A Quantitative Examination of Halibut Mortality in BSAI Groundfish Fisheries

Discussion Paper

Prepared for

North Pacific Fishery Management Council

January 2014

Prepared by

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Special thanks to Steve Lewis, GIS Coordinator, NMFS-AKR for assistance with the included GIS maps.

Please cite as: Northern Economics, Inc. *A* Quantitative Examination of Halibut Mortality in BSAI Groundfish Fisheries. Prepared for North Pacific Fishery Management Council. January 2014.

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1 Introduction

The Pacific halibut longline fishery was one of the first fully domestic fisheries to become established off Alaska. As the groundfish fisheries developed, regulations were implemented to limit bycatch of halibut, so as to minimize impacts on the domestic halibut fisheries. Halibut are taken as incidental catch in federally managed groundfish trawl, hook-and-line (HAL), and pot fisheries in the Gulf of Alaska (GOA) and Bering Sea/Aleutian Islands (BSAI) areas. Interception of both juvenile and adult halibut occurs in trawl fisheries targeting groundfish species (such as rockfish, flatfish, pollock, and Pacific cod). Incidental catch of halibut also occurs in groundfish HAL and pot fisheries that typically focus on Pacific cod. Regulations require that all halibut caught incidentally in these groundfish fisheries must be discarded, regardless of whether the fish are living. Halibut catch is controlled in the groundfish fisheries using prohibited species catch (PSC) limits. PSC limits are applied to specific target fisheries, gear types, and seasons. During some years, halibut PSC limits have resulted in the closure of specific groundfish fisheries prior to the fleet harvesting the available TAC.

In April 2011 the Council requested development of discussion papers on reducing Pacific halibut PSC limits in both BSAI and GOA. Council action was taken in June 2012 to reduce GOA halibut PSC limits; those reductions under GOA Plan Amendment 95 have been approved by the Secretary and are pending implementation in Federal regulations to coincide with implementation of groundfish harvest specifications for 2014/2015.

In March 2012 the Council requested a discussion paper to begin development of analyses to consider potential changes to the BSAI halibut PSC limits. Two papers were presented by Northern Economics to the Council at its meeting in Kodiak in June 2012. The first paper summarized the FMP basis of the current halibut PSC specifications, and the second summarized groundfish harvests wholesale values and halibut PSC by target fishery for 2003–2011. In February 2013 the Council requested that the second of the 2012 discussion papers be updated to include information for 2012, and include a discussion of potential management tools. This discussion paper is the result.

Data Used in this Report

Much of the information presented in this report is based on Catch Accounting System (CAS) data provided by Alaska Fishery Information Network (AKFIN) to Northern Economics at the request of the North Pacific Fishery Management Council (NPFMC) on October 16, 2013. The data show monthly totals of groundfish catch and halibut PSC by groundfish target fisheries by three-digit management zone and sector. The data also include estimates of the wholesale product values generated by the retained groundfish—these are estimates based on Commercial Operator Annual Reports (COAR) data and weekly or daily production reports submitted by processors.

Sector Definitions Used in this Report

The discussion paper summarizes the activities for the following sectors:

- A80-CPs: These are non-American Fisheries Act (AFA) trawl catcher processors (CPs). With passage of the Amendment 80 they were allowed to form cooperatives. The data for pre-

2008 years include all non-AFA trawl CPs regardless of whether they qualified to participate under A80.

- AFA-CPs: These are trawl CPs that are allowed to fish for pollock in the BSAI under AFA.
- AFA-MCVs: These are trawl catcher vessels (CVs) that are allowed to fish for pollock in the BSAI under AFA that deliver their fish to motherships or to CPs. Note that there may be some AFA-MCVs that also deliver to shore plants—their landings in these cases are not counted among landings for AFA-MCVs.
- AFA-CVs: These are trawl CVs that are allowed to fish for pollock in the BSAI under AFA that deliver their fish to shore plants. Note that there may be some AFA-CVs that on occasion deliver to motherships or to CPs—their landings in these cases are counted as AFA-MCVs landings.
- TRW-MCVs: These are non-AFA CVs that deliver their fish to motherships, floating processors or to CPs. Note that there may be some TRW-MCVs that deliver to shore plants—their landings in these cases are not counted among the TRW-MCVs.
- TRW-CVs: These are non-AFA CVs that deliver their fish to shore plants. Note that there may be some TRW-CVs that deliver to motherships or to CPs—their landings in these cases are counted as TRW-MCV landings.
- LGL-CPs: These are CPs that use longline gear. Some of these vessels may on occasion use pot gear—their landings in these cases are not counted among the LGL-CPs.
- LGL-CVs: These are CVs that use longline gear and deliver their harvests to shore plants. Some of these vessels have on occasion used pot gear or have delivered their catch to motherships or floating processors—their landings in these cases are not counted among the LGL-CVs. IFQ sablefish harvests and halibut bycatch in the IFQ fishery are not included.
- LGL-MCVs: These are CVs that use longline gear and deliver their harvests to motherships or floating processors. Some of these vessels have on occasion used pot gear or have delivered their catch to shore plants—their landings in these cases are not counted among the LGL-MCVs.
- POT-CPs: These are CPs that use pot gear. Some of these vessels may on occasion use longline gear—their landings in these cases are not counted among the POT-CPs.
- POT-CVs: These CVs use pot gear and deliver their harvests to shore plants. Some of these vessels have on occasion used longline gear or have delivered their catch to motherships or floating processors—their landings in these cases are not counted among the POT-CVs.
- POT-MCVs: These CVs use pot gear and deliver their harvests to motherships or floating processors. Some of these vessels have on occasion used longline gear or have delivered their catch to shore plants—their landings in these cases are not counted among the POT-MCVs.

In many cases throughout this report the data are aggregated to include multiple sectors. For example, the report summarizes catch and bycatch of the BSAI Trawl Limited Access sector. In this case, the report aggregates data from AFA-CPs, AFA-MCVs, AFA-CVs, TRW-CVs, and TRW-

MCVs. When aggregations of multiple sectors are used, the report will specifically indicate the included sectors.

Road Map to Remaining Sections of this Report

- Section 2 contains a brief summary of closures due to halibut PSC Limits
- Section 3 contains an overview of historical bycatch amounts relative to current PSC limits
- Section 4 contain summaries of halibut bycatch mortality by sector in BSAI target fisheries for pollock, Pacific cod and yellowfin sole, as well as a summary of halibut bycatch mortality in fisheries prosecuted by the Amendment 80 CPs.
- Section 5 contains excerpts from the November 11, 2012 "Report of the Halibut Bycatch Work Group" describing long-term options to reduce halibut bycatch.

2 Halibut Related Closures from 2000–2013 in the BSAI

This section provides a summary of halibut related in-season closures to directed fishing for groundfish species in the BSAI from 2000–2013. The summary is based on a spreadsheet developed by Northern Economics that captures in-season closures from the NMFS-AKR "Status of Fisheries" web page at http://www.fakr.noaa.gov/sustainablefisheries/default.htm. The table lists two types of closures:

1) *PSC Limit* indicates that the annual PSC Limit for the fishery has been reached on directed fishing for the species is disallowed for the remainder of the year;
2) *Seasonal PSC* indicates that a Seasonal PSC Limit has been reach and directed fishing for the species is disallowed for the remainder of the season.

Table 1. Directed Fishing Closures Resulting from Halibut PSC in the BSAI, 2000–2011

Gear	Sector	Area	FMP Sub-Area	Species Code	Closure Type	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
						Number of Halibut Related Directed Fishing Closures													
HAL	CPs	BSAI	ALL	PCOD	PSC Limit		1												
	CVs < 60 ft	BSAI	ALL	PCOD	PSC Limit		1												
	CVs >= 60 ft	BSAI	ALL	PCOD	PSC Limit		1												
HAL Total							**3**												
Trawl	All	BSAI	ALL	AKPL	PSC Limit			1		1		1							
					Seasonal PSC			2			2	2	3						
				FSOL	PSC Limit					1	1	1							
					Seasonal PSC					1	2	2	3						
				OFLT	PSC Limit					1		1							
					Seasonal PSC					1	2	2	3						
				RSOL	PSC Limit	1	1	1	1	1		1							
					Seasonal PSC	2	2	2	1		2	2	3						
				YSOL	PSC Limit			1	1		1		1						
					Seasonal PSC		2	2	2			2	1						
	A80 LA	AI	ALL	TURB	PSC Limit										1				
				SABL	PSC Limit										1				
		BS	ALL	TURB	PSC Limit										1				
				SABL	PSC Limit										1				
		BSAI	ALL	ARTH	PSC Limit										1				
				FSOL	PSC Limit									1		1			
				OFLT	PSC Limit									1		1			
				PCOD	Seasonal PSC										1				
				RSOL	PSC Limit									1		1			
				YSOL	PSC Limit									1					
					Seasonal PSC									1					
	CPs	BSAI	ALL	PCOD	PSC Limit			1	1		1	2							
	CVs	BSAI	ALL	PCOD	PSC Limit			1	1		1	2	1						
Trawl Total						**3**	**5**	**11**	**7**	**6**	**12**	**18**	**15**	**5**	**6**	**3**	**0**	**0**	**0**
Grand Total						**3**	**8**	**11**	**7**	**6**	**12**	**18**	**15**	**5**	**6**	**3**	**0**	**0**	**0**

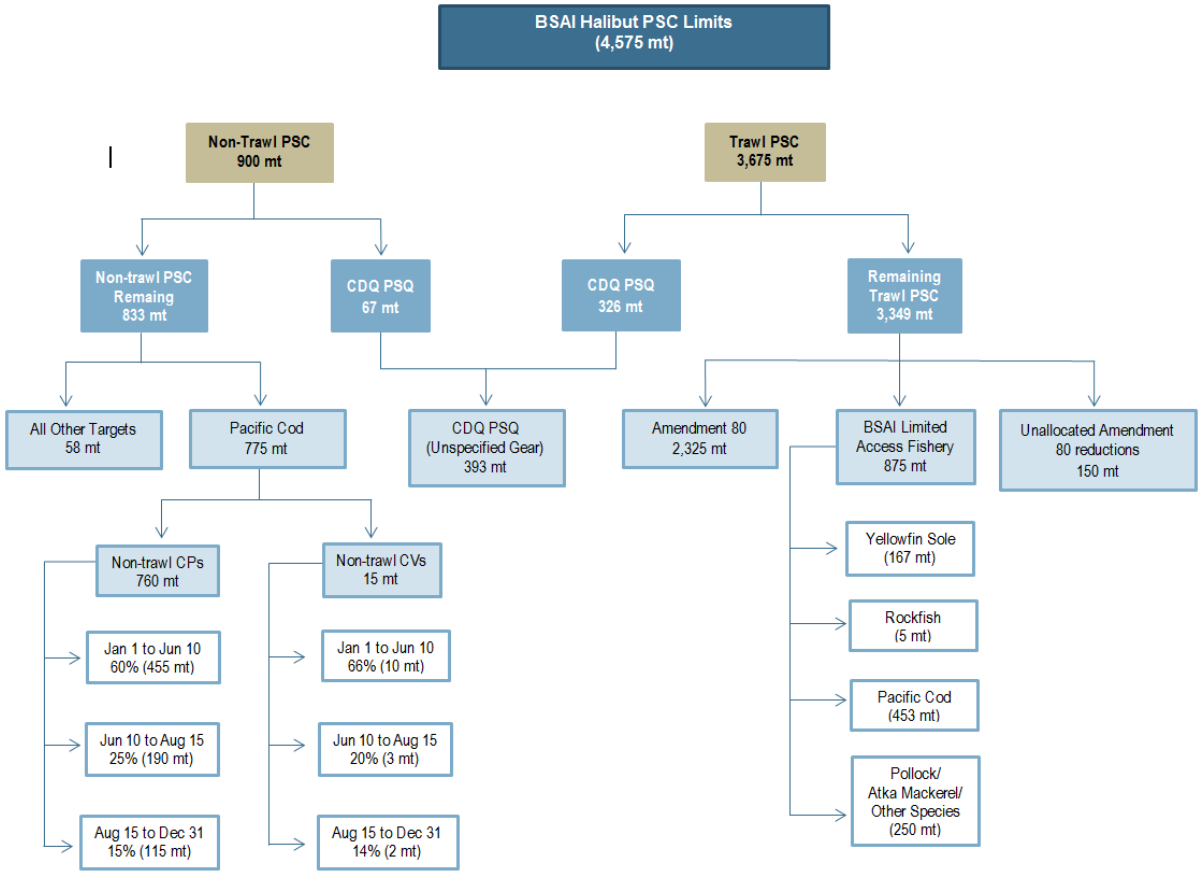
Notes: "A80 LA" is the Amendment 80 Limited Access Fleet; "BSAI TLA" is the BSAI Trawl Limited Access Fleet; The following species codes are used:

AKPL =	Alaska Plaice	OFLT =	Other Flatfish	SABL =	Sablefish
ARTH =	Arrowtooth Flounder	PCOD =	Pacific Cod	TURB =	Greenland Turbot
FSOL =	Flathead Sole	RSOL =	Rock Sole	YSOL =	Yellowfin Sole

3 Historical Bycatch Amounts Relative to Current PSC Limits

In this section, the 2014 annual harvest specifications for halibut PSC limits are summarized, along with apportionments to sectors within the baseline limits. A flow chart of the halibut PSC limits is provided in Figure 1. The limits are shown in Table 2–Table 4. Following these tables, we summarize halibut PSC totals for sectors and fisheries for the years 2003–2012.

Figure 1. Flow Chart of BSAI Halibut PSC Limits for 2014



Note: In the BSAI the halibut PSC limits and apportionments are unchanged between 2013 and 2014.

Source: Developed by Northern Economics based NFMS "Groundfish Harvest Specification Tables." (NMFS AKR, 2013).

Table 2 shows the 2014 apportionment of Halibut PSC to gear groups (non-trawl and trawl), CDQs, and sectors (Amendment 80 and trawl limited access). The Non-trawl PSC limit is 900 metric tons (mt) of which 67 mt are apportioned to the CDQs' Halibut Prohibited Species Quota (PSQ). The second section of Table 2 shows the division of the 3,675 mt total trawl PSC limit. The trawl PSC limit is subdivided between non-CDQ trawl fisheries (3,349 mt) and the CDQ Halibut PSQ (326 mt). The total CDQ Halibut PSQ is 393 mt and is "unspecified" with respect to the gears

with which it may be used. The third section of the table shows the division of the non-CDQ trawl PSC limit. Amendment 80 (implemented for fishing year 2008) phased in a reduced usage of overall 3,675 mt trawl PSC limit for halibut mortality. The 3,349 mt of halibut PSC remaining for the non-CDQ trawl fisheries is apportioned between the A80-CPs, and the BSAI Trawl Limited Access Sector—comprising AFA CV & CP plus all non-AFA trawl CVs. The final component is the unallocated 150 mt of PSC from reductions that were built into Amendment 80.

Table 2. Apportionment of Halibut PSC Limits to Gear Groups, CDQs and Sectors - 2014

Halibut Mortality Limits (MT)	Total non-trawl PSC	CDQ PSQ from Non-Trawl PSC*	Non-trawl PSC Remaining after CDQ PSQ	Total trawl PSC	CDQ PSQ from Trawl PSC*	Trawl PSC Remaining after CDQ PSQ	Amendment 80 sector	BSAI trawl limited access fishery	Amendment 80 based reductions (unallocated)
	900	67	833	3,675	326	3,349	2,325	875	150

Note: The 393 mt of combined CDQ Halibut PSQ may be used with any gear regardless of the source of the apportionment.

Source: Adapted by Northern Economics from Table 10 "Groundfish Harvest Specification Tables." (NMFS AKR, 2013)

Table 3 is adapted from NMFS' BSAI Groundfish Harvest Specifications Table 13 and shows the apportionment of the non-trawl halibut PSC limit. It should be noted that vessels using pot or jig gear are exempt from PSC limits, as are vessels fishing in the sablefish Individual Fishing Quota (IFQ) fishery. The apportionment for the Pacific cod fishery is split between CVs and CPs and by season—760 mt are allocated to the hook and line CPs and the remaining 15 mt are allocated to CVs. There are also three seasonal apportionments with 60 percent allocated to the January 1–June 10 season. A total of 58 mt of halibut PSC are apportioned for use in all other non-trawl targets (e.g. Greenland turbot, rockfish), but these are not apportioned between CPs and CVs or by seasons. These apportionments have been stable since 2008 and implementation of the Amendment 85.

Table 3. Apportionment of Halibut PSC Limits among Non-Trawl Harvesters and Seasons–2014

		Total	Non-trawl CPs	Non Trawl CVs
All Non-Trawl	**Season**	**833**	Not fully apportioned between CPs/CVs	
Pacific Cod	**Total**	**775**	**760**	**15**
	01/01 - 06/10	**465**	455	10
	06/10 - 08/15	**193**	190	3
	08/15 - 12/31	**117**	115	2
All Other Targets	05/01 - 12/31	**58**	Not apportioned between CPs/CVs	

Note: Groundfish pot and jig harvesters are exempt from halibut PSC limits, as are participants in the Sablefish hook and line IFQ fishery.

Source: Adapted by Northern Economics from Table 13 "Groundfish Harvest Specification Tables." (NMFS AKR, 2013)

Table 4 below shows the 2014 apportionment to target fisheries of the 875 mt PSC limit for trawlers operating under limited access. The apportionment can vary from year to year and is set in the annual specification process. The PSC limits shown in Table 4 are all binding constraints with the exception of the 250 mt apportionment for Pollock/Atka mackerel, and Other Species. If

the halibut PSC in fisheries for pollock, Atka mackerel or for "Other Species" reaches the PSC Limit (250 mt in 2013), then technically, directed fishing for pollock with non-pelagic gear is prohibited. However, directed fishing for pollock with non-pelagic gear at all-times was prohibited under Amendment 57, which was fully implemented in 2000. In effect, the PSC limit for pollock, Atka mackerel or "Other Species" is non-binding and its attainment does not cause NMFS to issue any closures to directed fishing.

Table 4. Apportionment of Halibut PSC Limits for Trawl Limited Access Harvesters–2014

Total Halibut PSC Mortality	Yellowfin Sole	Rock Sole/ flathead sole/ other flatfish[1]	Turbot/ arrowtooth/ sablefish[2]	Rockfish (04/15 - 12/31)	Pacific cod	Pollock/ Atka mackerel/ other species[3]
Metric Tons of Halibut Mortality						
875	167	0	0	5	453	250

Table Notes:
[2] "Other flatfish" for PSC monitoring includes all flatfish species, except for halibut (a prohibited species), flathead sole, Greenland turbot, rock sole, yellowfin sole, Kamchatka flounder and arrowtooth flounder.
[3] Arrowtooth flounder for PSC monitoring includes Kamchatka flounder.
[4] "Other species" for PSC monitoring includes sculpins, sharks, skates, and octopuses.
Source: Adapted by Northern Economics from Table 12 "Groundfish Harvest Specification Tables." (NMFS AKR, 2013)

Table 5 shows the five-year phase-in of additional reductions in halibut PSC limits for the A80-CPs. In 2008, the first year of operations under Amendment 80, A80-CPs were allocated 2,525 mt of halibut PSC. The apportionment is divided between individual A80 cooperatives and the A80 limited access fishery. The A80 limited access fishery is for A80-CPs that are not members of A80 cooperatives. In the first two years of the program (2008–2010) there were vessels in the A80 limited access fishery, but since 2011, all A80-CPs have been members of one of two A80 cooperatives.

Table 5. Annual Reductions is PSC Limits for Amendment 80 CPs

2008	2009	2010	2011	2012	2013 +
Halibut Mortality PSC Limits (mt)					
2,525	2,475	2,425	2,375	2,325	2,325

Source: Adapted by NEI from "Bering Sea and Aleutian Islands Groundfish Fishery Management Plan." (NMFS AKR 2011).

Table 6 and Figure 2 show halibut mortality by major apportionment groups from 2003–2012. Between 2003 and 2007, total halibut mortality by the all groups was relatively flat, ranging between 3,932–4,158 mt with an average of 4,036 mt. In 2008 there was a significant drop due primarily to reduced mortality by the A80-CPs. From 2008–2012, total annual halibut PSC mortality in all groups averaged 3,518 mt. Since 2008 the A80 CPs have had an average mortality of 2,010 mt, while the BSAI Trawl Limited Access Fishery and the LGL CVs & CPs have had average annual halibut PSC mortality totals of 711 mt and 593 mt respectively. Also noticeable in the table and figure is the sizeable year-over-year increase in halibut bycatch from 2011 to 2012. Over all sectors, including CDQs, there was an 18 percent increase in halibut PSC rates. The rates of AM-80 CPs had a year-over-year increase of 7 percent, while Longline CPs & CVs jumped 15

percent. The largest increase was seen in the BSAI Trawl Limited Access sectors, which experienced a 52 percent increase in halibut bycatch rates between from 2011 to 2012.

It be should be noted here that the data presented in Table 6 and Figure 2 separate the out CDQ from non-CDQ sectors and fisheries. In Section 4 that provides details on target fisheries, CDQ and Non-CDQ catches are reported together.[1] In general, halibut bycatch rates in the CDQ fisheries are about 72 percent of the rates seen in the non-CDQ fisheries over all gears.

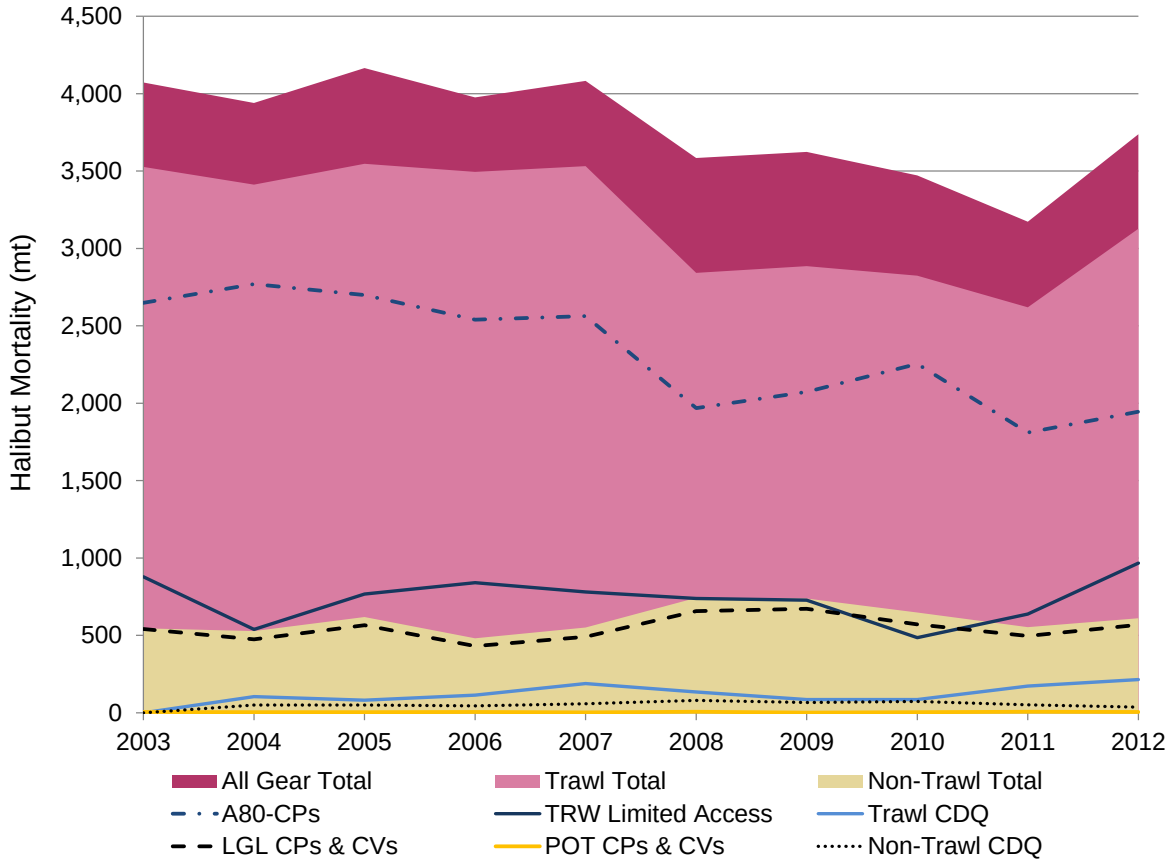
Table 6. Estimated Total Halibut PSC Mortality by Major Apportionment Groups

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Trawl Gear				**Trawl Halibut PSC Mortality (mt)**						
A80-CPs	2,649	2,770	2,698	2,540	2,563	1,969	2,073	2,254	1,810	1,945
TRW Limited Access	878	538	768	841	781	738	727	485	637	967
Trawl CDQ	-	105	81	114	188	135	85	86	172	215
Trawl Total	**3,527**	**3,412**	**3,547**	**3,495**	**3,532**	**2,842**	**2,886**	**2,824**	**2,620**	**3,127**
Non-Trawl Gear				**Non-Trawl Halibut PSC Mortality (mt)**						
LGL CPs & CVs	540	474	566	431	491	656	671	571	496	568
POT CPs & CVs	5	4	3	5	2	7	1	4	6	5
Non-Trawl CDQ	-	50	49	45	58	79	66	73	51	37
Non-Trawl Total	**546**	**528**	**618**	**481**	**551**	**742**	**738**	**648**	**553**	**611**
Unattributed CDQ	187	17	17	10	1	1	4	3	20	20
All Gear Total	**4,072**	**3,940**	**4,165**	**3,976**	**4,083**	**3,584**	**3,624**	**3,472**	**3,173**	**3,738**

Source: Developed by Northern Economics based on CAS data from AKFIN.

[1] As seen in Table 6, there is row showing "Unattributed CDQ". These are CDQ bycatch data that could not be assigned to a particular target fishery or to a particular harvesting sector under the data compilation algorithms used for this particular analysis.

Figure 2. Halibut Mortality by Major Apportionment Groups, 2003–2012



Note: The lines for halibut mortality of Pot CPs & CVs, are very close to zero and are difficult to discern from the horizontal axis. Also note that halibut mortality in Pot fisheries are exempt from halibut PSC limits.
Source: Developed by Northern Economics based on CAS data from AKFIN.

Information on this page and the next summarizes halibut PSC mortality in the context of PSC allowances for target fisheries that are currently in effect. Tables 7–9 all exclude CDQ harvests. Additional details for specific sectors and fisheries will be provided in Sections 3 and 4.

Table 7 summarizes halibut PSC mortality by BSAI Trawl Limited Access (BSAI TLA) vessels. After implementation of AM80, these vessels have operated under separate limits for halibut PSC as specified in Table 4.[2] Prior to 2008, trawl halibut PSC limits were not specifically set for the BSAI TLA fishery. After implementation of Amendment 80, the trawl halibut PSC limit was split between AM80-CPs and BSAI TLA vessels.

Since 2008, the largest portion of the halibut bycatch for BSAI TLA vessels occurs in the pollock/Atka mackerel fisheries,[3] noting that bycatch in the Atka Mackerel target fishery has accounted for less than two percent of bycatch in this apportionment. In 2009 and again in 2011,

[2] Prior to 2008, trawl halibut PSC allowances by target fishery were applied to all trawlers, except in Pacific cod fisheries where allowances were split between CVs and CPs.

[3] Harvest specifications prohibit BSAI trawl limited access vessels from participating in directed fishing for the "other species" part of this PSC allowance category.

halibut bycatch in the Pollock/Atka Mackerel fishery was higher than any other target fishery for the BSAI TLA vessels, but prior to 2008 the majority of PSC catches occurred in target fisheries for Pacific cod.[4] Bycatch in 2012 in BSAI TLA target fisheries for pollock/Atka Mackerel jumped by 26 percent. It is important to note that the apportionment on halibut bycatch to the pollock/Atka mackerel fisheries for the BSAI TLA fisheries is non-binding. If more than 250 mt of halibut are taken in these fisheries, then use of bottom trawl gear is no longer allowed in the pollock or Atka mackerel fisheries. The non-binding nature of this particular halibut PSC apportionment explains how the sector as whole exceeded its 875 mt overall limit but was not shut down.

Over the entire 10-year period shown, the largest portion of bycatch from what are now classified as BSAI TLA vessels occurred in Pacific Cod fisheries. After 2008, bycatch in the Pacific cod fishery has been markedly lower, but in 2012 there was increase from 2011 levels—halibut bycatch increased by 80 percent. Bycatch in the yellowfin sole fishery by the BSAI TLA also jumped significantly in 2012 with a year-over-year increase of over 77 percent.

Table 7. Halibut PSC Mortality in the Non-CDQ BSAI Trawl Limited Access Fisheries, 2003 - 2011

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Target Fishery / Apportionment Group	**Halibut PSC Mortality (mt) in BSAI Trawl Limited Access Fisheries**									
Pollock/Atka Mackerel	74	82	101	109	265	276	396	198	292	370
Pacific Cod	801	452	650	616	449	292	183	258	241	436
Yellowfin Sole	2	4	16	93	58	157	99	27	81	143
All Other Flatfish & Rockfish	NA	NA	NA	23	8	14	49	2	23	17
All Targets	**NA**	**NA**	**NA**	**841**	**781**	**738**	**727**	**485**	**637**	**967**

Note: NA indicates that the data has not available for disclosure to protect data confidentiality.
Source: Developed by Northern Economics based on CAS data from AKFIN.

Since 2008, allowances to the "Rock Sole/flathead sole/other flatfish" fisheries and to the Arrowtooth/Kamchatka have been set at zero each year, while allowances to rockfish fisheries have been set at 5 mt or less. In Table 7, BSAI TLA halibut bycatch in all flatfish target fisheries other than for yellowfin sole have been grouped with bycatch in the rockfish fisheries to allow disclosure under confidentiality rules. Halibut PSC mortality in this group of target fisheries appear to have exceeded initial BSAI TLA apportionments every year since 2008 with the exception of 2010.

Table 8 summarizes non-CDQ halibut PSC mortality of Amendment 80 vessels in target fisheries using the same general grouping of target fisheries used in apportioning halibut PSC prior to 2008. After 2008, with implementation of Amendment 80, A80-CPs participating in cooperatives were not constrained by target fishery or seasonal allowances.

There have been several noteworthy shifts in halibut bycatch by A80-CPs since 2008. It appears that many of the shifts have been driven by changes in fishing strategies with bycatch amounts in some fisheries declining while in other fisheries overall amounts have increased. In the five years since 2008, halibut bycatch over all of the A80 fisheries was only 78 percent of the amount experienced in the five years from 2003–2007. Halibut bycatch in fisheries for Pacific cod, rock

[4] Under Amendment 85, there was a reallocation of the Pacific cod ITAC from trawl vessels to non-trawl vessels, and this accounts for at least some of the reduction in halibut mortality in the BSIA TLA fishery after 2007.

sole, flathead sole and other flatfish fisheries have seen marked declines, while bycatch in the yellowfin sole, pollock, Atka mackerel, and arrowtooth/turbot fisheries have increased.

Overall, the A80-CPs have stayed well below their halibut PSC limits since operations under Amendment 80 began. As indicated in Table 1, there were a few occasions in when vessels operating in the A80 Limited Access Fishery reached PSC limits in particular fisheries and in those cases NMFS made in-season changes precluding vessels from participating in directed fishing.

Table 8. Halibut PSC Mortality by Amendment 80 Vessels and Target Fisheries, 2003 - 2011

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Target Fishery / Apportionment Group	**Halibut PSC Mortality (mt) by AM-80 CPs Fisheries**									
Rock sole, flathead sole, other flatfish	1,178	1,025	1,072	1,122	1,277	867	742	1,050	528	464
Arrowtooth/Kamchatka/Turbots	61	93	202	123	17	127	229	181	259	504
Yellowfin Sole	701	391	552	345	446	802	894	814	758	711
Pacific Cod	577	1,160	782	833	612	42	75	35	17	37
Pollock/Atka Mackerel/Other Species	83	50	77	88	195	97	105	119	157	162
Rockfish (includes sablefish targets)	48	51	13	29	17	33	30	55	92	67
All Targets	**2,649**	**2,770**	**2,698**	**2,540**	**2,563**	**1,969**	**2,073**	**2,254**	**1,810**	**1,945**

Note: Does not include bycatch from tows designated as CDQ harvest.
Source: Developed by Northern Economics based on CAS data from AKFIN.

Table 9 shows the halibut PSC mortality in non-CDQ longline target fisheries in sectors defined by halibut PSC apportionments. The increase in halibut mortality in the non-trawl fisheries for Pacific cod beginning in 2008 can be explained at least partially by the increased apportionment of Pacific cod Initial Total Allowable Catch (ITAC) to non-trawl fisheries under Amendment 85. As seen in Table 9, the LGL-CPs have been well below their 760 mt mortality limit since 2008. Since 2009, LGL-CVs in the Pacific cod have used less than 13 percent of their 15 mt halibut mortality limit.

Table 9. Halibut PSC Mortality in the BSAI Non-Trawl Fisheries, 2003 - 2011

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Target Fishery / Apportionment Group	**Halibut PSC Mortality (mt) by AM-80 CPs Fisheries**									
Pacific Cod (LGL-CPs)	495	440	541	392	468	625	648	542	476	549
Pacific Cod (LGL-CVs)	2	5	6	3	6	12	3	2	1	2
Other non-IFQ Longline Target Fisheries	22	22	12	17	7	3	8	11	4	6
All Targets	**520**	**467**	**559**	**412**	**481**	**640**	**658**	**555**	**482**	**556**

Note: Does not include bycatch from skates designated as CDQ harvest.
Source: Developed by Northern Economics based on CAS data from AKFIN.

4 Halibut Bycatch Mortality in Selected BSAI Target Fisheries

This section presents a series of tables and figures that show the sources of halibut bycatch in groundfish target fisheries by sector in the BSAI for the years 2003–2012. The summary is divided into selected target fisheries and regulatory sectors.

The tables and figures use data from AKFIN as described in the introduction. None of the tables and figures in Section 4 differentiate between CDQ and non-CDQ landings—CDQ groundfish landings and bycatch of halibut are included along with non-CDQ landings and bycatch.

Table 10 provides definitions and descriptions of key variables used in the tables and figures.

Table 10. Table Key—Definition of Table Sections

Section Labels	Description	Unit
Halibut Mortality (MT)[5]	The total halibut mortality for the target fishery for the time period	Metric tons
Groundfish Caught in Target Fishery (MT)	The total catch of the groundfish species in the target fishery for the time period	Metric tons
Halibut Bycatch Rate (%)	The total halibut bycatch mortality divided by the total groundfish harvest in the target fishery for the period.	Metric tons per metric ton
Wholesale Value in Target Fishery ($ millions)	The total value of the groundfish species harvested in the targeted fishery for the period. These values have been normalized to eliminate the variance caused by price changes, exchange rate or product changes over time, and thus use the average value of production per ton of harvest in each target fishery from 2003–2011. Differential values/mt were estimated for various and for roe seasons, (January–March) and the rest of the year.	Nominal U.S. Dollars
Value per Mortality-Ton ($ millions/Halibut MT)	The total wholesale value of production in the groundfish target fisheries divided by the total halibut bycatch mortality for the period. This value provides an indication of the amount of revenue harvesters and processors generate per ton of halibut bycatch mortality.	Nominal U.S. Dollars per metric ton

Note: Because the calculations of wholesale values are based on ten years of data, there are no issues of confidentiality. In other words, in all cases the number of processors contributing to an estimated value per ton of target catch met or exceeded the minimum number of processors required for release of the data.

[5] Halibut Mortality is an estimate based on observer data that includes, not only the number, weight, and length, of halibut bycatch but also includes the observer's assessment of the "viability" of halibut as they are return to the ocean. These data are combined with a halibut discard mortality rate (DMR) which is calculated by the International Pacific Halibut Commission (IPHC) for specific target fisheries and gears. DMRs for specific target fisheries are re-specified by the IPHC every three years. The most recent re-specification of DMRs occurred in December 2012 and will be in effect from 2013–2015.

4.1 Groundfish Harvests, Values and Halibut PSC in Pollock Target Fisheries

This section documents participation in the BSAI pollock target fisheries from 2003–2012 and summarizes catch, halibut bycatch and bycatch rates, as well as wholesale value and wholesale value generated per ton of halibut mortality. The section summarizes catch over several sectors of vessels. Similar sections for Pacific Cod, Atka mackerel, and Yellowfin sole are provided—all of these fisheries have significant participation by more than one sector. It should be noted that all of the figures and tables in this section include both CDQ and non-CDQ harvests.

Table 11 shows the number of unique harvesting vessels that participated in BSAI target fisheries for pollock by sector for the years 2003–2012.[6] This type of table is used throughout the analysis to determine whether data for a particular sector or fishery can be released in the report. NMFS guidelines on confidentiality require that at least three unique harvesting vessels (CVs or CPs) contribute to any catch or value number that is provided to the public. In Table 11 cells that are highlighted and shown in bolded text indicate that catch and value data are confidential.

In addition to the determination of confidentiality, Table 11 provides a useful summary of the size of the various fleets and their variability. The table can also be used as an indicator of participation trends in the fishery over time, particularly when catch data are confidential. As an example, Table 11 shows that there has been a large increase in the number of A80-CPs with catch reports assigned to pollock target fisheries since 2008.

Table 11. Number of Unique Observed Harvester Vessels in Pollock Target Fisheries by Sector, 2003–2012

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
	Unique Number of Harvesting Vessels									
Sector	**Pollock**									
A80-CP	**2**	**2**	6	3	3	17	19	16	15	16
AFA-CP	16	17	16	16	17	16	14	14	15	16
AFA-CV	82	83	82	80	81	79	78	80	80	81
AFA-MCV	16	17	17	17	17	18	17	16	14	15
LGL-CP	-	**1**	**1**	**2**	-	**1**	-	-	**1**	-
TRW-CV	3	3	**2**	**1**	**2**	**2**	**2**	**2**	**1**	-
TRW-MCV	**1**	**1**	-	-	-	-	-	-	-	**1**

Note: Shaded cells indicate that catch and value data are confidential and cannot be released. Also note that unobserved catcher vessels are counted as a single vessel and thus CV counts may be an underestimate.

Source: Developed by Northern Economics based on CAS data from AKFIN.

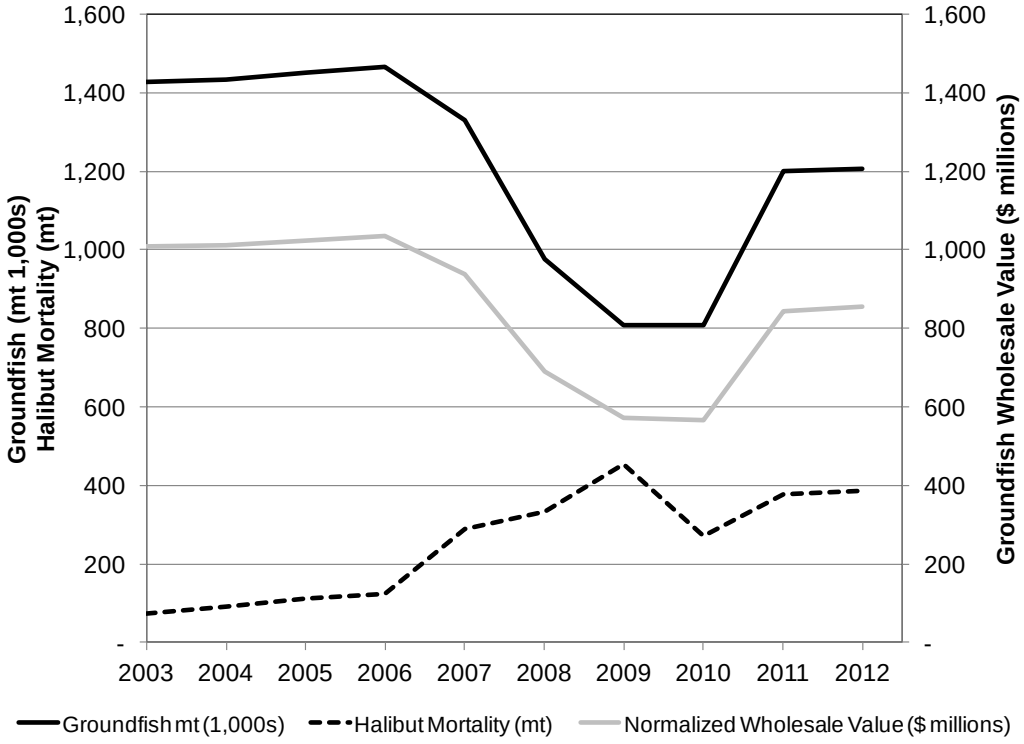
Figure 3 and Table 12 summarize groundfish harvests, wholesale values, and halibut mortality in BSAI pollock fisheries from 2003–2012. The data include harvests in CDQ fisheries. Similar tables

[6] Target fisheries are assigned by NMFS AKR to catch records "after the fact" based on the algorithms specific to each target fishery. In general, for a species to be called the "target," catch of that species must be greater than any other species. The target fishery is important because it determines the "bin" into which halibut mortality accumulates.

and figures will be used for each target fishery or sector that is summarized. The table and figure include information from only the four sectors for which confidential data can be reported.

- **Groundfish Caught in Pollock Target Fisheries**: As shown in Figure 3, total groundfish harvests in pollock target fisheries fell significantly beginning in 2007. As seen in Table 12, the three AFA sectors caught the vast majority of the groundfish harvested in pollock fisheries. However, there were also sufficient numbers of A80-CPs whose daily or weekly catch reports were assigned to the pollock target fisheries that they could be reported. While the A80-CPs target pollock harvests do not constitute large volumes relative to the AFA Sectors, the amount is clearly more important since implementation of Amendment 80.
- **Halibut Mortality (MT**): Total halibut mortality in pollock target fisheries increased significantly in 2007 and has remained generally high since then. The increases have been seen in each of the four sectors included in Table 12.
- **Halibut Bycatch Rate (%)**: Halibut bycatch rates show the tons of halibut mortality per ton of groundfish in the target fishery. In general, rates in the pollock target fishery are very low, particularly for AFA harvesters. The highest rate for any AFA sector was 0.07 percent by AFA CPs in 2009. Rates of A80-CPS are at least an order of magnitude higher than AFA vessels. Figure 4 and Figure 5 provide additional information on halibut bycatch rates by sector.
- **Wholesale Value in Pollock Target Fisheries ($ millions)**: Prior to 2008, the normalized annual wholesale value in the pollock target fisheries exceeded $1 billion per year. Since 2008, with lower pollock harvests, normalized wholesale values are significantly lower ($565.5 million in 2009). It should be noted that the estimates of wholesale value are normalized by using the average value of products produced per ton of the groundfish target fishery over the entire period. In this way, differences due to inflation, changes in product prices, product mixes, and currency exchange are minimized.
- **Value per MT of Mortality ($ millions/Halibut mt**): This field shows the estimated wholesale value generated in the pollock fishery per ton of halibut mortality. The three AFA sectors all generate well over $1 million of normalized wholesale revenue for each MT of halibut mortality. It should be noted that over this same period the normalized wholesale value of halibut and groundfish caught as bycatch in the directed halibut fishery in the BSAI was calculated at just over $6,000 per ton. The average estimated wholesale value per ton of halibut mortality for A80-CPs from 2008–2011 was just under $50,000. Figure 6 compares groundfish value per ton of halibut morality by sectors superimposed on bar charts of halibut mortality.

Figure 3. Harvest, Halibut Bycatch and Normalized Wholesale Value of Groundfish in Pollock Target Fisheries of Included Sectors, 2003–2012



Note: Includes only harvests and values of sectors included in Table 12. Axes values are scaled so that the changes in the different variables are relative

Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

Table 12. Groundfish and Halibut Harvests in Pollock Target Fisheries, 2003–2012

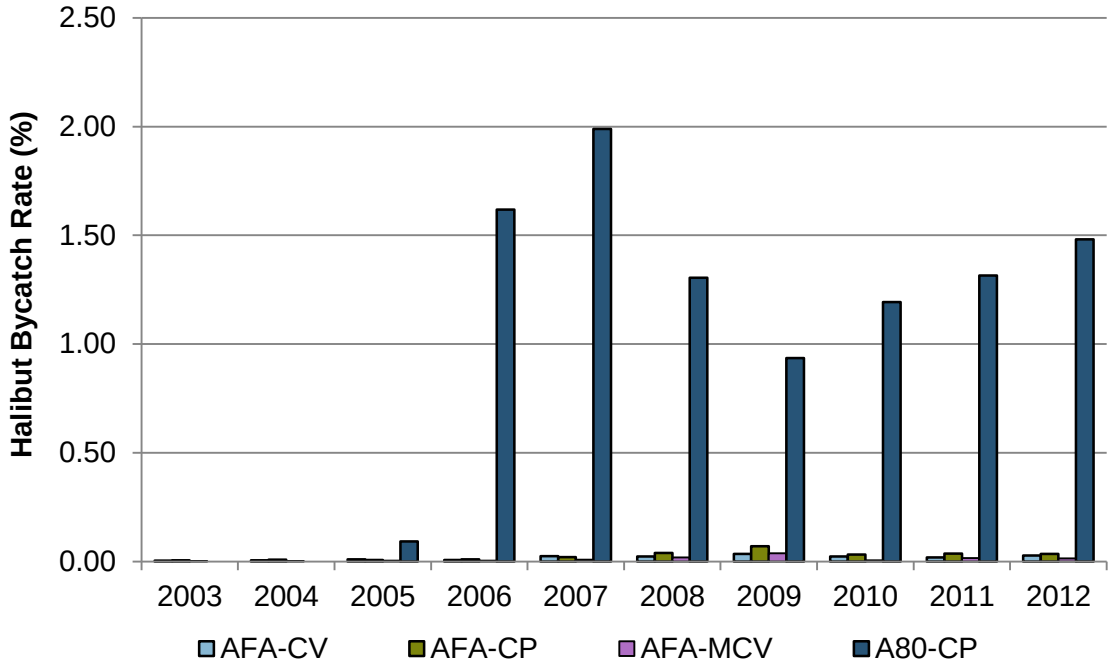
	Year									
Sector	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
	Groundfish Caught in Pollock Target Fisheries (MT)									
AFA-MCV	125,232	146,844	148,067	149,107	142,384	93,914	84,300	71,645	112,223	107,298
AFA-CV	645,056	630,494	644,765	647,082	571,853	429,332	356,071	357,106	524,447	535,050
AFA-CP	657,263	655,947	657,554	669,844	616,808	449,772	363,500	373,997	559,338	560,958
A80-CP	ND	ND	419	175	411	2,959	4,602	5,228	4,155	1,841
	Halibut Mortality (MT)									
AFA-MCV	3.5	4.3	6.9	5.5	11.9	17.4	31.6	4.4	17.9	14.8
AFA-CV	30.7	31.3	62.6	49.7	141.2	100.9	123.8	80.9	97.4	150.5
AFA-CP	38.8	56.5	41.5	64.3	128.6	176.0	255.3	118.1	206.2	192.6
A80-CP	ND	ND	0.4	2.8	8.2	38.6	43.1	58.8	54.7	27.3
	Halibut Bycatch Rate (%)									
AFA-MCV	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.01	0.02	0.01
AFA-CV	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.02	0.02	0.03
AFA-CP	0.01	0.01	0.01	0.01	0.02	0.04	0.07	0.03	0.04	0.03
A80-CP	ND	ND	0.09	1.62	1.99	1.30	0.94	1.12	1.32	1.48
	Wholesale Value in Pollock Target Fisheries ($ millions)									

	Year									
Sector	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
AFA-MCV	80.5	94.7	95.3	96.0	91.9	61.8	54.8	46.2	71.5	69.4
AFA-CV	505.4	494.0	505.2	507.0	448.2	336.4	279.0	279.6	410.8	419.2
AFA-CP	422.9	423.9	423.8	431.2	397.6	289.5	236.0	237.1	357.8	364.4
A80-CP	ND	ND	0.2	0.1	0.3	1.7	2.6	2.9	2.4	1.0
	Value per Mortality-Ton ($ millions/Halibut MT)									
AFA-MCV	23.27	22.10	13.81	17.58	7.74	3.56	1.74	10.51	3.99	4.70
AFA-CV	16.48	15.76	8.07	10.20	3.17	3.33	2.25	3.45	4.22	2.79
AFA-CP	10.89	7.51	10.22	6.70	3.09	1.65	0.92	2.01	1.74	1.89
A80-CP	ND	ND	0.63	0.04	0.03	0.04	0.06	0.05	0.04	0.04

Note: Wholesale values per ton of groundfish harvested in the pollock fishery have been normalized to reduce the effects of due to inflation, exchange rates, and other changes in market prices.
Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

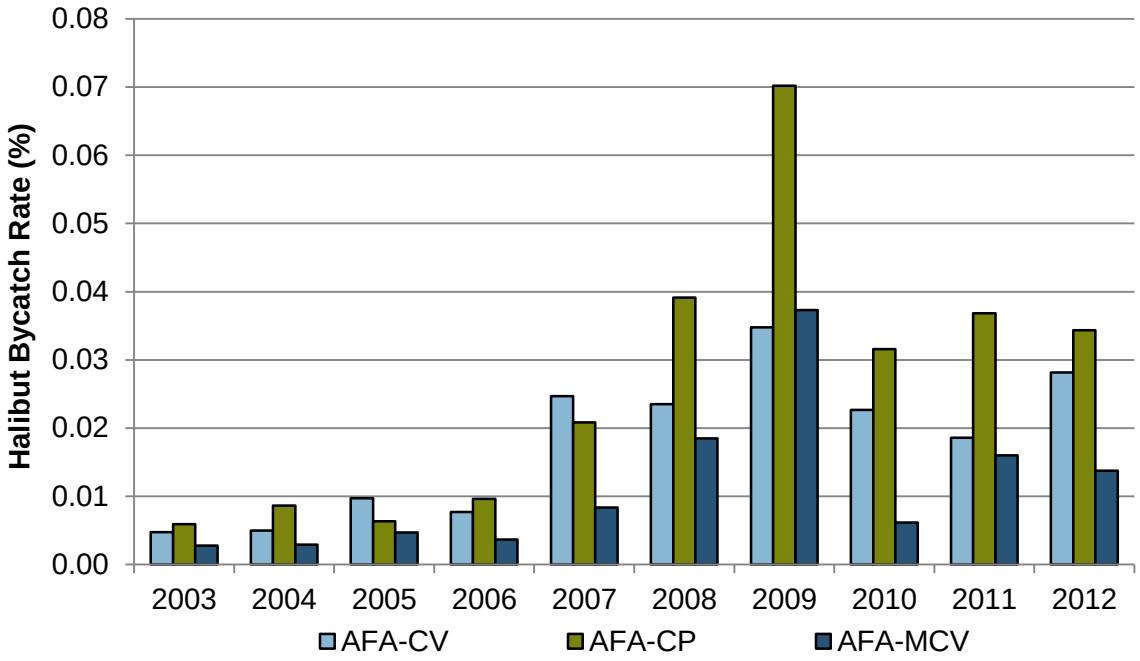
Figure 4 and Figure 5 show halibut bycatch rates in pollock target fisheries—Figure 4 includes A80-CPs, while Figure 5 only shows the bycatch by AFA harvesters and use a much lower scale for rates. Both figures show the significant increases in halibut bycatch rates in pollock target fisheries.

Figure 4. Halibut Bycatch Rates in Pollock Target Fisheries by Sector, 2003-2012



Note: Confidential data for 2003–2004 of A80-CPs has been dropped.
Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

Figure 5. Halibut Bycatch Rates in Pollock Target Fisheries by AFA Sectors, 2003-2012



Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

In Figure 4, bycatch rates by A80-CPs are an at least an order of magnitude higher than rates of AFA vessels, and thus the changes in bycatch rates of AFA vessels are overshadowed. The significant increase in the amount of pollock harvested by A80-CPs may be more a function of catch accounting and reporting than of a large increase in pollock targeting by these vessels. After implementation of AFA, only AFA qualified vessels were allowed to focus on pollock fisheries in the BSAI. In addition, since implementation of Amendment 57 in 1999, directed fishing for pollock with non-pelagic trawl gear has been prohibited. On the surface at least, it seems that there should be very little groundfish assigned to the pollock target fishery by A80-CPs because they use non-pelagic trawl gear in their fisheries for flatfish, rockfish, and Atka mackerel.

The key appears to be the changes to the Maximum Retainable Allowance (MRA) for pollock that were implemented as a regulatory amendment in July 2004, following the 2003 Council approval of Groundfish Retention Standards (GRS) under Amendment 79. The GRS was implemented in 2008. Under the regulatory amendment, the MRA for pollock is calculated at the time of the offload for non-AFA vessels. The rule allowed vessels to choose to retain greater amounts of pollock during a fishing trip as long as they were under the MRA at the time of the offload. As a consequence, it appears that the amount of catch that is assigned to pollock targets has increased.

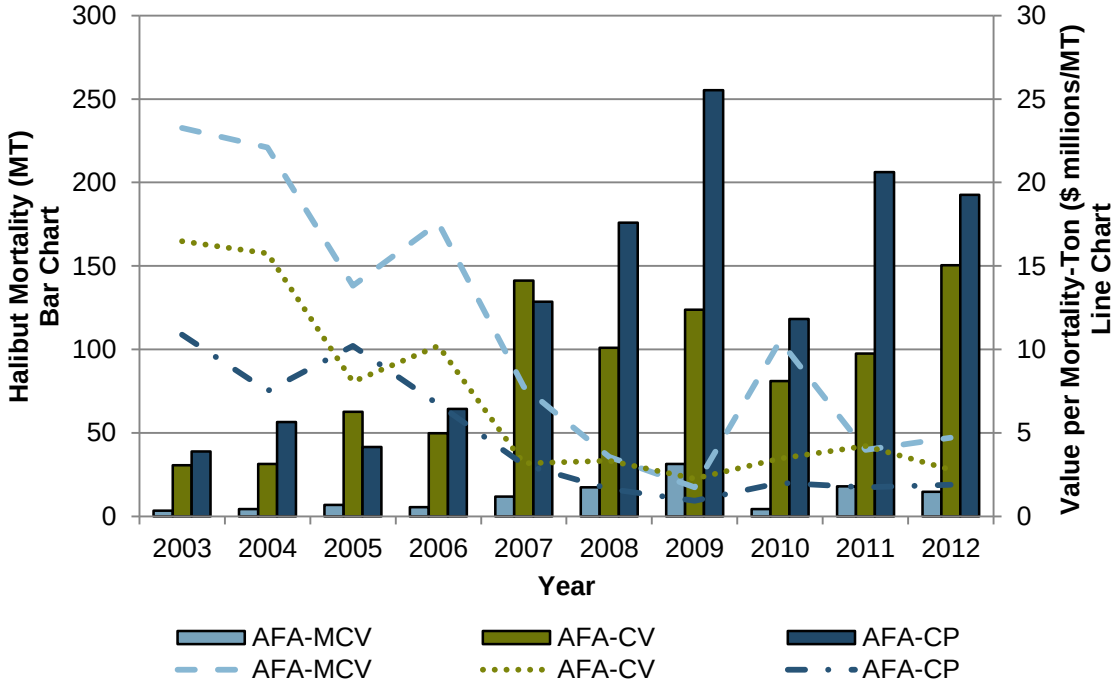
Figure 5 includes only AFA-CPs AFA-MCVs and AFA-CVs. In 2007, all three of these sectors experienced large increases in halibut bycatch rates—rates for AFA-MCVs and AFA-CPs more than doubled, while rates for AFA-CVs increased by more than 300 percent. Bycatch rates of AFA-CPs increased significantly in each of the next two years, before dropping back down in 2010–2012. While these bycatch rates are very low relative to bycatch rates seen in fisheries using non-pelagic trawls, the magnitude of the pollock fishery means that absolute levels of halibut

mortality have increased significantly. (See Figure 3 and Table 12, as well as Figure 6.) From 2003–2006, annual halibut mortality by all AFA harvesters averaged 99 mt/year. From 2007–2012, annual halibut mortality by all AFA harvesters averaged 312 mt/year.

Figure 6 combines absolute levels of halibut mortality for AFA harvesters with the estimated wholesale value generated in the pollock fisheries per ton of halibut bycatch. The figure uses two vertical axes—the bars (halibut mortality) use the left axis, while the lines (value/ton) use the right axis. The numbers in the chart are also shown in Table 12. In 2003, the estimated wholesale value per ton of halibut mortality in the AFA pollock fisheries ranged from $10.9 million/ton in the AFA-CP fishery to $23.3 million/ton in the AFA-MCV fishery. These are very large numbers relative to the $11,515 of wholesale value per ton generated by BSAI processors in directed halibut target fisheries over the 2003–2011 period.[7] The groundfish wholesale value per ton halibut bycatch mortality in the AFA pollock fisheries has declined dramatically since 2003. The biggest declines were seen in 2007, but value per ton of halibut bycatch appears to have bottomed out in 2009. In that year, AFA-CVs generated $2.2 million in wholesale value per ton of halibut bycatch, while AFA-MCVs and AFA-CPs generated $1.7 and $0.9 million respectively.

Nominally, the cause of the decline in value per bycatch ton is the combination of lower harvest levels in the pollock fisheries combined with higher bycatch rates. The decline in pollock harvests is directly related to lower biomass levels, but the root cause of the increase in bycatch rates is not as easily determined.

Figure 6. Annual Halibut Mortality and Groundfish Wholesale Value per MT of Halibut in Pollock Target Fisheries, 2003-2012



[7] This estimate is generated from data provided by AKFIN from COAR data and represents the average wholesale value per ton of halibut by BSAI processors from 2003–2011. The number translates to an average wholesale value per pound of $5.22.

Note: Wholesale values per ton of groundfish harvested in the pollock fishery have been normalized to reduce the effects of due to inflation, exchange rates, and other changes in market prices.

Source: Developed by Northern Economics based on CAS and COAR data from AKFIN

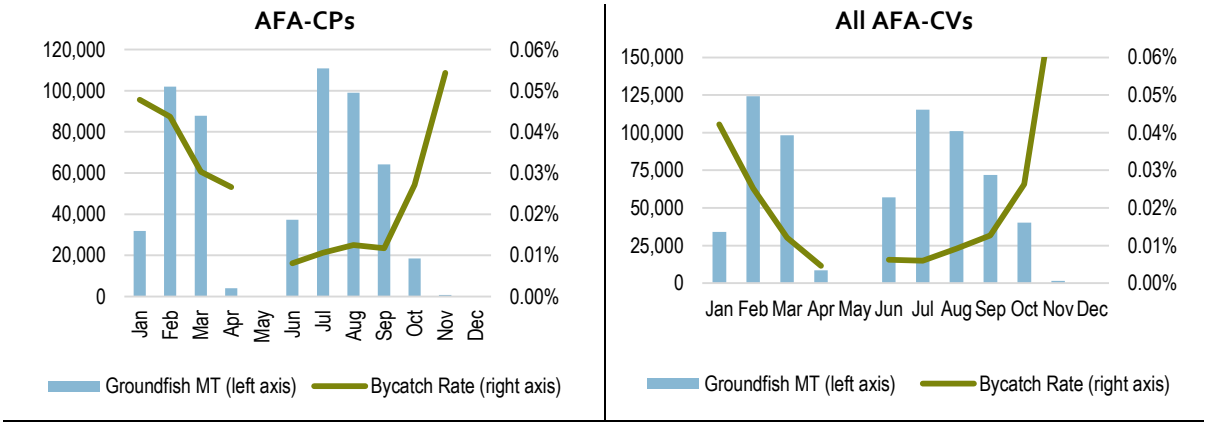
4.1.1 Monthly Variation in the Bycatch of Halibut in the Pollock Target Fisheries

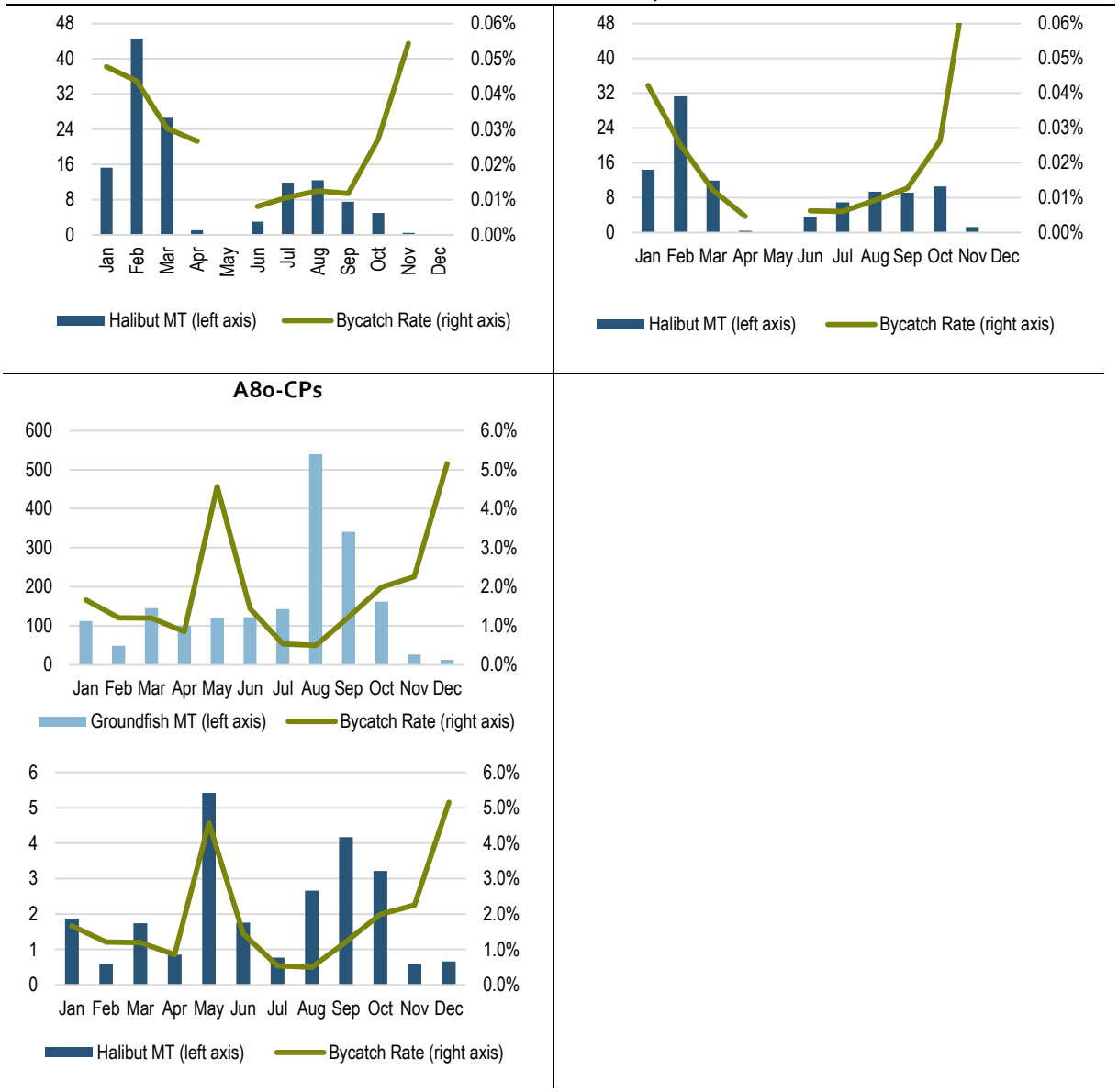
This section summarizes variations in bycatch of halibut in the pollock target fisheries by month. The summary is developed using three sets of two stacked figures. Each set summarizes bycatch of one sector: AFA-CPs, 2) All AFA-CVs (i.e. CVs and MCVs), and 3) A80-CPs. Each set includes two charts that are stacked vertically. The top chart in the set shows the 10-year average monthly groundfish harvest mt (columns) and the associated 10-year average halibut bycatch rate, (expressed as halibut bycatch as a percentage of groundfish harvested). The bottom chart shows halibut bycatch mortality mt, and also includes the line tracking average bycatch rate by month. The right-side scales for bycatch rate of the two stacked charts for a given sector are the same, but the scales are different across sectors.

Both the AFA-CPs and All AF-CVs pollock fisheries have experienced high average catch volumes in February and March, and again from July–September over the 10-years from 2003–2012. Meanwhile, total halibut mt for both the AFA fisheries are highest in February with bycatch rates of 0.04 percent and 0.03 percent in AFA-CP and AFA-CV/MCV fisheries, respectively. For both fisheries, halibut bycatch rates averaged approximately 0.01 percent from July through August.

A different picture emerges for the A80-CPs when they experience tows that are classified as targeting pollock. A80-CPs experienced much higher bycatch rates in pollock tows, though their average annual harvests represented less than one percent of the total of either the AFA-CV/MCV or AFA-CP fishery. Bycatch rates during the winter months were low relative to their highest rates in May and in October–December. The A80-CPs pollock fishery's average peak harvest occurred in August and coincided with their lowest halibut bycatch rate of the year of 0.5 percent.

Figure 7. Average Monthly Pollock Harvest & Halibut Bycatch by Sector/Fishery, 2003–2012





Source: All figures developed by Northern Economics based on CAS and COAR data from AKFIN Data.

4.2 Pacific Cod

This section examines halibut bycatch in the Pacific Cod fisheries by harvesting vessel sector. The structure of the section is similar to the previous section that focused on the pollock fishery

An examination of halibut bycatch in target fisheries for Pacific cod in the BSAI is complicated by the fact that it is an important fishery for nearly every harvesting sector in the BSAI. As seen in Table 13, there are as many as twelve different sectors that reported landings in Pacific cod target fisheries, depending, of course, on how sectors are defined. Table 13 provides a very disaggregated look at participation in the Pacific cod target fishery. This table not only provides a look at participation, but also provides an indication of whether data can be released under confidentiality restrictions—the shaded cells with bolded text indicate data points that cannot be

released without further aggregation. For some of the sectors listed in the table, aggregation with other sectors would not meaningfully change the results of the analysis. For example, AFA-MCVs can be aggregated with AFA-CVs to create a sector containing All AFA-CVs. The results should not change significantly, and several additional years of AFA-MCV data can be included. Similarly, combining POT-CVs with POT-MCVs, LGL-CVs with LGL-MCVs and non-AFA TRW-CVs with non-AFA TRW-MCVs will streamline the analysis, even though some of these data could be released regardless. Unfortunately, however, there does not appear to be a way to aggregate AFA-CPs into another sector without causing some harm to the results. This is because AFA-CPs receive a separate allocation of the Pacific cod ITAC. Combining them with the AFA-CVs would obfuscate the impacts of AFA-CVs. For this reason, the remaining discussion of bycatch in the Pacific cod target fishery will exclude AFA-CPs.

Table 13. Number of Unique Observed Harvester Vessels in Pacific Cod Target Fisheries by Sector, 2003–2012

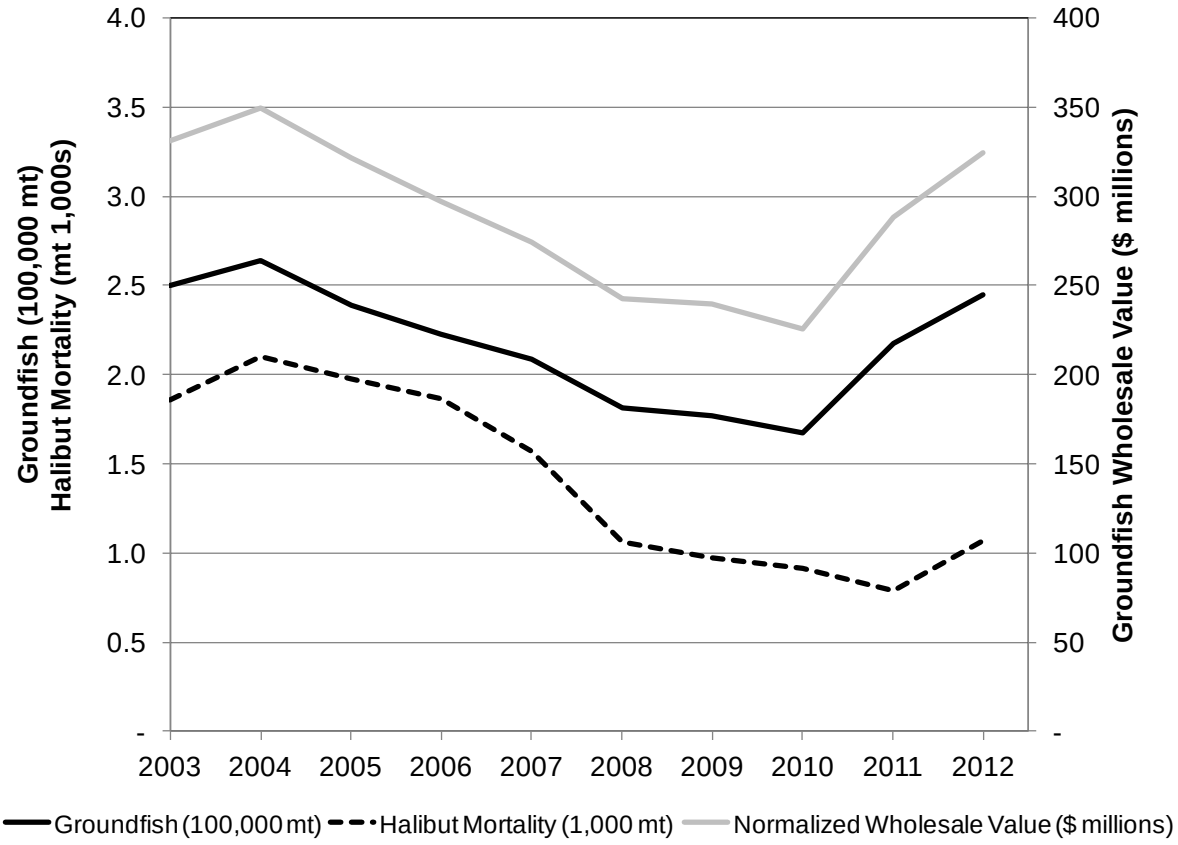
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
	Unique Number of Harvesting Vessels									
Sector	**Pacific Cod**									
A80-CP	18	19	18	18	22	12	15	14	14	14
AFA-CP	**1**	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	4
AFA-CV	59	59	49	44	45	48	37	33	35	42
AFA-MCV	3	**2**	**2**	**2**	**2**	5	**2**	3	7	9
TRW-CV	26	17	13	11	17	16	14	10	11	13
TRW-MCV	-	**2**	-	-	**2**	3	3	**2**	4	5
LGL-CP	39	39	39	39	37	39	38	36	31	31
LGL-CV	16	10	21	18	17	20	12	10	9	9
LGL-MCV	-	-	-	-	5	-	4	-	-	-
POT-CP	3	3	**2**	4	3	6	4	6	4	5
POT-CV	69	71	59	62	64	57	43	44	48	49
POT-MCV	-	-	-	4	4	5	-	-	-	-

Note: Shaded cells indicate that catch and value data are confidential and cannot be released. Also note that unobserved catcher vessels are counted as a single vessel and thus CV counts may be an underestimate.

Source: Developed by Northern Economics based on CAS data from AKFIN

As seen in Figure 8, groundfish harvests in Pacific cod target fisheries for included sectors[8] have declined every year from 2004–2010, as have normalized wholesale values of groundfish and halibut mortality. In 2011, groundfish harvests and wholesale value increased, but halibut mortality continued to decline. From 2007 to 2011, overall halibut mortality in the Pacific cod target fisheries declined at a greater rate than groundfish harvests. In 2012, total halibut mortality in the Pacific cod target fisheries increased for first time since 2004 and was at its highest level since 2007.

Figure 8. Harvest, Halibut Bycatch and Normalized Wholesale Value of Groundfish in Pacific Cod Target Fisheries of Included Sectors, 2003 - 2012



Note: Includes only harvests and values of sectors included in Table 14—i.e. AFA-CPs are not included. Axes values are scaled so that the changes in the different variables are relative. Also, Pot-CP data for 2005 are exclude for reasons of confidentiality.
Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

[8] In order to protect the confidentiality of data, groundfish harvests of the AFA-CP sector have not been included in Figure 8, nor are they included in Table 14.

Table 14 summarizes the groundfish harvests and halibut bycatch mortality in the Pacific cod target fisheries by sector from 2003–2012. The table contains the same five sections in the table used for the pollock target fisheries. The table does not include AFA-CPs because all of their data are considered confidential.

Table 14. Halibut and Target Mortality and Value in Pacific Cod Target fisheries, 2003-2012

Sector	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Groundfish Caught in Target Fishery (MT)										
All AFA-CVs	40,055	39,504	33,861	35,463	35,640	29,503	24,104	23,694	30,504	37,807
All TRW-CVs	12,169	5,948	3,145	3,686	6,046	7,354	6,556	7,225	10,389	11,885
A80-CPs	38,903	62,674	40,229	42,859	49,005	5,705	6,731	5,591	3,501	3,725
LGL-CPs	135,938	137,259	142,980	119,816	98,559	116,556	122,788	108,335	143,403	158,629
All LGL-CVs	480	647	1,110	655	852	991	693	360	475	748
POT-CPs	1,596	3,282	ND	3,207	2,780	4,606	4,817	5,163	3,370	5,417
All POT-CVs	21,090	14,522	14,403	17,296	15,776	16,683	10,965	17,232	25,542	26,246
Halibut Mortality (MT)										
All AFA-CVs	607.2	378.5	541.7	534.3	363.0	248.7	151.3	227.5	180.8	309.3
All TRW-CVs	171.8	63.4	54.6	50.9	65.7	41.7	29.9	28.9	59.2	129.7
A80-CPs	577.2	1,160.1	782.3	832.8	613.0	46.0	75.6	34.8	16.8	38.9
LGL-CPs	495.5	489.5	589.7	434.6	524.2	704.1	713.2	615.4	527.0	585.4
All LGL-CVs	2.5	4.6	5.9	2.9	6.3	11.9	3.0	1.7	1.3	1.8
POT-CPs	0.2	0.4	ND	0.6	0.0	1.0	0.2	0.6	1.4	0.8
All POT-CVs	2.0	2.3	2.2	3.8	0.7	4.4	0.2	1.7	3.8	3.9
Halibut Bycatch Rate (%)										
All AFA-CVs	1.516	0.958	1.600	1.507	1.019	0.843	0.628	0.960	0.593	0.818
All TRW-CVs	1.412	1.066	1.735	1.381	1.086	0.567	0.456	0.400	0.570	1.092
A80-CPs	1.484	1.851	1.945	1.943	1.251	0.807	1.123	0.622	0.478	1.045
LGL-CPs	0.365	0.357	0.412	0.363	0.532	0.604	0.581	0.568	0.367	0.369
All LGL-CVs	0.517	0.712	0.529	0.436	0.735	1.197	0.437	0.479	0.272	0.244
POT-CPs	0.010	0.011	ND	0.019	0.001	0.022	0.003	0.013	0.040	0.015
All POT-CVs	0.010	0.016	0.015	0.022	0.005	0.026	0.002	0.010	0.015	0.015
Wholesale Value in Target Fishery ($ millions)										
All AFA-CVs	45.64	44.66	38.03	40.11	40.41	33.64	28.06	27.41	35.40	42.97
All TRW-CVs	13.43	6.57	3.46	4.05	6.70	8.85	7.77	8.79	12.32	14.64
A80-CPs	52.44	81.42	55.23	57.32	63.47	7.83	9.31	7.80	4.49	5.08
LGL-CPs	193.17	195.09	203.01	171.08	141.11	165.84	174.80	154.46	202.73	224.21
All LGL-CVs	0.54	0.72	1.24	0.73	1.01	1.09	0.79	0.40	0.52	0.83
POT-CPs	2.26	4.73	ND	4.54	4.00	6.46	6.77	7.25	4.79	7.71
All POT-CVs	23.38	16.14	16.00	19.21	17.56	18.70	12.05	19.12	28.39	29.04
Value per Mortality-Ton ($ thousands/MT)										
All AFA-CVs	75.2	118.0	70.2	75.1	111.3	135.2	185.4	120.5	195.8	138.9
All TRW-CVs	78.2	103.6	63.3	79.5	102.1	212.3	260.1	304.3	208.0	112.9
A80-CPs	90.8	70.2	70.6	68.8	103.5	170.1	123.2	224.0	268.3	130.4
LGL-CPs	389.8	398.6	344.3	393.6	269.2	235.5	245.1	251.0	384.7	383.0
All LGL-CVs	216.4	157.1	210.9	255.1	161.8	92.2	260.7	229.9	404.3	453.6
POT-CPs	14,130.6	12,709.3	ND	7,311.6	114,184.4	6,271.7	43,457.7	11,170.0	3,517.6	9,224.2

All POT-CVs	11,458.7	7,017.6	7,203.9	5,113.6	23,899.5	4,289.4	71,878.2	10,980.0	7,549.7	7,523.7

Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

- **Groundfish Caught in the Pacific Cod Target Fishery:** As seen in Table 14, the three largest sectors in the Pacific cod target fisheries are the LGL-CPs, All AFA-CVs, and the POT-CVs. Prior to 2008 the A80-CPs had larger groundfish harvests in Pacific cod target fisheries than AFA CVs, but with the reallocation of Pacific cod under Amendment 85, their harvests have been significantly reduced. Since 2008, A80-CPs have averaged just 5,051 mt of groundfish in the Pacific cod target fishery, down from 46,734 mt on average from 2003–2007. None of the other sectors included in the table have experienced similar declines, although groundfish harvests in Pacific cod target fisheries by AFA-CPs (not shown) have also declined significantly since 2007. Of the remaining included sectors, three—All TRW CVs (non-AFA), POT-CPs, and All POT-CVs)—have seen average annual harvest increases since 2007, with increases ranging from 40–63 percent, while All AFA-CVs and All LGL-CVs have seen average harvest declines of 21 and 12 percent respectively.

- **Halibut Mortality (MT**): Overall halibut mortality in Pacific cod target fisheries (see the second section of Table 14) has clearly declined since 2003, due primarily to reductions in harvests by trawlers. Halibut mortality by LGL-CPs increased significantly in 2008 to the highest levels in the period and remained high in 2009 before dropping down again in 2010; it is conceivable that the formation of a voluntary cooperative among LGL-CPs in August 2010 may have helped reduce the sector's halibut mortality. The very large drop in mortality for A80-CPs after 2007 is due primarily to the reduced levels of activity in Pacific cod target fisheries, but may also be a result of the individual accountability inherent in catch share and cooperative systems. Halibut mortality by Trawl CVs increased significantly in 2012—up nearly 200 mt from 2011. Halibut mortality by year, in combination with normalized groundfish wholesale value per ton of halibut can be seen in Figure 10 (for trawl vessels), Figure 12 (for longline vessels), and Figure 14 (for pot vessels).

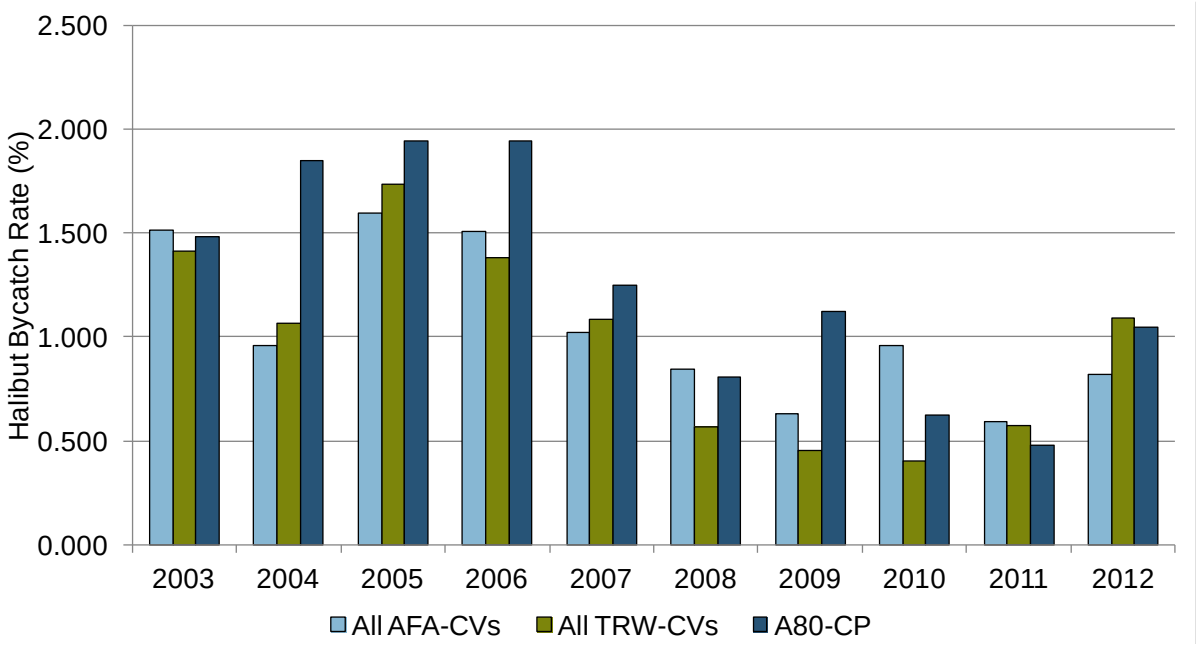
- **Halibut Bycatch Rate (%)**: Beginning in 2007, halibut bycatch rates by included trawl vessels in Pacific cod target fisheries declined significantly through 2011 but then increased dramatically in 2012. A80-CPs experienced an bycatch rate increase in 2009, and dropped again in the following years until nearly reaching 2009 levels in 2012. Similarly All AFA-CVs experienced a one-year increase (2010), a decrease (2011), and a recent increase (2012). Bycatch rates of the LGL-CPs from 2007–2010 were higher than from 2003–2006, but were lower again in 2011 and 2012. In 2008, bycatch rates of LGL-CVs were 1.19 percent the highest of any sector that year but have dropped dramatically since then. Bycatch rates of pot CPs & CVs vessels remain very low—generally at least an order of magnitude lower than any of the other sectors, and are the primary reason pot gear is exempt from halibut PSC limits. Figure 9 shows annual bycatch rates for the three included trawl sectors; Figure 11 shows bycatch rates for longline CPs and CVs; Figure 13 shows bycatch rates for pot CPs and CVs.

- **Wholesale Value in Pacific Cod Target Fisheries ($ millions)**: The wholesale values generated in the Pacific cod target fisheries as shown in the table are normalized by using the seasonal average value of products produced per ton of groundfish in the target fishery by the sector (or groups of sectors) over the 2003–2012 period. In this way, the influence on differences due to inflation, changes in product prices, product mixes, and currency

exchanges are minimized. In general, normalized wholesale value will track groundfish landings by sector.

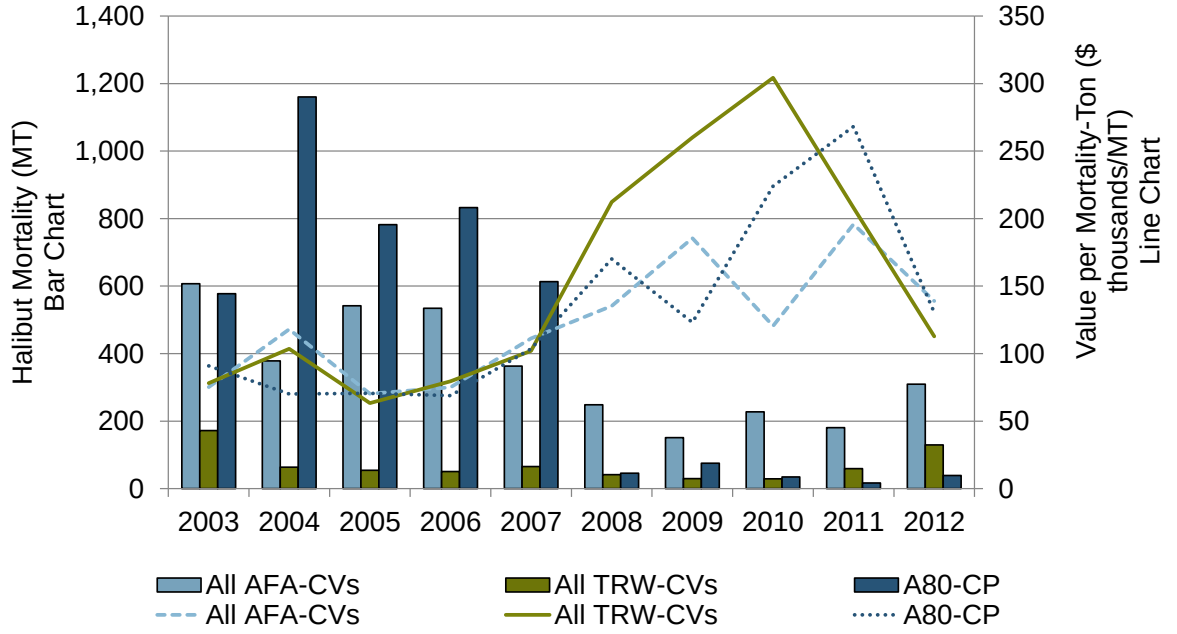
- **Value per MT of Halibut Mortality ($ millions/Halibut mt**): This field shows the normalized wholesale value generated in the Pacific cod fishery per ton of halibut mortality. The normalized groundfish wholesale value per ton of halibut, in combination with halibut mortality, can be seen in Figure 10 (for trawl vessels), Figure 12 (for longline vessels), and Figure 14 (for pot vessels). There is also a separate figure (Figure 15) that compares normalized groundfish wholesale value per ton of halibut across all sectors. Because of their extremely low bycatch rate, wholesale values per ton of halibut mortality for pot vessels are extremely high, usually in excess of $10 million. Values for trawl vessels generally ranged between $60,000 and $100,000 per ton of halibut mortality prior to 2007, but have increased significantly since then. The average wholesale value generated per mt of halibut bycatch by all of the sectors in the Pacific cod fishery is much higher the average wholesale value per mt of halibut in the IFQ halibut fishery itself.

Figure 9. Halibut Bycatch Rates in Pacific Cod Trawl Fisheries by Sector, 2003-2012



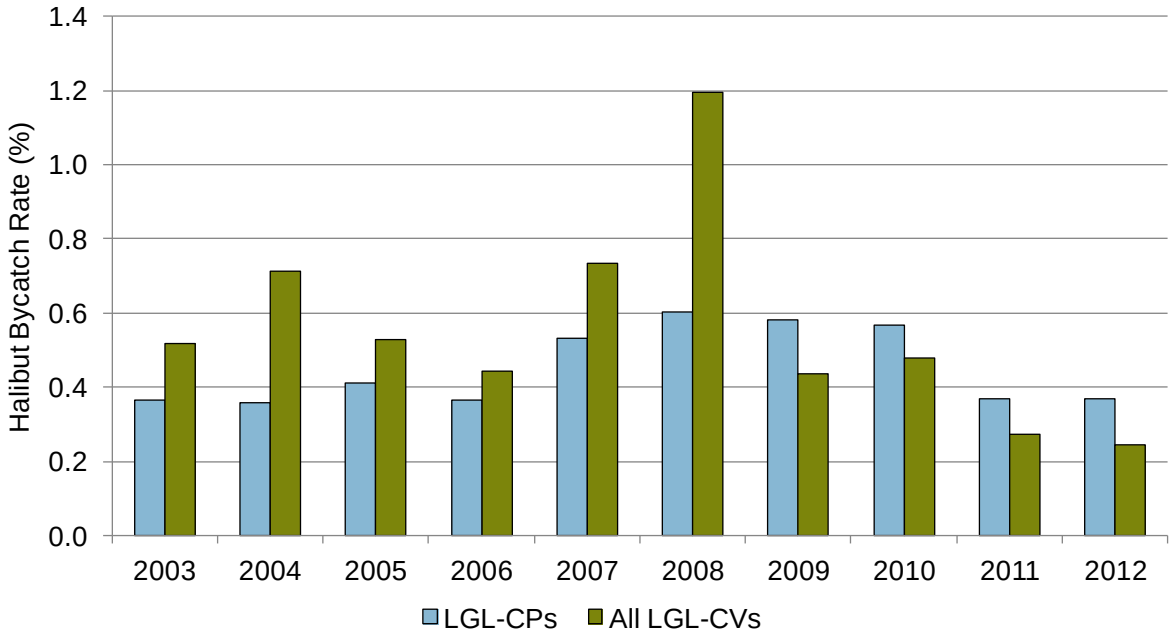
Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

Figure 10. Annual Halibut Mortality and Groundfish Wholesale Value per MT Halibut in Pacific Cod Trawl Fisheries, 2003-2012



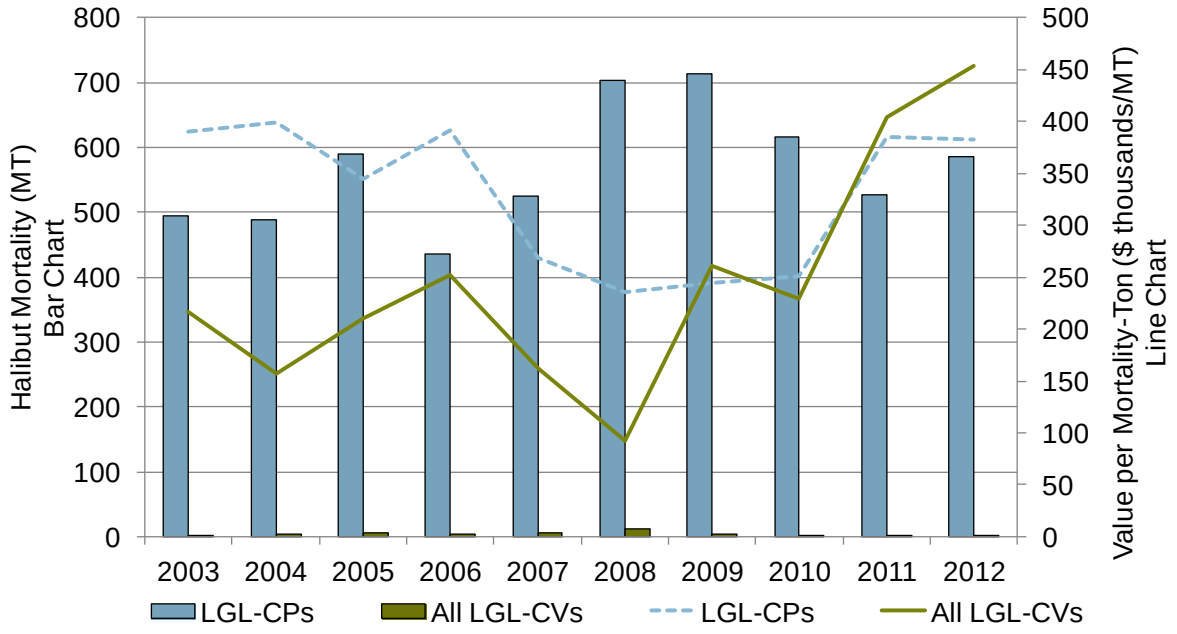
Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

Figure 11. Halibut Bycatch Rates in Pacific Cod Longline Fisheries by Sector, 2003-2012



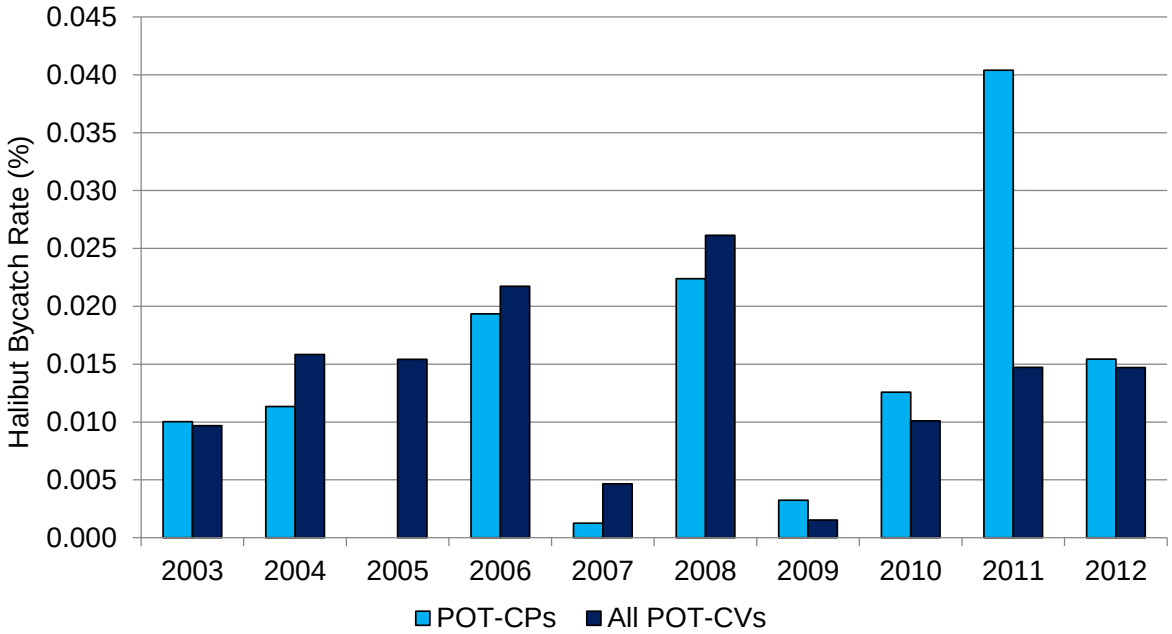
Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

Figure 12. Annual Halibut Mortality and Groundfish Wholesale Value per MT Halibut in Pacific Cod Longline Fisheries, 2003-2012



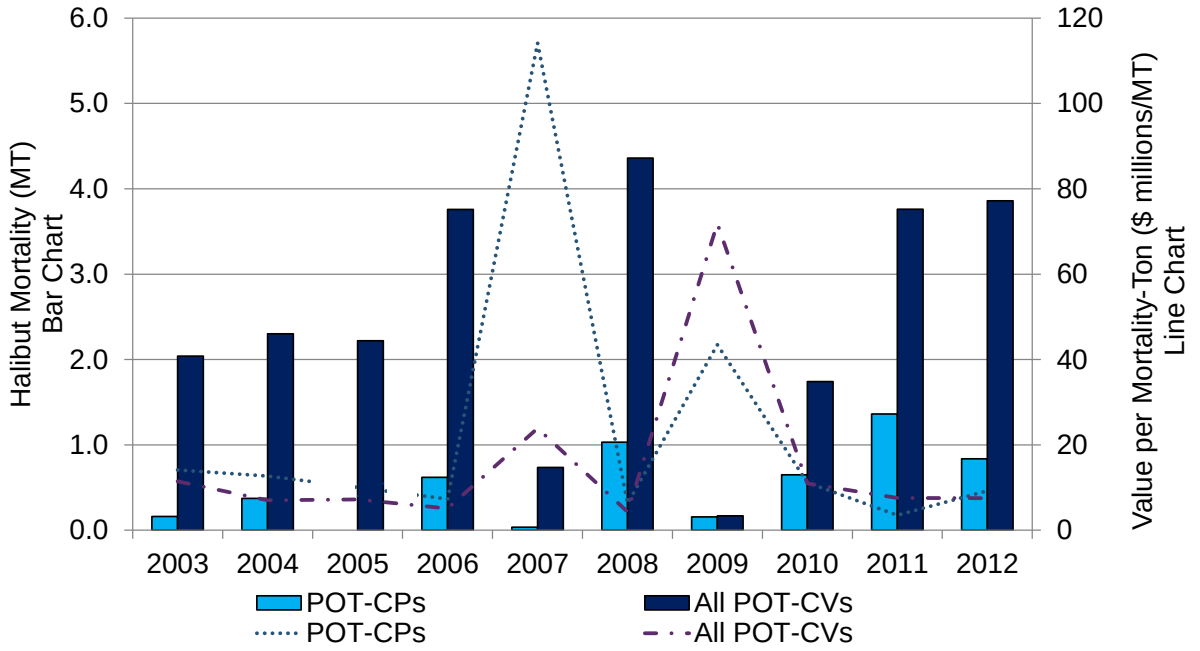
Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

Figure 13. Halibut Bycatch Rates in Pacific Cod Pot Fisheries by Sector, 2003-2012



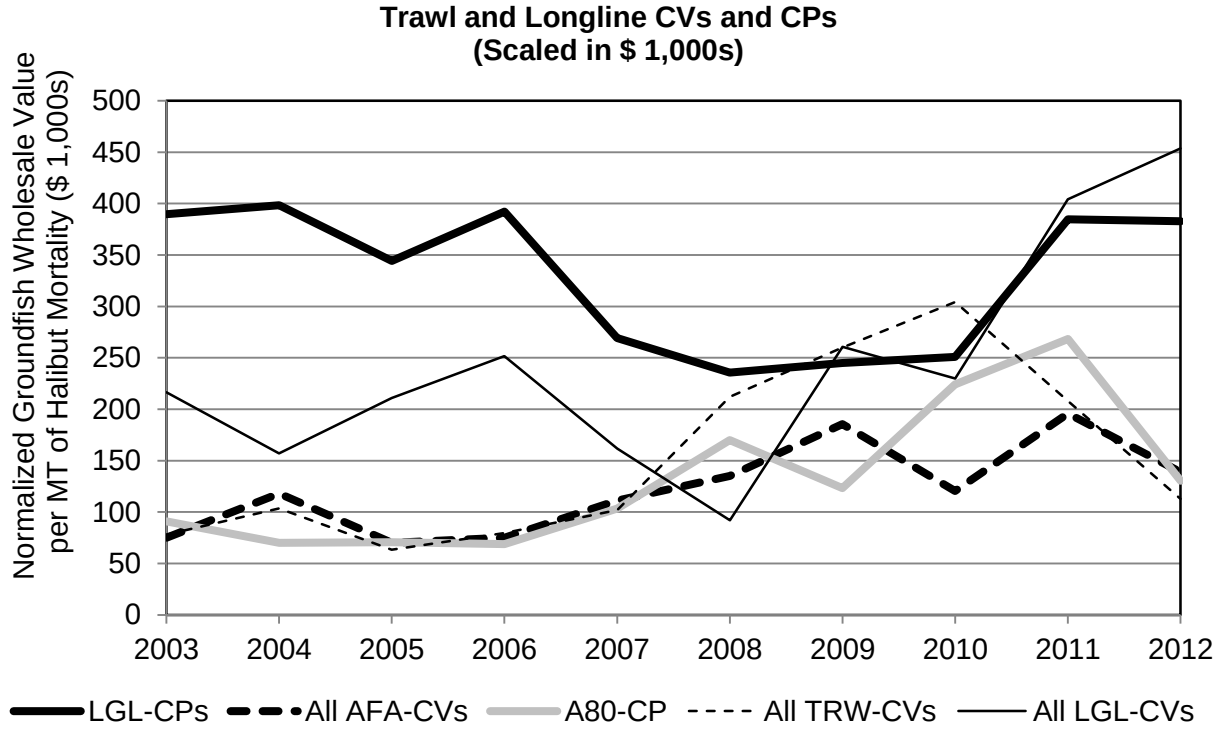
Note: Confidential data for 2005 of POT-CPs has been dropped.
Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

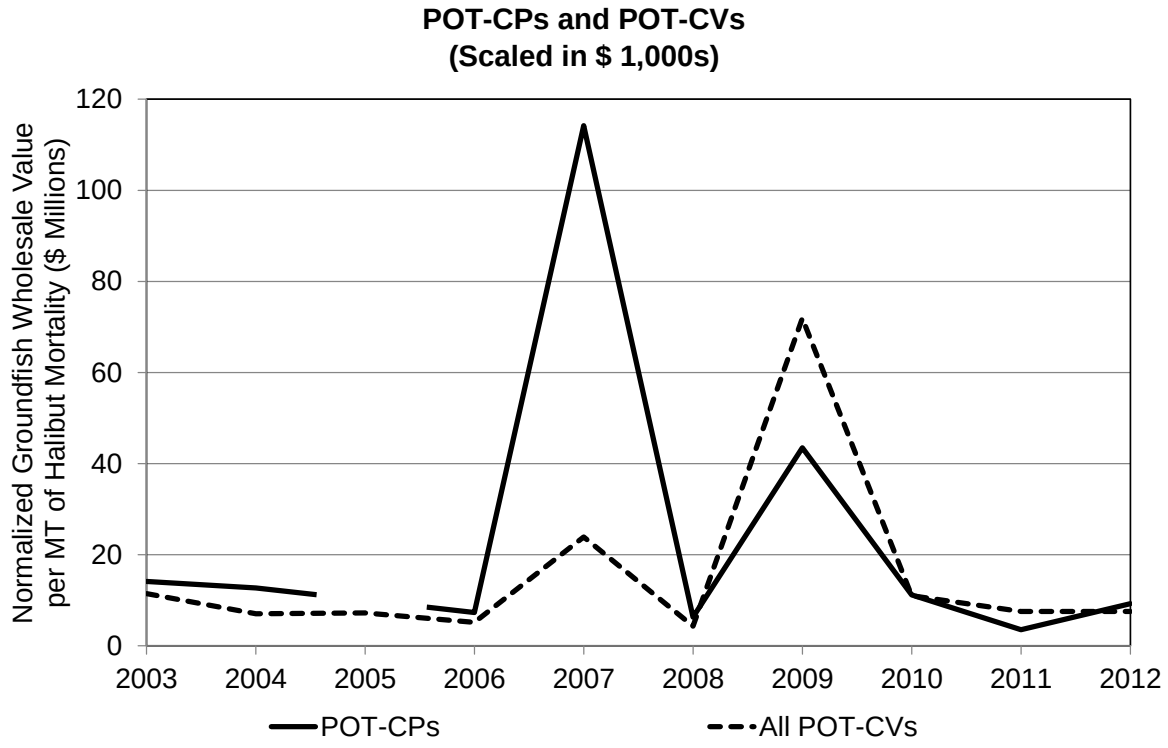
Figure 14. Annual Halibut Mortality and Groundfish Wholesale Value per MT Halibut in Pacific Cod Pot Fisheries, 2003-2012



Note: Confidential data for 2005 of POT-CPs has been dropped.
Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

Figure 15. Normalized Groundfish Wholesale Value per Ton of Halibut Mortality by Sector





Note: Confidential data for 2005 of POT-CPs has been dropped.

Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

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4.2.1 Geographic Distribution of Halibut Bycatch in the Target Fisheries for Pacific Cod

This section provides a series of four maps showing bycatch rates experienced by catcher processors and motherships in the BSAI Pacific Cod Fisheries in two 5-year periods: 2003–2007 and 2008–2012. These 5-year periods were chosen because A80 was implemented in 2008 as was the re-allocation of Pacific cod under Amendment 85.

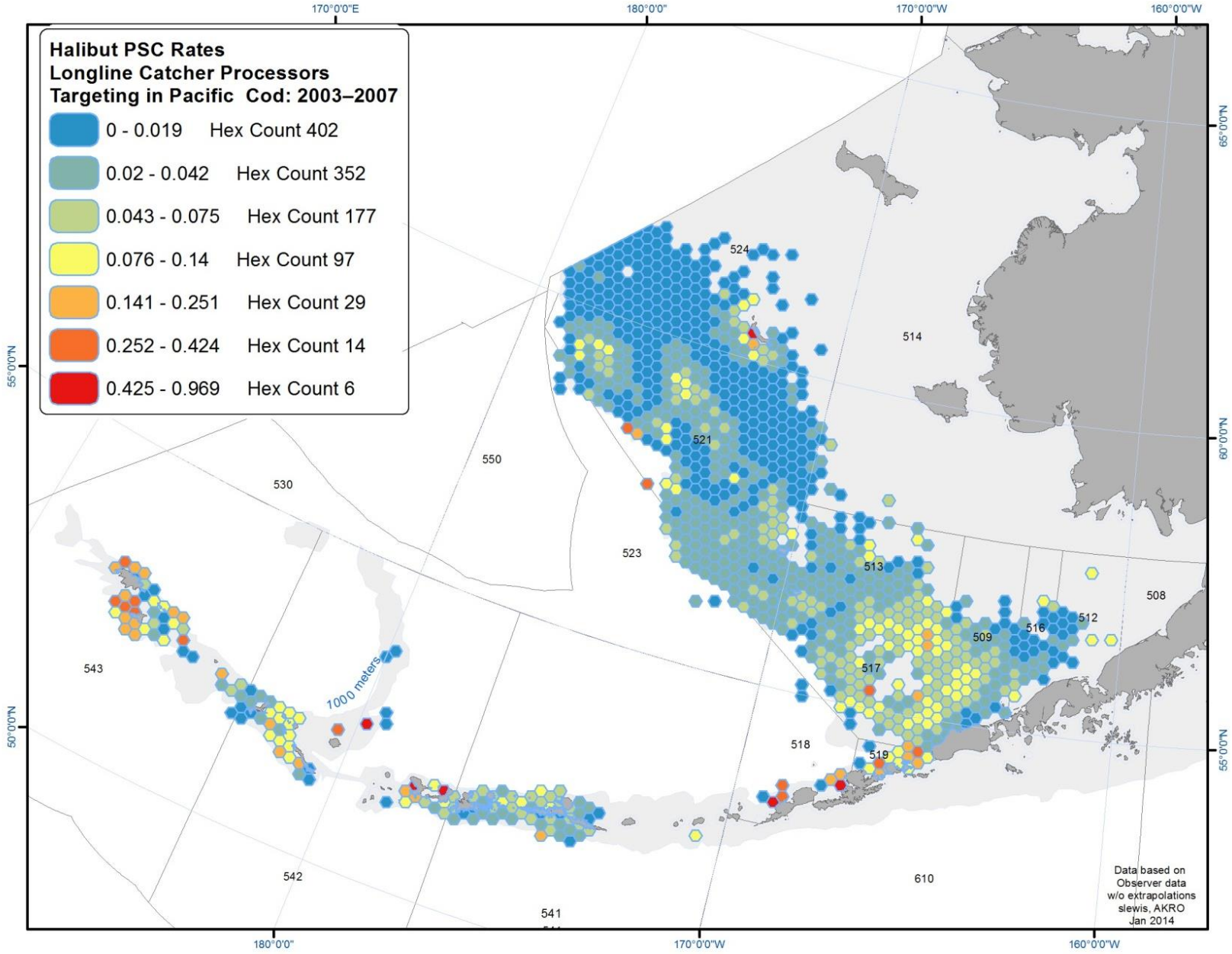
All of the maps were developed upon request specifically for this discussion paper by Steve Lewis at NMFS-AKR, using geographic information system (GIS) technology combined with observer data. In general, each of the hexagons in the figures are 20 kilometers in width, although the areas are smaller around land masses. Data used in the figures are taken directly from observer data over the 5-year period shown in each figure. In order to be included in the figure, a hexagon had to contain tows or sets from 3 or more vessels. There were no extrapolations of the data, and therefore the maps represent the distribution of bycatch rates of observed fishing activities only, and should not be interpreted as distribution of all bycatch in the target fisheries.[9] It should also be noted that the bycatch rates associated with individual colors are not consistent between figures, although the colors do remain in the same order from low to high.

Figure 16 show the geographic distribution of halibut rates from observed sets in the LGL-CP from 2003–2007; Figure 17 shows the bycatch rates of the LGL-CPs from 2008–2012. The overall geographic distribution does not show dramatic shifts, but there has been an increasing amount of effort and bycatch to the north in the later years, particularly in management zones 513, 509, 516, and 512. In addition there appears to by higher bycatch rates in cells in the southeast portion of zone 521 and the western portion of zone 513.

The changes between the two 5-year periods are much more noticeable for trawl catcher processors and motherships in Pacific cod target fisheries as seen in Figure 18 and Figure 19. There were only 138 cells included in the figure for 2008–2012, down from 489 in the figure for 2003–2007.

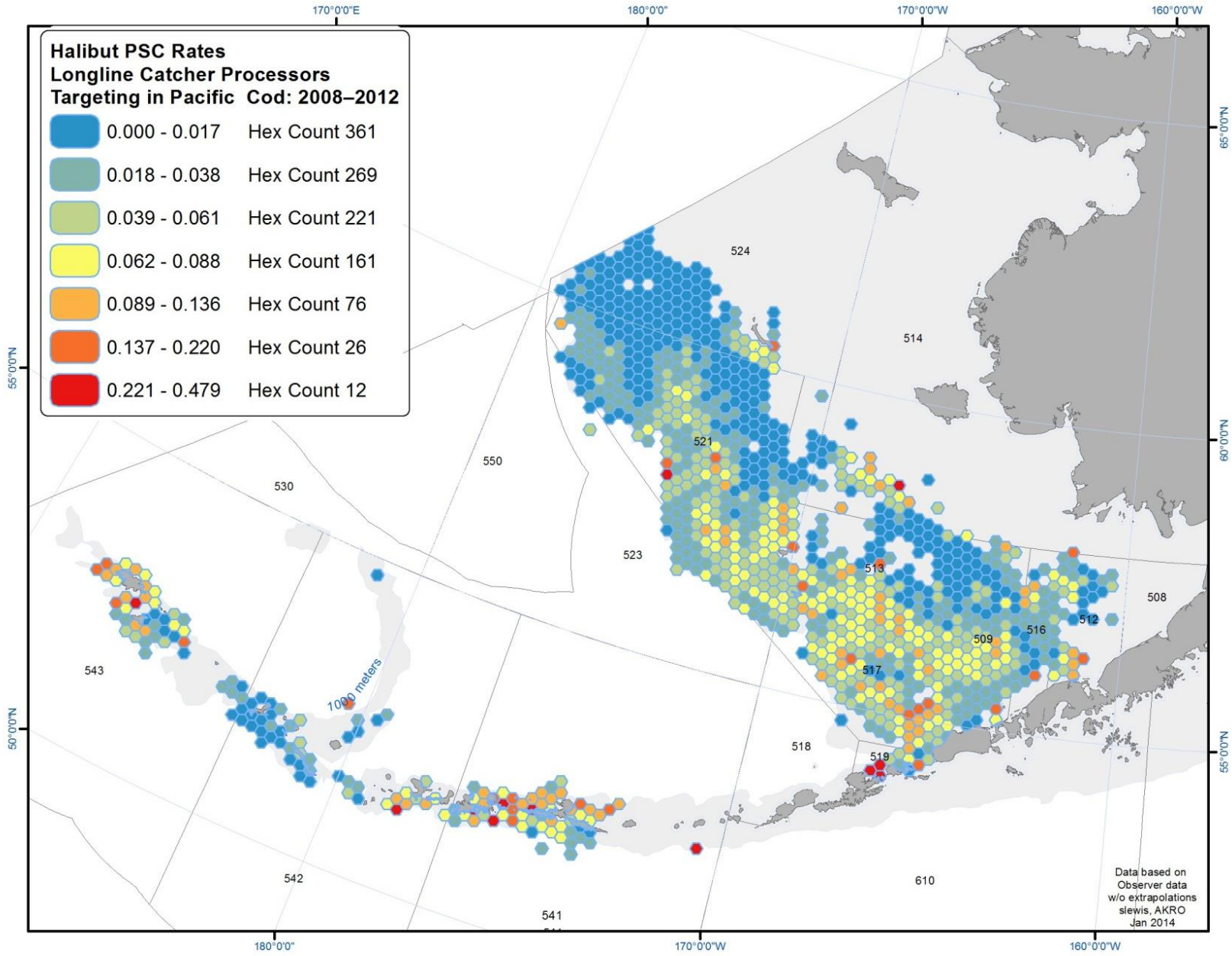
[9] The maps themselves do not include provide any indication of the number of observations from that cell, nor is there any way to discern the volume of catch or halibut bycatch within the cell. The only information that is known is that each colored cell had three or more observations during the period, and that the weighted average bycatch rate of the cell during the period fell within the range indicated in the map's legend.

Figure 16. Halibut PSC Rates from 2003–2007 in the Pacific Cod Fishery of Longline Catcher Processors



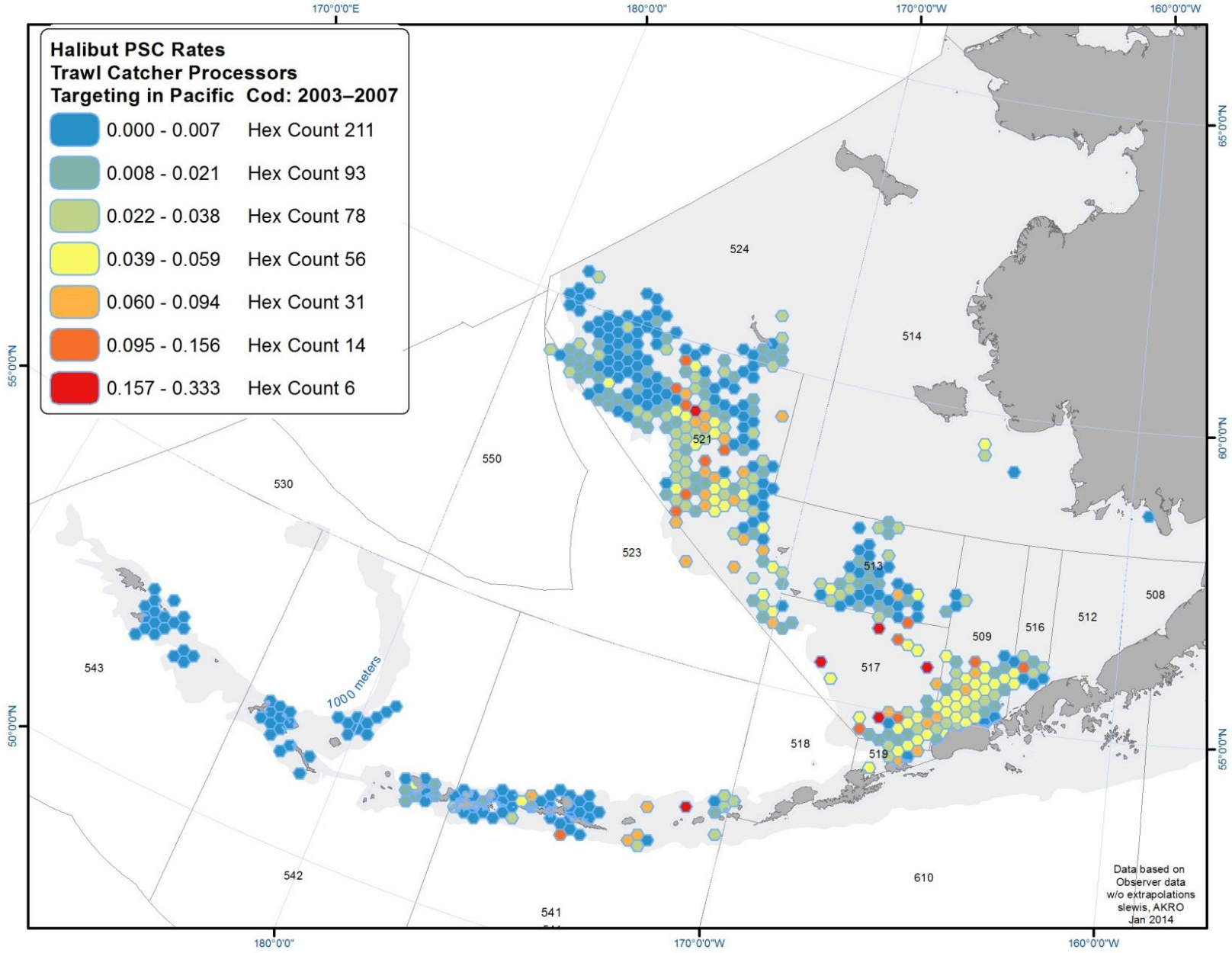
Source: Developed on request by Steve Lewis; GIS Coordinator/Analyst, NOAA Fisheries, Alaska Region, on January 10, 2014.

Figure 17. Halibut PSC Rates from 2008–2012 in the Pacific Cod Fishery of Longline Catcher Processors



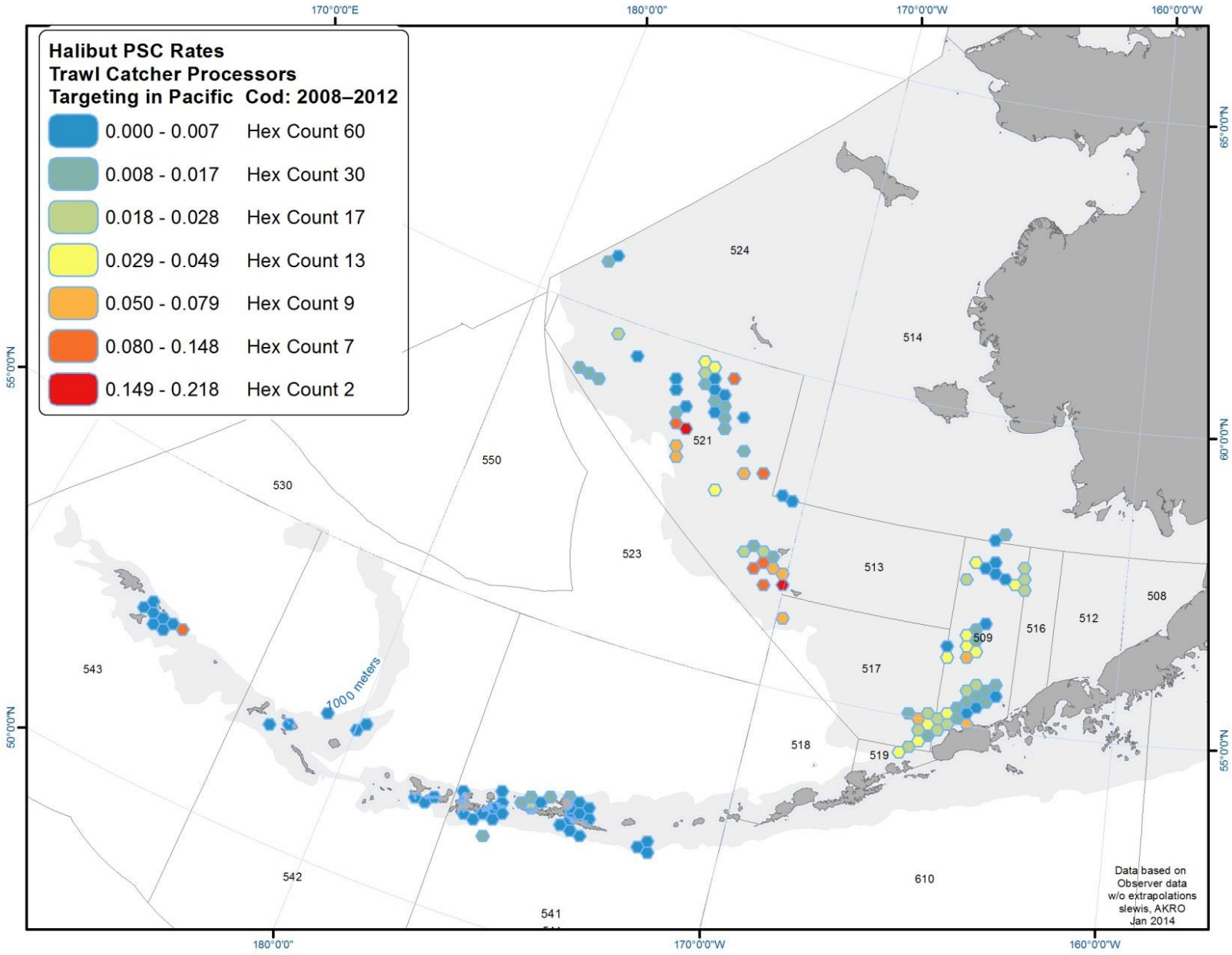
Source: Developed on request by Steve Lewis; GIS Coordinator/Analyst, NOAA Fisheries, Alaska Region, on January 10, 2014.

Figure 18. Halibut PSC Rates from 2003–2007 in the Pacific Cod Fishery of Trawl Catcher Processors and Motherships



Source: Developed on request by Steve Lewis; GIS Coordinator/Analyst, NOAA Fisheries, Alaska Region, on January 10, 2014.

Figure 19. Halibut PSC Rates from 2008–2012 in the Pacific Cod Fishery of Trawl Catcher Processors and Motherships



Source: Developed on request by Steve Lewis; GIS Coordinator/Analyst, NOAA Fisheries, Alaska Region, on January 10, 2014.

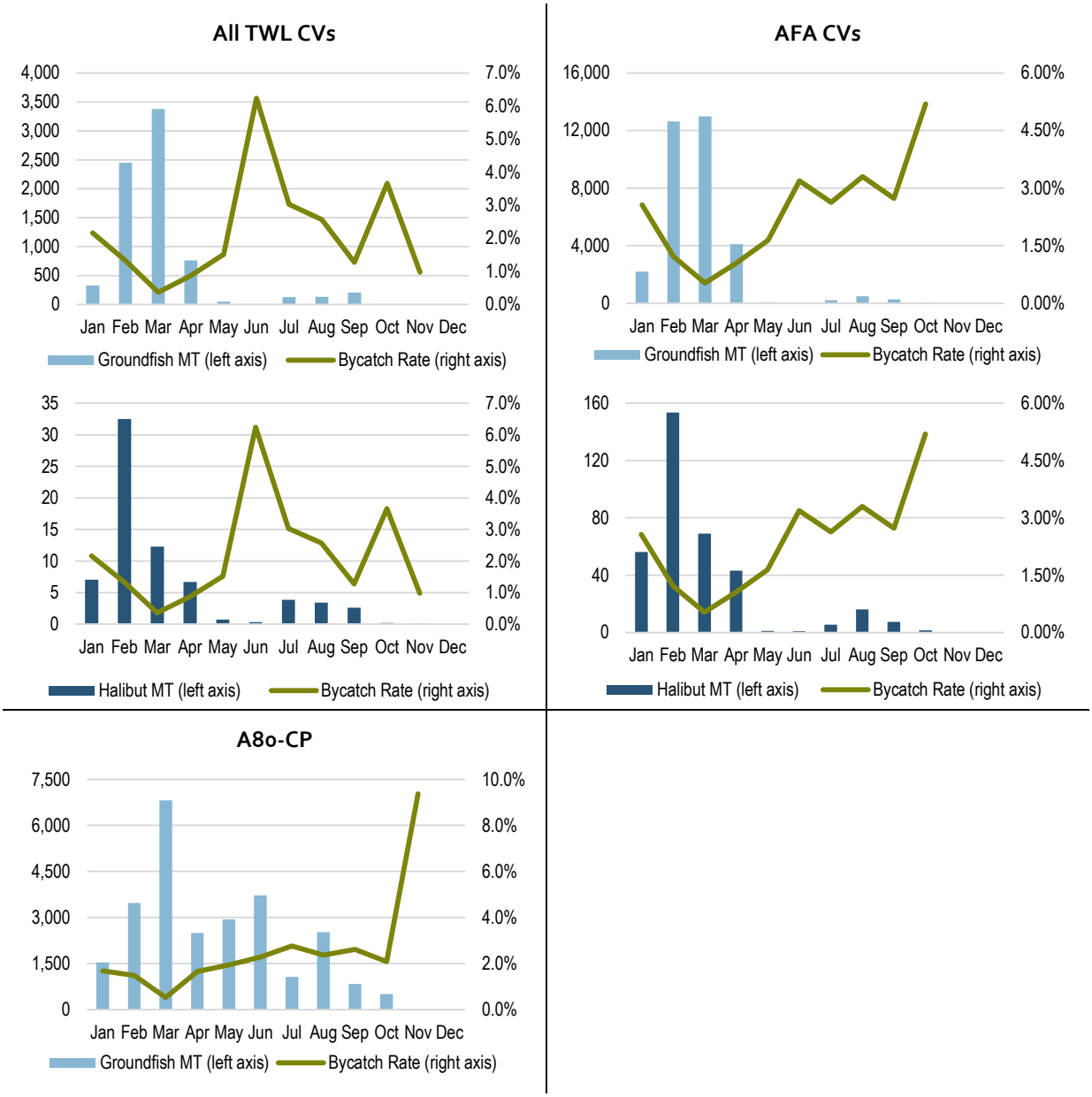
4.2.2 Variations in Halibut Bycatch by Month in Pacific Cod Target Fisheries

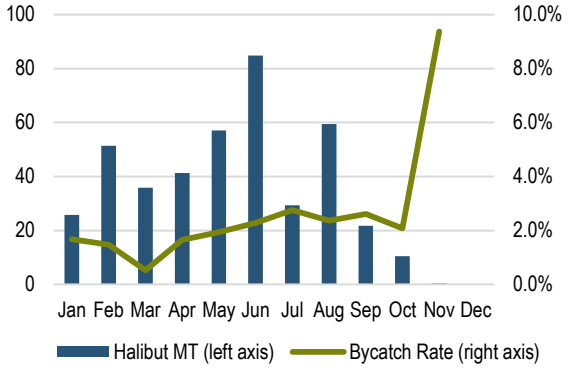
This section presents a series of charts that show the sources of halibut bycatch in the Pacific Cod target fisheries across sectors for the years 2003–2012. There are two charts stacked vertically for each included sector. The top chart of for each sector shows average monthly groundfish harvest levels (in the columns) in metric tons and the associated halibut bycatch rate (as a line), which is expressed as halibut bycatch as a percentage of groundfish harvested. The bottom chart shows halibut bycatch levels (in metric tons) but also includes the line tracking average bycatch rate by month. Figure 20 shows monthly variations for three trawl sectors, while Figure 21 shows monthly variations for four non-trawl sectors.

Average Pacific cod catch levels were highest and halibut bycatch rates lowest in March across the A80-CP, All AFA CVs, and All TRW CVs Pacific cod fisheries from 2003 to 2012. March bycatch rates for these fisheries averaged 0.5%, 0.5%, and 0.4%, respectively, over the 10-year period. Each of the three fisheries also tended to experience high catch volumes in February. Bycatch rates in February, however, were more than three times greater than those witnessed in March. Late-season participation in Pacific target fisheries the AFA-CVs and TRW-CVs were relatively low, but bycatch rates were noticeably higher. A80-CPs have had higher levels of activities in Pacific cod from April–October with relatively consistent bycatch rate between 1.66–2.75 percent.

Seasonality of halibut bycatch rates followed somewhat similar patterns across the four non-trawl sectors over the 10 years from 2003–2012 with generally lower bycatch rates January–May, and generally much higher bycatch rates June–December. Harvest patterns for the two CP sectors were very similar, but bycatch for the pot CPs was almost non-existent from January–May with an average rate of less than 0.0015 percent, while bycatch rates of the LGL-CP sector was two orders of magnitude higher at 0.28 percent.

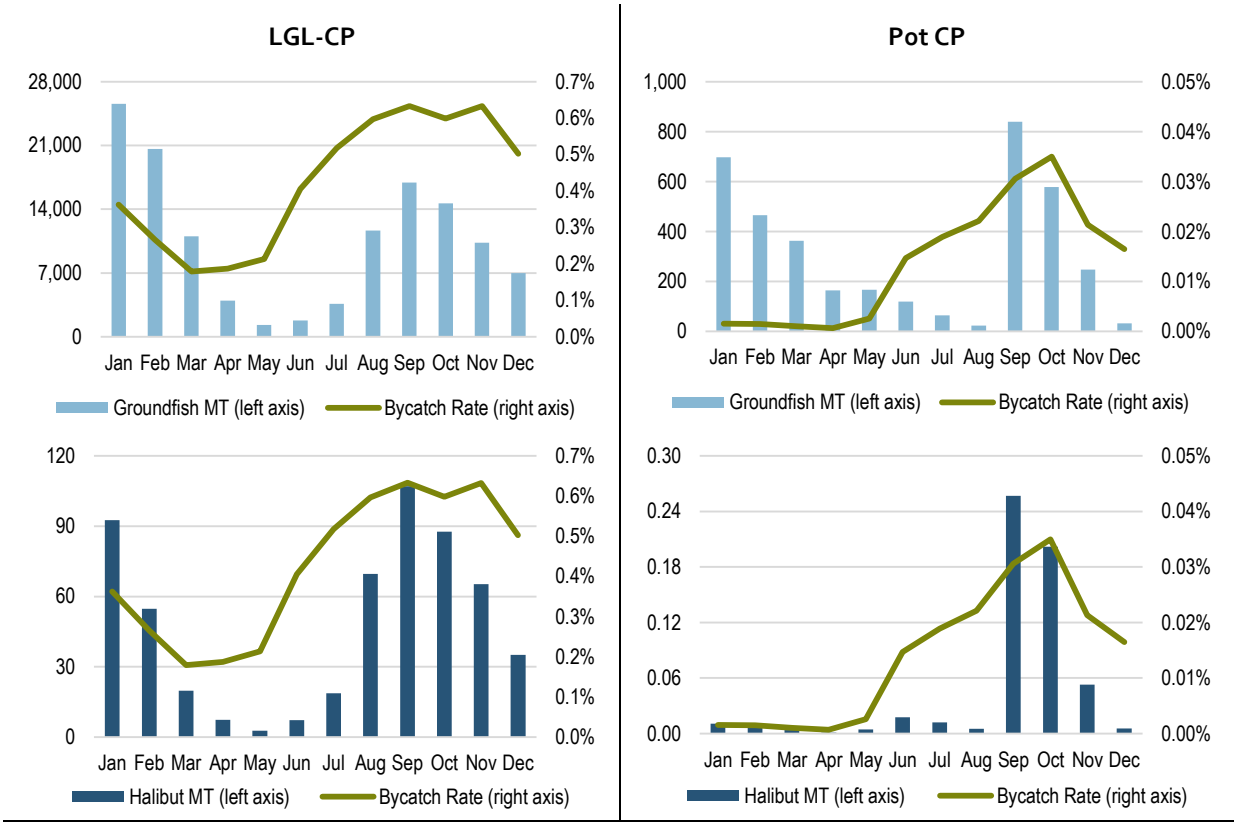
Figure 20. Average Monthly Pacific Cod Harvest & Halibut Bycatch by Trawl Sectors 2003-2012

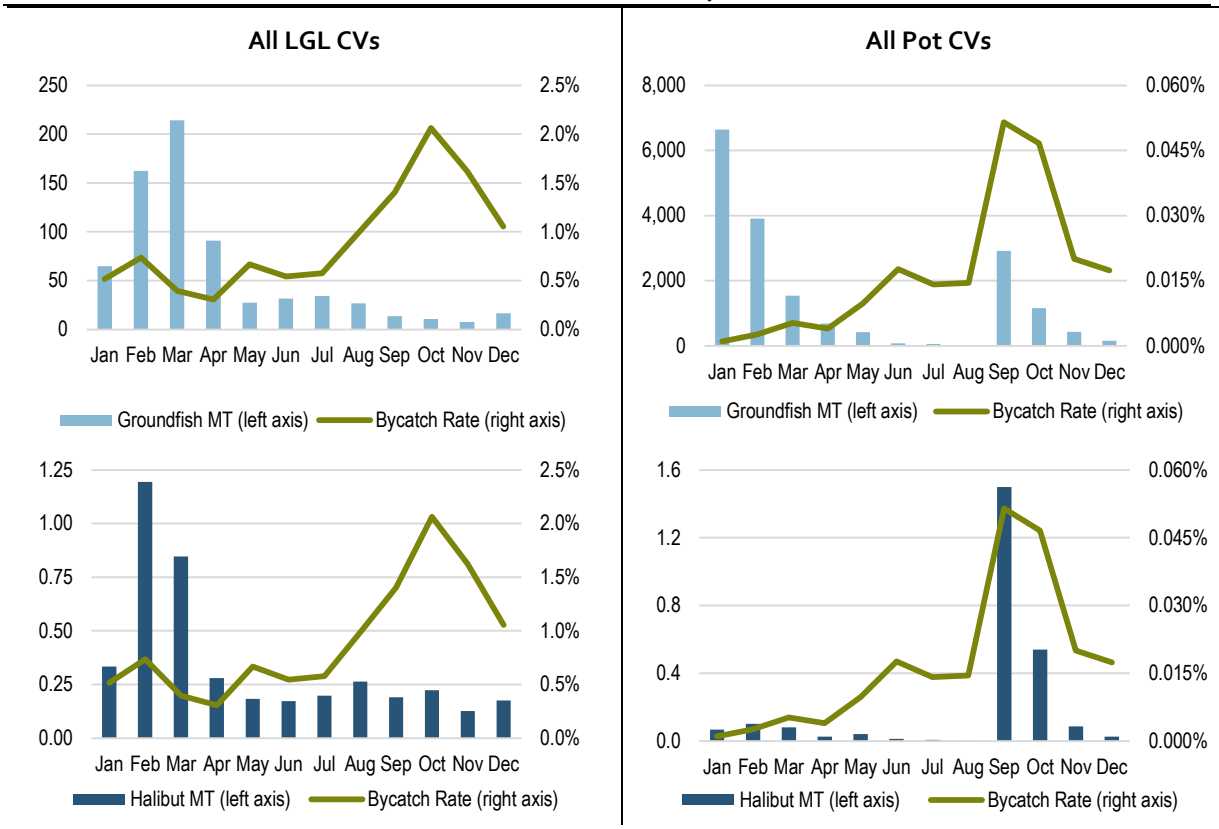




Source: All figures developed by Northern Economics based on CAS and COAR data from AKFIN Data.

Figure 21. Average Monthly Pacific Cod Harvest & Halibut Bycatch by Non-Trawl Sectors 2003-2012





Source: All figures developed by Northern Economics based on CAS and COAR data from AKFIN Data.

4.3 Yellowfin Sole

Three sectors, A80-CPs, AFA-CPs and TRW-MCVs, have had significant harvests in the yellowfin sole target fisheries from 2003–2012. The numbers of unique observed vessels with yellowfin sole targets by sector and year are shown in Table 15. Because of the very small number of observed CVs participating in the TRW-MCV sector, groundfish harvests and halibut bycatch cannot be disclosed. The number of AFA-CPs participating the yellowfin sole fishery has increased since 2008 and implementation of Amendment 80. The number of A80-CPs with target landings has remained relatively stable throughout the period, although it appears that since 2009 at least two CPs have dropped out of the fishery. It should also be re-iterated that all data in tables and figures in this section combine CDQ and non-CDQ harvests.

Table 15. Number of Unique Harvester Vessels in Yellowfin Sole Target Fisheries by Sector, 2003–2011

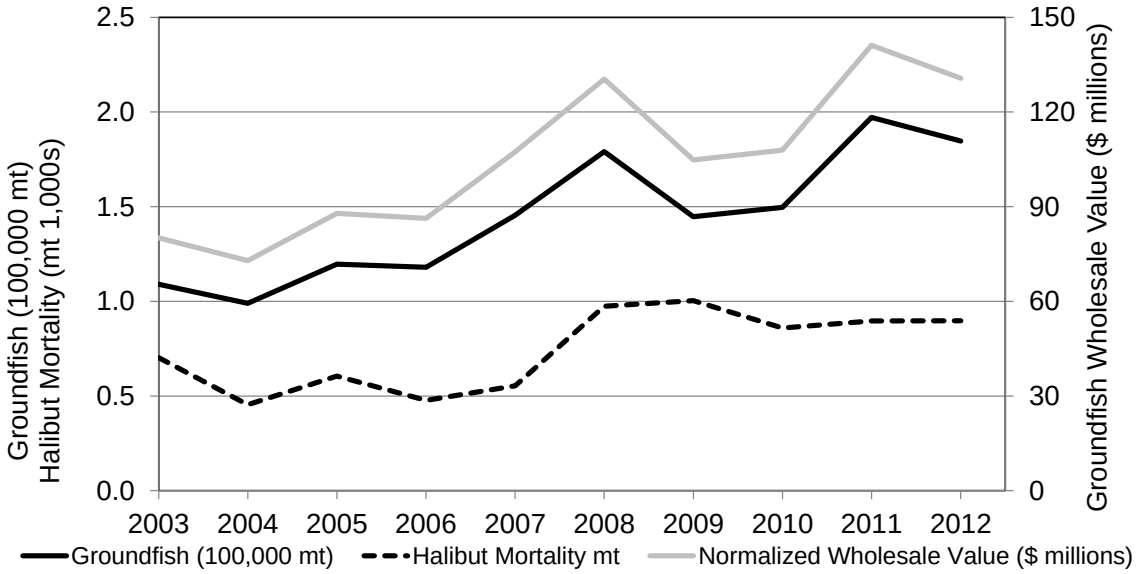
Sector	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
A80-CP	21	22	21	22	22	22	20	19	20	19
AFA-CP	3	4	5	6	8	12	8	9	9	10
AFA-CV	-	1	-	3	1	-	-	-	-	-
TRW-CV	-	-	-	1	2	3	-	-	-	-
TRW-MCV	1	1	1	1	1	1	1	-	2	3

Shaded cells indicate that catch and value data are confidential and cannot be released. Also note that unobserved catcher vessels are counted as a single vessel and thus CV counts may be an underestimate.

Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

Figure 22 provides an overview of the yellowfin sole fishery in terms of total groundfish, wholesale value (normalized), and halibut mortality. The data in the figure do not include trawl CVs. In general, landings and normalized wholesale values have been trending upward through the study period, although there were significant declines in harvest in 2004, 2009 and 2012. In 2009 and 2012, halibut mortality in the fishery actually increased, in spite of the drop in harvests.

Figure 22. Groundfish Harvest, Halibut Bycatch and Normalized Wholesale Value of Groundfish in Yellowfin Sole Target Fisheries of Included Sectors, 2003 - 2012



Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

Table 16 summarizes groundfish harvests, normalized wholesale values, and halibut bycatch in yellowfin sole fisheries for A80-CPs and AFA-CPs. In addition, Figure 23 depicts halibut bycatch rates by sector, and Figure 24 combines annual halibut mortality and normalized groundfish wholesale value per MT of halibut mortality.

- **Groundfish Caught in the Yellowfin Sole Fisheries:** As seen in Table 16, harvests of groundfish in yellowfin sole fisheries of both trawl CP sectors have generally increased over the study period. The increase for AFA-CPs has been much more significant if measured using 2003 as a base—in 2012 harvests by AFA-CPs in the yellowfin sole fishery were more than seven times the harvest in 2003. For A80-CPs, the magnitude of the increase has been greater—up over 40,000 mt. The increased harvests can be attributed at least in part to the sector allocation of yellowfin sole under Amendment 80, as well as the separate apportionments of halibut PSC.
- **Halibut Mortality (MT**): Halibut mortality in yellowfin sole fisheries by included sectors has varied significantly from year to year (see the second section of Table 16). Halibut mortality by year in yellowfin sole fisheries, in combination with normalized groundfish wholesale value per ton of halibut can be seen in Figure 24.

For A80-CPs, mortality levels declined by 250 mt in 2004, but then increased by 150 mt in 2005, before dropping back down by over 200 mt in 2006. With implementation of Amendment 80 in 2008, halibut mortality had its largest increase in the study period, with a year-over-year increase of over 70 percent. The large increase in 2008 corresponds to a large increase in groundfish harvests. Halibut mortality for A80-CPs jumped again in 2009, but has declined each year since and in 2012 was 150 mt less than the peak in 2009.

Halibut morality for AFA-CPs has had similar levels of variability, with significant increases corresponding to higher harvests in 2005 and 2006, followed by large swings since then. Halibut mortality in the AFA-CPs sector hit its highest level during the 10-year period in 2012.

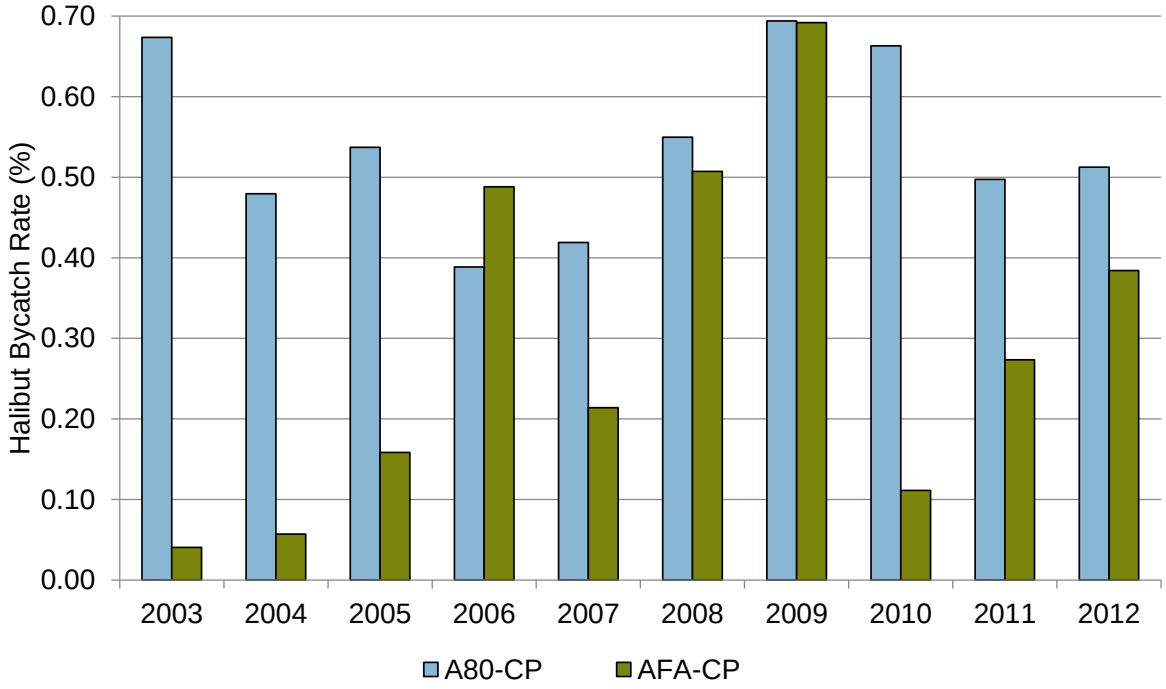
Table 16. Halibut and Target Mortality and Value in Yellowfin Sole Targeted Fisheries, 2003-2011

Sector	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Groundfish Caught in Target Fishery (MT)										
A80-CP	104,062	94,132	109,873	99,074	118,286	156,224	130,964	125,490	159,511	146,432
AFA-CP	4,989	4,842	9,788	18,946	27,212	22,883	13,694	24,099	37,579	38,271
Halibut Mortality (MT)										
A80-CP	701.0	451.4	590.2	384.9	495.8	858.6	908.8	832.3	793.2	750.6
AFA-CP	2.0	2.8	15.5	92.5	58.2	116.0	94.7	26.8	102.7	147.1
Halibut Mortality Rate (%)										
A80-CP	0.67	0.48	0.54	0.39	0.42	0.55	0.69	0.66	0.50	0.51
AFA-CP	0.04	0.06	0.16	0.49	0.21	0.51	0.69	0.11	0.27	0.38
Wholesale Value in Target Fishery ($ millions)										
A80-CP	76.8	69.5	80.9	73.7	89.2	114.1	95.6	90.4	115.7	105.0
AFA-CP	3.3	3.4	7.0	12.6	18.2	16.3	9.2	17.5	25.5	25.7
Value per Mortality-Ton ($ millions/MT)										
A80-CP	0.11	0.15	0.14	0.19	0.18	0.13	0.11	0.11	0.15	0.14
AFA-CP	1.62	1.21	0.45	0.14	0.31	0.14	0.10	0.66	0.25	0.18

Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

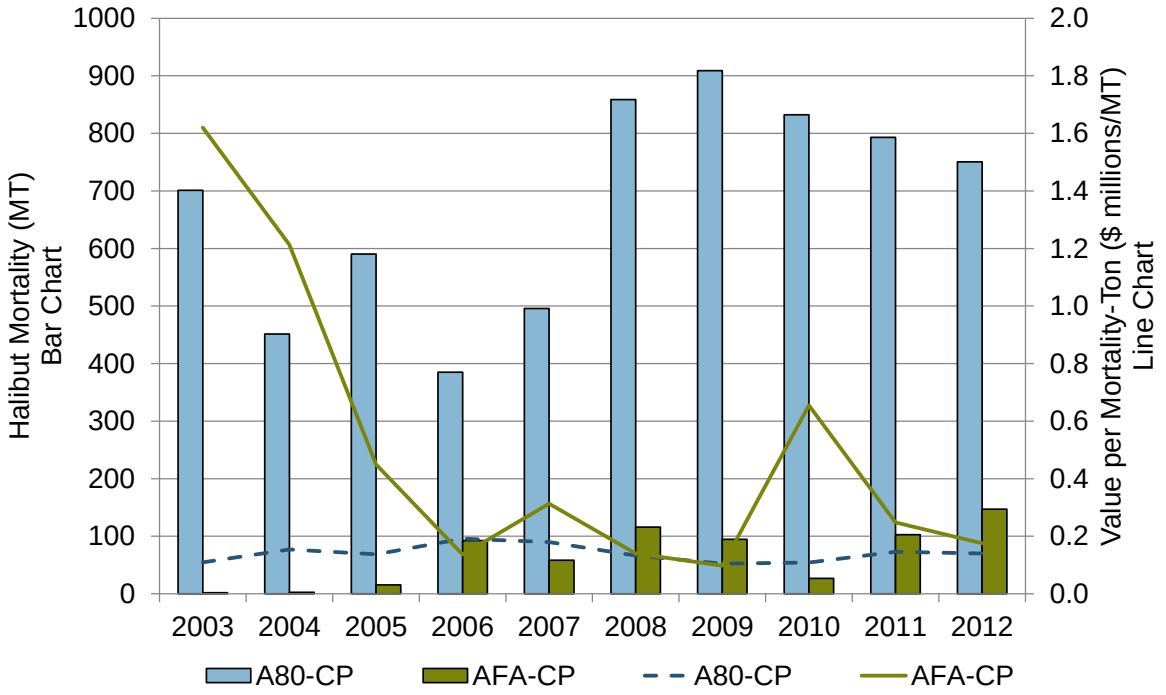
- **Halibut Bycatch Rate (%)**: The third section of Table 16 shows annual bycatch rates for the two included sectors. Figure 23 also presents halibut bycatch rates. Halibut bycatch rates for A80-CPs in the yellowfin sole fishery (measured as ton of halibut morality divided by tons of groundfish harvested) have been relatively stable during the study period, ranging from a low of 0.39 percent in 2006 to a high of 0.7 percent in 2009. Bycatch rates by AFA-CPs have had relatively greater variability, ranging from very low amounts of 0.04 percent and 0.06 percent in 2003 and 2004 to a high of 0.69 percent in 2009.
- **Wholesale Value in Yellowfin Sole Fisheries ($ millions)**: The wholesale values generated in yellowfin sole fisheries as shown in the table are normalized by using the average value of products produced per ton of groundfish in the target fishery by sector over 2003–2012. Because a normalized value per ton is used, wholesale value follows the same pattern as landings. The normalized value per ton of groundfish in the A-season for A80-CPs was $808.04/mt and $712.71/mt in the B-Season. For AFA-CPs, normalized values were $728.21/mt and $632.33/mt for the A and B seasons respectively.
- **Value per MT of Halibut Mortality ($ millions/Halibut mt**): This field shows the normalized wholesale value generated in the yellowfin sole fisheries per ton of halibut mortality. The normalized groundfish wholesale value per ton of halibut, in combination with halibut mortality, can also be seen in Figure 24. Over the study period, the weighted average wholesale value per ton of halibut for A80-CPs has been very stable at about $134,000/mt. For AFA-CPs, there have been wild variations, with normalized groundfish wholesale values ranging from $1.6 million/mt of halibut in 2003 to as low as $100,000/mt of halibut in 2009. For comparison, the normalized wholesale value of halibut in the directed halibut fisheries in the BSAI is estimated at $11,515/mt.

Figure 23. Halibut Bycatch Rates in Yellowfin Sole Targeted Fisheries by Sector, 2003-2012



Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

Figure 24. Annual Halibut Mortality and Groundfish Wholesale Value per MT Halibut in Yellowfin Sole Target Fisheries, 2003-2012

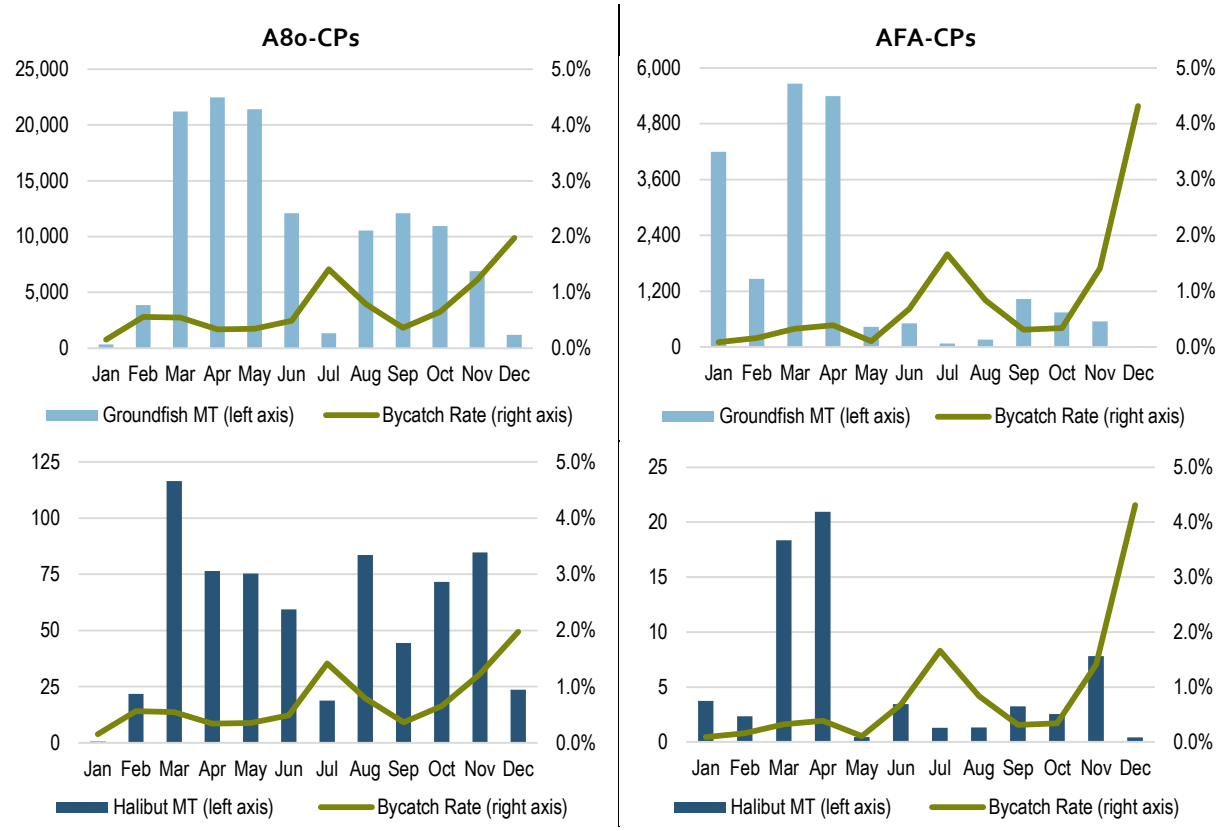


Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

4.3.1 Monthly Variation of Halibut Bycatch Rates in the Yellowfin Sole Target Fisheries

The month-to-month halibut bycatch rates for the A80-CP and AFA-CP yellowfin sole fisheries exhibited similar trends when monthly bycatch is averaged across the years 2003–2012. Bycatch rates remained less than 0.5% and 0.6% each of the first five months of the year for the AFA-CP and A80-CP fisheries, respectively, before increasing in June and spiking to around 1.5% in July. After then declining through August and September, bycatch rates for each fishery again increased through the last two months of the year. The fisheries also exhibited similarity with regard to the seasonality of yellowfin sole harvest peaks. While total catch levels were far higher in the A80 sector, both fisheries averaged large catch levels in March and April. Unlike the A80 fishery, however, the AFA fishery experienced large yellowfin sole catch volumes in January, with relatively low catch levels after April. The A80 fishery, meanwhile, witnessed large catch volumes through May and a secondary peak in catch volumes from August through October.

Figure 25. Average Monthly Yellowfin Sole Harvest & Halibut Bycatch by Sector, 2003-2012

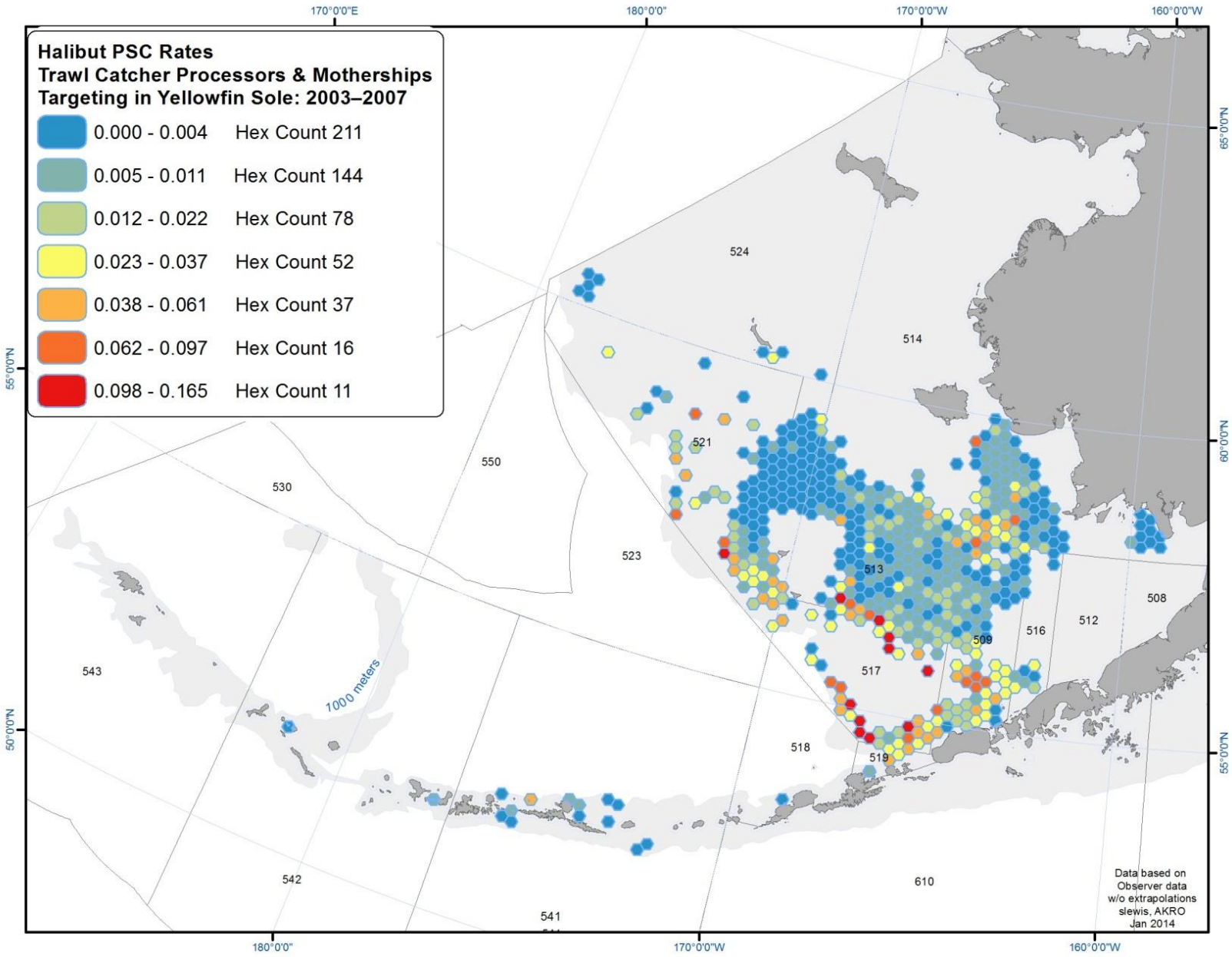


Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

4.3.2 Geographic Distribution of Halibut Bycatch in the Target Fisheries for Yellowfin Sole

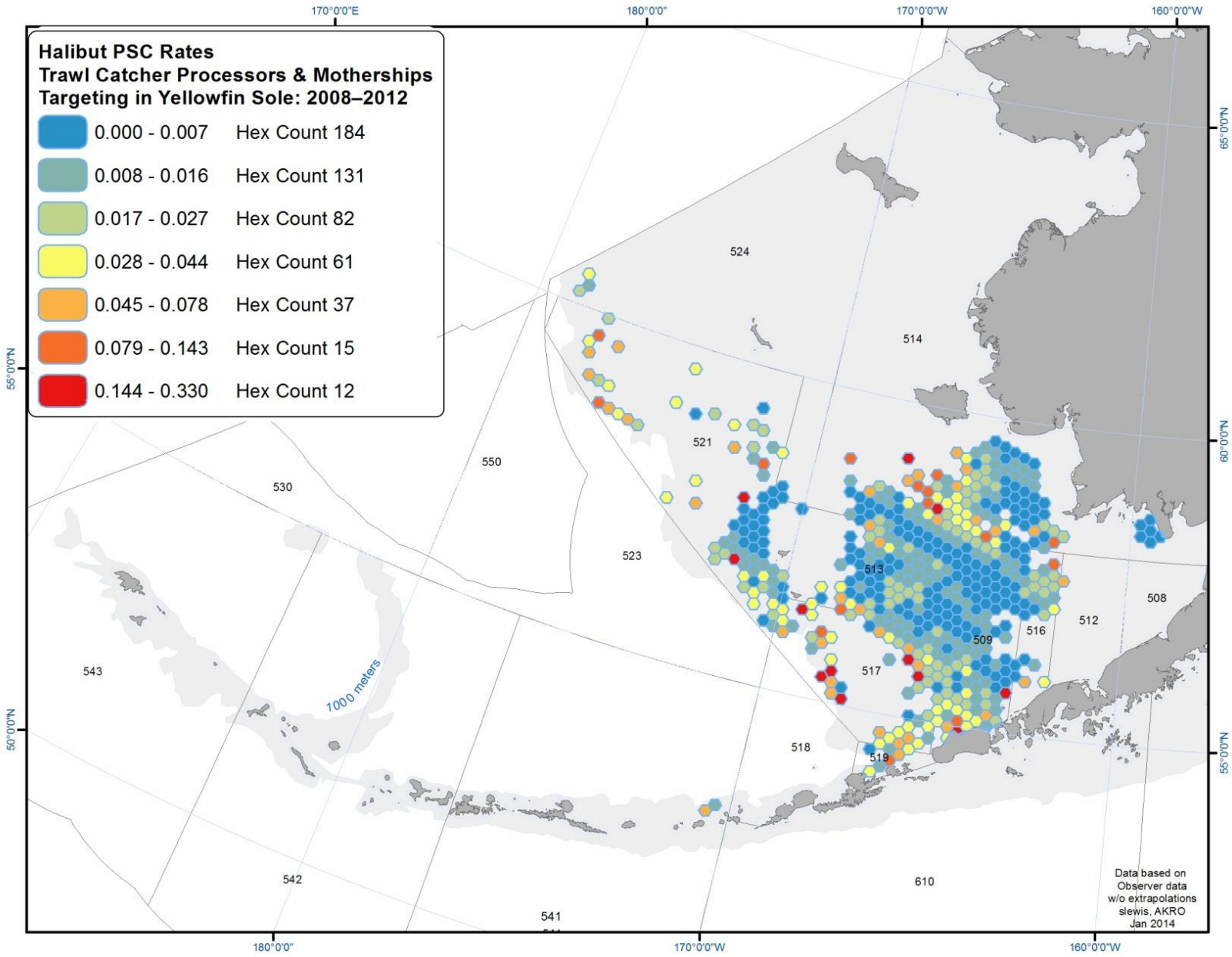
The maps on the following two pages show GIS based data of the distribution of observed halibut bycatch rates of in the trawl fishery for yellowfin sole. Unlike the previous section, the figures combine data from A80-CP, AFA-CP, and the TRW-MCV sectors. Figure 26 shows bycatch rates from 2003–2007, while Figure 27 shows rates from 2008–2012. The distributions of rates over the two periods are very similar from a geographical perspective, but although it must be noted that legend scale in the more recent period increases at about twice the rate as seen in the earlier period.

Figure 26. Halibut PSC Rates from 2003–2007 in the Yellowfin Sole Fishery of Trawl Catcher Processors and Motherships



Source: Developed on request by Steve Lewis; GIS Coordinator/Analyst, NOAA Fisheries, Alaska Region, on January 10, 2014.

Figure 27. Halibut PSC Rates from 2008–2012 in the Yellowfin Sole Fishery of Trawl Catcher Processors & Motherships



Source: Developed on request by Steve Lewis; GIS Coordinator/Analyst, NOAA Fisheries, Alaska Region, on January 10, 2014.

4.4 Halibut Bycatch in Target Fisheries of Amendment 80 CPs

This section provides a summary of groundfish harvests, wholesale value, and halibut mortality in the target fisheries of the A80-CPs. These vessels are the most diversified of all sectors in terms of the different number of target fisheries in which they have significant levels of participation. No other sector has had consistent and significant levels of participation in more than two target fisheries over the study period. Table 17 show participation in terms of unique numbers of A80-CPs by target fishery. Almost all of the A80-CPs participate in Yellowfin Sole and Rock Sole fisheries, while participation in rockfish, Atka mackerel, arrowtooth/Kamchatka fisheries and other flatfish/Alaska plaice[10] fisheries is more limited. Few vessels have participated in target fisheries for, Greenland turbot, or sablefish, and these two fisheries are excluded from the remaining tables and figures

Table 17. Counts of Unique A80-CPs Participating in Target Fisheries, 2003–2011

Fishery	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Pollock	**2**	**2**	6	3	3	17	19	15	15	16
Sablefish	-	3	**1**	-	**1**	3	**1**	-	-	-
Greenland Turbot	5	6	**2**	-	**1**	**2**	4	3	3	-
Other Flatfish & Plaice	6	11	11	6	7	5	5	4	7	8
Arrowtooth & Kamchatka	10	12	15	13	13	16	15	12	17	16
Rock Sole	21	22	22	22	21	21	21	19	18	19
Rockfish	11	10	6	8	8	11	11	14	16	15
Atka Mackerel	14	19	19	21	17	9	12	7	9	10
Flathead Sole	13	20	17	15	18	15	15	15	12	13
Pacific Cod	18	19	18	18	22	12	15	14	14	14
Yellowfin Sole	21	22	21	22	22	22	20	19	20	19
All Targets	**22**	**23**	**22**	**22**	**22**	**22**	**21**	**20**	**20**	**20**

Note: Shaded cells with bolded text indicate that landings and value data are confidential.
Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

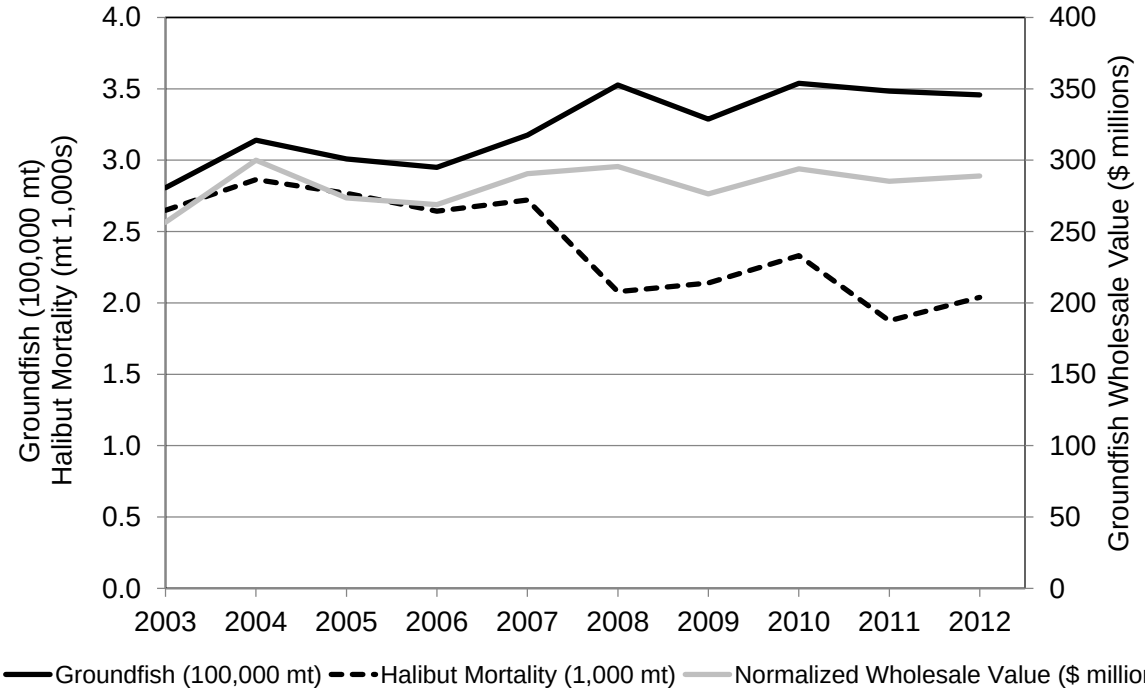
Figure 28 summarizes levels of groundfish harvests, normalized wholesale values, and halibut mortality over all BSAI target fisheries from 2003–2012.[11] Total groundfish harvests have been trending up over the study period, with a low in 2003 at around 280,000 mt increasing by 2010 to just over 350,000 mt. Normalized wholesale values of groundfish in all BSAI targets have increased from $260 to $290 million. While total harvests have increased, total halibut mortality by A80-CPs in BSAI target fisheries has declined. The highest levels were seen in 2004 (2,864 mt) and the lowest in 2011 (1,875 mt); there was a slight uptick in 2012 (2,039 mt). The big drop in halibut mortality corresponds to implementation of Amendment 80, which allowed the formation of cooperatives, and Amendment 85, which significantly reduced the apportionment of Pacific cod available to the sector.

[10] In this section, target fisheries for other flatfish and Alaska Plaice have been combined, as have target fisheries for arrowtooth and Kamchatka flounder.

[11] All harvests, values, and bycatch data in this section includes both CDQ and non-CDQ fisheries.

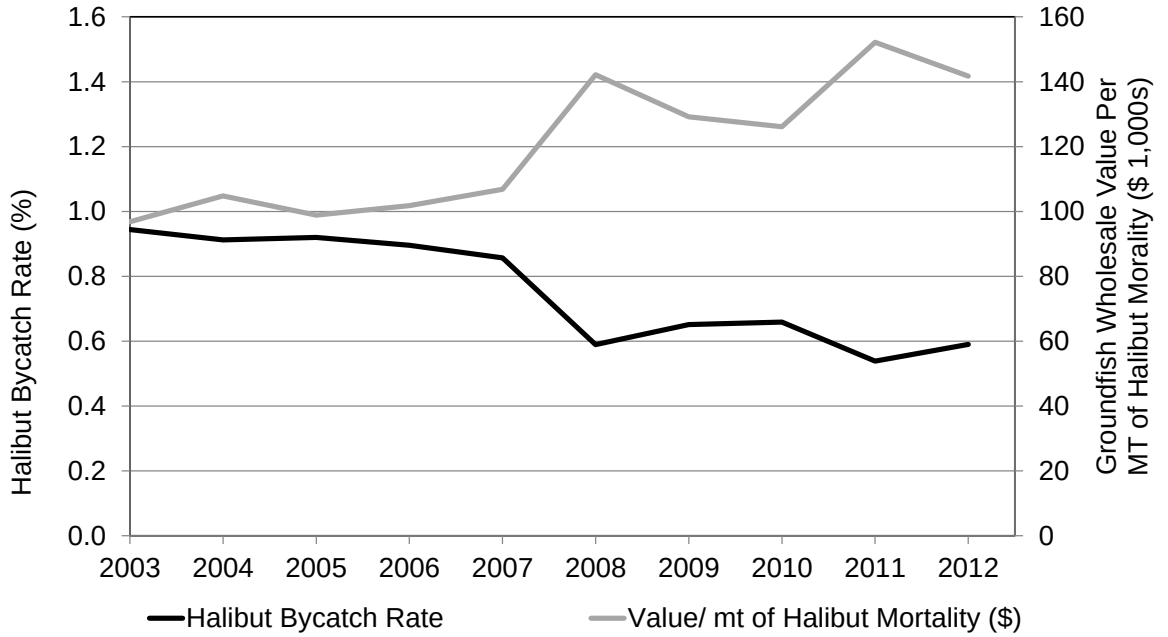
Figure 29 summarizes halibut bycatch rates (calculated as total groundfish mt ÷ total halibut mortality), and the normalized wholesale value of groundfish per mt of halibut mortality. The figure clearly shows the inverse relationship of these two measures. When bycatch rates go down, normalized groundfish value per mt of halibut mortality increases. Since 2003, halibut bycatch rates of A80-CPs in all of their target fisheries have declined from 0.94 percent to 0.59 percent—a 35 percent drop over the study period. Similarly, total groundfish value per mt of halibut mortality in all BSAI target fisheries has increased from $97,000 in 2003 to $142,000 in 2012.

Figure 28. Groundfish Harvest, Halibut Bycatch and Normalized Wholesale Value of Groundfish in All A80-CP Target Fisheries, 2003 - 2012



Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

Figure 29. Halibut Bycatch Rates and Groundfish Value per MT of Halibut Mortality for A80-CPs across All Target Fisheries, 2003–2012



Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

The summary information provided in Figure 28 and Figure 29 is re-configured for each of the reported target fisheries in a single figure with two side-by-side charts. The data going into each of the figures can be found in Table 18 on page 64. Discussions of the trends in each of the target fisheries are provided below with the fishery-specific figures and the full table following.

- **Yellowfin Sole** (see Figure 30): Groundfish landings in the yellowfin sole fishery for A80-CPs have trended up over the study period, with similar increases in normalized groundfish wholesale value. Levels of halibut mortality have generally tracked with changes in harvest—exceptions were seen in 2009 when halibut mortality increased while harvests decreased, and in 2011 when harvests increased and halibut mortality decreased. Bycatch rates in the yellowfin sole fishery have been relatively flat compared to changes in bycatch seen in other flatfish targets, ranging from 0.4 percent to 0.7 percent. Normalized wholesale values per mt of halibut mortality have ranged from $104,000/mt to $191,000/mt.
- **Rock Sole** (see Figure 31): Harvests of and normalized wholesale value of groundfish in A80-CP rock sole target fisheries bounced up and down between 2003–2007, with harvests ranging between at 37,000 mt and 49,000 mt and normalized wholesale values ranging between $37 million and $50 million. Both harvests and normalized wholesale values have increased significantly in the last 5 years, with harvests ranging between 49,000 mt and 84,000 mt. Interestingly, halibut mortality in the rock sole fishery moved in the opposite direction of harvest in four of the five years prior to 2008—halibut mortality went up when harvests in rock sole targets went down. Since 2008, the inverse relationship between catch and halibut morality was not seen except in 2012 when harvest jumped and bycatch fell. Bycatch rates in the rock sole fishery have had considerable variation—from over 2.5 percent in 2003 to 0.5 percent in 2012 (the lowest level in the 10-year period. During those same

years, normalized wholesale values per mt of halibut mortality have ranged from $39,000/mt in 2003 to $220,000/mt in 2012.

- **Atka Mackerel** (see Figure 32): Harvests, normalized wholesale value and halibut mortality in the A80-CP target fishery for Atka mackerel have all been relatively stable through most of the study period before harvests and value dropped in 2011 and again in 2012. With the exception of a spike in 2007 and an upward trend in the last two years, halibut mortality in the Atka Mackerel fishery has been relatively flat ranging between 55 mt and 92 mt. In 2007, halibut mortality jumped to 198 mt and in 2012 it increased to 144 mt. With the exception of the spike in 2007, bycatch rates in the Atka mackerel fishery have been relatively flat (approximately 0.1 percent) until 2011 and 2012 when the rate increased to 0.2 percent and 0.3 percent respectively. Normalized wholesale values per mt of halibut mortality have been greater than $600,000/mt every year except when bycatch spiked in 2007 and in the last two years.
- **Flathead Sole** (see Figure 33): Between 2003 and 2010, levels of groundfish harvest in the flathead sole fishery have bounced up and down between 18,883 mt (2003) to 27,993 mt (2008). After an increase in 2010, harvests in the flathead sole target fishery dropped significantly in 2011 and then reached their lowest level in the study period in 2012—6,134 mt. Industry sources indicate that operators may be deciding that participation in the flathead sole fishery is too costly with respect to Pacific cod and halibut—the primary constraining species. Between 2003 and 2010, halibut mortality ranged from 175 mt and 311 mt. In 2012, halibut mortality was 85.3 mt. Bycatch rates in the flathead sole fishery have varied widely from 2003–2008, but were relatively stable from 2008–2011, before jumping up again in 2012 to 1.4 percent. Prior to 2008, normalized wholesale values per mt of halibut mortality in the flathead sole fishery ranged between $60,000/mt and $100,000/mt. From 2008–2011, values per mt of halibut were greater than $100,000/mt until decreasing to $70,000/mt in 2012.
- **Rockfish** (see Figure 34): The rockfish target fishery includes the target fisheries for Pacific Ocean Perch (POP) as well as all other rockfish target fisheries.[12] Groundfish harvested in rockfish target fisheries declined from 2003–2005, increased from 2006–2008, and dropped in 2009. From 2010 to 2011, the harvest jumped by 9,000 mt to its highest level in the 10-year period at 22,804 before dipping back down in 2012 to 21,262mt. At approximately $1,000/mt, the normalized wholesale value of groundfish in rockfish target fisheries tracks closely with harvests. Halibut mortality generally tracked with groundfish harvests, although in 2007 halibut mortality dropped while groundfish harvests had a sizeable increase. Bycatch rates in the rockfish fisheries have bounced up and down ranging from 0.5 percent in 2004 to 0.1 percent in 2007. The bycatch rate has been approximately 0.4 percent for the past 3 years. Normalized wholesale values per mt of halibut mortality have also varied widely—from $200,000/mt in 2004 to nearly $860,000/mt in 2007, but appear to have stabilized between $233,000/mt in 2010 and $280,000/mt in 2012.
- **Pacific Cod** (see Figure 35): As indicated in earlier discussions of Pacific cod, A80-CP participation in the Pacific cod target fishery fell dramatically following the re-apportionment

[12] Other than POP, most rockfish species are closed to directed fishing by NFMS-AKR, because of low TAC levels—most of the activity in rockfish target fisheries as used here is actually in target fisheries for POP.

in 2008 under Amendment 85. From 2008–2012, groundfish harvests in the fishery have ranged between 3,501 mt and 6,731 mt, while normalized wholesale values of groundfish have ranged from $4.5 million to $9.3 million. Halibut mortality levels have generally tracked levels of harvest. Bycatch rates in the Pacific cod target fishery fell significantly with declines in harvest in 2008 to levels less than 1 percent. Normalized wholesale values per mt of halibut mortality increased as a result to over $250,000/mt. In 2012, the bycatch rate increased back up to 1.0 percent and consequently, the normalized wholesale value per mt of halibut decreased to $130,000/mt.

- **Pollock** (see Figure 36): As indicated in the discussion of the pollock target fisheries earlier, A80-CP participation in pollock target fisheries has increased significantly since 2008. In 2007 groundfish harvests in the pollock target fishery were 411 mt; by 2010, harvests increased an order of magnitude to 5,715 mt. In 2011 and 2012, harvests declined sharply back down to only 1,841 mt in 2012. Halibut mortality has tracked closely with groundfish harvests increasing from 0.4 mt in 2007 to 41.5 mt in 2008 and 58.8 mt in 2010. Halibut bycatch rates in the A80 target fisheries for pollock jumped sharply from 2005 to a peak in 2007 at 2.0 percent, but since 2009 have ranged between 0.9 percent and 1.5 percent. It should be noted that these rates are much higher than rates seen in mid-water fisheries for pollock. Normalized wholesale values per mt of halibut mortality since 2008 have ranged from $38,000/mt to $60,000/mt.
- **Arrowtooth and Kamchatka Flounder**[13] (see Figure 37): Prior to 2008, A80-CP participation in the arrowtooth flounder target fishery was constrained by TACs and apportionments of halibut PSC. Groundfish harvests in the arrowtooth flounder target fishery ranged between 1,841 mt (2007) and 5,693 mt (2005). In those early years, halibut bycatch rates were relatively high, peaking in 2005 at 3.5 percent. In 2008, under Amendment 80, groundfish harvests by A80-CPs in the arrowtooth flounder target fishery jumped to 16,077 mt and by 2010 had climbed to 31,426 mt and stayed near that level through 2012. In 2010, halibut mortality was 190.4 mt—10 mt less than halibut mortality in 2005. In 2011 and 2012, bycatch rates and halibut mortality noticeably increased. Coinciding with recent increases in halibut bycatch, the normalized wholesale value per mt of halibut mortality has fallen to $43,700, the lowest levels since 2006.

Figure 30. Summary Charts for the A80-CP Target Fishery for Yellowfin Sole, 2003–2012

Groundfish Harvest, Halibut Bycatch, and Value

Halibut Bycatch Rates and Value/Halibut MT

[13] Kamchatka flounder became a recognized target fishery in 2011, and is grouped with the arrowtooth flounder target fishery in this analysis.

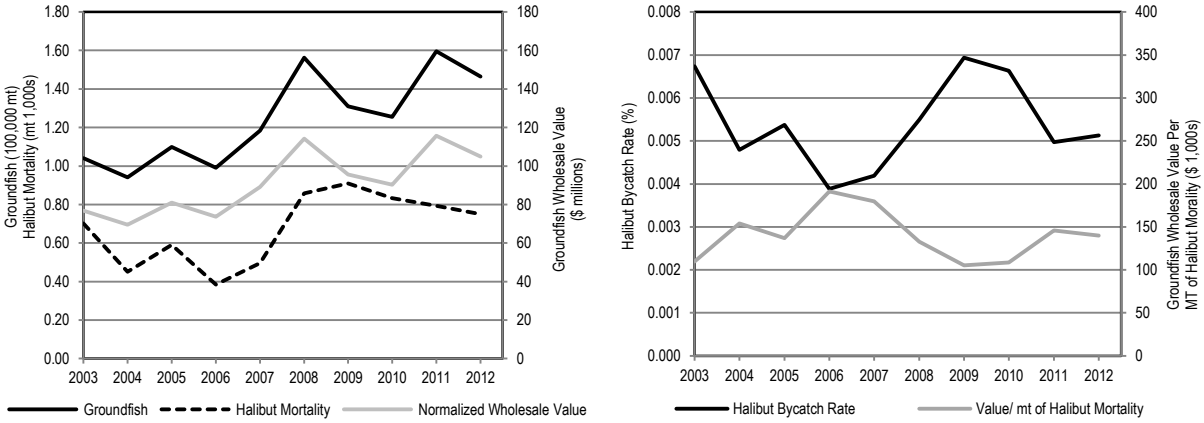


Figure 31. Summary Charts for the A80-CP Target Fishery for Rock Sole, 2003–2012

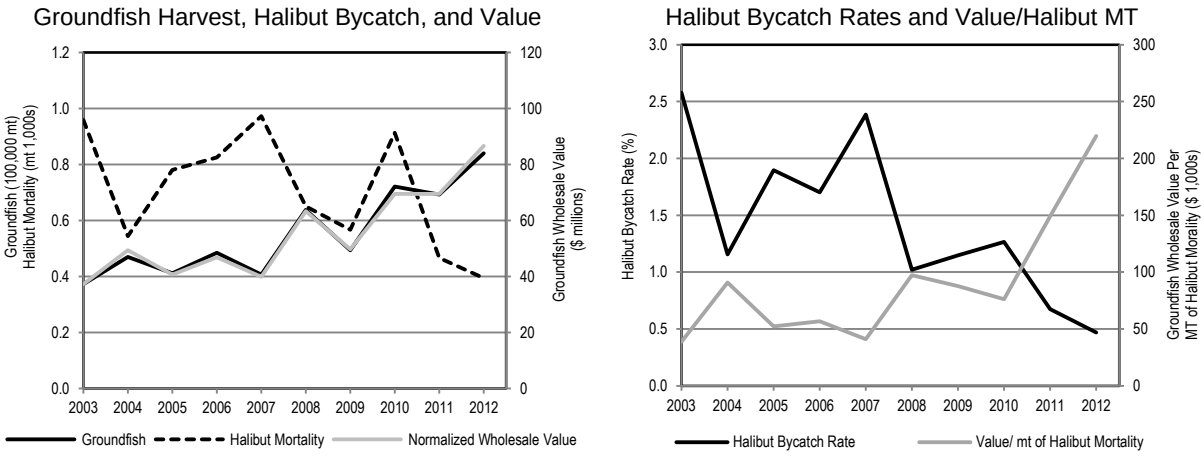
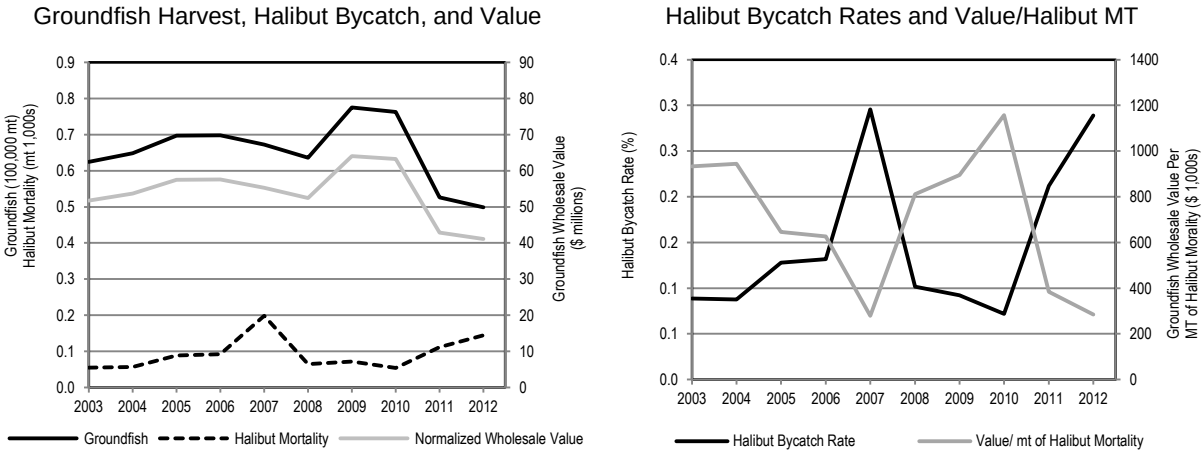


Figure 32. Summary Charts for the A80-CP Target Fishery for Atka Mackerel, 2003–2012



Source: All figures on this page were developed by Northern Economics based on CAS and COAR data from AKFIN.

Figure 33. Summary Charts for the A80-CP Target Fishery for Flathead Sole, 2003–2012

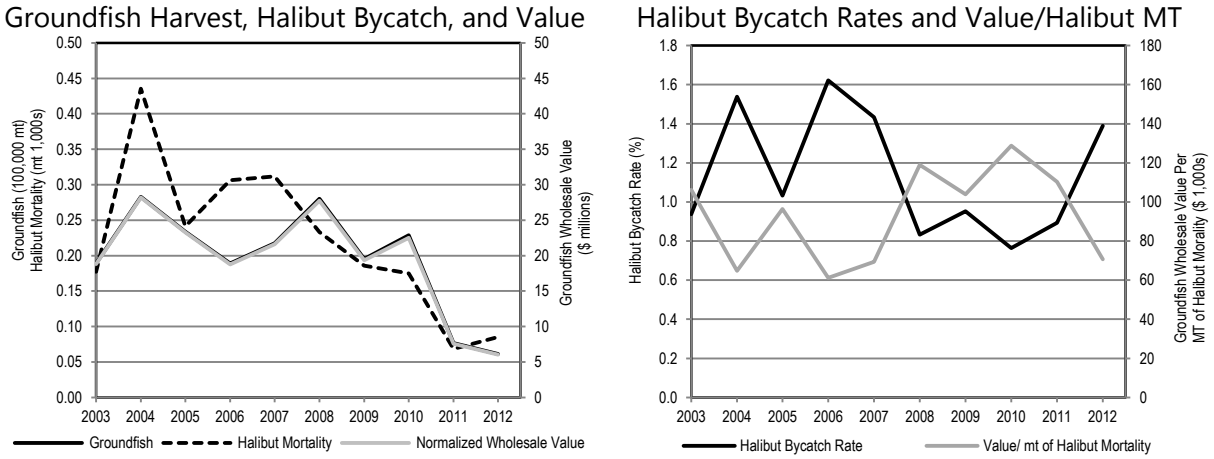


Figure 34. Summary Charts for the A80-CP Target Fishery for Rockfish, 2003–2012

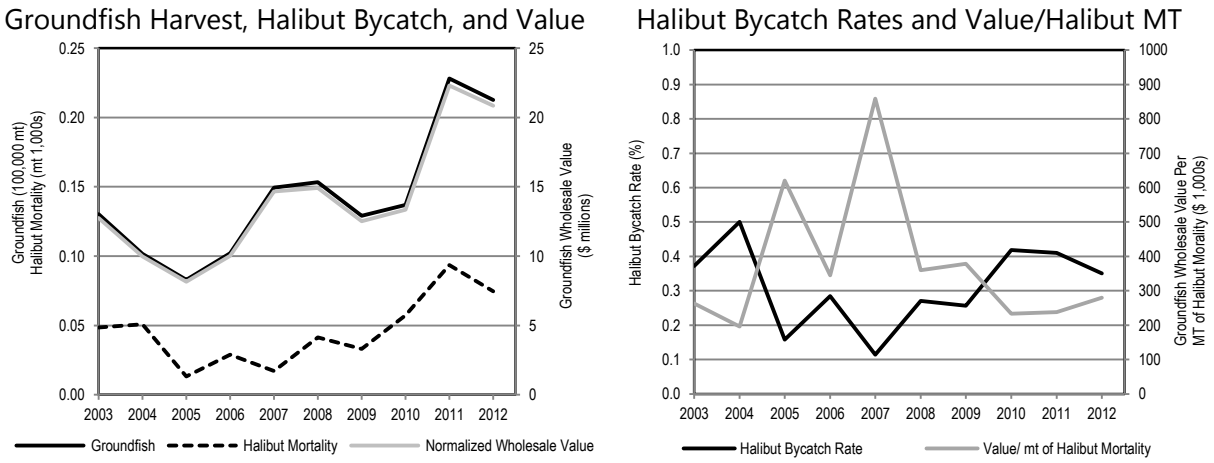
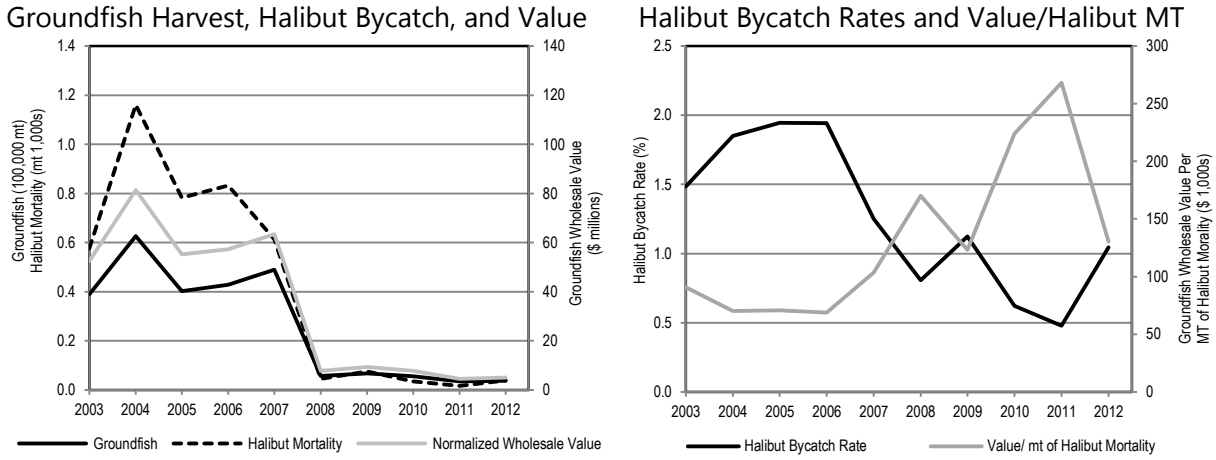


Figure 35. Summary Charts for the A80-CP Target Fisheries for Pacific cod, 2003–2012



Source: All figures on this page were developed by Northern Economics based on CAS and COAR data from AKFIN.

Figure 36. Summary Charts for the A80-CP Target Fisheries for Pollock, 2003–2012

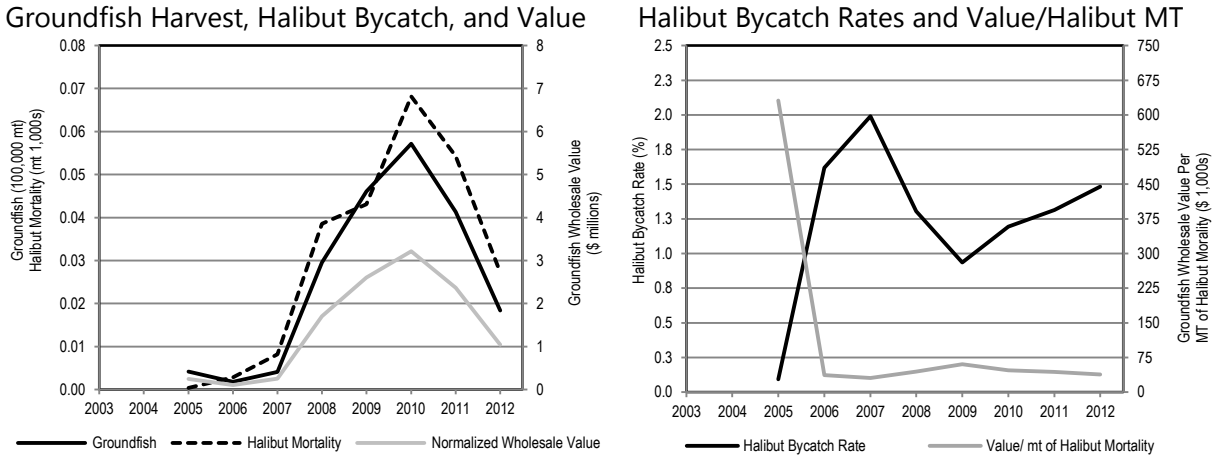
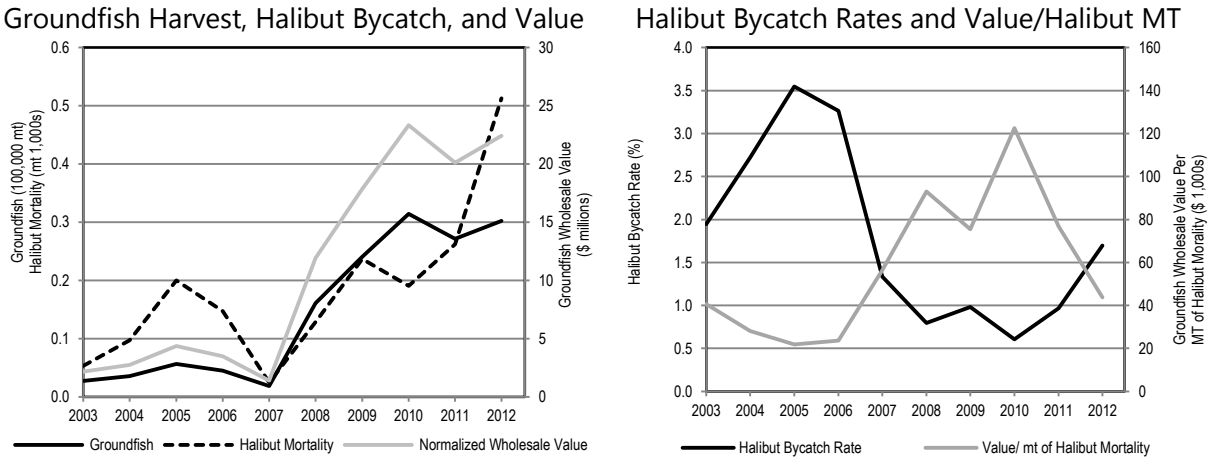


Figure 37. Summary Charts for the A80-CP Target Fishery for Arrowtooth/Kamchatka Flounder, 2003–2012



Source: All figures on this page were developed by Northern Economics based on CAS and COAR data from AKFIN.

Table 18. Halibut and Target Mortality and Value in the A80 Fishery, 2003-2012

Target	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
					Groundfish Caught in Target Fishery (MT)					
Arrowtooth & Kamchatka	2,732	3,566	5,639	4,505	1,841	16,077	24,070	31,426	27,117	30,200
Pollock	ND	ND	419	175	411	2,956	4,604	5,715	4,128	1,841
All Rockfish	13,013	10,167	8,298	10,207	14,950	15,340	12,897	13,686	22,804	21,262
Atka Mackerel	62,438	64,872	69,673	69,814	67,186	63,595	77,505	76,213	52,634	49,895
Rock Sole	37,240	47,023	41,191	48,511	40,751	63,842	49,396	72,128	69,284	84,025
Flathead Sole	18,883	28,269	23,384	18,885	21,732	27,999	19,510	22,890	7,684	6,134
Pacific Cod	38,903	62,674	40,229	42,859	49,005	5,705	6,731	5,591	3,501	3,725
Yellowfin Sole	104,062	94,132	109,873	99,074	118,286	156,224	130,964	125,490	159,511	146,432
All Target Fisheries	**280,599**	**313,932**	**300,792**	**295,023**	**317,540**	**352,698**	**328,766**	**353,929**	**348,393**	**345,748**
					Halibut Mortality (MT)					
Arrowtooth & Kamchatka	53.2	97.0	200.1	147.0	24.6	128.2	236.6	190.4	261.9	512.8
Pollock	ND	ND	0.4	2.8	8.2	38.6	43.1	68.2	54.3	27.3
All Rockfish	48.4	50.9	13.1	29.0	17.1	41.4	33.1	57.3	93.6	74.6
Atka Mackerel	55.4	56.9	89.0	92.0	198.7	64.7	71.5	54.7	111.4	144.1
Rock Sole	959.3	544.2	780.7	826.1	972.6	651.1	567.3	913.3	466.5	394.6
Flathead Sole	177.1	435.1	241.3	306.5	311.5	233.1	185.9	174.9	68.6	85.3
Pacific Cod	577.2	1160.1	782.3	832.8	613.0	46.0	75.6	34.8	16.8	38.9
Yellowfin Sole	701.0	451.4	590.2	384.9	495.8	858.6	908.8	832.3	793.2	750.6
All Target Fisheries	**2,649**	**2,864**	**2,768**	**2,642**	**2,721**	**2,079**	**2,140**	**2,331**	**1,875**	**2,039**
					Halibut Bycatch Rate (%)					
Arrowtooth & Kamchatka	1.9	2.7	3.5	3.3	1.3	0.8	1.0	0.6	1.0	1.7
Pollock	ND	ND	0.1	1.6	2.0	1.3	0.9	1.2	1.3	1.5
All Rockfish	0.4	0.5	0.2	0.3	0.1	0.3	0.3	0.4	0.4	0.4
Atka Mackerel	0.1	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.2	0.3
Rock Sole	2.6	1.2	1.9	1.7	2.4	1.0	1.1	1.3	0.7	0.5
Flathead Sole	0.9	1.5	1.0	1.6	1.4	0.8	1.0	0.8	0.9	1.4
Pacific Cod	1.5	1.9	1.9	1.9	1.3	0.8	1.1	0.6	0.5	1.0
Yellowfin Sole	0.7	0.5	0.5	0.4	0.4	0.5	0.7	0.7	0.5	0.5
All Target Fisheries	**0.7**	**0.5**	**0.5**	**0.4**	**0.4**	**0.5**	**0.7**	**0.7**	**0.5**	**0.5**
					Wholesale Value in Target Fishery ($ millions)					
Arrowtooth & Kamchatka	2.2	2.7	4.4	3.5	1.4	11.9	17.8	23.3	20.1	22.4
Pollock	ND	ND	0.2	0.1	0.3	1.7	2.6	3.2	2.4	1.0
All Rockfish	12.8	10.0	8.1	10.0	14.7	14.9	12.5	13.3	22.3	20.8
Atka Mackerel	51.7	53.7	57.5	57.6	55.3	52.5	64.1	63.2	42.8	41.1
Rock Sole	37.3	49.4	40.7	46.9	39.9	63.4	49.8	69.5	69.5	86.7
Flathead Sole	18.8	28.2	23.3	18.8	21.6	27.8	19.3	22.5	7.6	6.0
Pacific Cod	52.4	81.4	55.2	57.3	63.5	7.8	9.3	7.8	4.5	5.1
Yellowfin Sole	76.8	69.5	80.9	73.7	89.2	114.1	95.6	90.4	115.7	105.0
All Target Fisheries	**256.5**	**300.0**	**273.6**	**268.9**	**290.6**	**295.6**	**276.3**	**294.0**	**285.3**	**288.9**
					Value per Mortality-Ton ($ thousands/MT))					
Arrowtooth & Kamchatka	40.66	28.19	21.83	23.62	56.34	93.00	75.42	122.54	76.80	43.70
Pollock	ND	ND	630.95	36.75	30.65	44.13	60.43	47.21	43.67	38.26
All Rockfish	263.38	196.06	620.27	345.32	858.43	359.95	378.36	233.01	238.26	279.53
Atka Mackerel	933.58	944.05	645.55	625.88	278.37	810.90	895.66	1,156.45	384.36	285.19
Rock Sole	38.89	90.80	52.18	56.76	40.99	97.31	87.77	76.07	148.96	219.73
Flathead Sole	106.16	64.83	96.40	61.25	69.40	119.05	103.96	128.80	110.30	70.76
Pacific Cod	90.84	70.18	70.60	68.83	103.54	170.05	123.16	224.05	268.27	130.43
Yellowfin Sole	109.62	154.03	137.10	191.42	179.84	132.94	105.20	108.56	145.86	139.85
All Target Fisheries	**96.83**	**104.75**	**98.85**	**101.78**	**106.82**	**142.17**	**129.15**	**126.13**	**152.17**	**141.71**

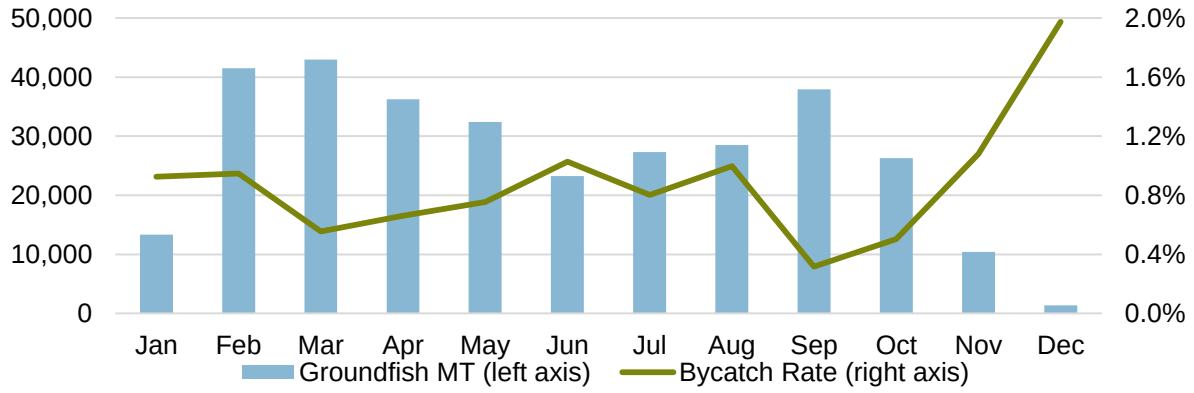
Note: Cell showing ND cannot be disclosed because of confidentiality.
Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

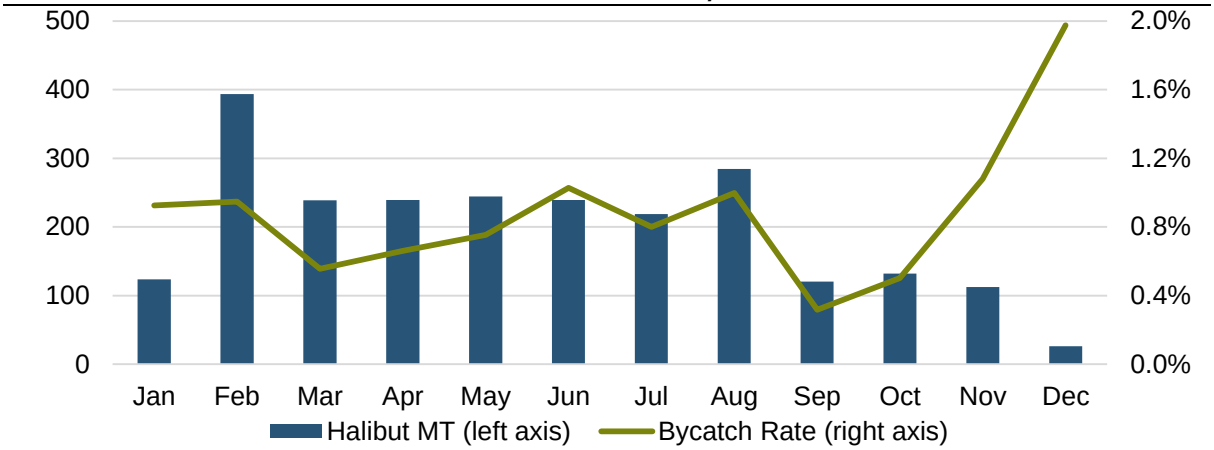
4.4.1 Monthly Variation of Halibut Bycatch Rates in the A80-CP Target Fisheries

Figure 38 is a two-chart figure showing monthly variations of groundfish harvests, halibut mortality, and bycatch rates over all of the A80 target fisheries from 2003–2012. In the figure, the upper chart shows average groundfish landings by month with an overlay of the average bycatch rate. The lower chart in the figure shows average halibut mortality by month and also contains that same overlay of average monthly halibut bycatch rates. The aggregate data shown in Figure 38 are useful as an overview of the halibut bycatch of the A80-CP sector, but tend to mask the dynamics of the multispecies fisheries in which the sector is engaged. Figure 39 through Figure 42, which show similar charts for each of the major target fisheries of the A80-CP sector (including previously presented charts for pollock, Pacific cod, and yellowfin sole), provide additional details on the monthly averages.

Over the 10-year period from 2003–2012 average groundfish harvests were highest in February and March. Halibut mortality was also substantially higher in February than in any other month. Halibut mortality drops off considerably in March and then stays relatively stable through July. Because groundfish harvests tend to drop off from April–June, bycatch rates climb steadily. Groundfish harvests begin to increase again in July and reach a high-point in September, a month in which halibut mortality has been quite low. Groundfish harvest drop off in October and November and are generally very low in December. Halibut mortality declines less on a percentage basis than groundfish harvests from October through December, which causes bycatch rates to increase to their highest level during the year.

Figure 38. Aggregate A80-CP Monthly Groundfish Harvest, Halibut Mortality and Bycatch Rates, 2003-2012





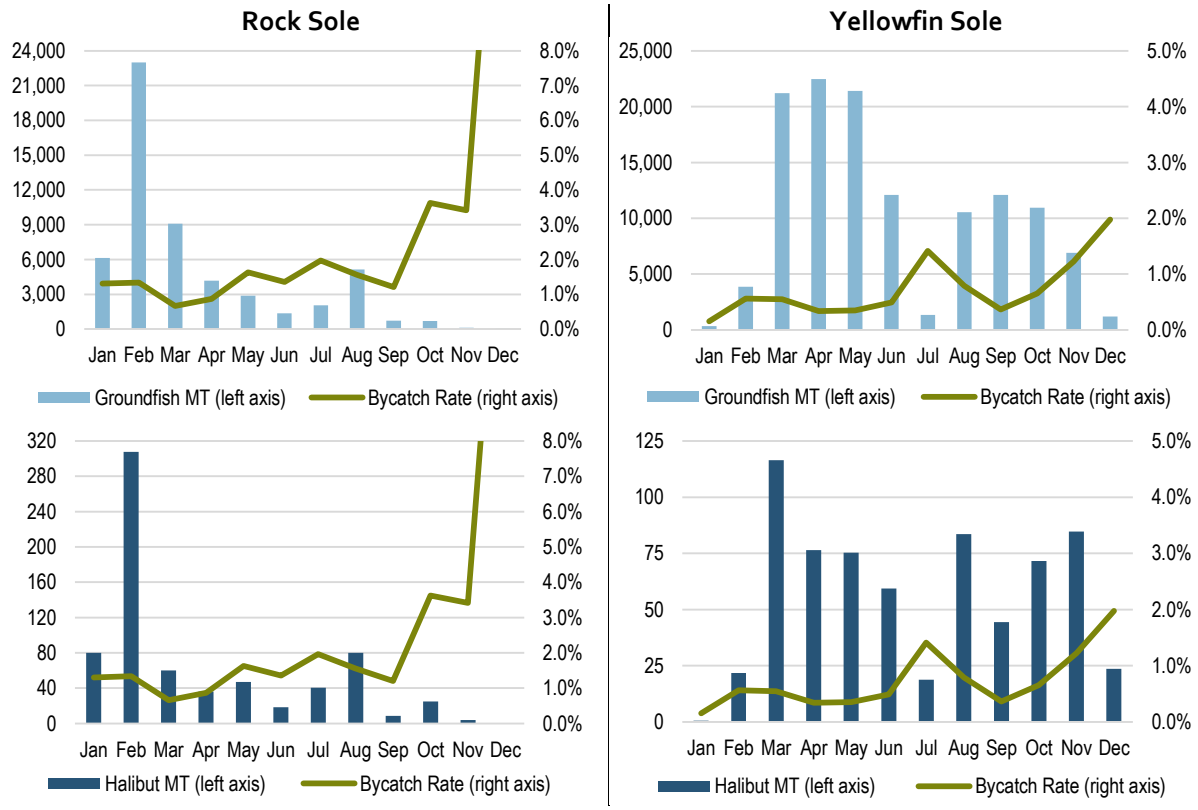
Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

Figure 39 shows groundfish harvest, halibut mortality, and halibut bycatch rates for A80-CP target fisheries for yellowfin sole and rock sole by month over the 10-year period 2003–2012. As in other figures showing monthly variations of bycatch, there are two stacked charts for each target fishery—the upper chart combines groundfish harvest (mt) with halibut bycatch rate, while the lower chart combines halibut mortality (mt) with the halibut bycatch rate. Yellowfin sole and rock sole are paired because they are the two largest target fisheries for the A80-CP sector. Harvests of rock sole are highest in February but the fishery begins with the season opening in late January and continues through March. The fishery early in the year focuses on roe bearing females. Targeted rock sole harvests are much lower the rest of the year. The yellowfin sole fishery generally follows on the heels of the rock sole fishery with the largest harvests from March through early June. Activity in the yellowfin sole fishery is typically very low in July but jumps again in August and continues through November or early December.

Halibut mortality in the rock sole fishery has the same general pattern as the harvests, and therefore bycatch rates are fairly stable through September with a low in March of approximately 0.6 percent and a high in July of about 2.0 percent. Bycatch rates in the rock sole target fishery have been much higher in the fall, but there is also very little effort during those months.

Halibut mortality in the yellowfin sole fishery generally tracks closely with groundfish harvests throughout the year, and thus bycatch has relatively little variation. There has been a spike in bycatch rates in July but there is also a relatively low level of activity that month. Bycatch rates in the yellowfin sole fishery have been highest in November and December.

Figure 39. Monthly Harvest and Bycatch in A80-CP Rock Sole and Yellowfin Sole Fisheries, 2003–2012



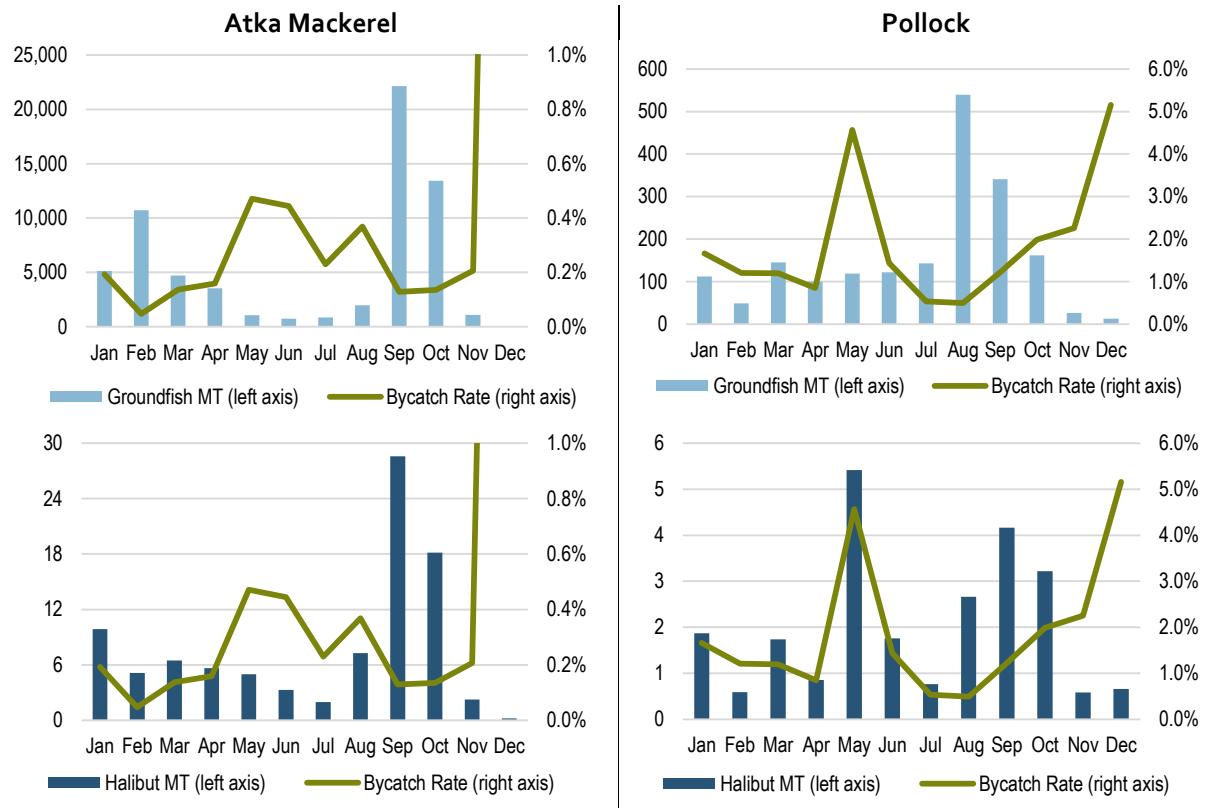
Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

Figure 40 shows groundfish harvest, halibut mortality and halibut bycatch rates for A80-CP target fisheries for Atka mackerel and pollock by month over the 10-year period 2003–2012. Atka mackerel and pollock are paired because prior to 2008 and implementation Amendment 80, halibut bycatch in these two target fisheries (when using bottom gear) was monitored as a group. For the A80-CP sector, Atka Mackerel is a much more important fishery overall than the pollock fishery.

Groundfish harvests in the Atka mackerel target fishery have been highest in September and October, but there has also been some activity from January through April. Halibut bycatch rates have been highest from May through August, but there is generally very little target activity during those months. The bycatch rate in December is off the chart at 6.0 percent, but less than 4 mt of groundfish were harvested in Atka mackerel target fisheries during December in the 10-year period.

Targeted fishing for pollock by A80-CPs is highest during August, which is also the month with the lowest average bycatch rates (~ 0.5 percent). Halibut mortality is highest in May when the bycatch rate is 4.6 percent. Higher bycatch rates are seen in December, but very little target fishing for pollock occurs during that month.

Figure 40. Monthly Harvest and Bycatch in A80-CP Atka Mackerel and Pollock Fisheries, 2003–2012

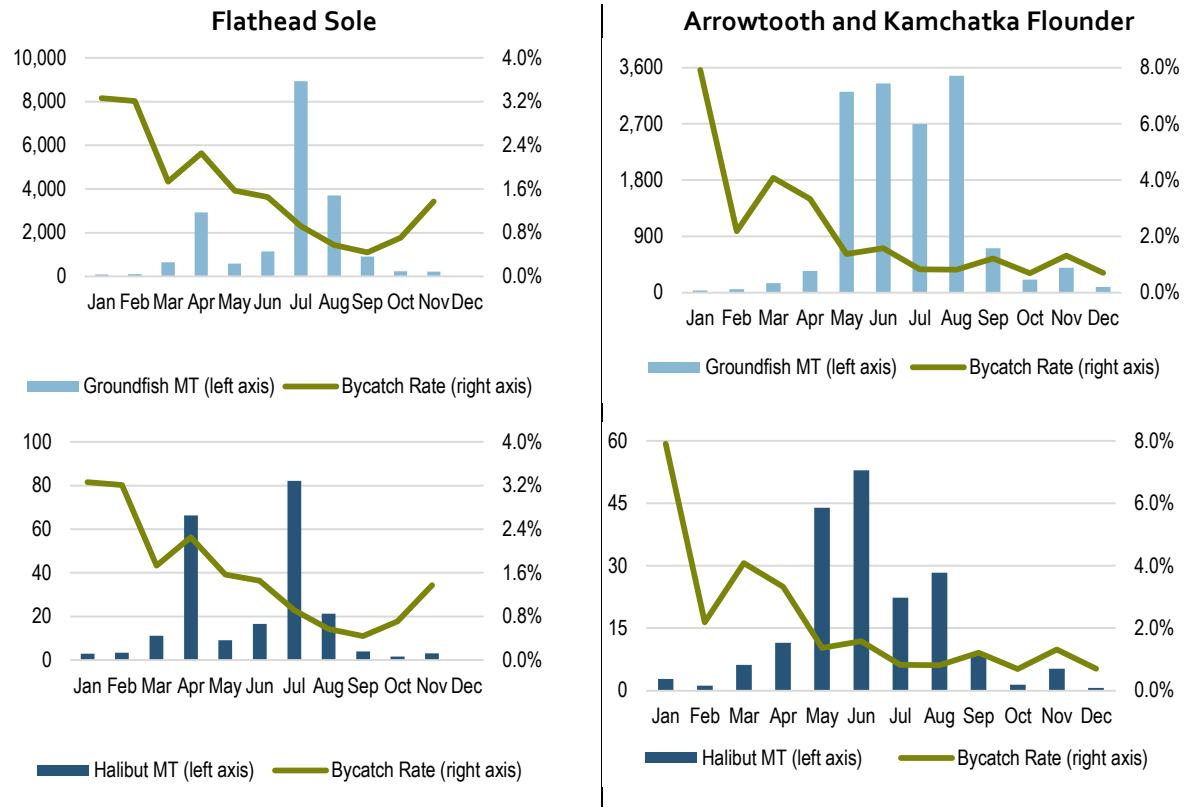


Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

Figure 41 shows groundfish harvest, halibut mortality and halibut bycatch rates for A80-CP target fisheries for flathead sole and for arrowtooth/Kamchatka flounder by month over the 10-year period 2003–2012. These two target fisheries are paired because activity in these fisheries has generally taken place during the summer months and both fisheries show a generally declining trend in halibut bycatch rates by month over the course of the year.

Groundfish harvests in the flathead sole target fishery have been highest in July, with bycatch rates of 0.9 percent. Bycatch mortality has been relatively high when flathead sole is targeted during April. Groundfish harvests in the arrowtooth/Kamchatka flounder target fisheries have taken place primarily between May and August. Bycatch rates average about 1.5 percent from May–June, but drop to an average of 0.8 percent from July–August.

Figure 41. Monthly Harvest and Bycatch in A80-CP Flathead Sole and Arrowtooth Fisheries, 2003–2012



Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

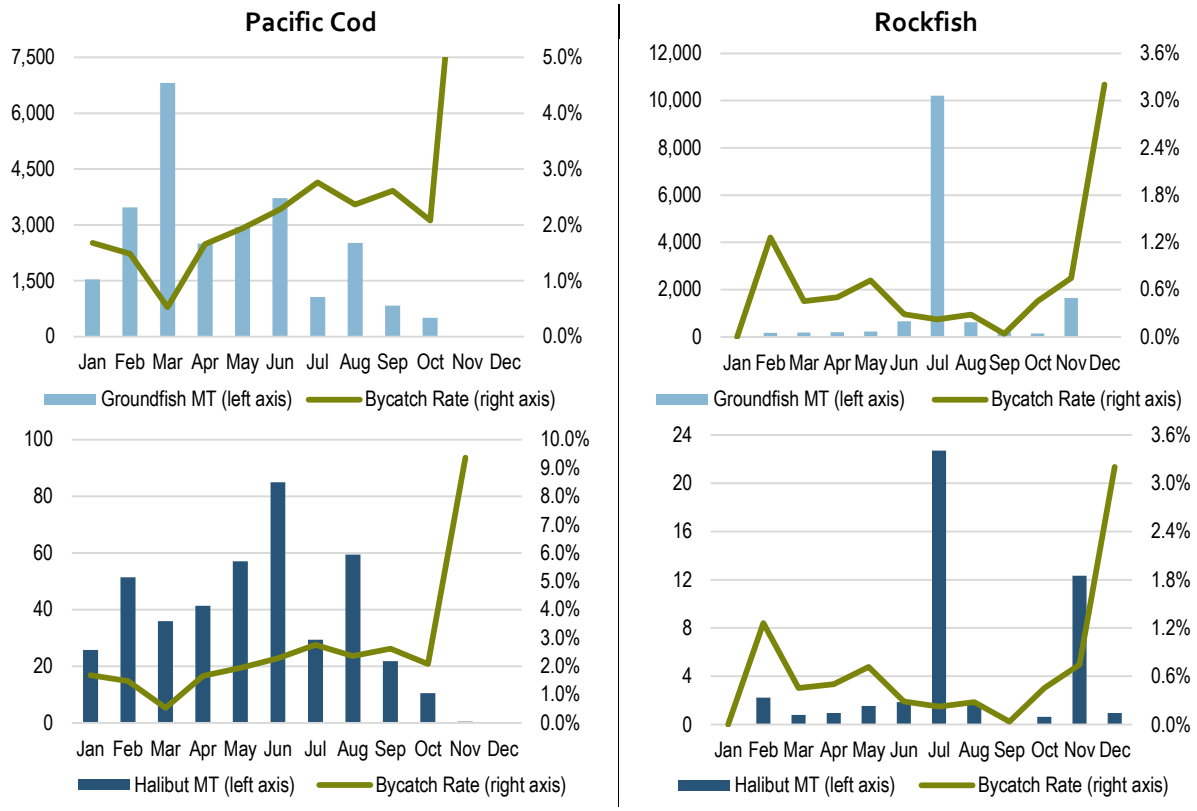
Figure 42 shows groundfish harvest, halibut mortality and halibut bycatch rates for A80-CP target fisheries for Pacific cod and rockfish by month over the 10-year period 2003–2012. These two target fisheries are paired for no other reason than the fact that they are the two remaining major target fisheries of the A80-CP sector.

As discussed earlier in the report, A80-CP activity in target fisheries for Pacific cod has declined dramatically following the re-apportionment of Pacific cod that occurred under Amendment 85. Therefore, the monthly averages shown in the figure are heavily skewed to activity from 2003–2007. When Pacific cod was targeted by the A80-CP sector, the biggest month in terms of

groundfish catch was March, followed by June and February. Halibut mortality was highest in June, but the bycatch rate was highest in July, with the exception that the very low levels of target activity in November had bycatch rates that were literally "off the chart" at 9.4 percent. Bycatch rates in the Pacific cod fishery were lowest during March at 0.5 percent.

The vast majority (72 percent) of groundfish harvests in the rockfish target fishery have taken place in July. Halibut mortality was also highest in July, with 49 percent of all halibut taken during the month. However, bycatch rates were lower in July (at 0.2 percent) than in any other month in the rockfish target fishery with more than 200 mt of groundfish harvest.

Figure 42. Monthly Harvest and Bycatch in A80-CP Pacific Cod and Rockfish Fisheries, 2003–2012



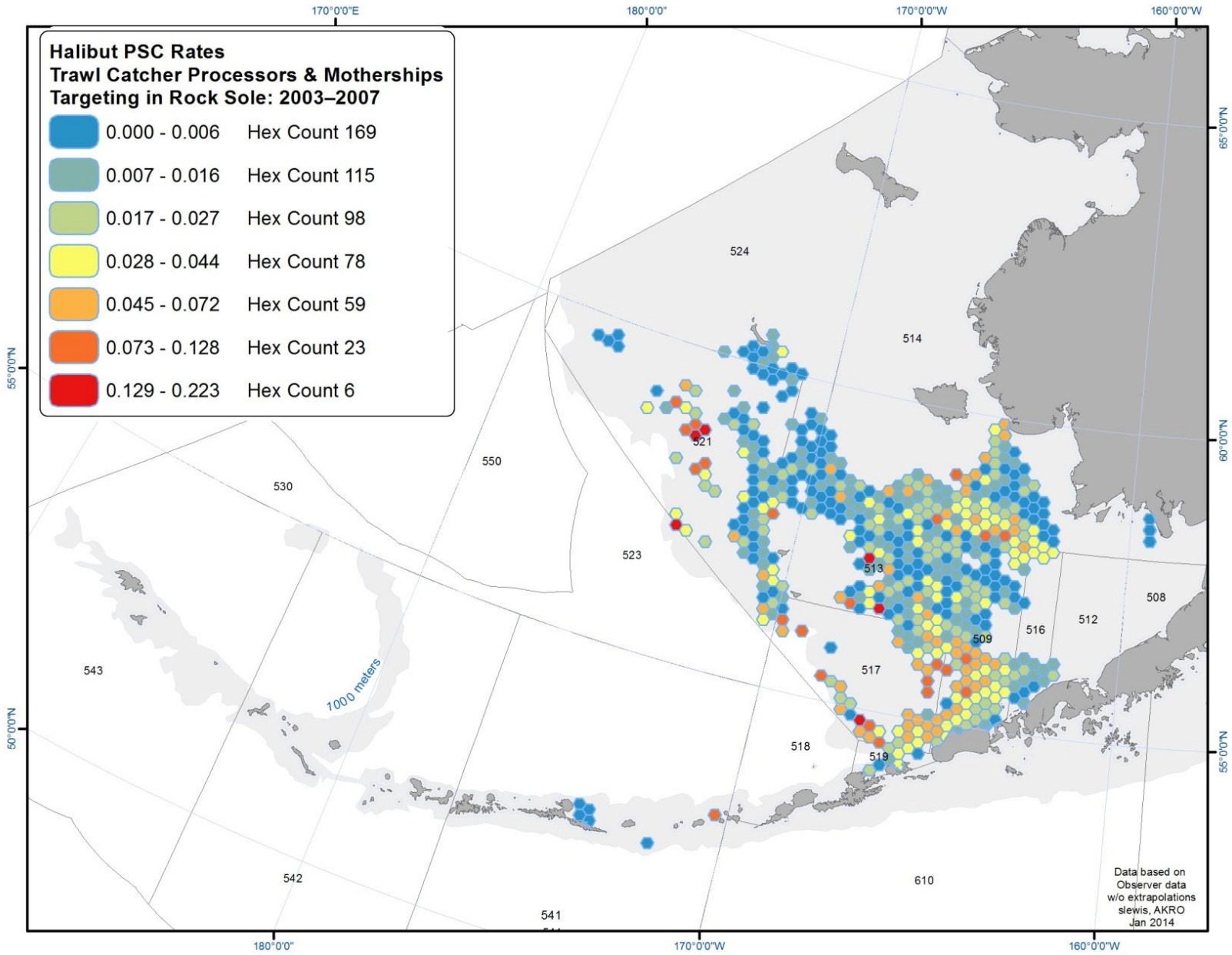
Source: Developed by Northern Economics based on CAS and COAR data from AKFIN.

4.4.2 Geographic Distribution of Halibut Bycatch in the Target Fisheries for Rock Sole

The maps on the following two pages show GIS based data of the distribution of observed halibut bycatch rates of in the trawl fishery for rock sole. In general the only sector included in these figures is the A80-CPs. Figure 43 shows bycatch rates from 2003–2007, while Figure 44 shown rates from 2008–2012. The geographic distribution of cells with disclosable halibut bycatch rates is noticeably reduced in 2008–2012 compared to 2003–2007, although it must be noted that the legend scale in the more recent period increases at more than twice the rate seen in the earlier period.

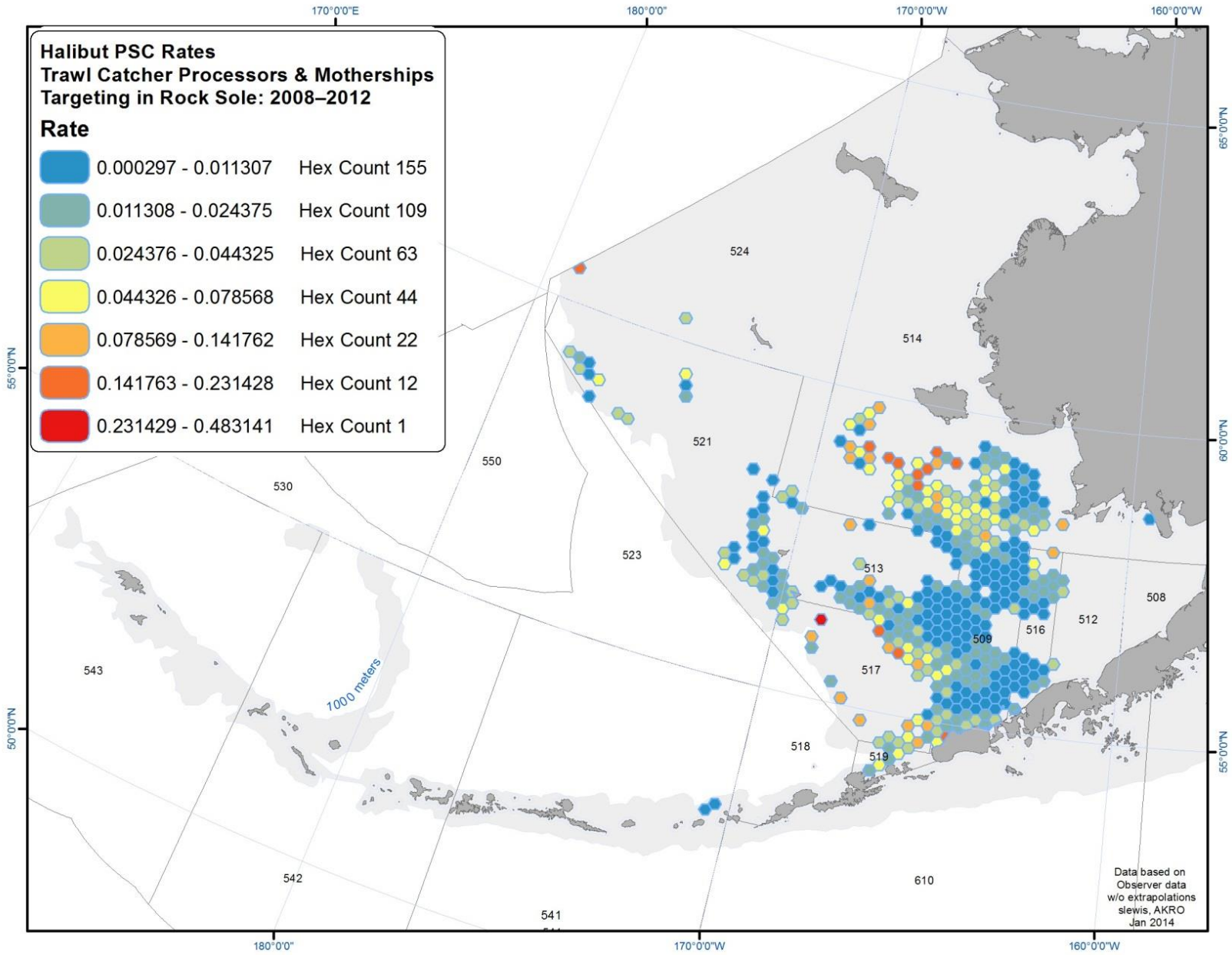
Note that maps showing the distribution of halibut bycatch in of trawl CPs in target fisheries for yellowfin sole and Pacific cod fisheries were presented in earlier sections.

Figure 43. Halibut PSC Rates from 2003–2007 in the Rock Sole Fishery of Trawl Catcher Processors and Motherships



Source: Developed on request by Steve Lewis; GIS Coordinator/Analyst, NOAA Fisheries, Alaska Region, on January 10, 2014.

Figure 44. Halibut PSC Rates from 2008–2012 in the Rock Sole Fishery of Trawl Catcher Processors & Motherships



Source: Developed on request by Steve Lewis; GIS Coordinator/Analyst, NOAA Fisheries, Alaska Region, on January 10, 2014.

5 Options to Reduce Halibut Bycatch in Alaska Groundfish Fisheries

The International Pacific Halibut Commission's (IPHC) has established the Halibut Bycatch Work Group to deal with the issues of halibut bycatch and to develop options to reduce halibut bycatch. Among other elements the work group has compiled a list of options for reducing halibut bycatch in the BSAI and Alaska in General. Six primary options were developed by the work group in 2012 and presented to stakeholders at the 2013 IPHC Annual Meeting. Since that time, additional ideas and options have been suggested to stimulate discussion among stakeholders and halibut users. All of the options have been summarized in the November 11, 2013 *Report of the Halibut Bycatch Work Group* (see www.iphc.int/documents/bycatch/Halibut_Byc_Work_Group_rept_v9.pdf). The text that follows is an excerpt of the options included in the *Report of the Halibut Bycatch Work Group*. The options are presented in their entirety and without editing or comment, but with some minor formatting changes.

5.1 Establishing updated Canada and U.S. bycatch reduction targets

Previous bycatch reduction goals and targets were contained in the recommendations by the 1992 Halibut Bycatch Work Group (Salveson et al. 1992). Prior to that time, halibut bycatch mortality in foreign fisheries had ranged from a high of 25 million pounds to as low as 7 million pounds during 1983-1986. The Work Group noted that the foreign fisheries off Alaska at that time were able to harvest the quantities and species composition which the domestic fisheries of the 1990s were taking, providing a rationale that domestic fisheries should be able to operate at levels of bycatch similar to the foreign fisheries. Using those levels as benchmarks, the Work Group recommended annual reductions of 10% of the Alaskan bycatch limits existing at that time, with a goal of reducing mortality "*…as far as possible over time consistent with the need to harvest the groundfish resources.*" (Salveson et al. 1992). In effect, no specific level of mortality was identified; rather, the Work Group recommended annual reductions to a level which was required to harvest the available groundfish yields. For Canada, the 1992 HBWG recommended an expansion of their observer program, with the results used as a basis for a bycatch control and reduction program. Finally, a lack of bycatch data for the U.S. west coast groundfish fisheries precluded the development of bycatch control measures, so the HBWG recommended that IPHC staff develop procedures to estimate bycatch.

These recommendations have been met with varied success. Recommendations for west coast trawl fisheries led to the IPHC staff developing estimates of bycatch for the west coast groundfish trawl fisheries (Williams et al. 1998), but that responsibility was subsequently taken on by NMFS and the PFMC. In 2001, an observer program was started, which collected fishery data from which to estimate halibut bycatch. In 2012, an individual quota program was introduced for the groundfish fishery, which required 100% monitoring and contained provisions for individual bycatch quotas as well. These actions served to significantly reduce bycatch in the area. In Canadian waters, DFO expanded their observer program and, in 1995, introduced an IFQ

program for its bottom trawl groundfish fishery, which also provided for individual halibut bycatch quotas. As a result, halibut bycatch has declined substantially. Advances in bycatch control have also occurred in the groundfish fisheries off Alaska. The NPFMC has both expanded scope of the fisheries covered by bycatch limits, and reduced the bycatch mortality limits in both the GOA and BSAI since the 1992 recommendations. As a result, the 2013 limits of 2,273 t for the GOA and 4,425 t for the BSAI apply to all federally managed groundfish fisheries off Alaska. The full suite of management actions taken off Alaska was reviewed by Karim et al. (2012), and reductions were noted, mainly for the BSAI. An additional reduction of 15% for the GOA groundfish fisheries are expected to be implemented in mid-2014, to be phased in over 2014-2016. The NPFMC is currently in the initial stages of reviewing the bycatch mortality limits for BSAI fisheries.

5.2 Authorising currently prohibited gear types to retain and sell halibut

With minor exceptions[14], IPHC gear regulations currently prohibit the retention of halibut caught by any gear other than hook and line. The prohibition dates back to 1944, when regulations prohibiting the use of nets of any kind were adopted. This definition was expanded to include pots in 1972 (Skud 1977). The rationale for the net prohibition was based on the concern for the ability of trawl nets to get large amounts of small, juvenile halibut and subsequent impact on recruitment to the setline fishery, and yield loss (IPHC 1948).

Requiring the retention of trawl-caught halibut has been suggested as an option for reducing bycatch mortality, i.e., discards, in the trawl fishery. Halibut are currently discarded as a regulatory requirement. Removing the discard requirement and, instead, requiring 100% retention of all sizes of halibut could lead to the complete elimination of trawl fishery bycatch.

Under this option, regulatory changes would be necessary. First, a change to the IPHC regulations defining the legal gear would be necessary, and may likely be the only action required of IPHC. Other and likely more significant regulatory measures would need to be developed by federal agencies to achieve a bycatch mortality reduction objective within the fishery management plans for the affected trawl fisheries. Program elements would need to be identified and designed for monitoring and catch estimation which may not currently exist.

Two primary elements of a plan requiring full retention are monitoring and disposition of the bycatch. Some groundfish trawl fisheries off Alaska are conducted under program requirements in which at least one observer is on board all the time. This is especially true for the fishery cooperatives and CDQ fisheries operating in the BSAI region. Monitoring for full halibut retention in these fisheries should be straightforward. These fleets are already required to retain all Pollock and Pacific cod. In the Gulf of Alaska groundfish fisheries, observer coverage (as measured by the number of trips where an observer is on board) is much lower, generally less than 20% in 2013. Certain fisheries, e.g., rockfish, have a 100% monitoring requirement but this represents only a portion of the overall total Gulf groundfish harvest. Monitoring for full halibut

[14] IPHC regulations (Section 19) allow for retention of halibut (1) in the BC sablefish trap (pot) fishery as a condition of license under regulations promulgated by DFO and (2) taken by trawl gear [off Alaska] as only as authorized by Prohibited Species Donation regulations of NMFS (IPHC 2013).

retention in many fisheries would be problematic, and violations would go unnoticed. It is likely that 100% monitoring would be necessary to ensure a full accounting of the retained fish.

The retained halibut could either be required to be donated to food banks or sold for profit. In the former instance, at-sea handling and processing standards may need to be developed to ensure appropriate quality for human consumption. Procedures to allow for tracking of product would be required. All costs of processing and storage on board the vessel would be borne by the groundfish operations, donated as in-kind payment. This would assist in creating the incentive desired by a bycatch reduction objective. If the fish were allowed to be sold into the marketplace, impacts to the directed halibut fishery ex-vessel prices markets could be expected due to the additional product on the market. A large fraction of the marketed bycatch would be smaller than the directed fishery product, so the competition may not be direct. It is likely that the direct fishery product would still command a premium however.

Different regulatory structures may be required if full retention of halibut bycatch was part of an IQ program or an open access program. In the case of an IQ fishery, it may help to achieve the bycatch reduction objective if there was an IBQ component. Experience with IBQs in rationalized trawl IQ programs off BC and the U.S. west coast has shown that bycatch can be substantially reduced with the slower paced IQ fishery. This topic will be discussed in a subsequent section.

Finally, a full retention requirement increases the discard mortality rate (DMR) of the bycatch to 100%. Currently, DMRs range from about 60% to 90% for trawl fisheries off Alaska, so an increase to 100% with the same bycatch mortality limits will likely have an impact on the groundfish fisheries unless they modify their fishing behavior. Reducing halibut encounter rates per unit of catch is one likely solution. Alternatively, rationalized management programs could be implemented to provide the proper incentives and/or fishing environment to modify behavior.

From an IPHC management and assessment standpoint, it is unclear what a full retention requirement would mean. The amount of bycatch mortality, i.e., the retained amount, would be reported and included into the assessment as is currently done. However, what constitutes exploitable biomass may need to be reviewed. This may spill over into reconsideration of the IPHC harvest policy and appropriate harvest rates.

5.3 Defining minimum standards for catch monitoring and reporting and implementing 100% monitoring

The goal of this proposal is the identification of minimum standards for monitoring and reporting of fisheries in which halibut is either caught as bycatch or is a directed catch. The standards would reflect a balance of objectives, including minimum monitoring levels enabling accurate estimates of halibut bycatch, the overall objectives of the monitoring program, the data needs for management of the halibut resource, and appropriate and relevant economic considerations which the monitoring programs require.

Once the standards are identified, existing programs would be examined to determine where deficiencies exist. Program components, specific fisheries or sectors could be prioritized for subsequent improvements. Plans would be developed to implement the improvements, which would include timelines and milestones to achieve the objective of improved monitoring.

For some areas, it may be determined that existing monitoring cannot be improved upon. Because of the risk created by inadequate catch estimation, alternate methods could be employed which would attempt to account for that uncertainty. For example, fishery TACs or allocations could be conservatively adjusted in those instances where uncertainty in catch estimates derived from the monitoring is highest. Alternatively, harvest rates may be reduced to reflect that uncertainty. Areas or programs with monitoring that meets or exceeds the standards would not be affected.

Analyses and identification of minimum standards should be done by a neutral body to ensure credibility. The work could be contracted to an independent scientific organization but overseen by the Commission. The results would be provided to the national parties for consideration and subsequent adoption.

5.4 Establishing individual vessel accountability for all halibut bycatch

Individual vessel accountability is the central focus of individual quota (IQ) fishery programs. This option would implement individual bycatch quota programs for the bycatch of all sizes of halibut at the individual vessel level. The benefits of IQ programs to reducing halibut bycatch have been demonstrated by those implemented for the BC trawl fishery and the U.S. west coast trawl fishery. Karim et al. (2012) examined these programs, including the monitoring and the accuracy of data collected by observers. The key to success with these programs is 100% monitoring, which enforces the accountability at the individual level.

Decision points exist in the design of individual-based programs which affect their efficiency and effectiveness, and therefore the success at achieving bycatch reduction goals. One of the elements of current programs which have been shown to enhance reductions includes the transferability of bycatch quota between users. Halibut bycatch allocations have also been made on a broad spatial scale which increases the opportunity to use across fisheries and areas, thus enhancing the value to operators, either in their own use or in transferring to others. Other elements of programs with individual bycatch allowances are reviewed in discussion papers by the NPFMC (2011, 2012).

The most significant decision point in these programs is the overall halibut bycatch quota which is subdivided among eligible operators. This represents the bycatch reduction objective. The approaches taken by DFO for the B.C. trawl fishery and by the PFMC for the U.S. west coast trawl fishery IQ program provide recent, relevant examples. In the case of the B.C. trawl fishery, halibut bycatch had averaged 1.57 Mlbs during the 10 years preceding implementation of the IQ plan in 1996. DFO set a cap of 1.0 Mlbs for the first year, only to see the fishery come in substantially under the cap, at 0.3 Mlbs (Karim et al. 2012). It has remained at about that level every year since, even with an overall halibut quota of 1.0 Mlbs. For the U.S. west coast trawl fishery, the IQ trawl program began in 2011 and in the ten years leading up to implementation, halibut bycatch in the trawl fishery averaged 0.41 Mlbs annually. Through an approach developed by the PFMC in which the IQ program's halibut bycatch quota varies with halibut abundance, the overall bycatch quota for the 2011 trawl IQ fishery was set at 0.28 Mlbs. The final estimate reported by NMFS was 0.05 Mlbs (Jannot et al. 2012), substantially below the fishery quota. Trawl IQ programs in both areas operate with 100% at-sea monitoring.

5.5 Time and area closures—e.g., identifying areas which might be designated as nursery grounds

Time and area closures for fishing have been often used to reduce bycatch (Fredin 1987, Witherell and Pautzke 1997). The 1979 Protocol to the Halibut Convention describes the types of measures the IPHC may adopt to develop and maintain the stock of halibut (McCaughran and Hoag 1992), which includes the following from Article III:

> *(b) establish one or more open or closed seasons as to each area; and…*
>
> *(g) close to all taking of halibut any area or portion of an area that the Commission finds to be populated by small, immature halibut and designates as nursery grounds.*

Importantly, IPHC only has authority to regulate fishing for halibut but not fisheries in which halibut is caught as bycatch and discarded. Those fisheries are regulated by agencies of the U.S. and Canada, and have the ability to create time/area closures likely based on broader criteria. Some of those may include habitat protection, catch limitation, protection of spawning grounds or stocks, and protection of sensitive species.

Over its history, IPHC has instituted year-round closures in only three areas following the determination that the areas served as nursery grounds. In 1932, an area in the vicinity of Noyes Island in Area 2C was closed; a second area on the Masset Grounds in Area 2B was closed for similar reasons. Both areas were reopened in 1960 after studies showed "an accumulation of old and large fish" in the areas (IPHC 1960). Finally, in 1967 a large area in the southeast Bering Sea was declared a nursery area and subsequently closed to halibut fishing. Although the area boundaries have been modified somewhat since first being established, the area currently remains closed.

Time/area closures are attractive for many reasons. They are clearly and easily defined. Geographic coordinates are straightforward to understand; the time component can be defined without difficulty. Enforcement of a time/area closure is also easily accomplished given the nature of the supporting regulation.

However, in some cases time/area closures may not achieve the intended goals of species' protection and reduction of bycatch. Trumble (1992) noted that time and area management is most effective for species which clearly aggregate within a defined area. Effectiveness is reduced as the species disperses, either within the area or across the area's boundary. Effectiveness also declines with increased spatial overlap of the target and bycatch species. Time/area closures may also shift the problem from one species to another species needing protection.

5.6 Defining areas with high bycatch as "areas of special concern" and reducing their catch limits accordingly; and adjusting catch limits upwards in areas that have minimized bycatch and implemented high standards of monitoring

These options seek to respond to the effects of bycatch in an area by making adjustments to the halibut fishery catch limits for those areas. The catch limit adjustments should be achievable within a conservation-based coastwide catch limit and consider the biological implications of catch increases in specific areas. Adjustments should be based on uncertainty associated with catch estimates (see section 3) in addition to performance of the management regime in minimizing bycatch. Establishing any TAC adjustments should also include discussion of impacts of bycatch in one regulatory area on available harvest in other regulatory areas. Adjustments could take various forms:

a. Reducing TACs in areas with bycatch to support availability of harvest in areas impacted by that bycatch; or

b. Assigning a larger proportion of any TAC reductions required for the conservation of the stock to areas with high bycatch and/or poor monitoring arrangements; assigning a larger proportion of any TAC increases when stock abundance is rising to areas with strong monitoring arrangements and effective bycatch reduction measures.

5.7 Other Options to Reduce Halibut Bycatch Mortality in Alaska

The previous six options were developed by the Project Team in 2012 and presented to stakeholders at the 2013 IPHC Annual Meeting. Since that time, additional ideas and options have been suggested, including the following, which were submitted by the U.S. to stimulate discussion among stakeholders and halibut users. These ideas are based on the philosophy that because halibut are regulatory discards (fishermen throw halibut back because they are required to, not because they are low value economic discards), fishery managers should seek to eliminate regulations that exacerbate discard, bycatch, and mortality of halibut. Implementation of this set of options could result in a halibut mortality savings of nearly 2,000 mt (over 4,000,000 pounds), based on existing estimates, assumptions, and back-of-the-envelope calculations.

5.7.1 GOA and BSAI Fixed Gear Fisheries

Preliminary information from the 2013 restructured observer program indicates that the Gulf of Alaska catcher vessel longline fisheries for halibut and groundfish have higher bycatch amounts and higher bycatch rates than any other fishery in Alaska (9,205 mt of halibut bycatch through August). The Bering Sea/Aleutian Islands longline fisheries also discard a substantial amount of halibut. There are a number of regulations that, if implemented together, can be changed to reduce bycatch and bycatch mortality in these fisheries:

1. Eliminate the minimum size limit for halibut. This regulation generates a huge waste of halibut resources, fuel, bait, and other inputs, and selectively removes females and faster growing fish from the population (thus increasing genetic selection for small, slow growing fish). Halibut is the only federally managed commercial fish species off Alaska with a minimum size limit.
2. Require mandatory retention of all halibut (of any size) any time there is available halibut IFQ onboard, in any fishery, including the directed halibut fishery. You catch it, you keep it, and it accrues against your quota. This regulation already applies to sablefish IFQ, and should also apply to halibut and other fixed gear fisheries.
3. Set the season opening date for halibut (and sablefish) at January 1. The January-March Pacific cod longline fishery has a high halibut bycatch rate, and these halibut should be retained per #2 above. Many longline fishermen start fishing for Pacific cod on January 1, discarding the halibut they catch per regulation. Then they may fish their halibut IFQ as a target fishery in March. Then they may target sablefish, turbot, or cod for the rest of the year, discarding halibut all through the remainder of the year once their halibut IFQ is used up (if they had any to begin with).
4. Authorize the use of pot gear in the Gulf of Alaska to catch sablefish IFQ (and authorize retention of halibut IFQ bycatch in pots in all areas).
5. Stop exempting the sablefish longline fishery from the halibut fixed gear PSC limits. This is an annual decision to exempt the fishery and generates unconstrained halibut discards and mortalities.

Estimated halibut mortality savings: say 11,000 mt (guesstimate of full year of data) × 0.16 mortality rate = 1,760 mt or 3,872,000 pounds. The current halibut PSC cap for GOA fixed gear fisheries is 300 mt, so about 1,460 mt would be saved. The savings in the BSAI are not estimated, but would be smaller.

5.7.2 BSAI Trawl Fisheries

The Bering Sea/Aleutian Islands trawl fisheries are fully observed and fully rationalized for target species at the individual vessel level. This situation provides a very interesting win-win possibility for the groundfish fishery, the halibut fishery, the halibut resource, and the consumer. The following program could result in a substantial reduction in halibut bycatch and mortality:

1. Issue individual halibut bycatch quota (halibut IBQ) for all trawl vessels based on their target groundfish quotas;
2. Require retention of all halibut caught against the IBQ; and
3. Authorize the sale of IBQ halibut to markets.[15]

[15] The sale of halibut is a critical component in that provides some benefit to offset the cost of reduction in halibut PSC, and also eliminates the waste of quality food. Some may argue against allowing the sale of trawl caught halibut, citing potential negative impacts to prices paid to halibut IFQ fishermen. However, these concerns may be overstated. Looking back just a few years ago, the markets can clearly handle additional product and still pay high exvessel prices to IFQ halibut fishermen. Additionally, the halibut landed by fixed gear and trawls would not be in direct competition with each other, as the vast majority of halibut caught by Bering Sea trawlers

The total halibut PSC limit for BSAI trawl fisheries is currently set at 3,200 mt. IBQ likely would be issued at less than that amount because the fleet will need less PSC if each vessel can manage its own bycatch (and have the time and incentive to limit halibut bycatch to stay within their individual IBQ amounts by changing locations, targets, gear modifications, etc.). In addition, the mortality rate for discarded halibut would no longer apply, so the limit would actually represent less halibut caught as bycatch. Current rates of bycatch mortality assigned to various target fisheries (64-88%, with ~80% average) would now be 100% mortality with all halibut retained. The trawl fisheries would thus have a 20% reduction in halibut bycatch, just by requiring retention. It is also likely that the NPFMC would include an additional reduction in PSC limits as part of an IBQ program. While not being proposed at this time, a PSC limit that floats with abundance could be easily implemented once an IBQ system is in place.

The halibut IFQ fishery and resource wins by the reduction in halibut mortality and the resultant increase in halibut IFQ catch limits and halibut spawning biomass. The groundfish fleet wins by giving each vessel a tool to manage its own halibut, issuance of a valuable asset (the IBQ), and the allowed retention and sale of halibut. The consumer wins as the waste of quality food is eliminated.

Estimated halibut mortality savings: Assume for this exercise the NPFMC included a 15% reduction in PSC limit when issued as IBQ. 3,200 X 0.85 = 2,720 mt, for a mortality savings of 480 mt. Additionally, any unused IBQ at the end of the year would result in additional halibut mortality savings.

5.7.3 GOA trawl fisheries.

The Gulf of Alaska trawl fisheries remain a race for fish and halibut PSC. The NPFMC is currently evaluating rationalizing the trawl fisheries, which will allow changes in individual vessel behavior and potential provide a mechanism to reduce halibut bycatch rates. Reductions in halibut PSC limits, beyond the 15% reduction recently adopted, could be considered as part of the amendment to rationalize the fisheries. Once the GOA trawl catcher vessel fleet is rationalized, and has full at-sea monitoring of the catch, this fishery could also be a candidate for IBQs in the future similar to the BSAI, with consequent savings in halibut mortality.

would be frozen at sea and shipped to Asia, and be of smaller size and different product forms that would command lower prices than halibut caught by fixed gear (similar to sablefish and turbot). Other people may argue that the sale of halibut would provide incentive for trawl captain to target halibut. However, it would be a foolish captain that used his halibut IBQ to target a few thousand dollars of halibut, rather than wisely utilize halibut IBQ to allow him to catch millions of dollars in groundfish. Either way, fishing stops when the IBQ is used up.

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