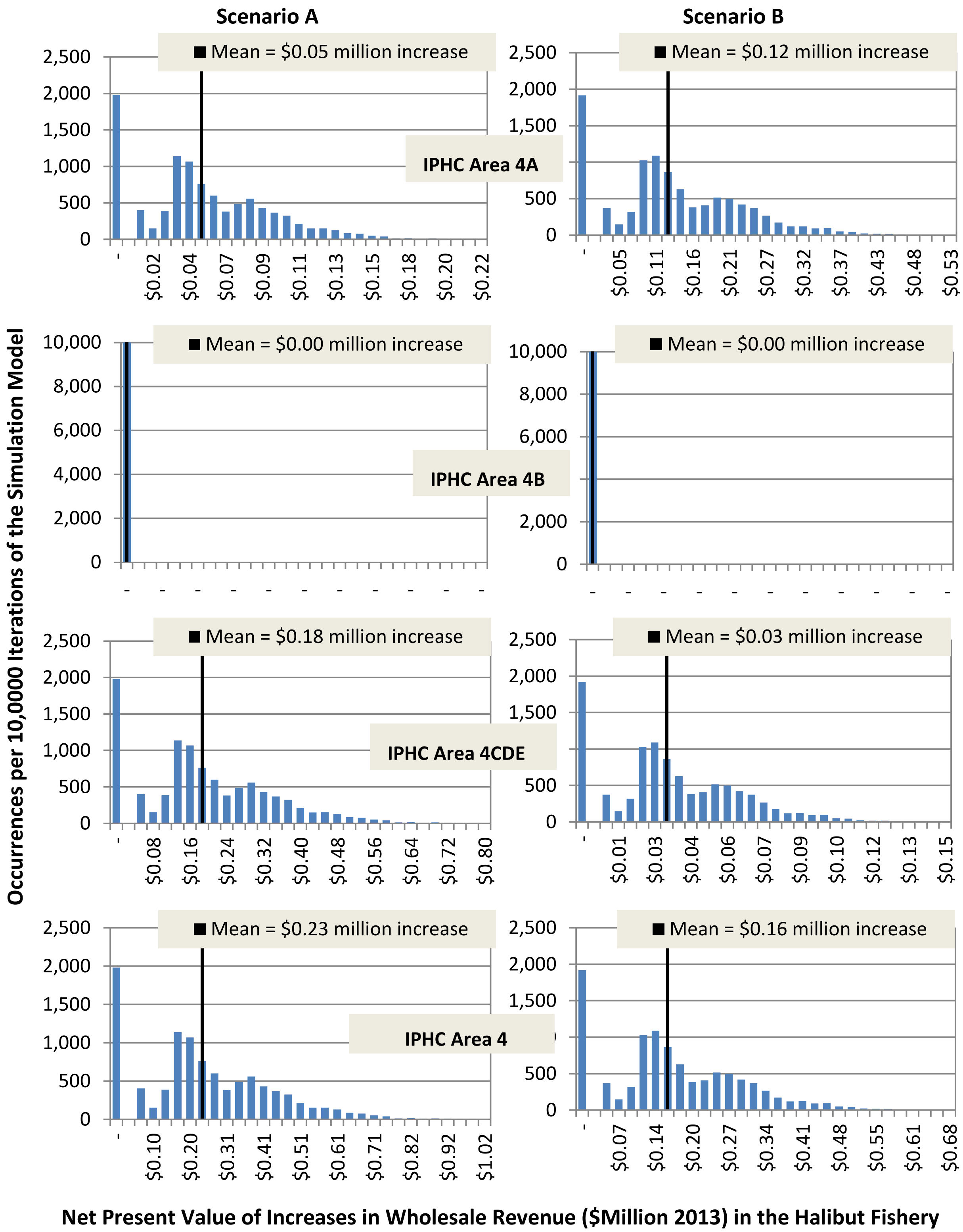


1) Scenario A assumes that CDQ participants choose to drop target fisheries in months that have historically produced the least wholesale revenue per ton of halibut mortality.

2) Scenario B assumes open access type fishery closures when the cap is reached.

Source: Developed by Northern Economics based on IMS Model runs for Option 6.4.

Figure 5-79 Net Present Value of Revenue Impacts to Commercial Halibut Fisheries of Option 6.4



Note: Scenario A assumes that CDQ participants drop target months that have historically generated the least wholesale revenue per month, while Scenario B assumes that CDQ participants make no behavioral changes, and if the cap is hit then all vessels leave the fishery.

5.7.7 Summary of Impacts of All Options to Reduce Halibut PSC Mortality in BSAI Groundfish Fisheries

In this section we compile the IMS Model results of similar options (from a reduction percentage perspective) and show the combined impact to the commercial halibut fishery and to the affected sectors in the groundfish fishery.

5.7.7.1 Comparison of Impact for Options to Reduce Halibut PSC Limit by 10 Percent

In this section we compile IMS Model results for each suboption that reduced halibut PSC limits to 90 percent of the status quo—i.e. a 10 percent reduction. While this level of reduction has been proposed for all six of the PSC limit groups, this reduction was projected to materially affect only two groups—the participants in the BSAI TLA fisheries and the A80-CPs. Table 5-127 shows the mean values of the net present value of changes from the status quo in wholesale revenue over the 10-year period as estimated by the IMS Model. Table 5-128 on the next page shows the annual average reductions from the status quo of halibut PSC mortality in the groundfish fishery and the annual average increases in halibut catch in the commercial halibut fisheries over 10-year future period as estimated by the IMS Model. The tables show the results from 10,000 iterations of the IMS Model for each affected group and for each scenario. The two scenarios are intended to represent a lower impact case (Scenario A) and a higher impact case (Scenario B). Which of the two scenarios is a better estimate is not necessarily a choice that decision-makers can control.

It is important to note the time period distinction between the information in the two tables. In Table 5-127, the numbers reflect average changes from the status quo in the net present value over the 10-year period modelled—i.e. the average of a single numeric result for each of the 10,000 iterations. In Table 5-128, on the following page, the numbers reflect the average change from the status quo in each year over the 10 year period over all 10,000 iterations—these numbers reflect the average change over 100,000 draws for each Scenario.

In Table 5-127 the estimated foregone net present value of wholesale revenue for vessels participating the BSAI TLA and the A80-CP fisheries combine to a total of $19.73 million under Scenario A and $35.11 million under Scenario B. The estimated increase in the net present value of wholesale revenue accruing to the commercial halibut fishery sums to $5.26 million for Scenario A and $7.42 million for Scenario B. The combined ratio of net present value changes (groundfish fishery to commercial halibut fishery) under Scenario A is -3.76 to 1, while under Scenario B the ratio is -4.73 to 1.

Table 5-127 Mean Values of Net Present Value Changes in Wholesale Revenue from a 10 Percent PSC Limit Reduction

	Groundfish Fishery Impacts			Commercial Halibut Fishery Impacts							
	PSC Limit	Scenario A	Scenario B	Scenario A				Scenario B			
Option	All Areas	All Areas		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	MT	Net Present Value of Change in Wholesale Revenues ($2013 Millions) from the Status Quo									
#2 BSAI TLA	788	($9.79)	($15.66)	$0.43	$0.04	$0.57	$1.05	$0.69	$0.06	$0.67	$1.41
#3 A80-CP	2093	($9.94)	($19.45)	$0.32	$0.01	$3.88	$4.21	$0.18	-	$5.83	$6.00
#4 Longline CV	14	-	-	-	-	-	-	-	-	-	-
#5 Longline CP	684	-	-	-	-	-	-	-	-	-	-
#6 CDQ	351	-	-	-	-	-	-	-	-	-	-
#7 Longline Other	52	-	-	-	-	-	-	-	-	-	-
All Options	3,982	($19.73)	($35.11)	$0.75	$0.05	$4.45	$5.26	$0.86	$0.06	$6.50	$7.42

Source: Developed by Northern Economics based on IMS Model results.

Table 5-128 summarizes the average annual change in halibut PSC mortality by IPHC area under all of the iterations run for the each scenario. In the top half of the table, the numbers show the average annual change in halibut PSC mortality (in round weight mt mortality) for the affected groundfish fisheries—these will always be negative numbers or zero (-). The lower half of the table shows the average annual change in the halibut harvest (in net weight mt) in the commercial halibut fishery. The numbers in the lower half will always be positive or zero (-). Further, the numbers in the lower half of the table will always have a smaller magnitude than the numbers in the upper portion. The reasons for this are threefold: First, the numbers for the commercial halibut fishery are net weight tons and therefore only 75 percent of round weight tons. Second, the harvest numbers are deflated by the average catch-to-allocation ratio in Area 4—which from 2008 to 2013 averaged 95 percent. Finally, as discussed in great detail in Section 5.4.2, changes in halibut PSC mortality are reflected in FCEYs for the commercial halibut fishery in terms of O26 fish, and O26 halibut PSC mortality constitutes from 50–70 percent of Total halibut PSC mortality depending on the gear and fishery in which the reduction has occurred.

Vessels in the BSAI TLA and A80-CP fisheries are estimated reduce their halibut PSC mortality by an average 52 mt (round weight) annually under Scenario A and 73.5 mt (round weight) under Scenario B. Bycatch reductions in Area 4CDE range from 85 to 88 percent in Scenarios A and B respectively, while halibut PSC mortality reductions in Area 4A range from 14 down to 11.5 percent. The commercial halibut fishery is projected to realize an annual increase in harvests ranging from 22.2 to 31.4 mt (net weight) in Area 4 as a whole with the same percentage splits by subarea as realized for halibut PSC mortality reductions.

Although not shown in the table, for every ton of annual reductions in halibut PSC mortality, the groundfish fisheries are estimated to forego nearly $379,000 in net present value over the 10-year period under Scenario A and nearly $478,000 under Scenario B. The commercial halibut fishery is expected gain roughly $240,000 in net present value over the 10-year period for every annual ton of increased catch—this $240,000 gain in net present value per annual ton of increase is constant under all option and scenarios.

Table 5-128 Average Annual Changes in Halibut PSC Mortality and Halibut Harvests with a 10 Percent Reduction in PSC Limits

	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Option	**Average Annual Change in Groundfish Halibut PSC mortality (Round Weight MT) from the Status Quo**							
#2 BSAI TLA	-5.00	-0.49	-6.57	-12.06	-7.94	-0.64	-7.95	-16.53
#3 A80-CP	-3.08	-0.06	-36.88	-40.03	-1.72	-	-55.25	-56.97
#4 Longline CV	-	-	-	-	-	-	-	-
#5 Longline CP	-	-	-	-	-	-	-	-
#6 CDQ	-	-	-	-	-	-	-	-
#7 Longline Other	-	-	-	-	-	-	-	-
All Options	-8.09	-0.55	-43.45	-52.09	-9.66	-0.64	-63.20	-73.50
Option	**Average Annual Change in Directed Halibut Catch (Net Weight MT) from the Status Quo**							
#2 BSAI TLA	1.83	0.19	2.40	4.41	2.91	0.23	2.85	5.99
#3 A80-CP	1.36	0.03	16.43	17.81	0.74	-	24.64	25.39
#4 Longline CV	-	-	-	-	-	-	-	-
#5 Longline CP	-	-	-	-	-	-	-	-
#6 CDQ	-	-	-	-	-	-	-	-
#7 Longline Other	-	-	-	-	-	-	-	-
All Options	3.18	0.22	18.83	22.23	3.65	0.23	27.49	31.37

Source: Developed by Northern Economics based on IMS Model results.

5.7.7.2 Comparison of Impact for Options to Reduce Halibut PSC Limit by 20 Percent

In this section we compile IMS Model results for suboptions that reduce halibut PSC limits by 20 percent, i.e., to 80 percent of the status quo. As with the 10 percent reduction options, the proposed change is projected to materially affect only two groups—the participants in the BSAI TLA fisheries and the A80-CPs.

Table 5-129 shows the mean values of the net present value of changes from the status quo in wholesale revenue over the 10-year period as estimated by the IMS Model, while Table 5-130 summarizes the average annual change in halibut harvest and halibut PSC mortality. The estimated foregone net present value of wholesale revenue for vessels participating the BSAI TLA and the A80-CP fisheries combine to a total of $82.69 million under Scenario A and $165.93 million under Scenario B. The estimated increase in the net present value of wholesale revenue accruing to the commercial halibut fishery sums to $22.53 million for Scenario A and $25.72 million for Scenario B. The combined ratio of net present value changes (groundfish fishery to commercial halibut fishery) is -3.67 to 1 with Scenario A, and -6.41 to 1 with Scenario B.

Table 5-129 Mean Values of Net Present Value Changes in Wholesale Revenue from a 20 Percent PSC Limit Reduction

	Groundfish			Direct Halibut Fishery Impacts							
	PSC Limit	Scenario A	Scenario B	Scenario A				Scenario B			
Option	All Areas	All Areas		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	MT	Net Present Value of Change in Wholesale Revenues ($2013 Millions) from the Status Quo									
#2 BSAI TLA	700	($30.47)	($50.35)	$0.95	$0.18	$1.20	$2.33	$1.28	$0.26	$1.79	$3.33
#3 A80-CP	1860	($52.22)	($114.58)	$2.76	$0.01	$17.44	$20.21	$2.57	-	$19.82	$22.39
#4 Longline CV	12	-	-	-	-	-	-	-	-	-	-
#5 Longline CP	608	-	-	-	-	-	-	-	-	-	-
#6 CDQ	312	-	-	-	-	-	-	-	-	-	-
#7 Longline Other	46	-	-	-	-	-	-	-	-	-	-
All Options	3,538	($82.69)	($164.93)	$3.72	$0.18	$18.64	$22.53	$3.85	$0.26	$21.61	$25.72

Source: Developed by Northern Economics based on IMS Model results.

Table 5-130 Annual Average Changes in Halibut PSC Mortality and Halibut Harvests with a 20 Percent Reduction in PSC Limits

	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Option	Average Annual Change in Groundfish Halibut PSC Mortality (Round Weight MT) from the Status Quo							
#2 BSAI TLA	-11.00	-2.09	-14.23	-27.33	-14.67	-3.00	-21.01	-38.69
#3 A80-CP	-26.38	-0.06	-164.78	-191.23	-24.42	-	-187.49	-211.91
#4 Longline CV	-	-	-	-	-	-	-	-
#5 Longline CP	-	-	-	-	-	-	-	-
#6 CDQ	-	-	-	-	-	-	-	-
#7 Longline Other	-	-	-	-	-	-	-	-
All Options	-37.38	-2.16	-179.02	-218.56	-39.09	-3.00	-208.50	-250.60
Option	Average Annual Change in Directed Halibut Catch (Net Weight MT) from the Status Quo							
#2 BSAI TLA	4.03	0.74	5.06	9.83	5.40	1.11	7.56	14.06
#3 A80-CP	11.66	0.03	73.74	85.43	10.84	-	83.75	94.59
#4 Longline CV	-	-	-	-	-	-	-	-
#5 Longline CP	-	-	-	-	-	-	-	-
#6 CDQ	-	-	-	-	-	-	-	-
#7 Longline Other	-	-	-	-	-	-	-	-
All Options	15.69	0.77	78.80	95.26	16.24	1.11	91.31	108.65

Source: Developed by Northern Economics based on IMS Model results.

Table 5-130 summarizes the average annual change in halibut harvest and halibut PSC mortality by IPHC area under all of the iterations run for the each Scenario. Vessels in the BSAI TLA and A80-CP fisheries are estimated to reduce their halibut PSC mortality by an average 218.6 mt (round weight) annually under Scenario A and 250.6 mt (round weight) under Scenario B. Halibut PSC mortality reductions in Area 4CDE range from 83 to 84 percent in Scenarios A and B respectively, while halibut PSC mortality reductions in Area 4A range from 16.5 down to 15 percent. The commercial halibut fishery is projected to realize an annual increase in harvests ranging from 95.3 to 108.7 mt (net weight) in Area 4 as a whole with the same percentage splits by subarea as calculated for the groundfish fishery halibut PSC reductions.

Although not shown in the table, for every ton of annual reductions in halibut PSC mortality, the groundfish fisheries are estimated to forego over $378,000 in net present value over the 10-year period under Scenario A and over $658,000 under Scenario B. As with all other options, the commercial halibut fishery is expected gain roughly $240,000 in net present value over the 10-year period for every average annual ton of increased catch.

5.7.7.3 Comparison of Impact for Options to Reduce Halibut PSC Limit by 30 Percent

In this section we compile IMS Model results for each suboption that reduces halibut PSC limits to 70 percent of the status quo—i.e. a 30 percent reduction. Unlike options to reduce by PSC Limits by 10 and 20 percent, the proposed change is projected to materially affect the longline CP Pacific cod fishery in addition to the BSAI TLA and A80-CP fisheries. Table 5-131 shows the mean values of the net present value of changes from the status quo in wholesale revenue over the 10-year period as estimated by the IMS Model, while Table 5-132 on page 290 shows changes in annual average halibut PSC mortality reductions from the groundfish fishery and annual average harvest increases for the commercial halibut fishery.

Table 5-131 Mean Values of Net Present Value Changes in Wholesale Revenue from a 30 Percent PSC Limit Reduction

	Groundfish			Direct Halibut Fishery Impacts							
	PSC Limit	Scenario A	Scenario B	Scenario A				Scenario B			
Option	All Areas	All Areas		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	MT	Net Present Value of Change in Wholesale Revenues ($2013 Millions) from the Status Quo									
#2 BSAI TLA	613	($61.67)	($92.44)	$1.61	$0.36	$1.82	$3.79	$2.66	$0.43	$2.76	$5.85
#3 A80-CP	1628	($161.21)	($285.27)	$6.36	$2.01	$35.20	$43.57	$7.15	$1.24	$37.86	$46.26
#4 Longline CV	11	-	-	-	-	-	-	-	-	-	-
#5 Longline CP	532	($10.15)	($24.08)	$0.21	$0.08	$1.24	$1.53	$0.58	$0.45	$2.47	$3.50
#6 CDQ	273	-	-	-	-	-	-	-	-	-	-
#7 Longline Other	41	-	-	-	-	-	-	-	-	-	-
All Options	3,098	($233.02)	($401.79)	$8.19	$2.45	$38.26	$48.90	$10.39	$2.13	$43.09	$55.61

Source: Developed by Northern Economics based on IMS Model results.

The estimated foregone net present value of wholesale revenue for vessels participating the BSAI TLA fisheries, the A80-CPs, and longline CPs in the Pacific cod fishery combine to a total of $233 million under the Scenario A and nearly $401 million under Scenario B. The estimated increase in the net present value of wholesale revenue accruing to the commercial halibut fishery sums to nearly $49 million for Scenario A and $55.6 million for Scenario B. The combined ratio of net present value changes (groundfish to halibut fishery) under Scenario A is -4.77 to 1, while under Scenario B the ratio is -7.23 to 1.

Table 5-132 summarizes the average annual change in halibut PSC mortality by IPHC area under all of the iterations run for the each Scenario. Vessels in the BSAI TLA fisheries, along with A80-CPs, longline CPs are estimated to reduce their halibut PSC mortality by an average 471.9 mt (round weight) annually under Scenario A and 541.1 mt (round weight) under Scenario B. Halibut PSC mortality reductions in Area 4CDE account for about 78 percent of the total under both scenarios, while halibut PSC mortality reductions in Area 4A range from 17 to 19 percent. The commercial halibut fishery is projected to realize an annual increase in harvests ranging from 206.5 to 234.9 mt (net weight) in Area 4 under the two scenarios, with the same percentage splits by subarea as calculated for the groundfish fishery halibut PSC mortality reductions.

Although not shown in the table, for every ton of annual reductions in halibut PSC mortality, the groundfish fisheries are estimated to forego nearly $494,000 in net present value over the 10-year period under Scenario A, and more than $742,000 under Scenario B. As with all other options, the halibut fishery is expected gain roughly $240,000 in net present value over the 10-year period for every average annual ton of increased catch.

Table 5-132 Annual Average Changes in Halibut PSC Mortality and Halibut Harvests with a 30 Percent Reduction in PSC Limits

	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Option	**Average Annual Change in Groundfish Halibut PSC Mortality (Round Weight MT) from the Status Quo**							
#2 BSAI TLA	-18.63	-4.30	-21.45	-44.38	-31.43	-5.20	-33.03	-69.66
#3 A80-CP	-60.75	-19.06	-334.50	-414.31	-68.13	-11.51	-361.29	-440.94
#4 Longline CV	-	-	-	-	-	-	-	-
#5 Longline CP	-1.90	-0.60	-10.73	-13.23	-5.21	-3.94	-21.35	-30.50
#6 CDQ	-	-	-	-	-	-	-	-
#7 Longline Other	-	-	-	-	-	-	-	-
All Options	-81.28	-23.96	-366.68	-471.92	-104.77	-20.65	-415.67	-541.09
Option	**Average Annual Change in Directed Halibut Catch (Net Weight MT) from the Status Quo**							
#2 BSAI TLA	6.80	1.54	7.71	16.05	11.23	1.83	11.62	24.69
#3 A80-CP	26.90	8.48	148.56	183.94	30.21	5.26	160.01	195.47
#4 Longline CV	-	-	-	-	-	-	-	-
#5 Longline CP	0.91	0.32	5.24	6.47	2.46	1.88	10.41	14.75
#6 CDQ	-	-	-	-	-	-	-	-
#7 Longline Other	-	-	-	-	-	-	-	-
All Options	34.60	10.35	161.50	206.45	43.90	8.97	182.04	234.91

Source: Developed by Northern Economics based on IMS Model results.

5.7.7.4 Comparison of Impact for Options to Reduce Halibut PSC Limit by 35 Percent

In this section we compile IMS Model results for each suboption that reduces halibut PSC limits to 65 percent of the status quo—i.e. a 35 percent reduction. Under this reduction option, CDQ groundfish fisheries are affected along with the longline CPs, A80-CPs, and vessels in the BSAI TLA fisheries. None of the reduction options will materially affect the longline CVs. Similarly, none of the options that reduce PSC limits in the hook and line fisheries for target fisheries other than for Pacific cod or sablefish will have a material impact.

Table 5-133 on the following page shows that estimated foregone net present value of wholesale revenues in affected fisheries from the status quo combine for a total of $329.6 million under Scenario A, and over $565 million under Scenario B. The estimated increase from the status quo in net present value of wholesale revenue accruing to the halibut fishery ranges from $64.5 million to $72.7 million under the two scenarios. The combined ratio of net present value changes under Scenario A is -5.11 to 1, while under Scenario B the ratio is -7.77 to 1.

Table 5-133 Mean Values of Net Present Value Changes in Wholesale Revenue from a 35 Percent PSC Limit Reduction

Option	Groundfish			Direct Halibut Fishery Impacts							
	PSC Limit	Scenario A	Scenario B	Scenario A				Scenario B			
	All Areas	All Areas		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	MT	Net Present Value of Change in Wholesale Revenues ($2013 Millions) from the Status Quo									
#2 BSAI TLA	569	($77.87)	($145.30)	$1.87	$0.45	$2.37	$4.69	$4.00	$0.56	$3.85	$8.41
#3 A80-CP	1511	($223.91)	($367.51)	$8.54	$3.48	$43.66	$55.68	$9.45	$1.53	$47.24	$58.22
#4 Longline CV	10	-	-	-	-	-	-	-	-	-	-
#5 Longline CP	494	($27.33)	($50.41)	$0.36	$0.64	$2.87	$3.87	$0.91	$0.69	$4.31	$5.92
#6 CDQ	254	($0.45)	($2.03)	$0.05	-	$0.18	$0.23	$0.12	-	$0.03	$0.16
#7 Longline Other	38	-	-	-	-	-	-	-	-	-	-
All Options	2,876	($329.56)	($565.24)	$10.82	$4.56	$49.09	$64.47	$14.49	$2.78	$55.44	$72.71

Source: Developed by Northern Economics based on IMS Model results.

Table 5-134 shows changes in annual average halibut PSC mortality reductions from the groundfish fishery and annual average harvest increases for the commercial halibut fishery. The groundfish fisheries are estimated to reduce their halibut PSC mortality by an average of 622.5 mt to 706.4 mt (round weight) under the two scenarios. The commercial halibut fishery is projected to realize an annual increase in harvests ranging from 272.3 to 307.0 mt (net weight) with 76 percent of the change accruing to 4CDE. The groundfish fisheries are estimated to forego nearly $520,000 to $800,000 in net present value over the 10-year period for every average annual ton of halibut PSC mortality reductions. As with all other options, the halibut fishery is expected gain roughly $240,000 in net present value for every average annual ton of increased catch.

Table 5-134 Annual Average Changes in Halibut PSC Mortality and Halibut Harvests with a 35 Percent Reduction in PSC Limits

	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Option	Average Annual Change in Groundfish Halibut PSC Mortality (Round Weight MT) from the Status Quo							
#2 BSAI TLA	-21.73	-5.32	-28.17	-55.23	-46.86	-6.64	-45.02	-98.52
#3 A80-CP	-81.38	-33.07	-416.99	-531.44	-90.38	-14.25	-450.10	-554.73
#4 Longline CV	-	-	-	-	-	-	-	-
#5 Longline CP	-3.22	-5.33	-24.96	-33.51	-8.04	-5.96	-37.45	-51.45
#6 CDQ	-0.51	-	-1.86	-2.37	-1.30	-	-0.36	-1.66
#7 Longline Other	-	-	-	-	-	-	-	-
All Options	-106.85	-43.72	-471.97	-622.54	-146.57	-26.85	-532.93	-706.35
Option	Average Annual Change in Directed Halibut Catch (Net Weight MT) from the Status Quo							
#2 BSAI TLA	7.89	1.88	9.99	19.77	16.88	2.36	16.28	35.53
#3 A80-CP	36.09	14.70	184.39	235.18	39.88	6.45	199.41	245.75
#4 Longline CV	-	-	-	-	-	-	-	-
#5 Longline CP	1.51	2.69	12.14	16.34	3.87	2.93	18.22	25.02
#6 CDQ	0.21	-	0.76	0.97	0.53	-	0.15	0.67
#7 Longline Other	-	-	-	-	-	-	-	-
All Options	45.70	19.27	207.29	272.26	61.16	11.74	234.06	306.97

Source: Developed by Northern Economics based on IMS Model results.

6 Initial Regulatory Flexibility Analysis

6.1 Introduction

This Initial Regulatory Flexibility Analysis (IRFA) addresses the statutory requirements of the Regulatory Flexibility Act (RFA) of 1980, as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (5 U.S.C. 601-612). This IRFA evaluates the potential adverse economic impacts on small entities directly regulated by the proposed action.

The RFA, first enacted in 1980, was designed to place the burden on the government to review all regulations to ensure that, while accomplishing their intended purposes, they do not unduly inhibit the ability of small entities to compete. The RFA recognizes that the size of a business, unit of government, or nonprofit organization frequently has a bearing on its ability to comply with a federal regulation. Major goals of the RFA are: (1) to increase agency awareness and understanding of the impact of their regulations on small business, (2) to require that agencies communicate and explain their findings to the public, and (3) to encourage agencies to use flexibility and to provide regulatory relief to small entities.

The RFA emphasizes predicting significant adverse economic impacts on small entities as a group distinct from other entities, and on the consideration of alternatives that may minimize adverse economic impacts, while still achieving the stated objective of the action. When an agency publishes a proposed rule, it must either ‘certify’ that the action will not have a significant adverse economic impact on a substantial number of small entities, and support that certification with the ‘factual basis’ upon which the decision is based; or it must prepare and make available for public review an IRFA. When an agency publishes a final rule, it must prepare a Final Regulatory Flexibility Analysis, unless, based on public comment, it chooses to certify the action.

In determining the scope, or ‘universe’, of the entities to be considered in an IRFA, NMFS generally includes only those entities that are directly regulated by the proposed action. If the effects of the rule fall primarily on a distinct segment, or portion thereof, of the industry (e.g., user group, gear type, geographic area), that segment would be considered the universe for the purpose of this analysis.

6.2 IRFA Requirements

Until the North Pacific Fishery Management Council (Council) makes a final decision on a preferred alternative, a definitive assessment of the proposed management alternatives cannot be conducted. In order to allow the agency to make a certification decision, or to satisfy the requirements of an IRFA of the preferred alternative, this section addresses the requirements for an IRFA. Under 5 U.S.C., section 603(b) of the RFA, each IRFA is required to contain:

- A description of the reasons why action by the agency is being considered;
- A succinct statement of the objectives of, and the legal basis for, the proposed rule;
- A description of and, where feasible, an estimate of the number of small entities to which the proposed rule will apply (including a profile of the industry divided into industry segments, if appropriate);
- A description of the projected reporting, record keeping, and other compliance requirements of the proposed rule, including an estimate of the classes of small entities that will be subject to the requirement and the type of professional skills necessary for preparation of the report or record;
- An identification, to the extent practicable, of all relevant federal rules that may duplicate, overlap, or conflict with the proposed rule;

- A description of any significant alternatives to the proposed rule that accomplish the stated objectives of the proposed action, consistent with applicable statutes, and that would minimize any significant economic impact of the proposed rule on small entities. Consistent with the stated objectives of applicable statutes, the analysis shall discuss significant alternatives, such as:
    1. The establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities;
    2. The clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities;
    3. The use of performance rather than design standards;
    4. An exemption from coverage of the rule, or any part thereof, for such small entities.

In preparing an IRFA, an agency may provide either a quantifiable or numerical description of the effects of a proposed action (and alternatives to the proposed action), or more general descriptive statements, if quantification is not practicable or reliable.

6.3 Definition of a Small Entity

The RFA recognizes and defines three kinds of small entities: (1) small businesses, (2) small non-profit organizations, and (3) small government jurisdictions.

Small businesses. Section 601(3) of the RFA defines a 'small business' as having the same meaning as 'small business concern', which is defined under Section 3 of the Small Business Act (SBA). 'Small business' or 'small business concern' includes any firm that is independently owned and operated and not dominant in its field of operation. The SBA has further defined a "small business concern" as one "organized for profit, with a place of business located in the United States, and which operates primarily within the United States or which makes a significant contribution to the U.S. economy through payment of taxes or use of American products, materials or labor…A small business concern may be in the legal form of an individual proprietorship, partnership, limited liability company, corporation, joint venture, association, trust or cooperative, except that where the firm is a joint venture there can be no more than 49 percent participation by foreign business entities in the joint venture."

The SBA has established size criteria for all major industry sectors in the United States, including fish harvesting and fish processing businesses. Effective July 22, 2013, a business involved in *finfish harvesting* is a small business if it is independently owned and operated and not dominant in its field of operation (including its affiliates) and if it has combined annual gross receipts not in excess of $19.0 million for all its affiliated operations worldwide. A business involved in *shellfish harvesting* is a small business if it is independently owned and operated and not dominant in its field of operation (including its affiliates) and if it has combined annual gross receipts not in excess of $5.0 million for all its affiliated operations worldwide. A *seafood processor* is a small business if it is independently owned and operated, not dominant in its field of operation, and employs 500 or fewer persons on a full-time, part-time, temporary, or other basis, at all its affiliated operations worldwide. A business that *both harvests and processes* fish (i.e., a catcher processor) is a small business if it meets the criteria for the applicable fish harvesting operation (i.e., finfish or shellfish). A wholesale business servicing the fishing industry is a small business if it employs 100 or fewer persons on a full-time, part-time, temporary, or other basis, at all its affiliated operations worldwide.

The SBA has established "principles of affiliation" to determine whether a business concern is "independently owned and operated." In general, business concerns are affiliates of each other when one concern controls or has the power to control the other, or a third party controls or has the power to control both. The SBA considers factors such as ownership, management, previous relationships with or ties to another concern, and contractual relationships, in determining whether affiliation exists. Individuals or firms that have identical or substantially identical business or economic interests, such as family members, persons with common investments, or firms that are economically dependent through contractual or other relationships, are treated as one party with such interests aggregated when measuring the size of the concern in question. The SBA counts the receipts or employees of the concern whose size is at issue and those of all its domestic and foreign affiliates, regardless of whether the affiliates are organized for profit, in determining the concern's size. However, business concerns owned and controlled by Indian Tribes, Alaska Regional or Village Corporations organized pursuant to the Alaska Native Claims Settlement Act (43 U.S.C. 1601), Native Hawaiian Organizations, or Community Development Corporations authorized by 42 U.S.C. 9805 are not considered affiliates of such entities, or with other concerns owned by these entities solely because of their common ownership.

Affiliation may be based on stock ownership when (1) a person is an affiliate of a concern if the person owns or controls, or has the power to control 50 percent or more of its voting stock, or a block of stock which affords control because it is large compared to other outstanding blocks of stock, or (2) if two or more persons each owns, controls or has the power to control less than 50 percent of the voting stock of a concern, with minority holdings that are equal or approximately equal in size, but the aggregate of these minority holdings is large as compared with any other stock holding, each such person is presumed to be an affiliate of the concern.

Affiliation may be based on common management or joint venture arrangements. Affiliation arises where one or more officers, directors, or general partners, controls the board of directors and/or the management of another concern. Parties to a joint venture also may be affiliates. A contractor and subcontractor are treated as joint venturers if the ostensible subcontractor will perform primary and vital requirements of a contract or if the prime contractor is unusually reliant upon the ostensible subcontractor. All requirements of the contract are considered in reviewing such relationship, including contract management, technical responsibilities, and the percentage of subcontracted work.

Small organizations. The RFA defines "small organizations" as any not-for-profit enterprise that is independently owned and operated, and is not dominant in its field.

Small governmental jurisdictions. The RFA defines "small governmental jurisdictions" as governments of cities, counties, towns, townships, villages, school districts, or special districts with populations of fewer than 50,000.

6.4 Reason for Considering the Proposed Action

Consistent with the MSA's National Standard 1 and National Standard 9, the Council and NMFS use halibut PSC limits to minimize halibut bycatch (halibut PSC) in the groundfish fisheries to the extent practicable, while achieving, on a continuing basis, the optimum yield from the groundfish fisheries. Although fishermen are required by regulation to avoid the capture of any prohibited species in groundfish fisheries, the use of halibut PSC limits in the groundfish fisheries provide an additional constraint on halibut PSC mortality, and promote conservation of the halibut resource. Halibut PSC limits provide a regulated upper limit to halibut interceptions, as continued groundfish fishing is prohibited once a halibut PSC limit has been reached for a particular sector and/or season. This provides the maximum benefit to fishermen and communities that depend on both halibut and groundfish resources, as well as U.S. consumers.

The halibut resource is fully allocated. The IPHC accounts for incidental halibut removals in the groundfish fisheries, recreational and subsistence catches, and other sources of halibut mortality before setting commercial halibut catch limits each year. Declines in the exploitable biomass of halibut since the late 1990s, and decreases in the Pacific halibut catch limits set by the IPHC for the directed BSAI halibut fisheries, have raised concerns about the levels of halibut PSC mortality by the commercial groundfish trawl and hook-and-line sectors. Reductions in halibut PSC mortality have not been proportional to the reductions in directed halibut harvest limits over this time period, although Council recognizes industry efforts to reduce halibut PSC mortality. Under National Standard 8, the Council must also provide for the sustained participation of and minimize adverse economic impacts on fishing communities, and BSAI coastal communities are affected by reduced catch limits for the directed halibut fishery, especially in IPHC Area 4CDE.

The proposed action would reduce the halibut PSC limits in the BSAI, which are established for the BSAI trawl and fixed gear sectors in Federal regulation, and in some cases, in the BSAI Groundfish FMP. Overall halibut PSC limits can be modified only through an amendment to the regulations and the FMP, although seasonal and some fishery apportionments of those PSC limits would continue to be set annually through the BSAI groundfish harvest specifications process.

The purpose of the proposed action is to minimize halibut PSC mortality in the commercial groundfish fisheries to the extent practicable, while preserving the potential for the full harvest of the groundfish total allowable catches (TACs) assigned to the trawl and hook-and-line sectors. The proposed action minimizes halibut PSC mortality to the extent practicable in consideration of the management measures currently available to the groundfish fleet, the uncertainty about the extent to which halibut PSC mortality in the groundfish fishery has adverse effects on the halibut resource, and the need to ensure that catch in the trawl and hook-and-line fisheries contributes to the achievement of optimum yield in the groundfish fisheries. Minimizing halibut PSC mortality while achieving optimum yield is necessary to maintain a healthy marine ecosystem, ensure long-term conservation and abundance of halibut, provide maximum benefit to fishermen and communities that depend on halibut and groundfish resources, as well as U.S. consumers, and comply with the Magnuson-Stevens Act and other applicable Federal law.

Halibut savings that would occur from reducing halibut PSC mortality below current usage would accrue to the directed halibut fisheries in both the near term and long term. Near term benefits would result from the PSC mortality reductions of halibut that are over 26 inches in length (O26). These halibut would be available to the commercial halibut fishery in the year that the PSC mortality is foregone, or when the fish reach the legal size limit for the commercial halibut fishery (greater than or equal to 32 inches in total length). Longer term benefits in the directed fisheries would accrue from a reduction of halibut PSC mortality that are less than 26 inches (U26). Benefits from these smaller halibut would occur as they recruit into the directed halibut fisheries.

6.5 Objectives of Proposed Action and its Legal Basis

Under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), the Secretary of Commerce (NMFS Alaska Regional Office) and the North Pacific Fishery Management Council have the responsibility to prepare fishery management plans and associated regulations for the marine resources found to require conservation and management. NMFS is charged with carrying out the Federal mandates of the Department of Commerce with regard to marine fish, including the publication of Federal regulations. The Alaska Regional Office of NMFS, and Alaska Fisheries Science Center, research, draft, and support the management actions recommended by the Council. The Bering Sea and Aleutian Islands (BSAI) groundfish fisheries are managed under the Fishery Management Plan for Groundfish of the BSAI Management Area. The proposed action represents an amendment, as required, to the fishery management plan, as well as amendments to associated Federal regulations.

Principal objectives of the FMP amendment and proposed regulations are to minimize bycatch to the extent practicable, provide additional harvest opportunities in the directed halibut fishery, and help to improve halibut stock conditions.

6.6 Number and Description of Directly Regulated Small Entities

This section provides estimates of the number of harvesting vessels that are considered small entities. These estimates may overstate the number of small entities (and conversely, understate the number of large entities). The RFA requires a consideration of affiliations between entities for the purpose of assessing if an entity is small. The estimates do not take into account all affiliations between entities. There is not a strict one-to-one correlation between vessels and entities; many persons and firms are known to have ownership interests in more than one vessel, and many of these vessels with different ownership, are otherwise affiliated with each other. For example, vessels in the American Fisheries Act (AFA) catcher vessel sectors are categorized as “large entities” for the purpose of the RFA under the principles of affiliation, due to their being part of the AFA pollock cooperatives. However, vessels that have other types of affiliation, (i.e., ownership of multiple vessel or affiliation with processors), not tracked in available data, may be misclassified as a small entity.

The entities directly regulated by this action are those entities that harvest groundfish from the trawl and hook and line Federal fisheries of the Bering Sea and Aleutian Islands, except for the sablefish target fishery. An exhaustive description of list of small entities will be included in the public review draft.

6.7 Recordkeeping and Reporting Requirements

To be completed once a preferred alternative has been selected.

6.8 Federal Rules that may Duplicate, Overlap, or Conflict with Proposed Action

To be completed once a preferred alternative has been selected.

6.9 Description of Significant Alternatives to the Proposed Action that Minimize Economic Impacts on Small Entities

To be completed once a preferred alternative has been selected.

7 Magnuson-Stevens Act and FMP Considerations

7.1 Magnuson-Stevens Act National Standards

Below are the 10 National Standards as contained in the Magnuson-Stevens Fishery and Conservation Act (Magnuson-Stevens Act). Once the Council has selected a preferred alternative, a brief discussion of how the alternative is consistent with the National Standards, will be included. In recommending a preferred alternative, the Council must consider how to balance the national standards.

National Standard 1 — Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery.

National Standard 2 — Conservation and management measures shall be based upon the best scientific information available.

National Standard 3 — To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

National Standard 4 — Conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various U.S. fishermen, such allocation shall be (A) fair and equitable to all such fishermen, (B) reasonably calculated to promote conservation, and (C) carried out in such a manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

National Standard 5 — Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources, except that no such measure shall have economic allocation as its sole purpose.

National Standard 6 — Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

National Standard 7 — Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

National Standard 8 — Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

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.

National Standard 10 — Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

7.2 Section 303(a)(9) Fisheries Impact Statement

Section 303(a)(9) of the Magnuson-Stevens Act requires that a fishery impact statement be prepared for each FMP amendment. A fishery impact statement is required to assess, specify, and analyze the likely effects, if any, including the cumulative conservation, economic, and social impacts, of the conservation and management measures on, and possible mitigation measures for (a) participants in the fisheries and fishing communities affected by the plan amendment; (b) participants in the fisheries conducted in adjacent areas under the authority of another Council; and (c) the safety of human life at sea, including whether and to what extent such measures may affect the safety of participants in the fishery.

The EA/RIR/IRFA prepared for this plan amendment constitutes the fishery impact statement. The likely effects of the proposed action are analyzed and described throughout the EA/RIR/IRFA. The effects on participants in the fisheries and fishing communities are analyzed in the RIR/IRFA sections of the analysis (Sections 5 and 6). The effects of the proposed action on safety of human life at sea are evaluated in Section 5, and will be addressed for the preferred alternative, once it has been selected, above under National Standard 10, in Section 7.1. Based on the information reported in this section, there is no need to update the Fishery Impact Statement included in the FMP.

The proposed action directly regulates the groundfish fisheries in the EEZ off Alaska, which are under the jurisdiction of the North Pacific Fishery Management Council. The proposed action may also affect participants in halibut fisheries, conducted both under the North Pacific Council jurisdiction, and in adjacent areas under the jurisdiction of the Pacific Fishery Management Council.

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