AGENDA D-1(c)
DECEMBER 2006

MEMORANDUM

TO: Council, AP and SSC

FROM: Chris Oliver
Executive Director

DATE: November 27, 2006

SUBJECT: Bering Sea/Aleutians Islands SAFE Report and 2007/2008 harvest specifications

ESTIMATED TIME 8 HOURS (all D-1 items)

ACTION REQUIRED

Final action to approve the 2006 BSAI Stock Assessment and Fishery Evaluation (SAFE) report and final BSAI groundfish harvest specifications for 2007 and 2008:

1. Acceptable Biological Catch (ABC) and annual Total Allowable Catch (TAC);
2. Bycatch allowances and seasonal apportionments of Pacific halibut, red king crab, Tanner crab, opilio crab, and herring to target fishery (PSC) categories; and
3. Approve halibut discard mortality rates for 2007-2009 non-CDQ groundfish fisheries and 2007 CDQ fisheries.

BACKGROUND

At this meeting, the Council is scheduled to make final recommendations on groundfish and bycatch specifications (as listed above) to manage the 2007 and 2008 Bering Sea/Aleutian Islands (BSAI) groundfish fisheries.

BSAI SAFE Document The BSAI Groundfish Plan Team met in Seattle on November 13-17, 2006, to prepare the final BSAI SAFE Report. This SAFE report forms the basis for BSAI groundfish harvest specifications for the 2007 and 2008 fishing years. The BSAI SAFE report, along with the GOA SAFE Report, the Economic SAFE report and an Ecosystem Considerations report are incorporated into the Environmental Impact Statement for BSAI and GOA Groundfish Specifications. These documents were mailed to the Council in late November. SSC and AP recommendations will be provided to the Council during the meeting.

Amendment 48 to the BSAI Groundfish FMP made two significant changes with respect to the stock assessment process. The first change allows the preparation of updated assessments for species whose assessments are dependent largely on data from the EBS slope survey and the Aleutian Islands shelf survey. These surveys are conducted only in even-numbered years; therefore, the BSAI SAFE report contains all new assessments.

The second change is that recommendations for ABCs and overfishing levels (OFLs) are required for each of the next two years; BSAI Groundfish Plan Team recommendations are under Item D-1(c)(1). In September, preliminary projections of ABC and OFL for 2007 and 2008 were made on the basis of last year's stock assessments (Item D-1(c)(2)). In this SAFE report, the Plan Team has revised most of those projections. Such revisions are typically due to the development of new models; collection of new catch, survey, age composition, or size composition data; or use of new methodology for recommending ABCs.

ABCs, TACs, and Apportionments At this meeting, the Council will establish final catch specifications for the 2007 and 2008 fisheries. The BSAI Groundfish Plan Team recommended OFLs and ABCs for 2006 and 2007. The sum of the recommended ABCs for 2007 and 2008 are 2,391,435 mt and 2,351,755 mt, respectively. These are approximately 666,000 mt and 705,000 mt below the sum of the 2006 ABCs, respectively. However, these values still exceed the 2 million t cap employed by the Council as a conservation measure in setting TACs. Overall, the status of the stocks continues to appear relatively favorable, although some stocks are declining due to poor recruitment in recent years. Total biomass for 2007 (16,900,000 mt) is down relative to last year's estimate of 17,300,000 mt.

The 2006 bottom trawl survey estimated an Eastern Bering Sea *walleye pollock* biomass of 2,850,000 mt, down 45% from the 2005 estimate. The 2006 EIT survey estimated a biomass of 1,560,000 mt, down 53% from the 2004 estimate. The BSAI Plan Team accepted the SSC's determination that EBS pollock qualified for management under Tier 1 and the Aleutian Islands (AI) and Bogoslof stocks qualified for management under Tier 5. An age-structured model for the AI pollock stock, which was introduced in 2004, has not been adopted to assess this stock.

A range of ABC values from 1,200,000 mt – 1,510,000 mt was discussed by the Plan Team for EBS pollock, with arguments offered in support of candidate values spanning the full range. The Team recommended an ABC of 1,300,000 mt, with the following rationale. In 2006, vessels needed to travel farther to catch pollock, lower bottom trawl and the EIT survey pollock abundances were observed, some evidence exists for recently reduced Bering Sea productivity, and abundance of arrowtooth flounder, an important predator of pollock, is increasing. A catch of 1,300,000 mt would maintain the spawning exploitation rate at the current level.

This year's EBS shelf bottom trawl survey resulted in a biomass estimate of 518,000 mt for *Pacific cod*, down about 14% from the 2005 estimate and close to the previous minimum for the time series (517,000 mt in 1991). Estimated 2007 spawning biomass for the BSAI stock is 307,000 mt, up about 10% from last year's estimate for 2006 and up about 25% from last year's F40% projection for 2007. Abundance is projected to continue to decrease during 2007-2009 because recent (2000-2004) recruitments are below average. The Team recommends setting the 2007 ABC at the maximum permissible value of 176,000 mt, 9% below the 2006 ABC of 194,000 mt.

A revised split-sex age-structured model that incorporated GOA trawl survey lengths and biomass estimates for depths of 500 meters or less was used for *Sablefish*. The survey abundance index increased 8% from 2005 to 2006, following a 2.5% decrease from 2004 to 2005. Spawning biomass is projected to remain stable from 2006 to 2007. The 1997 and 2000 year classes continue to be important parts of the total biomass and each is projected to account for 13% of 2007 spawning biomass. A 5-year exponential weighting of longline survey relative abundance has been used to apportion the combined 2006 ABC among regions, resulting in increased apportionments to the EBS and AI, of 2,980 mt and 2,810 mt, respectively.

This year's EBS bottom trawl survey resulted in a biomass estimate for *yellowfin sole* of 2,130,000 mt, an approximate decrease of 25% from last year's survey. This decrease could be due in part to the lower than normal bottom temperatures encountered on the survey. *Greenland turbot* continues to be the only flatfish species that remains low in abundance compared to 1970 levels. As in previous years, the Plan Team and authors acknowledged large uncertainties in the assessment and recommended the ABC be set at a value less than the maximum permissible. Both the EBS and AI *arrowtooth flounder* biomass estimates are peaking. There is no directed fishery and the stock continues to have a high discard rate. This year's EBS bottom trawl survey resulted in a biomass estimate for *northern rock sole* of 1,670,000 mt, compared to the 2005 estimate of 1,490,000 mt. This is an increase of 12% over the biomass estimate last year. Despite this increase, as for several other flatfish stocks, the northern rock sole stock is expected to decline due to low recruitment in the last decade. However, good recruitment in 2001 and 2002 should increase the stock biomass at the beginning of the next decade. This year's survey biomass of *flathead sole* was 645,000 mt, a 4% increase from 2005. Disaggregating the youngest and oldest age classes in the current assessment may have led in part to the 35% increase in assessed biomass over last year. *Alaska plaice* mature before recruiting to the fishery, leading to a high projected 2007 spawning biomass of 295,000 mt. The recommended ABC for *Pacific ocean perch* increased by nearly half from 2006, but is consistent with increases in trawl survey biomass and spawning biomass and indicative of successful rebuilding. The Plan Team continued to recommend setting a combined BSAI OFL and ABC for *northern, shortraker, and rougheye rockfishes*; these specifications changed little from last year. Since 2001, year-class size for *Atka mackerel* is forecast to be below average, which has led to a decrease in biomass since last year. Projected spawning biomass for 2007 is 130,000 mt, a decrease of 17% from last year. None of the groundfish stocks are overfished or approaching an overfished condition.

When setting TACs to not exceed the 2 million mt cap, the Council also may wish to consider that the 2006 catch exceeded TAC for five categories: EBS pollock, BSAI yellowfin sole, Alaska plaice (by more than double), and other flatfish (by more than sixfold). Catches totaled 99 percent of the OY cap.

Adopt prohibited species catch limits for Pacific halibut, crab, and herring

Halibut Trawl Fisheries: A 3,675 mt limit on halibut mortality has been established for trawl gear. This limit can be apportioned to the trawl fishery categories as shown in the adjacent box. The trawl halibut PSC mortality cap for Pacific cod (non-CDQ) is limited to 1,434 mt.

Categories used for prohibited species catch

Trawl fisheries
1. Greenland turbot, arrowtooth flounder and sablefish
2. rock sole and "other flatfish"
3. yellowfin sole
4. rockfish
5. Pacific cod
6. pollock, Atka mackerel and "other species"

Non-trawl fisheries
1. Pacific cod
2. other non-trawl (longline sablefish and rockfish, and jig gear)
3. groundfish pot (exempt in recent years)

Halibut Fixed Gear Fisheries: A 900 mt non-trawl gear halibut mortality can be apportioned to the fishery categories listed in the adjacent box. The hook-and-line halibut PSC mortality cap for Pacific cod is capped at 775 mt. Item D-1(c)(3) lists the 2006 and 2007 PSC allocations and seasonal apportionments for the trawl and non-trawl fisheries. Item D-1(c)(4) summarizes 2006 PSC bycatch accounting for BSAI CDQ and non-CDQ fisheries.

Crab: Prescribed bottom trawl fisheries in specific areas are closed when PSC limits of *C. bairdi* Tanner crab, *C. opilio* crab, and red king crab are taken. A stair step procedure for determining PSC limits for red king crab taken in Zone 1 trawl fisheries based on abundance of Bristol Bay red king crab as shown in the adjacent table was implemented in 1997. In 1999, red king crab bycatch was reduced by an additional 3,000 crabs. Based on the 2006 estimate of effective spawning biomass (157 million pounds), the PSC limit for 2007 is 197,000 red king crab. The regulations also specify that up

PSC limits for red king crab and *C. bairdi* Tanner crab

Species	Zone	Crab Abundance	PSC Limit
Red King Crab	Zone 1	< threshold or 14.5 million lb effective spawning biomass (ESB)	33,000
		> threshold, but < 55 million lb of ESB	97,000
		> 55 million lb of ESB	197,000
Tanner Crab	Zone 1	0-150 million crabs	0.5% of abundance
		150-270 million crabs	750,000
		270-400 million crabs	850,000
		> 400 million crabs	1,000,000
Tanner Crab	Zone 2	0-175 million crabs	1.2% of abundance
		175-290 million crabs	2,100,000
		290-400 million crabs	2,550,000
		> 400 million crabs	3,000,000

to 35% of the PSC apportioned to the rock sole fishery can be used in the 56° - 56°10'N strip of the Red King Crab Savings Area. The red king crab cap has generally been allocated among the pollock/mackerel/other species, Pacific cod, rock sole, and yellowfin sole fisheries. Once a fishery exceeds its red king crab PSC limit, Zone 1 is closed to that fishery for the remainder of the year, unless further allocated by season.

Since 1997, PSC limits for *bairdi* in Zones 1 and 2 have been based on total abundance of *bairdi* crab as indicated by the NMFS trawl survey. Based on 2006 abundance (866 million crab), and an additional reduction implemented in 1999, the PSC limit for *C. bairdi* in 2007 will be 980,000 (1,000,000 minus 20,000) *bairdi* crab in Zone 1 and 2,970,000 (3,000,000 minus 30,000) crab in Zone 2.

In 1998, PSC limits for snow crab (*C. opilio*) are based on total abundance of *opilio* crab as indicated by the NMFS standard trawl survey. The snow crab PSC cap is set at 0.1133% of the Bering Sea snow crab abundance index, with a minimum PSC of 4.5 million snow crab and a maximum of 13 million snow crab. This number was further reduced by 150,000 crab in 1999. Using the 2006 survey estimate of 3.25 billion crab would result in a 2007 *opilio* crab PSC limit of 3,537,000 crab, if left unadjusted. However, the crab FMP mandates a minimum of 4,350,000 snow crab (4,500,000 minus 150,000). Snow crab taken within the "Snow Crab Bycatch Limitation Zone" accrues toward the PSC limits established for individual trawl fisheries. Upon attainment of a snow crab PSC limit apportioned to a particular trawl target fishery, that fishery is prohibited from fishing within the snow crab zone.

Herring: In 1991, an overall herring PSC bycatch cap of 1 percent of the EBS biomass of herring was implemented. This cap is apportioned to the seven PSC fishery categories. Annual herring assessments are complete and indicate there will be very little change in the Bering Sea herring PSC limit for 2007. The herring biomass estimate for spring 2007 for the eastern Bering sea is 178,652 mt, a very slight decline from the 2006 biomass estimate of 189,253 t. The corresponding herring PSC limit for 2007 at 1% of this amount would be 1,787 mt. ADF&G will advise the Council if there are substantial changes made to the assessments for 2007.

Seasonal apportionment of bycatch limits The Council may also seasonally apportion the bycatch allowances. Regulations require that seasonal apportionments of bycatch allowances be based on information listed in the adjacent box.

Halibut discard mortality rates Following a schedule adopted by the Council in 2000, halibut bycatch mortality in the 2007-2009 open access fisheries is managed using long-term mean discard mortality rates (DMRs). These were presented to and adopted by the Council in October 2006 (see below). For CDQ fisheries, annually revised halibut DMRs were also presented and adopted.

Minutes from the BSAI Groundfish Plan Team meeting will be distributed at the meeting.

Factors to be considered for seasonal apportionments of bycatch allowances.

1. Seasonal distribution of prohibited species;
2. Seasonal distribution of target groundfish species relative to prohibited species distribution;
3. Expected prohibited species bycatch needs on a seasonal basis relevant to change in prohibited species biomass and expected catches of target groundfish species;
4. Expected variations in bycatch rates throughout the fishing year;
5. Expected changes in directed groundfish fishing seasons;
6. Expected start of fishing efforts; and
7. Economic effects of establishing seasonal prohibited species apportionments on segments of the target groundfish industry.

Recommended Pacific halibut discard mortality rates (DMRs) for 2007-2009 BSAI non-CDQ fisheries.	
Gear/Target	**Recommendation for 2007-2009**
Trawl	
Atka mackerel	76
Bottom pollock	74
Pacific cod	70
Other Flatfish	74
Rockfish	76
Flathead sole	70
Pelagic pollock	88
Rock sole	80
Sablefish	75
Turbot	70
Arrowtooth fldr	75
Yellowfin sole	80
Pot	
Pacific cod	7
Longline	
Pacific cod	11
Rockfish	17
Turbot	13

Recommended Pacific halibut discard mortality rates (DMRs) for 2007 BSAI CDQ Fisheries	
Gear/Target	**Recommendation for 2007**
Trawl	
Atka mackerel	86
Bottom pollock	85
Flathead sole	70[1]
Pelagic pollock	90
Rockfish	76[1]
Yellowfin sole	86
Pot	
Pacific cod	7[1]
Sablefish	34
Longline	
Pacific cod	10
Turbot	13[1]

[1] Open access DMRs

Sablefish update In December 2005, the Council requested that AFSC Auke Bay Laboratory (ABL) scientists investigate a number of issues related to sablefish management in the Bering Sea and Aleutian Islands. The Council requested that ABL staff conduct experimental research in 2006 to determine the effectiveness of different size escape rings, soak times, and biodegradable panels, in conjunction with ongoing efforts to develop catch-per-unit-effort indices, for sablefish pot gear. Some of the requested research has been summarized in the 2006 BSAI SAFE sablefish chapter (Item D-1(c)(6)). State, Federal, and Council staff will work together to address three potential changes to sablefish pot gear regulations: 1) escape rings; 2) changes to required biodegradable panels; and 3) banning at-sea storage of pots.

Table 1. Bering Sea Aleutian Islands Groundfish Plan Team OFL, ABC, and TAC Recommendations for the 2007-2008 Fisheries (mt)

		2006				2007			2008		
Species	Area	OFL	ABC	TAC	Catch**	OFL	ABC	TAC	OFL	ABC	TAC
Pollock	EBS	2,090,000	1,930,000	1,478,500	1,486,004	1,640,000	1,300,000		1,500,000	1,300,000	
	Aleutian Islands	39,100	29,400	19,000	1,742	21,400	16,800		21,400	16,800	
	Bogoslof District	50,600	38,000	10	0	48,000	5,220		48,000	5,220	
Pacific cod	BSAI	230,000	194,000	189,768	186,882	207,000	176,000		154,000	131,000	
Sablefish	BS	3,680	3,060	2,440	1,027	3,520	2,980		3,290	2,970	
	AI	3,740	3,100	2,620	1,033	3,320	2,810		3,100	2,800	
Yellowfin sole	BSAI	144,000	121,000	90,686	97,648	160,000	136,000		158,000	134,000	
Greenland turbot	Total	14,200	2,740	3,500	1,935	15,600	2,440		16,000	2,490	
	BS		1,890	2,700	1,433		1,680			1,720	
	AI		850	800	502		760			770	
Arrowtooth flounder	BSAI	166,000	136,000	12,000	12,794	193,000	158,000		208,000	171,000	
Northern rock sole	BSAI	150,000	126,000	41,500	36,430	144,000	121,000		152,000	128,000	
Flathead sole	BSAI	71,800	59,800	19,500	17,871	95,300	79,200		92,800	77,200	
Alaska plaice	BSAI	237,000	188,000	8,000	17,263	241,000	190,000		252,000	199,000	
Other flatfish	BSAI	24,200	18,100	3,500	21,339	28,500	21,400		28,500	21,400	
Pacific Ocean perch	BSAI	17,600	14,800	12,600	12,784	26,100	21,900		25,600	21,600	
	BS		2,960	1,400	1,036		4,160			4,080	
	AI total		11,840	11,200	11,748		17,740			17,520	
	WAI		5,372	5,085	5,495		7,720			7,620	
	CAI		3,212	3,035	3,184		5,050			5,000	
	EAI		3,256	3,080	3,069		4,970			4,900	
Northern rockfish	BSAI	10,100	8,530	5,000	3,761	9,750	8,190		9,700	8,150	
Shortraker	BSAI	774	580	596	202	564	424		564	424	
Rougheye	BSAI	299	224	223	202	269	202		269	202	
Other rockfish	BSAI	1,870	1,400	1,050	570	1,330	999		1,330	999	
	BS		810	460	153		414			414	
	AI		590	590	417		585			585	
Atka mackerel	Total	130,000	110,000	63,000	61,117	86,900	74,000		64,200	54,900	
	WAI		41,360	20,000	14,563		20,600			15,300	
	CAI		46,860	35,500	39,230		29,600			22,000	
	EAI/BS		21,780	7,500	7,324		23,800			17,600	
Squid	BSAI	2,620	1,970	1,275	1,414	2,620	1,970		2,620	1,970	
Other species	BSAI	93,800	70,400	29,000	26,469	95,900	71,900		95,900	71,900	
Sharks						1,700	1,200		1,700	1,200	
Skates						49,200	36,900		49,200	36,900	
Sculpins						41,200	30,900		41,200	30,900	
Octopus						3,800	2,900		3,800	2,900	
Total	BSAI	3,481,383	3,057,104	1,983,768	1,988,487	3,024,073	2,391,435		2,837,273	2,352,025	

**catch is through November 4, 2006 (includes CDQ).

North Pacific Fishery Management Council OFL, ABC, and TAC Preliminary Recommendations for the 2007-2008 Fisheries (mt)

Species	Area	2006				2007			2008		
		OFL	ABC	TAC	Catch**	OFL	ABC	TAC	OFL	ABC	TAC
Pollock	EBS	2,090,000	1,930,000	1,485,000	1,485,000	1,707,000	1,419,800	1,419,800	1,418,100	1,168,700	1,168,700
	Aleutian Islands	39,100	29,400	19,000	19,000	39,100	29,400	19,000	39,100	29,400	19,000
	Bogoslof District	50,600	5,500	10	0	50,600	5,500	10	50,600	5,500	10
Pacific cod	BSAI	230,000	194,000	189,768	188,180	176,100	148,500	144,045	144,900	121,700	118,049
Sablefish	BS	3,680	3,060	2,820	921	3,080	2,580	2,580	2,680	2,240	2,240
	AI	3,740	3,100	3,000	1,070	3,120	2,620	2,620	2,720	2,260	2,260
Yellowfin sole	BSAI	144,000	121,000	95,701	95,701	138,900	117,100	117,100	126,200	106,400	106,400
Greenland turbot	Total	14,200	2,740	2,740	2,487	18,300	2,630	2,630	17,500	2,630	2,630
	BS	n/a	1,890	1,890	1,890	n/a	1,815	1,815	n/a	1,815	1,815
	AI	n/a	850	850	597	n/a	815	815	n/a	815	815
Arrowtooth flounder	BSAI	166,000	136,000	13,000	13,000	172,200	140,500	20,000	177,400	144,800	144,800
Rock sole	BSAI	150,000	126,000	41,500	35,098	146,000	122,500	85,736	133,100	111,600	111,600
Flathead sole	BSAI	71,800	59,800	19,500	18,528	67,100	55,900	22,000	62,700	52,200	52,200
Alaska plaice	BSAI	237,000	188,000	8,000	17,000	227,100	180,200	32,000	218,400	173,200	129,637
Other flatfish	BSAI	24,200	18,100	3,500	3,500	24,200	18,100	5,000	24,200	18,100	18,100
Pacific ocean perch	BSAI	17,600	14,800	12,600	12,068	17,900	15,100	15,100	17,900	15,100	15,100
	BS	n/a	2,960	1,400	868	n/a	3,020	3,020	n/a	3,020	3,020
	AI total	n/a	11,840	11,200	11,200	n/a	12,080	12,080	n/a	12,080	12,080
	WAI	n/a	5,372	5,085	5,085	n/a	5,481	5,481	n/a	5,481	5,481
	CAI	n/a	3,212	3,035	3,035	n/a	3,277	3,277	n/a	3,277	3,277
	EAI	n/a	3,256	3,080	3,080	n/a	3,322	3,322	n/a	3,322	3,322
Northern rockfish	BSAI	10,100	8,530	4,500	3,887	10,100	8,500	5,000	10,000	8,500	5,000
Shortraker rockfish	BSAI	774	580	580	169	774	580	580	774	580	580
Rougheye rockfish	BSAI	299	224	224	183	299	224	224	299	224	224
Other rockfish	BSAI	1,870	1,400	1,050	556	1,870	1,400	1,400	1,870	1,400	1,400
	BS	n/a	810	460	251	n/a	810	810	n/a	810	810
	AI	n/a	590	590	305	n/a	590	590	n/a	590	590
Atka mackerel	Total	130,000	110,000	63,000	63,000	107,300	90,900	63,000	75,200	65,100	65,100
	WAI	n/a	41,360	15,500	15,500	n/a	34,182	16,782	n/a	24,481	24,481
	CAI	n/a	46,860	40,000	40,000	n/a	38,718	38,718	n/a	27,728	27,728
	EAI/BS	n/a	21,780	7,500	7,500	n/a	18,000	7,500	n/a	12,891	12,891
Squid	BSAI	2,620	1,970	1,275	1,437	2,620	1,970	1,275	2,620	1,970	1,970
Other species	BSAI	89,404	58,882	29,000	29,000	89,404	62,950	40,900	89,404	62,950	35,000
Total	BSAI	3,476,987	3,013,086	1,994,180	1,989,785	3,003,067	2,426,954	2,000,000	2,615,267	2,094,554	2,000,000

** 2006 catch is based on projected catch and includes CDQ

TABLE 7.—2006 AND 2007 PROHIBITED SPECIES BYCATCH ALLOWANCES FOR THE BSAI TRAWL AND NON-TRAWL FISHERIES

Trawl fisheries	Prohibited species and zone					
	Halibut mortality (mt) BSAI	Herring (mt) BSAI	Red King Crab (animals) Zone 1[1]	C. opilio (animals) COBLZ[1]	C. bairdi (animals)	
					Zone 1[1]	Zone 2[1]
Yellowfin sole	886	152	33,843	4,106,752	340,844	1,788,459
January 20–April 1	262	n/a	n/a	n/a	n/a	n/a
April 1–May 21	195	n/a	n/a	n/a	n/a	n/a
May 21–July 1	49	n/a	n/a	n/a	n/a	n/a
July 1–December 31	380	n/a	n/a	n/a	n/a	n/a
Rock sole/other flat/flathead sole[2]	779	27	121,413	810,091	365,320	596,154
January 20–April 1	448	n/a	n/a	n/a	n/a	n/a
April 1–July 1	164	n/a	n/a	n/a	n/a	n/a
July 1–December 31	167	n/a	n/a	n/a	n/a	n/a
Turbot/arrowtooth/sablefish[3]	n/a	12	n/a	52,358	n/a	n/a
Rockfish	n/a	n/a	n/a	n/a	n/a	n/a
July 1–December 31	69	10	n/a	52,358	n/a	10,988
Pacific cod	1,434	27	26,563	184,402	183,112	324,176
Midwater trawl pollock	n/a	1,353	n/a	n/a	n/a	n/a
Pollock/Atka mackerel/other[4]	232	192	406	106,591	17,224	27,473
Red King Crab Savings Subarea[6]	n/a	n/a	n/a	n/a	n/a	n/a
(non-pelagic trawl)	n/a	n/a	42,495	n/a	n/a	n/a
Total trawl PSC	3,400	1,770	182,225	5,329,548	906,500	2,747,250
Non-trawl fisheries						
Pacific cod—Total	775					
January 1–June 10	320					
June 10–August 15	0					
August 15–December 31	455					
Other non-trawl—Total	58					
May 1–December 31	58					
Groundfish pot and jig	exempt					
Sablefish hook-and-line	exempt					
Total non-trawl PSC	833					
PSQ reserve[5]	342	n/a	14,775	432,126	73,500	222,750
PSC grand total	4,575	2,012	197,000	5,761,674	980,000	2,970,000

[1] Refer to § 679.2 for definitions of areas.
[2] "Other flatfish" for PSC monitoring includes all flatfish species, except for halibut (a prohibited species), Greenland turbot, rock sole, yellowfin sole and arrowtooth flounder.
[3] Greenland turbot, arrowtooth flounder, and sablefish fishery category.
[4] Pollock other than pelagic trawl pollock, Atka mackerel, and "other species" fishery category.
[5] With the exception of herring, 7.5 percent of each PSC limit is allocated to the CDQ program as PSQ reserve. The PSQ reserve is not allocated by fishery, gear or season.
[6] In December 2005, the Council recommended that red king crab bycatch for trawl fisheries within the RKCSS be limited to 35 percent of the total allocation to the rock sole/flathead sole/"other flatfish" fishery category (see § 679.21(e)(3)(ii)(B)).

Bering Sea Aleutian Islands Prohibited Species Report (includes CDQ fisheries)

Through: 18-NOV-06

**National Marine Fisheries Service
Alaska Region, Sustainable Fisheries
Catch Accounting**

Chinook Salmon

Trawl Gear

Seasons	Account	Units	Total Catch	Limit	Remaining	% Taken	Last Wk Catch
	BS Pollock (Pelagic)	Count	81,243	26,825	-54,418	303%	0
	BS Chinook Salmon PSQ	Count	1,738	2,175	437	80%	0
	AI Pollock (Pelagic)	Count	70	647	577	11%	0
	AI Chinook Salmon PSQ	Count	0	53	53	0%	0
Total:			**83,051**	**29,700**	**-53,351**	**280%**	**0**

Halibut Mortality

Non-Trawl Gear

Seasons	Account	Units	Total Catch	Limit	Remaining	% Taken	Last Wk Catch
X	Pacific Cod (Hook-and-Line)	MT	398	775	377	51%	0
	Non-Pacific Cod (Hook-and-Line)	MT	18	58	40	30%	0
Total:			**415**	**833**	**418**	**50%**	**0**

Trawl Gear

Seasons	Account	Units	Total Catch	Limit	Remaining	% Taken	Last Wk Catch
	Pacific Cod	MT	1,494	1,434	-60	104%	0
	Rockfish	MT	29	69	40	42%	0
X	Rock Sole, Flathead Sole, Other Flatfish (Trawl)	MT	1,002	779	-223	129%	0
	Pollock, Atka Mackerel, Other Species	MT	231	232	1	100%	0
X	Yellowfin Sole (Trawl)	MT	551	886	335	62%	0
	Turbot/Sablefish/Arrowtooth Flounder	MT	118	0	-118	0%	0
Total:			**3,426**	**3,400**	**-26**	**101%**	**0**

Trawl and Hook-and-Line Gear

Seasons	Account	Units	Total Catch	Limit	Remaining	% Taken	Last Wk Catch
	Halibut Mortality PSQ	MT	136	342	206	40%	13
Total:			**136**	**342**	**206**	**40%**	**13**

Herring (includes CDQ fisheries)

Trawl Gear

Seasons	Account	Units	Total Catch	Limit	Remaining	% Taken	Last Wk Catch
	Pacific Cod	MT	36	27	-9	132%	0
	Rockfish	MT	0	10	10	0%	0
	Rock Sole, Flathead Sole, Other Flatfish	MT	5	27	22	18%	0
	Pollock, Atka Mackerel, Other Species	MT	223	192	-31	116%	0
	Pollock Pelagic	MT	224	1,350	1,126	17%	0
	Yellowfin Sole	MT	14	152	138	9%	0
	Greenland Turbot, Arrowtooth, Sablefish	MT	0	12	12	1%	0
Total:			**501**	**1,770**	**1,269**	**28%**	**0**

Opilio (Tanner) Crab - COBLZ

Trawl Gear

Seasons	Account	Units	Total Catch	Limit	Remaining	% Taken	Last Wk Catch
	Pacific Cod	Count	75,920	184,402	108,482	41%	0
	Rockfish	Count	0	62,356	62,356	0%	0
	Rock Sole, Flathead Sole, Other Flatfish	Count	118,638	810,091	691,453	15%	0
	Pollock, Atka Mackerel, Other Species	Count	2,246	106,591	104,345	2%	0
	Yellowfin Sole	Count	752,758	4,103,752	3,350,995	18%	0
	Greenland Turbot, Arrowtooth, Sablefish	Count	3,872	62,356	58,484	6%	0
	Opilio Crab PSQ	Count	2,746	432,126	429,380	1%	665
Total:			**956,180**	**5,761,674**	**4,805,494**	**17%**	**665**

Bairdi Crab, Zone 1

Trawl Gear

Seasons	Account	Units	Total Catch	Limit	Remaining	% Taken	Last Wk Catch
	Pacific Cod	Count	100,648	183,112	82,464	55%	0
	Rock Sole, Flathead Sole, Other Flatfish	Count	71,523	365,320	293,797	20%	0
	Pollock, Atka Mackerel, Other Species	Count	833	17,224	16,391	5%	0
	Yellowfin Sole	Count	36,194	340,844	304,650	11%	0
	Bairdi Crab PSQ	Count	505	73,500	72,995	1%	0
Total:			**209,703**	**980,000**	**770,297**	**21%**	**0**

Bairdi Crab, Zone 2

Trawl Gear

Sea-sons	Account	Units	Total Catch	Limit	Remaining	% Taken	Last Wk Catch
	Pacific Cod	Count	92,169	324,176	232,007	28%	0
	Rockfish	Count	0	10,988	10,988	0%	0
	Rock Sole, Flathead Sole, Other Flatfish	Count	228,910	596,154	367,244	38%	0
	Pollock, Atka Mackerel, Other Species	Count	704	27,473	26,769	3%	0
	Yellowfin Sole	Count	315,411	1,788,459	1,473,048	18%	0
	Bairdi Crab PSQ	Count	3,302	222,750	219,448	1%	324
Total:			**640,497**	**2,970,000**	**2,329,503**	**22%**	**324**

Red King Crab, Zone 1

Trawl Gear

Sea-sons	Account	Units	Total Catch	Limit	Remaining	% Taken	Last Wk Catch
	Pacific Cod	Count	6,232	26,563	20,331	23%	0
	Rock Sole, Flathead Sole, Other Flatfish	Count	51,003	121,413	70,410	42%	0
	Pollock, Atka Mackerel, Other Species	Count	202	406	204	50%	0
	Yellowfin Sole	Count	12,337	33,843	21,506	36%	0
	Red King Crab PSQ	Count	3,883	14,775	10,892	26%	383
Total:			**73,657**	**197,000**	**123,343**	**37%**	**383**

"Other flatfish" for PSC monitoring: all flatfish species, except for Pacific halibut (a prohibited species), flathead sole, Greenland turbot, rock sole, yellowfin sole, arrowtooth flounder.

COBLZ: C. Opilio Crab Bycatch Limitation Zone. 50 CFR 679.21(e) and Figure 13.

Zone 1: Federal Reporting Areas 508, 509, 512, 516.

Zone 2: Federal Reporting Areas 513, 517, 521.

Data is based on observer reports extrapolated to total groundfish harvest. Estimates for all weeks may change due to incorporation of late or corrected data.

Bering Sea Aleutian Islands Seasonal Prohibited Species Report (includes CDQ fisheries)	National Marine Fisheries Service Alaska Region, Sustainable Fisheries Catch Accounting
Through: 18-NOV-06	
Account: ALL	

Non-Chinook Salmon, CVOA

Trawl Gear

Season	Begin	End	Units	Total Catch	Limit	Remaining	% Taken
Non-Chinook Salmon CVOA	15-AUG-06	14-OCT-06	Count	26,432	38,850	12,418	68%
Non-Chinook Salmon PSQ CVOA	15-AUG-06	14-OCT-06	Count	0	3,150	3,150	0%
Total:				**26,432**	**42,000**	**15,568**	**63%**

Halibut Mortality

Pacific Cod (Hook-and-Line)

Season	Begin	End	Units	Total Catch	Limit	Remaining	% Taken
1st Season	01-JAN-06	10-JUN-06	MT	168	320	152	52%
2nd Season	10-JUN-06	15-AUG-06	MT	1	0	-1	0%
3rd Season	15-AUG-06	31-DEC-06	MT	229	455	226	50%
Total:				**398**	**775**	**377**	**51%**

Rock Sole, Flathead Sole, Other Flatfish (Trawl)

Season	Begin	End	Units	Total Catch	Limit	Remaining	% Taken
1st Season	20-JAN-06	01-APR-06	MT	470	448	-22	105%
2nd Season	01-APR-06	01-JUL-06	MT	133	164	31	81%
3rd Season	01-JUL-06	31-DEC-06	MT	399	167	-232	239%
Total:				**1,002**	**779**	**-223**	**129%**

Yellowfin Sole (Trawl)

Season	Begin	End	Units	Total Catch	Limit	Remaining	% Taken
1st Season	20-JAN-06	01-APR-06	MT	166	262	96	64%
2nd Season	01-APR-06	21-MAY-06	MT	261	195	-66	134%
3rd Season	21-MAY-06	01-JUL-06	MT	75	49	-26	154%
4th Season	01-JUL-06	31-DEC-06	MT	48	380	332	13%
Total:				**551**	**886**	**335**	**62%**

CVOA: Catcher Vessel Operational Area. 50 CFR 679.22(a)(5) and Figure 2.

Other flatfish for PSC monitoring: all flatfish species, except for Pacific halibut (a prohibited species), flathead sole, Greenland turbot, rock sole, yellowfin sole, arrowtooth flounder.

Data is based on observer reports extrapolated to total groundfish harvest. Estimates for all weeks may change due to incorporation of late or corrected data.

AGENDA D-1(c)
Supplemental
DECEMBER 2006

Addendum to Chapter 2:

Revisions to the Assessment of the Pacific Cod Stock in the Eastern Bering Sea and Aleutian Islands Area

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EXECUTIVE SUMMARY

Why is an Addendum Needed?

In the Pacific cod chapter of the 2006 BSAI SAFE report (Thompson et al. 2006), nine models were presented, one of which was similar to the model chosen last year by the Plan Team and SSC and the other eight of which represented a set of alternatives. The authors recommended use of one of the alternative models, specifically Model B1. This model attempted to estimate the catchability coefficient of the EBS shelf bottom trawl survey and used a simpler selectivity function than previous assessments of the Pacific cod stock. The Plan Team concurred with the authors' recommendation and based its ABC and OFL recommendations on Model B1.

After the Plan Team meeting, an external reviewer identified a problem with the parameter estimates obtained by Model B1. In non-technical terms, the problem can be described as follows: The basic goal of stock assessment modeling is to develop a mathematical model of population dynamics that matches the data as closely as possible (i.e., to minimize the "distance" between what the model says the stock is doing and what the data say the stock is doing). Unfortunately, the various data sets used in a stock assessment are typically somewhat inconsistent with one another, and the models developed to represent the population dynamics of the stock and the interaction of the various fishing gears with the stock can be sufficiently complicated that it is sometimes possible to find parameter values that *appear* to give the best possible fit to the data, when in reality other parameter values exist that give an even better fit. This is what happened in the case of Model B1.

Although modern stock assessment models typically contain dozens, or even hundreds, of dimensions (parameters), an analogy can be drawn in terms of topography for the two-dimensional case: The objective is to find the lowest elevation (closest fit to the data) in the topography of some geographic region. While it is usually easy to find the lowest elevation in a particular valley (a "local minimum"), it is harder to prove that no other valley exists somewhere else in the region with an even lower minimum elevation (the "global minimum"). The problem becomes harder as the size of the geographic region increases, and harder still as the dimensionality of the problem increases. Fortunately, the ADMB programming language (Fournier 2005), which is utilized by all age-structured assessments of BSAI and GOA groundfish stocks, contains a number of sophisticated features (e.g., extremely accurate computation of derivatives and "phased" estimation of parameters, so that the most influential parameters are estimated first) that substantially reduce the chances of converging on a local minimum different from the global minimum. In developing the original version of Model B1, appropriate tests were conducted to make sure that the model had truly converged. However, by altering the path by which the minimum is approached, it turns out that a different minimum can be found for Model B1, resulting in a revised version of the model that fits the data better than the original.

What is Included in this Addendum?

This addendum includes substitutes for the "Results" and "Projections and Harvest Alternatives" sections of the Pacific cod chapter of the 2006 SAFE report. To ensure that all revised parameter estimates are made available, substitutes for certain portions of the "Model Evaluation" section are also included.

Because the chapter authors and Plan Team recommended adoption of the original version of Model B1, the substitute sections contained in this addendum are based on the revised version of Model B1. While this seems to be the most straightforward way to address the implications of the revised model, readers should be aware that the authors or Plan Team might have reached different conclusions regarding model choice had the need for a revision been discovered earlier. In order to minimize potential confusion, no model recommendations or ABC recommendations are contained in this addendum. However, several alternative ABC values are presented in the interest of allowing those responsible for final harvest specifications to make a fully informed decision.

To facilitate comparison with the Pacific cod chapter of the SAFE report, table and figure numbers used here are identical with those used in the SAFE report.

It should be noted that Model B2, which is closely related to Model B1, is affected by the problem of incorrect identification of the global minimum in the same way as Model B1. However, because the results from the revised version of Model B2 are so close to the results from the revised version of Model B1 (as was also true in the original versions of those two models), only the results from the revised version of Model B1 are presented here, in the interest of keeping this addendum as concise as possible.

What are the Major Implications?

The major qualitative conclusions from the Pacific cod chapter of the SAFE report are unchanged:

1) All of the models are in basic agreement as to which year classes appear to be strong and which appear to be weak.
2) In particular, all of the models agree that the 2000-2004 year classes currently appear to be weak.
3) From about 1993 to the present, all of the models indicate that female spawning biomass has been fairly stable, although the trend over the last couple of years is downward in all models.
4) All of the models project continued declines in spawning biomass and maximum permissible ABC for the next 2-3 years.

Although the major qualitative conclusions of the assessment are unchanged, if the revised version of Model B1 is accepted as the preferred model, the values of several key outputs change significantly:

1) Projected 2007 female spawning biomass for the BSAI stock is 351,000 t, up about 14% from the original version of Model B1.
2) Projected 2007 total age 3+ biomass for the BSAI stock is 1,080,000 t, up about 13% from the original version of Model B1.
3) The projected maximum permissible 2007 ABC for the BSAI stock is 202,000 t, up about 15% from the original version of Model B1.
4) The projected 2007 OFL for the BSAI stock is 238,000 t, up about 15% from the original version of Model B1.

MODEL EVALUATION

Goodness of Fit

The following table presents values of the various components of the objective function from the original and revised versions of Model B1 (except for the inclusion of the values for the revised version, this is a subset of Table 2.16 in the SAFE report; also, it should be noted that all log likelihood, log prior, and objective function values are multiplied by -1, meaning that a lower value indicates a better fit):

Objective function component	Original	Revised
pre-1982 shelf trawl survey abundance	0.40	0.37
post-1981 shelf trawl survey abundance	45.29	46.26
slope trawl survey abundance	0.22	0.22
Jan-May trawl fishery size composition	266.07	266.62
Jun-Dec trawl fishery size composition	440.95	438.00
longline fishery size composition	489.07	491.40
pot fishery size composition	172.44	171.95
pre-1982 shelf trawl survey size composition	35.18	35.25
post-1981 shelf trawl survey size composition	188.30	189.94
slope trawl survey size composition	1.17	1.17
post-1981 shelf trawl survey age composition	94.91	98.44
post-1981 shelf trawl survey size-at-age	420.83	414.33
recruitment	30.04	29.94
log priors	18.59	17.92
objective function (sum of the above)	2,203.47	2,201.80

It should be noted that the values in the above table are not strictly comparable, because different values of the parameters governing the distribution of recruitments were required for the two versions of Model B1 (see "Parameters Estimated Conditionally" in the Pacific cod chapter of the SAFE report). However, when the recruitment distribution parameters were held constant at the levels obtained in the original version, the results were similar to the above. In particular, it is clear that the revised version provides a better overall fit (lower objective function) than the original version, given that equal weights are assigned to the various components of the objective function.

With the above caveat in mind, the following conclusions emerge: Of the 14 components of the objective function, the revised version of Model B1 fit better than the original version in 7 cases, and the original version fit better than the revised version in the other 7 cases. The biggest single improvement between the two versions was in the post-1981 shelf trawl survey size-at-age component, where the revised version showed an improvement of 6.5 units relative to the original version.

For the length composition and age composition components of the likelihood, another way to assess goodness of fit is by comparing input sample sizes and "effective" output sample sizes (see Pacific cod chapter of the SAFE report). The following table shows the average of the input sample sizes (Input N) for each length or age composition component and the ratio between the average effective sample size and the average input sample size under the original and revised versions of Model B1 (a higher ratio implies a better fit):

Gear	Type	Input N	Original	Revised
Jan-May trawl fishery	Length	169	1.52	1.52
Jun-Dec trawl fishery	Length	42	1.99	2.03
longline fishery	Length	191	1.79	1.80
pot fishery	Length	100	2.44	2.48
pre-82 shelf survey	Length	100	0.64	0.64
post-81 shelf survey	Length	104	0.93	0.92
slope survey	Length	23	10.27	10.02
post-81 shelf survey	Age	94	0.60	0.55

Of the seven length composition components, the revised version of Model B1 had a higher ratio in three cases, the original version had a higher ratio in two cases, and the two versions had virtually identical ratios in two cases. For the age component, the original version had a higher ratio than the revised version. However, it is important to note that for the most recent year of age data (2005), both the original and revised versions gave excellent fits (effective N = 190 and 185 for the original and revised versions, respectively).

Final Parameter Estimates and Associated Schedules

The following table presents estimates of some key parameters from the original and revised versions of Model B1 (except for the last row and the inclusion of values for the revised version, this is a subset of Table 2.16 in the SAFE report):

Parameter	Original	Revised
Sigma(R)	0.62	0.63
ln(post-1976 Rmed)	13.62	13.70
ln(pre-1977 Rmed)-ln(post-1976 Rmed)	-1.18	-1.19
Pre-1982 shelf trawl survey catchability	0.97	0.89
Post-1981 shelf trawl survey catchability	0.57	0.52
Initial fishing mortality rate	0.075	0.069

The first three rows in the above table describe parameters governing the distribution of recruitments. The row labeled "Sigma(R)" shows the standard deviation of the distribution of log-scale recruitment deviations, the row labeled "ln(post-1976 Rmed)" shows the median log-scale recruitment for the post-1976 environmental regime, and the row labeled "ln(pre-1977 Rmed)-ln(post-1976 Rmed)" shows the log of the ratio of median log-scale recruitments between the pre-1977 and post-1976 environmental regimes (i.e., a negative value in this row means that median recruitment was lower in the pre-1977 regime than in the post-1976 regime).

The last three rows in the above table show the estimates of the shelf trawl survey catchability coefficient for the pre-1982 portion and post-1981 portions of the time series and the initial (equilibrium) fishing mortality rate.

Estimates of year-, season-, and gear-specific fishing mortality rates from the revised version of Model B1 are shown in Table 2.18, estimates of regime-specific median recruitments and annual recruitment deviations from the revised version of Model B1 are shown in Table 2.19, and estimates of selectivity parameters from the revised version of Model B1 are shown in Table 2.20.

Schedules of selectivity at length from the revised version of Model B1 are shown for the commercial fisheries in Table 2.21a and for the bottom trawl surveys in Table 2.21b. The schedules in Tables 2.21a and 2.21b are plotted in Figure 2.6.

Schedules of length at age, proportion mature at age, and weight at age from the revised version of Model B1 are shown in Table 2.22.

RESULTS

Definitions

The biomass estimates presented here will be defined in three ways: 1) age 3+ biomass, consisting of the biomass of all fish aged three years or greater in January of a given year; 2) spawning biomass, consisting of the biomass of all spawning females in a given year; and 3) survey biomass, consisting of the biomass of all fish that the model estimates should have been observed by the survey in July of a given year. The recruitment estimates presented here will be defined as numbers of age 0 fish in a given year. The fishing mortality rates presented here will be defined as full-selection, instantaneous fishing mortality rates expressed on a per annum scale. In all comparisons involving last year's results, it is important to note that table entries labeled "Last Year's Values" do not correspond to the values given in last year's SAFE report, because the values given in last year's SAFE report corresponded to the authors' preferred model, not the model chosen by the Plan Team and SSC. Instead, table entries labeled "Last Year's Values" correspond to the results given last year under the model chosen by the Plan Team and SSC.

Biomass

Table 2.23 shows the time series of EBS (not expanded to BSAI) Pacific cod age 3+ and female spawning biomass for the years 1977-2006 as estimated last year under the Plan Team's and SSC's preferred model and this year under the revised version of Model B1. In the case of female spawning biomass, the two estimated time series are accompanied by their respective 95% confidence intervals.

The estimated EBS female spawning biomass time series and confidence intervals from the revised version of Model B1 are shown, together with the revised version of Model B1's estimated time series of EBS age 3+ biomass, in Figure 2.7. Figure 2.7 also compares the observed and model-estimated time series from the EBS shelf bottom trawl survey. All three biomass trends estimated by the revised version of Model B1 are fairly flat from about 1992 through about 2004, but all three show a declining trend for at least the last couple of years.

The biomasses estimated by the revised version of Model B1 are significantly higher than those estimated by the original version. In the Pacific cod chapter of the SAFE report, Model A2 provides the most optimistic estimates of biomass, with the biomass estimates from Model A1 and the original versions of Models B1 and B2 close to one another but significantly below those of Model A2 (see Figure 2.3 of the SAFE report). In contrast, the revised version of Model B1 now provides the most optimistic estimates of biomass, slightly higher than the estimates from Model A2. While the reasons for the increased biomass estimates resulting from the revised version of Model B1 are likely complicated and inter-related, some key factors are likely as follows: There are five internally estimated parameters whose correlations with estimated 2006 female spawning biomass exceed 0.5 in absolute value: 1) the logarithm of the post-1981 shelf trawl survey catchability coefficient (correlation = –0.95), 2) post-1976 median log-scale recruitment (correlation = 0.89), 3) initial equilibrium fishing mortality rate (correlation = –0.75), 4) the logarithm of the pre-1982 shelf trawl survey catchability coefficient (correlation = –0.57), and 5) the width of the longline fishery selectivity peak during the years 1989-1999 (correlation = –0.55). Of these parameters, the estimates of all five changed in the direction that would tend to cause 2006 female spawning biomass to increase. Perhaps most significantly, the estimate of the post-1981 shelf trawl survey catchability coefficient changed from 0.57 to 0.52. Given that the post-1981 shelf trawl survey selectivity schedule was estimated to be approximately asymptotic in both the original and revised versions of Model B1, the change in the estimated value of the catchability coefficient could account for a major portion of the change in estimated biomass.

Recruitment

Table 2.24 shows the time series of EBS (not expanded to BSAI) Pacific cod age 0 recruitment (1000s of fish) for the years 1977-2005 as estimated last year under the Plan Team's and SSC's preferred model and this year under the revised version of Model B1. Both estimated time series are accompanied by their respective 95% confidence intervals.

The revised version of Model B1's recruitment estimates for the entire time series (1964-2005) are shown in Figure 2.8, along with their respective 95% confidence intervals and regime-specific averages. For the time series as a whole, the largest year classes appear to have been the 1976-1977 cohorts. Other large cohorts include the 1978, 1982, 1984, 1989, 1992, 1996, and 1999 year classes. Of the five classes spawned immediately after the strong 1999 year class, however, none have 95% confidence intervals that extend above the 1977-2005 average. One potential bright spot on the horizon is the 2005 year class, whose point estimate is just below the 1977-2005 average. However, its confidence interval is fairly large, since the only data currently available to estimate its strength is the size composition data from the 2006 shelf trawl survey.

To date, it has not been possible to estimate a reliable stock-recruitment relationship for this stock. With the move to SS2, prospects for future estimation of such a relationship should improve. In the interim, Figure 2.9 is provided to give some indication of the relationship between stock and recruitment. The Ricker (1954) curve shown in this figure (fit by maximum likelihood from the outputs of the stock assessment model, ignoring process error) is intended to be illustrative only, and is not recommended for management purposes.

Exploitation

Table 2.25 shows the time series of EBS Pacific cod catch divided by age 3+ biomass for the years 1977-2006 as estimated last year under the Plan Team's and SSC's preferred model and this year under the revised version of Model B1.

The average value of this ratio over the entire time series is about 0.11, slightly less than the average value of 0.13 obtained in the model chosen last year by the Plan Team and SSC. The estimated values exceed the average for every year after 1989 except 1993, whereas none of the estimated values exceed the average in any year prior to 1990. This finding is similar to that obtained in past assessments.

Figure 2.10 plots the trajectory of relative fishing mortality and relative female spawning biomass from 1977 through 2006 based on the revised version of Model B1, overlaid with the current harvest control rules (fishing mortality rates in the figure are standardized relative to $F_{35\%}$ and biomasses are standardized relative to $B_{35\%}$, per SSC request). The entire trajectory lies underneath both the F_{OFL} and $maxF_{ABC}$ control rules except for the years 1977 and 1978. It should be noted that the current harvest control rules did not go into effect until 1999.

PROJECTIONS AND HARVEST ALTERNATIVES

Amendment 56 Reference Points

Amendment 56 to the BSAI Groundfish Fishery Management Plan (FMP) defines the "overfishing level" (OFL), the fishing mortality rate used to set OFL (F_{OFL}), the maximum permissible ABC, and the fishing mortality rate used to set the maximum permissible ABC. The fishing mortality rate used to set ABC (F_{ABC}) may be less than this maximum permissible level, but not greater. Because reliable estimates of reference points related to maximum sustainable yield (MSY) are currently not available but reliable estimates of reference points related to spawning per recruit are available, Pacific cod in the BSAI are managed under Tier 3 of Amendment 56. Tier 3 uses the following reference points: $B_{40\%}$, equal to 40% of the equilibrium spawning biomass that would be obtained in the absence of fishing; $F_{35\%}$, equal to the fishing mortality rate that reduces the equilibrium level of spawning per recruit to 35% of the level that would be obtained in the absence of fishing; and $F_{40\%}$, equal to the fishing mortality rate that reduces the equilibrium level of spawning per recruit to 40% of the level that would be obtained in the absence of fishing. The following formulae apply under Tier 3:

3a)Stock status: $B/B_{40\%} > 1$

$F_{OFL} = F_{35\%}$

$F_{ABC} \leq F_{40\%}$

3b)Stock status: $0.05 < B/B_{40\%} \leq 1$

$F_{OFL} = F_{35\%} \times (B/B_{40\%} - 0.05) \times 1/0.95$

$F_{ABC} \leq F_{40\%} \times (B/B_{40\%} - 0.05) \times 1/0.95$

3c)Stock status: $B/B_{40\%} \leq 0.05$

$F_{OFL} = 0$

$F_{ABC} = 0$

Estimation of the $B_{40\%}$ reference point used in the above formulae requires an assumption regarding the equilibrium level of recruitment. In this assessment, it is assumed that the equilibrium level of recruitment is equal to the post-1976 average (i.e., the arithmetic mean of all estimated recruitments from year classes spawned in 1977 or later). Other useful biomass reference points which can be calculated using this assumption are $B_{100\%}$ and $B_{35\%}$, defined analogously to $B_{40\%}$. These reference points are estimated as follows, based on the revised version of Model B1:

Reference point:	$B_{35\%}$	$B_{40\%}$	$B_{100\%}$
BSAI:	300,000 t	343,000 t	858,000 t
EBS:	252,000 t	288,000 t	721,000 t

For a stock exploited by multiple gear types, estimation of $F_{35\%}$ and $F_{40\%}$ requires an assumption regarding the apportionment of fishing mortality among those gear types. For this assessment, the apportionment was based on the revised version of Model B1's estimates of fishing mortality by gear for the three most recent complete years of data (2003-2005). The average fishing mortality rates for those years implied that total fishing mortality was divided among the three main gear types according to the following percentages: trawl 30.1%, longline 59.5%, and pot 10.4%. This apportionment results in estimates of $F_{35\%}$ and $F_{40\%}$ equal to 0.41 and 0.34, respectively.

Short-Term Projections: Specification of OFL and Maximum Permissible ABC

The age 3+ biomass estimates for 2007 from the revised version of Model B1 are 1,080,000 t and 908,000 t for the BSAI and EBS, respectively.

BSAI spawning biomass for 2007 is estimated by the revised version of Model B1 at a value of 351,000 t (EBS value = 295,000 t). This is about 2% above the BSAI $B_{40\%}$ value of 343,000 t (EBS value = 288,000 t), thereby placing Pacific cod in Tier 3a. If the stock were fished at the maximum permissible rate, the model projects that spawning biomass would be about 13% below $B_{40\%}$ in 2008 (Tier 3b). Given this, the revised version of Model B1 estimates maximum permissible BSAI ABC, BSAI OFL, and the associated fishing mortality rates for 2007 and 2008 as follows:

Quantity	2007	2008
BSAI maximum permissible ABC	202,000 t	147,000 t
BSAI OFL	238,000 t	172,000 t
Fishing mortality rate at maximum permissible ABC	0.34	0.30
Fishing mortality rate at OFL	0.41	0.36

In the event that a 2007 ABC lower than the maximum permissible value is deemed advisable, the table below provides some short-term projections associated with a range of alternatives. The table shows projected annual values of ABC and OFL for different fixed levels of ABC in 2007, under the assumption that ABC would be set at the maximum permissible level thereafter. The fixed levels of 2007 ABC range from 200,000 t down to 160,000 t (all ABCs and OFLs are for the entire BSAI stock, and are shown in thousands of t). In all projections, both ABC and OFL are expected to increase after 2009, though it should be noted that these future increases are predicated on the assumption that future recruitments will tend to approximate the long-term (post-1976) average. The last two rows show the average for the years 2006-2009 and the coefficient of variation (ratio of standard deviation to average) for those same years. In general, lowering the 2007 ABC below the maximum permissible value would be expected to decrease both the projected average ABC and the projected coefficient of variation, though only slightly.

	2007 ABC=200		2007 ABC=190		2007 ABC=180		2007 ABC=170		2007 ABC=160	
Year	ABC	OFL	ABC	OFL	ABC	OFL	ABC	OFL	ABC	OFL
2006	194	230	194	230	194	230	194	230	194	230
2007	200	238	190	238	180	238	170	238	160	238
2008	147	173	151	177	154	181	157	185	161	189
2009	123	145	124	147	126	149	128	150	129	152
Ave.	166	196	165	198	164	199	162	201	161	202
CV	0.19	0.20	0.18	0.19	0.16	0.18	0.15	0.18	0.14	0.17

Long-Term Projections

Standard Harvest Scenarios

A standard set of projections is typically produced for each stock managed under Tiers 1, 2, or 3 of Amendment 56. This set of projections encompasses seven harvest scenarios designed to satisfy the requirements of Amendment 56, the National Environmental Policy Act, and the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA).

For each scenario, the projections begin with the vector of 2006 numbers at age estimated in the assessment. This vector is then projected forward to the beginning of 2007 using the schedules of natural mortality and selectivity described in the assessment and the best available estimate of total (year-end) catch for 2006. In each subsequent year, the fishing mortality rate is prescribed on the basis of the spawning biomass in that year and the respective harvest scenario. In each year, recruitment is drawn from an inverse Gaussian distribution whose parameters consist of maximum likelihood estimates determined from recruitments estimated in the assessment. Spawning biomass is computed in each year based on the time of peak spawning and the maturity and weight schedules described in the assessment. Total catch is assumed to equal the catch associated with the respective harvest scenario in all years. This projection scheme is run 1000 times to obtain distributions of possible future stock sizes, fishing mortality rates, and catches.

Five of the seven standard scenarios will be used in an Environmental Assessment prepared in conjunction with the final SAFE. These five scenarios, which are designed to provide a range of harvest alternatives that are likely to bracket the final TAC for 2007, are as follow ("*max* F_{ABC}" refers to the maximum permissible value of F_{ABC} under Amendment 56):

Scenario 1: In all future years, *F* is set equal to *max* F_{ABC}. (Rationale: Historically, TAC has been constrained by ABC, so this scenario provides a likely upper limit on future TACs.)

Scenario 2: In all future years, *F* is set equal to a constant fraction of *max* F_{ABC}, where this fraction is equal to the ratio of the F_{ABC} value for 2007 recommended in the assessment to the *max* F_{ABC} for 2007. (Note: Because no ABC recommendation is contained in this addendum, Scenario 2 is not included in the projections.)

Scenario 3: In all future years, *F* is set equal to 50% of *max* F_{ABC}. (Rationale: This scenario provides a likely lower bound on F_{ABC} that still allows future harvest rates to be adjusted downward when stocks fall below reference levels.)

Scenario 4: In all future years, *F* is set equal to the 2002-2006 average *F*. (Rationale: For some stocks, TAC can be well below ABC, and recent average *F* may provide a better indicator of F_{TAC} than F_{ABC}.)

Scenario 5: In all future years, *F* is set equal to zero. (Rationale: In extreme cases, TAC may be set at a level close to zero.)

Two other scenarios are needed to satisfy the MSFCMA's requirement to determine whether a stock is currently in an overfished condition or is approaching an overfished condition. These two scenarios are as follow (for Tier 3 stocks, the MSY level is defined as $B_{35\%}$):

Scenario 6: In all future years, *F* is set equal to F_{OFL}. (Rationale: This scenario determines whether a stock is overfished. If the stock is expected to be 1) above its MSY level in 2007 or 2) above ½ of its MSY level in 2007 and above its MSY level in 2017 under this scenario, then the stock is not overfished.)

Scenario 7: In 2007 and 2008, *F* is set equal to *max* F_{ABC}, and in all subsequent years, *F* is set equal to F_{OFL}. (Rationale: This scenario determines whether a stock is approaching an overfished condition. If the stock is expected to be above its MSY level in 2019 under this scenario, then the stock is not approaching an overfished condition.)

Projections corresponding to the standard scenarios are shown for the revised version of Model B1 in Tables 2.26-2.31.

Status Determination

Harvest Scenarios #6 and #7 are intended to permit determination of the status of a stock with respect to its minimum stock size threshold (MSST). Any stock that is below its MSST is defined to be *overfished*. Any stock that is expected to fall below its MSST in the next two years is defined to be *approaching* an overfished condition. Harvest Scenarios #6 and #7 are used in these determinations as follows:

Is the stock overfished? This depends on the stock's estimated spawning biomass in 2007:

a. If spawning biomass for 2007 is estimated to be below ½ $B_{35\%}$, the stock is below its MSST.
b. If spawning biomass for 2007 is estimated to be above $B_{35\%}$ the stock is above its MSST.
c. If spawning biomass for 2007 is estimated to be above ½ $B_{35\%}$ but below B35%, the stock's status relative to MSST is determined by referring to harvest Scenario #6 (Table 2.30). If

the mean spawning biomass for 2017 is below $B_{35\%}$, the stock is below its MSST. Otherwise, the stock is above its MSST.

Is the stock approaching an overfished condition? This is determined by referring to harvest Scenario #7 (Table 2.31):

a. If the mean spawning biomass for 2009 is below ½ $B_{35\%}$, the stock is approaching an overfished condition.

b. If the mean spawning biomass for 2009 is above $B_{35\%}$, the stock is not approaching an overfished condition.

c. If the mean spawning biomass for 2009 is above ½ $B_{35\%}$ but below $B_{35\%}$, the determination depends on the mean spawning biomass for 2019. If the mean spawning biomass for 2019 is below $B_{35\%}$, the stock is approaching an overfished condition. Otherwise, the stock is not approaching an overfished condition.

In the case of BSAI Pacific cod, spawning biomass for 2007 is estimated to be above $B_{35\%}$ under the revised version of Model B1. Therefore, the stock is above its MSST and is not overfished. Mean spawning biomass for 2009 in Table 2.31 is above ½ $B_{35\%}$ but below $B_{35\%}$, and mean spawning biomass for 2019 is above $B_{35\%}$. Therefore, the stock is not approaching an overfished condition.

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Mark Maunder identified the problem with the local minimum in the objective function for the original version of Model B1 that led to the need for this addendum. Anne Hollowed reviewed an earlier draft of this addendum.

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Table 2.18—Estimates of Pacific cod fishing mortality rates, expressed on an annual time scale (revised version of Model B1). Empty cells indicate that recorded catch was negligible or that no catch was recorded.

	Trawl			Longline			Pot		
Year	Sea. 1	Sea. 2	Sea. 3	Sea. 1	Sea. 2	Sea. 3	Sea. 1	Sea. 2	Sea. 3
1964	0.017	0.006	0.007	0.002	0.000	0.004			
1965	0.018	0.007	0.008	0.003	0.000	0.005			
1966	0.022	0.008	0.009	0.003	0.000	0.006			
1967	0.039	0.015	0.017	0.006	0.001	0.010			
1968	0.074	0.030	0.034	0.010	0.002	0.020			
1969	0.074	0.029	0.034	0.010	0.002	0.020			
1970	0.120	0.049	0.058	0.017	0.003	0.035			
1971	0.095	0.037	0.043	0.013	0.002	0.027			
1972	0.111	0.044	0.050	0.016	0.002	0.032			
1973	0.157	0.064	0.073	0.023	0.004	0.045			
1974	0.205	0.088	0.100	0.030	0.005	0.059			
1975	0.190	0.082	0.090	0.028	0.004	0.051			
1976	0.187	0.081	0.085	0.028	0.004	0.049			
1977	0.107	0.043	0.042	0.017	0.002	0.024			
1978	0.097	0.039	0.038	0.016	0.002	0.021			
1979	0.053	0.021	0.020	0.008	0.001	0.011			
1980	0.037	0.015	0.014	0.006	0.001	0.008			
1981	0.020	0.018	0.024	0.002	0.001	0.005			
1982	0.020	0.017	0.014	0.000	0.000	0.002			
1983	0.030	0.018	0.017	0.002	0.001	0.002			
1984	0.033	0.017	0.017	0.004	0.002	0.015			
1985	0.039	0.020	0.016	0.011	0.001	0.018			
1986	0.044	0.019	0.016	0.008	0.000	0.015			
1987	0.050	0.012	0.016	0.018	0.001	0.024			
1988	0.102	0.020	0.037	0.000	0.001	0.001			
1989	0.110	0.014	0.016	0.003	0.005	0.005	0.000	0.000	0.000
1990	0.098	0.010	0.010	0.012	0.017	0.018		0.001	0.000
1991	0.119	0.017	0.007	0.028	0.027	0.039	0.000	0.001	0.003
1992	0.079	0.015	0.008	0.067	0.036	0.010	0.004	0.007	0.000
1993	0.097	0.007	0.012	0.072	0.000	0.000	0.003	0.000	
1994	0.084	0.007	0.022	0.079	0.000	0.028	0.007		0.004
1995	0.118	0.011	0.015	0.088	0.000	0.039	0.017	0.005	0.005
1996	0.102	0.004	0.013	0.080	0.000	0.035	0.025	0.010	0.005
1997	0.107	0.005	0.011	0.091	0.000	0.064	0.020	0.006	0.005
1998	0.064	0.008	0.014	0.076	0.000	0.044	0.014	0.005	0.002
1999	0.065	0.005	0.005	0.081	0.003	0.036	0.015	0.002	0.003
2000	0.068	0.006	0.006	0.055	0.002	0.051	0.023		0.000
2001	0.033	0.009	0.007	0.048	0.008	0.054	0.015	0.001	0.005
2002	0.050	0.012	0.005	0.059	0.015	0.045	0.013	0.001	0.005
2003	0.045	0.012	0.004	0.062	0.013	0.051	0.019	0.000	0.008
2004	0.055	0.015	0.004	0.066	0.013	0.054	0.015	0.001	0.006
2005	0.062	0.009	0.001	0.068	0.018	0.065	0.016		0.007
2006	0.070	0.009	0.001	0.075	0.024	0.078	0.021		0.008

Table 2.19—Estimates of Pacific cod regime-specific median recruitments and recruitment deviations (revised version of Model B1). Deviations are expressed as the difference between the logarithm of annual recruitment at age 0 and the logarithm of median recruitment for the respective environmental regime.

Year	ln(Median Recruitment)	Annual Deviation
1964	12.505	-0.400
1965	12.505	-0.484
1966	12.505	-0.549
1967	12.505	-0.554
1968	12.505	-0.438
1969	12.505	-0.182
1970	12.505	-0.236
1971	12.505	-0.300
1972	12.505	-0.137
1973	12.505	0.474
1974	12.505	1.381
1975	12.505	-0.937
1976	12.505	2.337
1977	13.695	0.885
1978	13.695	0.422
1979	13.695	0.356
1980	13.695	-0.378
1981	13.695	0.294
1982	13.695	0.822
1983	13.695	-0.565
1984	13.695	0.574
1985	13.695	-0.500
1986	13.695	-0.560
1987	13.695	-0.779
1988	13.695	0.283
1989	13.695	0.503
1990	13.695	-0.043
1991	13.695	0.300
1992	13.695	0.380
1993	13.695	-0.606
1994	13.695	-0.183
1995	13.695	0.375
1996	13.695	0.483
1997	13.695	-0.131
1998	13.695	0.191
1999	13.695	0.400
2000	13.695	-0.262
2001	13.695	-0.394
2002	13.695	-0.467
2003	13.695	-0.549
2004	13.695	-0.812
2005	13.695	-0.012

Table 2.20—Estimates of Pacific cod selectivity parameters (revised version of Model B1). The first column lists the years defining the era for which the parameter values in that row are applicable. The eras for the commercial fisheries are 1964-1988, 1989-1999, and 2000-2006 (no eras *per se* are defined for the surveys, although separate shelf bottom trawl surveys are defined for the years prior to 1982 and after 1981). The second column lists the particular parameter being described. Four parameters define the shape of the selectivity function: the size at which selectivity first reaches a value of 1.0 ("*peak location*"), the logit transform of the region (within the range from *peak location* to the maximum length in the model) over which selectivity remains at a value of 1.0 ("logit(*peak width*)"), the log of the variance term in the ascending curve ("ln(*asc. variance*)"), and the log of the variance term in the descending curve ("ln(*des. variance*)"). See text for further description of these parameters and how they are used to define the selectivity function. The remaining columns correspond to the fishery or survey to which the values are applicable, using the following notation: TWL1 = January-May trawl fishery, TWL2 = June-December trawl fishery, LGL = longline fishery, POT = pot fishery, SRV1 = pre-1982 shelf trawl survey, SRV2 = post-1981 shelf trawl survey, and SRV3 = slope trawl survey.

Years	Parameter	TWL1	TWL2	LGL	POT
1964-1988	peak location	76.146	79.750	72.678	
1989-1999	peak location	78.018	75.708	69.589	70.632
2000-2006	peak location	80.240	80.629	66.091	65.856
1964-1988	logit(peak width)	-7.881	-0.144	-3.785	
1989-1999	logit(peak width)	-2.152	1.678	-1.271	-1.818
2000-2006	logit(peak width)	-8.250	1.279	-2.873	-8.209
1964-1988	ln(asc. variance)	6.323	6.406	5.523	
1989-1999	ln(asc. variance)	6.340	6.198	5.321	5.141
2000-2006	ln(asc. variance)	6.260	6.486	5.279	4.733
1964-1988	ln(des. variance)	6.308	5.719	6.267	
1989-1999	ln(des. variance)	6.054	4.059	6.423	6.576
2000-2006	ln(des. variance)	6.300	3.888	6.630	7.185

Years	Parameter	SRV1	SRV2	SRV3
n/a	peak location	40.233	44.403	55.756
n/a	logit(peak width)	-8.936	3.685	-1.425
n/a	ln(asc. variance)	5.255	7.083	4.221
n/a	ln(des. variance)	6.987	2.474	5.538

Table 2.21a—Schedules of Pacific cod selectivities at length in the commercial fisheries as defined by final parameter estimates (revised version of Model B1). Lengths (cm) correspond to mid-points of size bins. Len. = length, FOR = 1964-1988, DOM = 1989-1999, NEW = 2000-2006.

	Jan-May Trawl Fishery			Jun-Dec Trawl Fishery			Longline Fishery			Pot Fishery	
Len.	FOR	DOM	NEW	FOR	DOM	NEW	FOR	DOM	NEW	DOM	NEW
10.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22.5	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
25.5	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
28.5	0.02	0.01	0.01	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.00
31.5	0.03	0.02	0.01	0.02	0.02	0.03	0.00	0.00	0.00	0.00	0.00
34.5	0.04	0.04	0.02	0.03	0.03	0.04	0.00	0.00	0.01	0.00	0.00
37.5	0.07	0.06	0.03	0.05	0.05	0.06	0.01	0.01	0.02	0.00	0.00
40.5	0.10	0.08	0.05	0.08	0.08	0.09	0.02	0.02	0.04	0.00	0.00
43.5	0.15	0.12	0.08	0.11	0.12	0.12	0.03	0.04	0.07	0.01	0.01
47.5	0.23	0.19	0.13	0.18	0.20	0.19	0.08	0.09	0.17	0.04	0.05
52.5	0.37	0.32	0.23	0.29	0.33	0.30	0.20	0.24	0.39	0.15	0.21
57.5	0.54	0.48	0.37	0.44	0.51	0.44	0.40	0.49	0.69	0.36	0.54
62.5	0.72	0.65	0.55	0.61	0.70	0.61	0.66	0.78	0.94	0.68	0.91
67.5	0.87	0.82	0.73	0.78	0.87	0.77	0.90	0.98	1.00	0.94	1.00
72.5	0.98	0.95	0.89	0.92	0.98	0.90	1.00	1.00	0.97	1.00	0.97
77.5	1.00	1.00	0.99	0.99	1.00	0.99	0.97	1.00	0.89	0.99	0.90
82.5	0.93	0.99	0.99	1.00	1.00	1.00	0.85	0.95	0.76	0.93	0.81
87.5	0.79	0.90	0.91	1.00	1.00	1.00	0.68	0.84	0.61	0.81	0.70
92.5	0.61	0.72	0.76	0.99	1.00	1.00	0.50	0.68	0.46	0.66	0.58
97.5	0.44	0.52	0.58	0.87	1.00	1.00	0.33	0.51	0.32	0.50	0.47
102.5	0.28	0.33	0.40	0.65	0.86	0.76	0.20	0.35	0.21	0.36	0.36

Table 2.21b—Schedules of Pacific cod selectivities at length in the bottom trawl surveys as defined by final parameter estimates (revised version of Model B1). Lengths (cm) correspond to mid-points of size bins.

	Shelf Survey		
Length	pre-1982	post-1981	Slope
10.5	0.01	0.38	0.00
13.5	0.02	0.45	0.00
16.5	0.05	0.52	0.00
19.5	0.11	0.59	0.00
22.5	0.19	0.67	0.00
25.5	0.32	0.74	0.00
28.5	0.49	0.81	0.00
31.5	0.67	0.87	0.00
34.5	0.84	0.92	0.00
37.5	0.96	0.96	0.01
40.5	1.00	0.99	0.03
43.5	0.99	1.00	0.11
47.5	0.95	1.00	0.37
52.5	0.87	1.00	0.86
57.5	0.76	1.00	1.00
62.5	0.63	1.00	1.00
67.5	0.50	1.00	0.98
72.5	0.38	1.00	0.81
77.5	0.28	1.00	0.55
82.5	0.19	1.00	0.30
87.5	0.13	1.00	0.14
92.5	0.08	1.00	0.05
97.5	0.05	1.00	0.02
102.5	0.03	1.00	0.00

Table 2.22—Schedules of Pacific cod length (cm), proportion mature, and weight (kg) by season and age as estimated by the revised version of Model B1. Pop. = population, Sea. 1 = Jan-Jun, Sea. 2 = Jul-Aug, Sea. 3 = Sep-Dec, Beg. = beginning of season, Mid. = middle of season, S.Dev. = standard deviation, Mat. = proportion mature, Twl. = trawl fishery, Lgl. = longline fishery, pot = pot fishery, shelf = shelf survey, slope = slope survey.

		Length				Pop. Weight		Fishery Weight			Survey Wt.	
Sea.	Age	Beg.	Mid.	S.Dev.	Mat.	Beg.	Mid.	Twl.	Lgl.	Pot	Shelf	Slope
1	1	11.10	13.79	3.54	0.00	0.01	0.02	0.03	0.04	0.06	0.02	0.07
1	2	23.44	25.85	4.87	0.01	0.13	0.17	0.24	0.31	0.42	0.18	0.45
1	3	34.47	36.61	5.80	0.05	0.43	0.53	0.73	0.87	1.08	0.54	1.00
1	4	44.32	46.23	6.42	0.18	0.98	1.13	1.45	1.55	1.77	1.13	1.52
1	5	53.11	54.82	6.80	0.38	1.75	1.94	2.34	2.31	2.48	1.94	2.13
1	6	60.97	62.50	7.00	0.59	2.72	2.95	3.34	3.16	3.25	2.95	2.93
1	7	67.99	69.35	7.07	0.75	3.86	4.12	4.42	4.12	4.17	4.12	3.82
1	8	74.25	75.47	7.05	0.85	5.12	5.40	5.55	5.21	5.27	5.40	4.73
1	9	79.85	80.94	6.97	0.90	6.47	6.76	6.71	6.37	6.49	6.76	5.63
1	10	84.85	85.82	6.83	0.93	7.86	8.16	7.89	7.57	7.76	8.14	6.55
1	11	89.31	90.18	6.67	0.95	9.27	9.56	9.07	8.78	9.04	9.49	7.48
1	12	93.30	94.08	6.49	0.96	10.65	10.94	10.25	9.99	10.32	10.72	8.42
1	13	96.86	97.55	6.71	0.97	11.98	12.24	11.33	11.08	11.50	11.68	9.13
1	14	100.04	100.66	6.90	0.98	13.16	13.38	12.35	12.12	12.60	12.41	9.79
2	1	16.41	17.96	3.54		0.05	0.05	0.07	0.10	0.15	0.06	0.17
2	2	28.19	29.57	4.87		0.27	0.27	0.36	0.48	0.65	0.28	0.65
2	3	38.71	39.94	5.80		0.71	0.71	0.92	1.11	1.33	0.72	1.19
2	4	48.10	49.21	6.42		1.38	1.38	1.68	1.82	2.04	1.38	1.72
2	5	56.49	57.48	6.80		2.26	2.26	2.61	2.60	2.75	2.26	2.39
2	6	63.99	64.87	7.00		3.33	3.33	3.66	3.48	3.55	3.33	3.22
2	7	70.68	71.47	7.07		4.54	4.54	4.79	4.48	4.53	4.54	4.11
2	8	76.66	77.36	7.05		5.86	5.86	6.00	5.59	5.67	5.86	5.00
2	9	82.00	82.63	6.97		7.23	7.23	7.28	6.76	6.90	7.23	5.90
2	10	86.77	87.33	6.83		8.63	8.63	8.59	7.95	8.17	8.60	6.81
2	11	91.03	91.53	6.67		10.03	10.03	9.85	9.16	9.45	9.91	7.73
2	12	94.83	95.28	6.49		11.39	11.39	10.97	10.36	10.72	11.07	8.66
2	13	98.23	98.63	6.71		12.64	12.64	11.87	11.44	11.88	11.95	9.36
2	14	101.27	101.62	6.90		13.71	13.71	12.63	12.45	12.93	12.61	10.00
3	1	19.48	21.48	3.54		0.10	0.10	0.13	0.19	0.27	0.10	0.30
3	2	30.93	32.72	4.87		0.37	0.37	0.50	0.67	0.87	0.39	0.84
3	3	41.16	42.75	5.80		0.88	0.88	1.14	1.33	1.56	0.89	1.35
3	4	50.29	51.72	6.42		1.62	1.62	1.96	2.06	2.26	1.62	1.91
3	5	58.45	59.72	6.80		2.56	2.56	2.93	2.86	2.99	2.56	2.63
3	6	65.73	66.87	7.00		3.68	3.68	4.00	3.77	3.83	3.68	3.48
3	7	72.24	73.26	7.07		4.93	4.93	5.15	4.80	4.86	4.93	4.36
3	8	78.05	78.96	7.05		6.26	6.26	6.38	5.92	6.02	6.26	5.24
3	9	83.24	84.05	6.97		7.65	7.65	7.67	7.09	7.26	7.64	6.13
3	10	87.88	88.60	6.83		9.05	9.05	8.97	8.29	8.54	9.00	7.03
3	11	92.02	92.67	6.67		10.44	10.44	10.18	9.49	9.81	10.26	7.94
3	12	95.72	96.30	6.49		11.77	11.77	11.25	10.68	11.06	11.35	8.87
3	13	99.02	99.54	6.71		12.98	12.98	12.11	11.74	12.20	12.16	9.55
3	14	101.97	102.43	6.90		13.98	13.98	12.82	12.73	13.22	12.77	10.18

Table 2.23—Time series of EBS (not expanded to BSAI) Pacific cod age 3+ biomass and female spawning biomass for the years 1977-2006 as estimated last year under the Plan Team's and SSC's preferred model and this year under the revised version of Model B1, 1977-2006 (note that the entries labeled "Last Year's Values" do not correspond to the values given in last year's SAFE report, because the values given in last year's SAFE report corresponded to the authors' preferred model, not the model chosen by the Plan Team and SSC). The columns labeled "L95%CI" and "U95%CI" represent the bounds of the 95% confidence intervals of the female spawning biomass point estimates ("Mean").

	Last Year's Values				This Year's Values			
	Age 3+	Female Spawning Biomass			Age 3+	Female Spawning Biomass		
Year	Biomass	Mean	L95%CI	U95%CI	Biomass	Mean	L95%CI	U95%CI
1977	206,295	32,871	23,372	42,369	351,043	63,970	41,324	86,616
1978	249,016	48,058	36,761	59,354	413,578	88,355	60,761	115,949
1979	469,543	76,760	60,268	93,252	748,089	129,390	92,587	166,193
1980	891,564	134,915	109,848	159,982	1,158,690	203,880	152,721	255,039
1981	1,187,170	243,335	205,705	280,965	1,517,400	324,615	252,425	396,805
1982	1,472,030	381,235	330,376	432,094	1,803,040	472,195	375,383	569,007
1983	1,607,040	501,700	441,912	561,488	1,940,570	606,100	488,186	724,014
1984	1,625,670	567,600	504,904	630,296	2,008,660	684,250	553,518	814,982
1985	1,726,130	577,950	516,926	638,974	2,108,490	706,050	570,447	841,653
1986	1,674,350	565,500	508,045	622,955	2,052,550	701,450	565,308	837,592
1987	1,748,410	564,550	510,416	618,684	2,063,370	699,800	564,756	834,844
1988	1,706,510	564,450	513,092	615,808	1,962,320	688,100	555,996	820,204
1989	1,548,160	543,900	495,219	592,582	1,762,380	643,350	516,940	769,760
1990	1,359,840	513,600	468,179	559,021	1,550,070	590,400	472,457	708,343
1991	1,213,970	456,835	415,863	497,807	1,419,360	521,900	414,943	628,857
1992	1,152,860	375,875	339,795	411,955	1,343,810	437,945	342,257	533,633
1993	1,136,790	337,610	305,129	370,091	1,311,710	398,420	311,291	485,549
1994	1,160,790	346,000	315,330	376,670	1,357,450	402,690	320,606	484,774
1995	1,206,320	354,910	325,102	384,718	1,397,110	409,055	329,568	488,542
1996	1,118,340	344,020	314,354	373,686	1,306,820	398,060	319,530	476,590
1997	1,014,240	333,220	303,174	363,266	1,222,930	389,370	310,931	467,809
1998	906,286	296,725	266,672	326,778	1,170,450	359,855	281,849	437,861
1999	915,133	275,280	245,114	305,446	1,238,220	353,235	275,064	431,406
2000	901,674	266,385	235,573	297,197	1,275,970	364,415	284,616	444,214
2001	903,325	268,275	236,733	299,817	1,318,360	388,395	305,981	470,809
2002	962,447	275,295	243,594	306,996	1,390,490	413,955	329,578	498,332
2003	992,856	277,895	246,138	309,652	1,375,020	423,905	338,912	508,898
2004	954,107	284,915	252,345	317,485	1,305,670	423,950	339,499	508,402
2005	886,480	283,075	249,153	316,997	1,194,340	406,580	324,056	489,104
2006	n/a	n/a	n/a	n/a	1,061,930	370,620	291,470	449,770

Table 2.24—Time series of EBS (not expanded to BSAI) Pacific cod age 0 recruitment (1000s of fish) as estimated last year under the Plan Team's and SSC's preferred model and this year under the revised version of Model B1, 1977-2005 (note that the entries labeled "Last Year's Values" do not correspond to the values given in last year's SAFE report, because the values given in last year's SAFE report corresponded to the authors' preferred model, not the model chosen by the Plan Team and SSC). The columns labeled "L95%CI" and "U95%CI" represent the lower and upper bounds of the 95% confidence interval for each cohort.

	Last Year's Values			This Year's Values		
Year	Recruits	L95%CI	U95%CI	Recruits	L95%CI	U95%CI
1977	2,087,960	1,727,781	2,523,294	1,761,770	1,387,935	2,236,296
1978	522,535	312,677	873,249	1,109,022	814,494	1,510,054
1979	1,074,910	834,512	1,384,544	1,038,138	780,328	1,381,125
1980	370,327	233,561	587,207	498,211	328,889	754,705
1981	482,648	339,877	685,403	975,982	761,914	1,250,194
1982	1,637,790	1,407,769	1,905,306	1,654,235	1,370,367	1,996,905
1983	315,147	205,383	483,561	413,432	280,562	609,228
1984	1,494,730	1,285,365	1,738,179	1,291,338	1,074,664	1,551,698
1985	428,535	314,820	583,336	441,251	327,515	594,484
1986	286,273	206,672	396,524	415,638	312,832	552,229
1987	200,418	134,291	298,974	333,938	239,140	466,316
1988	658,175	544,584	795,467	965,730	799,657	1,166,293
1989	1,224,710	1,061,143	1,413,498	1,203,482	1,006,723	1,438,697
1990	657,983	532,483	813,062	696,888	555,982	873,505
1991	640,898	524,260	783,476	982,327	816,702	1,181,541
1992	1,031,550	898,553	1,184,225	1,063,770	891,879	1,268,789
1993	280,836	212,685	370,814	396,896	299,301	526,314
1994	351,743	280,394	441,241	605,736	484,720	756,965
1995	627,883	531,606	741,596	1,058,231	885,921	1,264,055
1996	878,950	767,880	1,006,078	1,179,663	1,000,228	1,391,288
1997	411,017	340,031	496,831	638,106	521,369	780,981
1998	631,846	539,514	739,979	880,891	736,783	1,053,186
1999	943,613	820,365	1,085,367	1,084,869	920,607	1,278,440
2000	693,481	586,035	820,616	559,825	459,265	682,403
2001	300,762	234,407	385,904	490,549	396,657	606,667
2002	411,992	323,510	524,669	455,878	357,802	580,837
2003	272,626	193,079	384,942	420,029	313,607	562,565
2004	435,093	279,269	677,917	322,804	203,525	511,987
2005	n/a	n/a	n/a	719,028	473,563	1,091,727

Table 2.25—Time series of EBS Pacific cod catch divided by age 3+ biomass as estimated last year under the Plan Team's and SSC's preferred model and this year under the revised version of Model B1, 1977-2006 (note that the entries labeled "Last Year's Values" do not correspond to the values given in last year's SAFE report, because the values given in last year's SAFE report corresponded to the authors' preferred model, not the model chosen by the Plan Team and SSC). The last entry in each column is based on partial catches for the respective year, because the year was/is still in progress at the time of the assessment.

Year	Last Year's Values	This Year's Values
1977	0.16	0.09
1978	0.18	0.11
1979	0.08	0.05
1980	0.05	0.04
1981	0.05	0.04
1982	0.04	0.03
1983	0.06	0.05
1984	0.08	0.06
1985	0.08	0.07
1986	0.08	0.07
1987	0.09	0.07
1988	0.12	0.10
1989	0.12	0.10
1990	0.13	0.11
1991	0.17	0.15
1992	0.14	0.12
1993	0.12	0.10
1994	0.15	0.13
1995	0.19	0.16
1996	0.19	0.16
1997	0.23	0.19
1998	0.17	0.14
1999	0.16	0.12
2000	0.17	0.12
2001	0.16	0.11
2002	0.17	0.12
2003	0.18	0.13
2004	0.19	0.14
2005	0.21	0.15
2006	n/a	0.17

Table 2.26—Projections for BSAI Pacific cod catch (t), spawning biomass (t), and fishing mortality under the assumption that $F = max\ F_{ABC}$ in 2007-2019 (Scenario 1, revised version of Model B1), with random variability in future recruitment.

Catch Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	202177	202177	202177	202177	0
2008	146631	146633	146633	146637	2
2009	122326	122442	122467	122696	123
2010	128134	130089	130500	134291	2062
2011	146015	159532	162265	187917	14275
2012	151208	190743	196680	254813	34570
2013	147045	211637	215344	292153	47496
2014	146719	222306	223346	310663	52716
2015	143933	226555	226422	319649	54141
2016	141309	227757	226885	316573	54654
2017	138005	228242	226612	317181	54440
2018	140107	228010	226382	316044	53670
2019	142048	226096	226467	314680	53266
Spawning Biomass Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	351030	351030	351030	351030	0
2008	298054	298057	298058	298065	4
2009	270924	271109	271150	271512	196
2010	269045	271193	271603	275663	2206
2011	279805	290702	292563	311675	10805
2012	284561	313179	317666	363014	26812
2013	282161	328721	335565	409764	42465
2014	281106	337205	345952	436202	51748
2015	279528	341082	351228	458079	55536
2016	276984	342811	353371	455675	56893
2017	275273	345934	354065	459002	57012
2018	276606	345196	354379	456690	56534
2019	278536	343963	354786	452836	56323
Fishing Mortality Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	0.344	0.344	0.344	0.344	0.000
2008	0.296	0.296	0.296	0.296	0.000
2009	0.268	0.268	0.268	0.268	0.000
2010	0.266	0.268	0.268	0.273	0.002
2011	0.277	0.288	0.290	0.311	0.011
2012	0.282	0.312	0.313	0.344	0.020
2013	0.279	0.329	0.322	0.344	0.023
2014	0.278	0.337	0.325	0.344	0.023
2015	0.277	0.342	0.326	0.344	0.024
2016	0.274	0.343	0.326	0.344	0.025
2017	0.272	0.344	0.326	0.344	0.025
2018	0.274	0.344	0.326	0.344	0.025
2019	0.276	0.344	0.327	0.344	0.024

Table 2.27—Projections for BSAI Pacific cod catch (t), spawning biomass (t), and fishing mortality under the assumption that $F = ½ \, max \, F_{ABC}$ in 2007-2019 (Scenario 3, revised version of Model B1), with random variability in future recruitment.

Catch Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	106861	106861	106861	106861	0
2008	94778	94779	94779	94781	1
2009	87552	87623	87639	87778	75
2010	93470	94670	94920	97244	1258
2011	106364	112903	113559	122734	5284
2012	111685	126312	128720	152360	14027
2013	111339	137077	140612	180362	22858
2014	112709	145004	148720	196286	27960
2015	112389	149535	153588	208758	30050
2016	112516	152162	156107	210268	30820
2017	110798	154942	157310	211714	30911
2018	112810	155006	157963	211042	30546
2019	114797	155083	158445	210132	30269
Spawning Biomass Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	358095	358095	358095	358095	0
2008	337303	337307	337308	337315	4
2009	324776	324964	325004	325371	198
2010	328882	331066	331483	335609	2242
2011	343719	355034	357008	377076	11310
2012	353957	385625	390842	441435	30093
2013	357439	415876	423455	511577	51787
2014	362618	440211	450044	566261	68121
2015	364740	459661	469754	606510	77513
2016	365743	472531	483444	627773	82312
2017	369268	483074	492753	638793	84378
2018	371193	491526	499257	647595	84785
2019	379278	495317	504021	652180	84665
Fishing Mortality Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	0.172	0.172	0.172	0.172	0.000
2008	0.165	0.165	0.165	0.165	0.000
2009	0.159	0.159	0.159	0.160	0.000
2010	0.161	0.163	0.163	0.165	0.001
2011	0.169	0.172	0.171	0.172	0.001
2012	0.172	0.172	0.172	0.172	0.000
2013	0.172	0.172	0.172	0.172	0.001
2014	0.172	0.172	0.172	0.172	0.001
2015	0.172	0.172	0.172	0.172	0.001
2016	0.172	0.172	0.172	0.172	0.002
2017	0.172	0.172	0.172	0.172	0.002
2018	0.172	0.172	0.172	0.172	0.002
2019	0.172	0.172	0.172	0.172	0.001

Table 2.28—Projections for BSAI Pacific cod catch (t), spawning biomass (t), and fishing mortality under the assumption that F = the 2002-2006 average in 2007-2019 (Scenario 4, revised version of Model B1), with random variability in future recruitment.

Catch Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	145949	145949	145949	145949	0
2008	128747	128747	128747	128747	0
2009	119535	119566	119573	119634	33
2010	124107	124970	125155	126832	907
2011	134297	141060	142393	154874	6938
2012	137439	157678	160982	193226	19187
2013	135834	170429	175070	228002	30337
2014	136789	179232	184109	246393	36090
2015	136509	184389	189143	259319	38074
2016	136271	186220	191483	259589	38645
2017	134709	189046	192455	260973	38536
2018	135863	189120	192918	260073	38087
2019	138538	188667	193326	258133	37848
Spawning Biomass Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	355276	355276	355276	355276	0
2008	320249	320253	320254	320261	4
2009	296636	296827	296869	297243	202
2010	292508	294748	295176	299410	2300
2011	301424	313020	315026	335464	11518
2012	307067	338961	344072	394224	29905
2013	307036	363805	370993	457406	49993
2014	309674	382477	391657	501585	63826
2015	308570	396276	405952	531814	70845
2016	310210	406483	415128	542257	73987
2017	311682	412665	420915	551201	75058
2018	312799	415582	424797	554755	74950
2019	317988	420855	427673	554323	74638
Fishing Mortality Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	0.240	0.240	0.240	0.240	0.000
2008	0.240	0.240	0.240	0.240	0.000
2009	0.240	0.240	0.240	0.240	0.000
2010	0.240	0.240	0.240	0.240	0.000
2011	0.240	0.240	0.240	0.240	0.000
2012	0.240	0.240	0.240	0.240	0.000
2013	0.240	0.240	0.240	0.240	0.000
2014	0.240	0.240	0.240	0.240	0.000
2015	0.240	0.240	0.240	0.240	0.000
2016	0.240	0.240	0.240	0.240	0.000
2017	0.240	0.240	0.240	0.240	0.000
2018	0.240	0.240	0.240	0.240	0.000
2019	0.240	0.240	0.240	0.240	0.000

Table 2.29—Projections for BSAI Pacific cod catch (t), spawning biomass (t), and fishing mortality under the assumption that $F = 0$ in 2007-2019 (Scenario 5, revised version of Model B1), with random variability in future recruitment.

Catch Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	0	0	0	0	0
2008	0	0	0	0	0
2009	0	0	0	0	0
2010	0	0	0	0	0
2011	0	0	0	0	0
2012	0	0	0	0	0
2013	0	0	0	0	0
2014	0	0	0	0	0
2015	0	0	0	0	0
2016	0	0	0	0	0
2017	0	0	0	0	0
2018	0	0	0	0	0
2019	0	0	0	0	0
Spawning Biomass Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	365315	365315	365315	365315	0
2008	384118	384122	384123	384130	4
2009	403483	403675	403716	404091	202
2010	432062	434306	434735	438975	2303
2011	468735	480475	482512	503244	11670
2012	502596	536384	541666	594932	31667
2013	529383	594759	602907	699452	57672
2014	554142	648553	659508	802237	81845
2015	573201	694521	707972	882233	100208
2016	586599	734476	747209	949262	112761
2017	601707	764145	777874	986769	120628
2018	614745	790359	801412	1016610	124915
2019	632262	805159	819277	1040890	126944
Fishing Mortality Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	0.000	0.000	0.000	0.000	0.000
2008	0.000	0.000	0.000	0.000	0.000
2009	0.000	0.000	0.000	0.000	0.000
2010	0.000	0.000	0.000	0.000	0.000
2011	0.000	0.000	0.000	0.000	0.000
2012	0.000	0.000	0.000	0.000	0.000
2013	0.000	0.000	0.000	0.000	0.000
2014	0.000	0.000	0.000	0.000	0.000
2015	0.000	0.000	0.000	0.000	0.000
2016	0.000	0.000	0.000	0.000	0.000
2017	0.000	0.000	0.000	0.000	0.000
2018	0.000	0.000	0.000	0.000	0.000
2019	0.000	0.000	0.000	0.000	0.000

Table 2.30—Projections for BSAI Pacific cod catch (t), spawning biomass (t), and fishing mortality under the assumption that $F = F_{OFL}$ in 2007-2019 (Scenario 6, revised version of Model B1), with random variability in future recruitment.

Catch Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	237943	237943	237943	237943	0
2008	158661	158663	158664	158667	2
2009	129086	129216	129244	129499	138
2010	135751	137944	138404	142656	2313
2011	155620	170748	173846	202604	16173
2012	160321	203792	211879	289181	41371
2013	154658	224246	232854	328183	57225
2014	153890	233188	240288	343610	62128
2015	150139	235450	242069	350339	62991
2016	147449	235214	241321	347722	63314
2017	142721	234217	240313	345219	62969
2018	145246	234747	239540	342364	62146
2019	147202	234462	239503	342474	61916
Spawning Biomass Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	348202	348202	348202	348202	0
2008	283969	283972	283973	283980	4
2009	254151	254336	254376	254737	195
2010	252015	254153	254562	258602	2195
2011	262579	273383	275227	294160	10703
2012	266378	294460	298791	342310	26072
2013	263122	307967	313850	382038	39652
2014	261756	313808	320814	401197	46222
2015	259380	315955	323187	412561	48078
2016	257126	316138	323297	411441	48441
2017	254626	316079	322751	411523	48118
2018	255968	315596	322390	408955	47483
2019	257507	314780	322499	406323	47236
Fishing Mortality Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	0.414	0.414	0.414	0.414	0.000
2008	0.339	0.339	0.339	0.339	0.000
2009	0.301	0.301	0.301	0.301	0.000
2010	0.298	0.301	0.301	0.306	0.003
2011	0.311	0.325	0.327	0.351	0.013
2012	0.316	0.352	0.356	0.413	0.027
2013	0.312	0.369	0.369	0.414	0.034
2014	0.310	0.376	0.373	0.414	0.036
2015	0.307	0.379	0.374	0.414	0.037
2016	0.304	0.379	0.374	0.414	0.038
2017	0.301	0.379	0.373	0.414	0.039
2018	0.303	0.379	0.373	0.414	0.038
2019	0.305	0.378	0.373	0.414	0.037

Table 2.31—Projections for BSAI Pacific cod catch (t), spawning biomass (t), and fishing mortality under the assumption that $F = max\ F_{ABC}$ in each year 2007-2008 and $F = F_{OFL}$ thereafter (Scenario 7, revised version of Model B1), with random variability in future recruitment.

Catch Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	202177	202177	202177	202177	0
2008	146631	146633	146633	146637	2
2009	144062	144198	144228	144495	144
2010	143499	145745	146217	150574	2369
2011	159161	174442	177564	206596	16292
2012	161364	204916	212936	289958	41240
2013	154674	224224	232738	327632	57087
2014	153679	232891	239975	343216	62089
2015	149885	235176	241832	350133	62990
2016	147310	235061	241183	347561	63318
2017	142642	234131	240240	345133	62971
2018	145200	234803	239504	342323	62147
2019	147181	234440	239485	342455	61916
Spawning Biomass Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	351030	351030	351030	351030	0
2008	298054	298057	298058	298065	4
2009	269414	269598	269639	269999	195
2010	260478	262612	263020	267053	2191
2011	266850	277637	279478	298378	10686
2012	268210	296264	300577	344029	26044
2013	263800	308574	314471	382590	39664
2014	261969	313960	321014	401447	46266
2015	259415	316015	323258	412769	48121
2016	257129	316149	323331	411597	48472
2017	254618	316086	322771	411660	48137
2018	255960	315598	322401	409000	47494
2019	257504	314784	322505	406327	47242
Fishing Mortality Projections					
Year	L90%CI	Median	Mean	U90%CI	Std. Dev.
2007	0.344	0.344	0.344	0.344	0.000
2008	0.296	0.296	0.296	0.296	0.000
2009	0.320	0.320	0.320	0.321	0.000
2010	0.309	0.311	0.312	0.317	0.003
2011	0.317	0.330	0.333	0.357	0.013
2012	0.319	0.354	0.358	0.414	0.027
2013	0.313	0.370	0.369	0.414	0.034
2014	0.311	0.377	0.373	0.414	0.036
2015	0.307	0.379	0.374	0.414	0.037
2016	0.304	0.379	0.374	0.414	0.038
2017	0.301	0.379	0.373	0.414	0.039
2018	0.303	0.379	0.373	0.414	0.038
2019	0.305	0.378	0.373	0.414	0.037

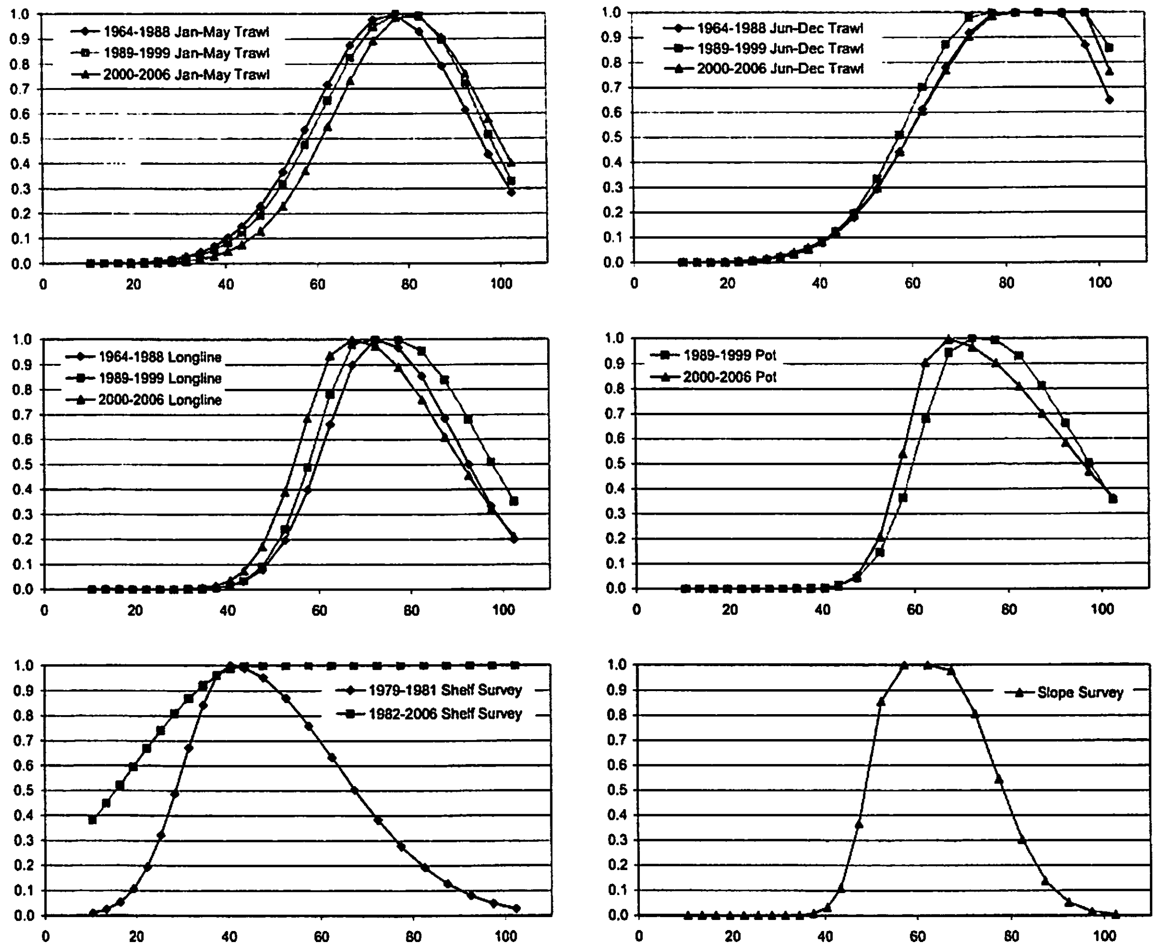

Figure 2.6—Selectivity at length (cm, evaluated at midpoints of length bins) as estimated by the revised version of Model B1.

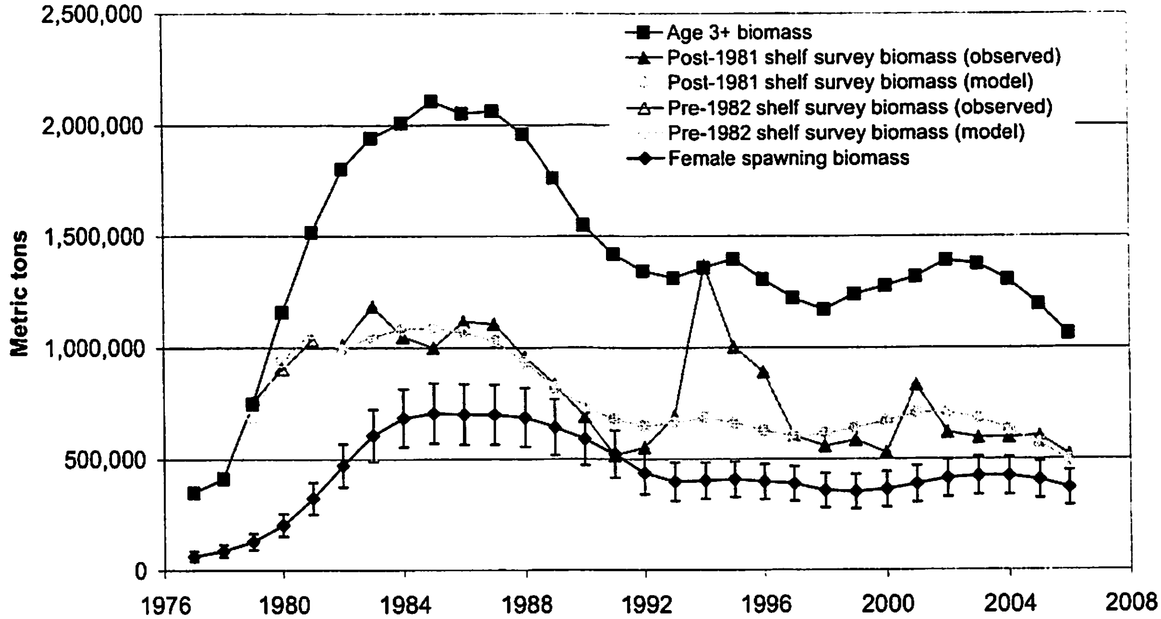

Figure 2.7—Biomass time trends (age 3+ biomass, female spawning biomass, survey biomass) of EBS Pacific cod as estimated by the revised version of Model B1.

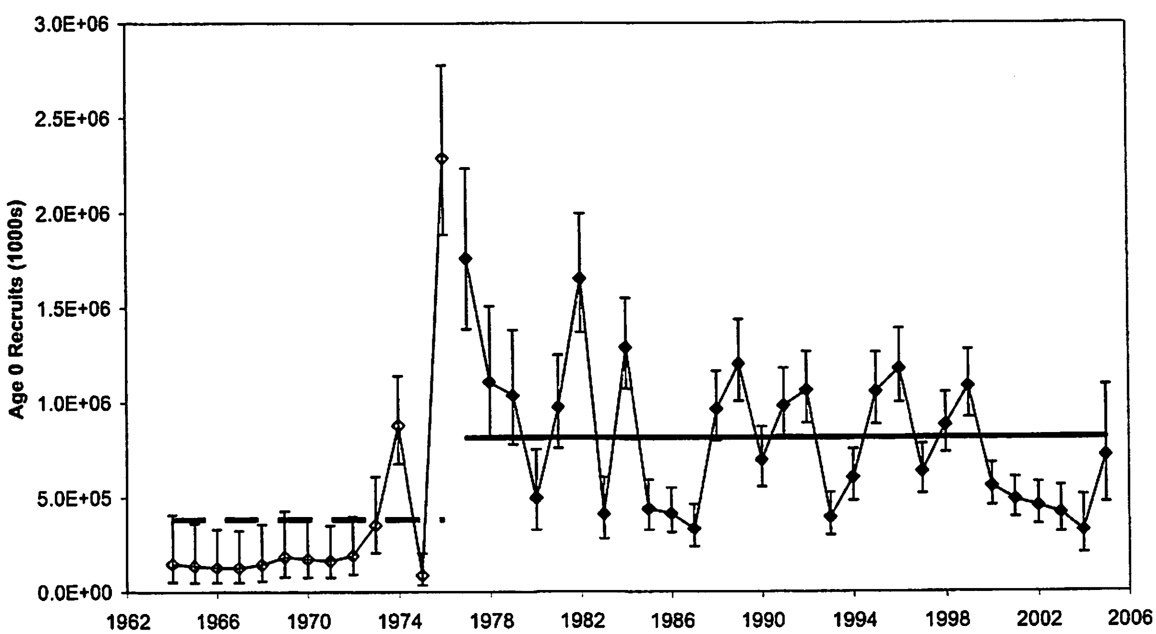

Figure 2.8—Time series of EBS Pacific cod recruitment at age 0, with 95% confidence intervals, as estimated by the revised version of Model B1.

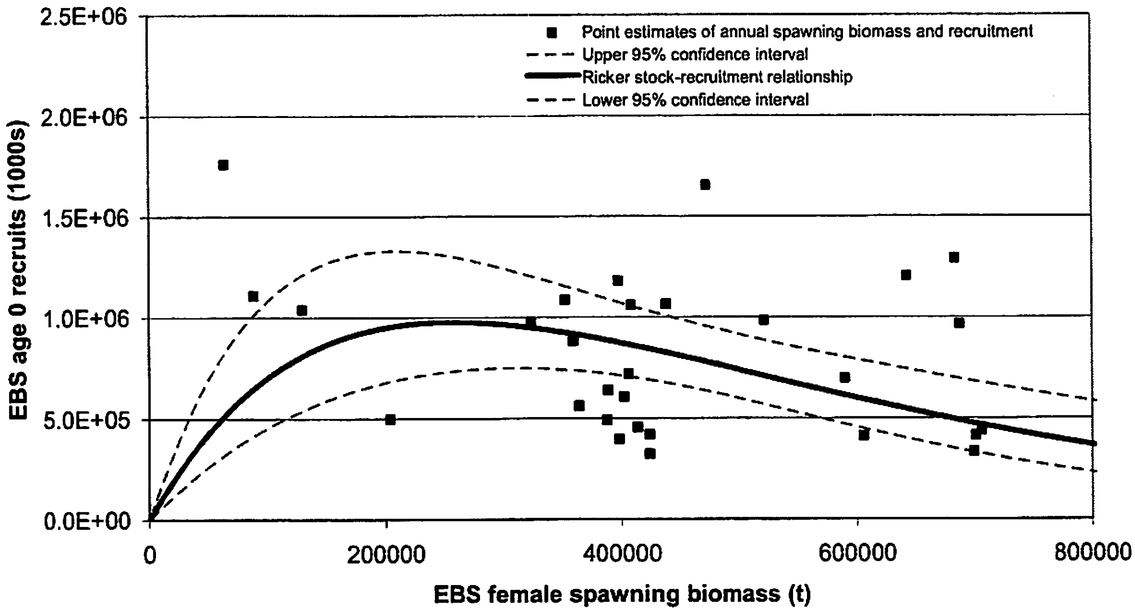

Figure 2.9—Age 0 recruitment versus female spawning biomass for Pacific cod during the years 1977-2005 as estimated by the revised version of Model B1, with Ricker stock-recruitment curve (for illustrative purposes only).

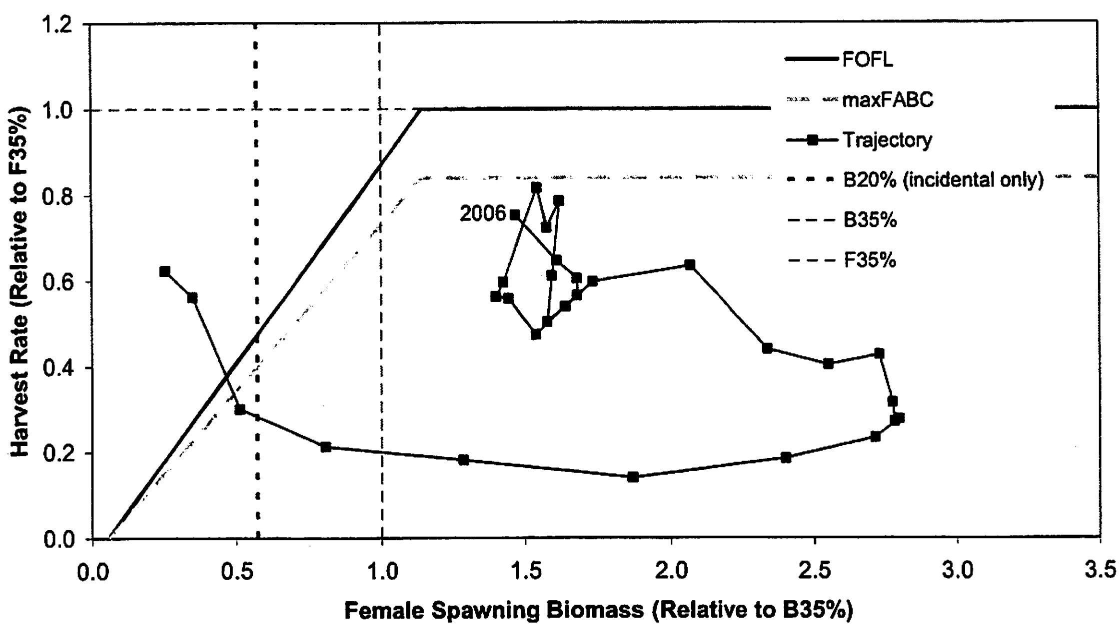

Figure 2.10—Trajectory of Pacific cod fishing mortality and female spawning biomass as estimated by the revised version of Model B1, 1977-present. Because Pacific cod is a key prey of Steller sea lions, harvests would be restricted to incidental catch in the event that spawning biomass fell below $B_{20\%}$.

HAND DELIVERY

December 7, 2006

Dr. Doug Demaster

Re: Recent Disturbances at the BSAI Plan Team Meeting.

Dear Doug:

We the undersigned members of the North Pacific seafood industry are writing to you in support of the Plan Team and its process; and to underscore the importance of this process to conservation of North Pacific fisheries and the sustainability of our industry.

It has been reported that at the most recent meeting of the BSAI Plan Team, a member of our industry was abusive and disruptive of the proceedings, going so far as to appear to threaten one of the assessment authors. We do not condone such behavior. The open process used by the Plan Team allows the public, including members of industry, to interact with the scientists every step of the way. This builds mutual trust and understanding between the industry and the scientists. This culture of mutual respect has fostered a climate that is the envy of most other regions of the country. It is the foundation of the science based management programs of the North Pacific, which are commonly cited as one of the most successful examples of fishery management any where in the world.

We wish to first inform you of our respect and appreciation for Dr. Grant Thompson. His scientific work is widely recognized as of the highest caliber. And, his personal integrity is above reproach. It is important to us that both you and he understand that he has the support of the North Pacific seafood industry.

Secondly, it is important to us that appropriate steps be taken to ensure that such behavior as occurred at the last Plan Team meeting not be repeated. We are hopeful that these steps can be directed at the individual involved, and not the entire industry. It would be unfortunate if the Plan Team process were undermined by the actions of one misguided individual. The transparency and the interactive working relationships at the Plan Team are crucial, in our view, to the successful scientific process employed in the North Pacific.

Thank you for your consideration of these views.

Sincerely;

Recent Disturbances at the BSAI Plan Team Meeting.

Kevin Duffy
At-sea Processors Association

Dave Benton
Marine Conservation Alliance

Julie Bonney
Alaska Groundfish Databank

Lori Swanson
Groundfish Forum, Inc.

Glenn Reed
Pacific Seafood Processors Association

Thorn Smith
North Pacific Longline Association

Brent Paine
United Catcher Boats

Shirley Marquhardt
City of Unalaska

Linda Kozak
Alaskan Leader Fisheries

Dave Fraser
Adak Fisheries

Gerry Merrigan
Prowler Fisheries

Simon Kinneen
Norton Sound Economic
Development Corporation

Cc: Bill Hogarth, Assistant Administrator for Fisheries, NOAA

Stephanie Madsen, Chair North Pacific Fishery Management Council

North Pacific Fishery Management Council

Stephanie Madsen, Chair
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December 28, 2005

Dr. Doug DeMaster
Alaska Fishery Science Center
7600 Sand Point Way NE, Bldg 4
Seattle, WA 98115

Dear Doug:

In December 2005, the Council requested that AFSC Auke Bay Laboratory scientists investigate a number of issues related to sablefish management in the Bering Sea and Aleutian Islands. The Council requested that ABL staff conduct experimental research in 2006 to determine the effectiveness of different size escape rings, soak times, and biodegradable panels, in conjunction with ongoing efforts to develop catch-per-unit-effort indices, for sablefish pot gear. The requested research could be summarized in a discussion paper or as an appendix to the sablefish chapter in the 2006 BSAI SAFE report, which could be reviewed by the BSAI Plan Team at its September 2006 meeting. The paper would address three potential changes to sablefish pot gear regulations based on research results. Potential changes include: 1) escape rings; 2) changes to required biodegradable panels; and 3) banning at-sea storage of pots.

In a separate action, Council staff was tasked with preparing an amendment to the BSAI Groundfish FMP. The amendment would allow the Council flexibility in setting the sablefish fixed gear/trawl allocations in the Bering Sea and Aleutian Islands management areas to allow for maximizing catch in the IFQ and CDQ fixed gear sectors, without leaving fish unharvested. Inclusion of more detailed information regarding the use of pot gear in the BSAI sablefish fisheries in the 2006 BSAI SAFE report would be extremely useful in developing that analysis.

On behalf of the Council, I would like to thank you and your staff for considering this request in setting 2006 research priorities. Your staff should contact Jane DiCosimo for assistance or additional information regarding these requests.

Sincerely,

Chris Oliver

Chris Oliver
Executive Director

cc: Phil Rigby

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SSC and AP Recommendations for BSAI Groundfish OFLs, ABCs, and TACs for the 2007-2008 Fisheries (mt)

Species	Area	2006				2007			2008		
		OFL	ABC	TAC	Catch**	OFL	ABC	TAC	OFL	ABC	TAC
Pollock	EBS	2,090,000	1,930,000	1,478,500	1,486,004	1,640,000	1,394,000	1,394,000	1,431,000	1,318,000	1,318,000
	AI	39,100	29,400	19,000	1,742	54,500	44,500	19,000	50,300	41,000	19,000
	Bogoslof	50,600	38,000	10	0	48,000	5,220	10	48,000	5,220	10
Pacific cod*	BSAI	230,000	194,000	189,768	186,882	207,000	176,000	170,720	154,000	131,000	127,070
Sablefish	BS	3,680	3,060	2,440	1,027	3,520	2,980	2,980	3,290	2,970	2,970
	AI	3,740	3,100	2,620	1,033	3,320	2,810	2,810	3,100	2,800	2,800
Yellowfin sole	BSAI	144,000	121,000	90,686	97,648	240,000	225,000	136,000	261,000	245,000	150,000
Greenland turbot	Total	14,200	2,740	3,500	1,935	15,600	2,440	2,440	16,000	2,490	2,490
	BS		1,890	2,700	1,433		1,680	1,680		1,720	1,720
	AI		850	800	502		760	760		770	770
Arrowtooth flounder	BSAI	166,000	136,000	12,000	12,794	193,000	158,000	20,000	208,000	171,000	30,000
Northern rock sole	BSAI	150,000	126,000	41,500	36,430	200,000	198,000	55,000	271,000	268,000	75,000
Flathead sole	BSAI	71,800	59,800	19,500	17,871	95,300	79,200	30,000	92,800	77,200	45,000
Alaska plaice	BSAI	237,000	188,000	8,000	17,263	241,000	190,000	25,000	252,000	199,000	60,000
Other flatfish	BSAI	24,200	18,100	3,500	3,155	28,500	21,400	10,000	28,500	21,400	21,400
Pacific Ocean perch	BSAI	17,600	14,800	12,600	12,784	26,100	21,900	19,900	25,600	21,600	21,600
	BS		2,960	1,400	1,036		4,160	2,160		4,080	4,080
	AI total		11,840	11,200	11,748		17,740	17,740		17,520	17,520
	WAI		5,372	5,085	5,495		7,720	7,720		7,620	7,620
	CAI		3,212	3,035	3,184		5,050	5,050		5,000	5,000
	EAI		3,256	3,080	3,069		4,970	4,970		4,900	4,900
Northern rockfish	BSAI	10,100	8,530	5,000	3,761	9,750	8,190	8,190	9,700	8,150	8,150
Shortraker	BSAI	774	580	596	202	564	424	424	564	424	424
Rougheye	BSAI	299	224	223	202	269	202	202	269	202	202
Other rockfish	BSAI	1,870	1,400	1,050	570	1,330	999	999	1,330	999	999
	BS		810	460	153		414	414		414	414
	AI		590	590	417		585	585		585	585
Atka mackerel	Total	130,000	110,000	63,000	61,117	86,900	74,000	63,000	64,200	54,900	54,900
	WAI		41,360	20,000	14,563		20,600	9,600		15,300	15,300
	CAI		46,860	35,500	39,230		29,600	29,600		22,000	22,000
	EAI/BS		21,780	7,500	7,324		23,800	23,800		17,600	17,600
Squid	BSAI	2,620	1,970	1,275	1,414	2,620	1,970	1,970	2,620	1,970	1,970
Other species	BSAI	93,800	70,400	29,000	26,469	91,700	68,800	37,355	91,700	68,800	58,015
Total	BSAI	3,481,383	3,057,104	1,983,768	1,970,303	3,188,973	2,676,035	2,000,000	3,014,973	2,642,125	2,000,000

*TAC reduced 3,000 mt for state water fishery **catch is through November 4, 2006 (includes CDQ).

#1 Ed Richardson PCC

Public Testimony Sign-Up Sheet
Agenda Item D-1 (c) BSAI Specs

	NAME (PLEASE PRINT)	AFFILIATION
1	BRENT PAINE	UCB
2	PAUL MacGregor	APA
3	LORI SWANSON	GFF
4	GLENN REED	PSPA
5	~~THORN SMITH~~	~~PSPA~~ PROHIBITED SPECIES CONSERVATION COOP.
6	Jon Warrenchuk	Oceana
7	Michelle Ridgway	ADACC
8	Donna Parker	Arctic Storm
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NOTE to persons providing oral or written testimony to the Council: Section 307(1)(I) of the Magnuson-Stevens Fishery Conservation and Management Act prohibits any person " to knowingly and willfully submit to a Council, the Secretary, or the Governor of a State false information (including, but not limited to, false information regarding the capacity and extent to which a United State fish processor, on an annual basis, will process a portion of the optimum yield of a fishery that will be harvested by fishing vessels of the United States) regarding any matter that the Council, Secretary, or Governor is considering in the course of carrying out this Act.

Draft BSAI Team minutes
Nov 16-17, 2006

The Bering Sea Team reviewed the joint **sablefish** assessment and **BSAI Pacific cod** assessments jointly with the GOA Plan Team. BSAI Team comments are in the Joint Team minutes for these two species.

Pollock The Team reviewed separate assessments for Eastern Bering Sea, Aleutian Island, and Bogoslof pollock stocks. Jim Ianelli summarized three alternative models presented in this year's EBS assessment. The Team concurred with author's recommendation for Model 2, which added stations to cover pollock in strata 8 and 9 (NW of standard strata) 40 mi strongly to the east and north. Those stations should also be fished in future surveys and included in future models. The Team discussion application of tier 1 and tier 3 to the EBS pollock stock. The SSC determined Tier 1 status for this stock has been acceptable, but the Team has recommended Tier 3 and maxABC for the last 4-5 years. Tier 1 does not reduce the exploitation rate when the population is below $B_{40\%}$.. The Team accepted Tier 1 for the EBS stock.

Having accepted Tier 1 status, there was not consensus on how to set the ABC. The author's method for setting the maximum permissible ABC harvest rate was unchanged. For the last five years, ABC for this stock has been set at the maximum. Ultimately, the Team endorsed the authors' recommendation to set ABC at 1,300,000 t, rather than at the maximum permissible value. A range of ABC values from 1,200,000 – 1,512,000 t were discussed by Plan Team, with arguments offered in support of candidate values spanning the full range.

The Team recognized that the ecosystem has fundamentally changed and discussed whether to apply the new model (with additional strata) to the new ecosystem regime. Public comment suggested that the Team take a retrospective view because the EBS pollock fishery had occurred in the northwest portion of the EBS in the past. Another public comment suggested that a disproportionate amount of harvest was coming out of Catcher Vessel Operating Area. Chronological changes in sea ice cover, with indicators such as zooplankton, forage fish, and pollock recruitment, have illustrated lower EBS productivity during last several years in the EBS, in general. The Team recognized lower than expected estimated biomass in both the bottom trawl survey and echo-integration survey, the change in population distribution.

A catch of 1,300,000 t would maintain the spawning exploitation rate at the current level. In contrast, the F40% ABC recommendation of 1,390,000 t and the maximum permissible value of 1,512,000 t would increase spawning exploitation rate to the highest values since 1980. On the other hand, an ABC of 1,300,000 t does not preserve markedly more spawning biomass compared to the $F_{40\%}$ ABC recommendation of 1,394,000 t (Figure 1.45). One reason was cited for recommending an ABC equal the maximum permissible value; the 2007 female spawning biomass is near Bmsy, which is the target spawning biomass. The Team chose to accept the senior author's recommendation of 1,300,000 t for an ABC less than the maximum permissible value and to maintain the spawning exploitation rate at the current level. However there was not consensus on this recommendation, as the effect of projected fixed annual catches of 1.2, 1.3, and 1.4 million t on female spawning biomass are relatively close when projected two years forward.

Steve Barbeaux reviewed the assessment for the Aleutian Island pollock stock. The Team accepted Tier 5 status for this stock. The author revised M from 0.3 to 0.235 based on lower productivity of the AI stock from ecosystem modeling and the assessment's model of M. The Team encourages the author to continue his exploration of age-structured models. The Team concurred with the SSC in that adoption of such a model was precluded until greater confidence in the stock structure and spatial distribution of pollock was expressed. The Team supports continuation of the experimental fishery survey and genetic studies to resolve pollock stock structure.

Jim Ianelli presented the Bogoslof pollock assessment of two age-structured models. The two models differed in whether a portion of Donut Hole catches were excluded (Model 1) or included (Model 2). Both models imply that age 5+ biomass peaked in 1983, and is supported largely by an enormous 1978 year class (more than 5 times larger than any subsequent year class). Following a decline from the 1983 peak, biomass appears to have been fairly stable since about 1992. The Team supported the authors' examination of these models, but felt that adoption of any of the models is premature in part, because the portion of the catch data from the "Donut Hole" area included in the model is uncertain. It is uncertain whether Bogoslof pollock can be usefully modeled as a closed stock because the amount of interchange with pollock in the Bering Sea is unknown. The Team accepted Tier 5 status for this stock. The Team concurs with the SSC's approach for a more conservative approach than setting ABC at the maximum permissible.

Flatfish Tom Wilderbuer summarized the *yellowfin sole* assessment. For this assessment 7 different configurations of the stock assessment model were considered, all of which differ in the estimation process of catchability and natural mortality. Model 1 is the base model which has been used in past assessments and operates by fixing M at 0.12 and then estimates q using the relationship between survey catchability and the annual average water temperature at the sea floor. The team accepted the authors' recommendation to use Model 1, the model the Team has supported in previous assessments. The team extensively discussed whether to manage this stock in Tier 1 or Tier 3 in the 2007 fishing season. The assessment presentation included 2 analyses of the Tier 1 application to yellowfin sole. The first was a management strategy evaluation of the sensitivity of the Tier 1 methodology to changes in the underlying productivity of a fish stock using two productivity regimes estimated from two distinct yellowfin sole spawner-recruit time series, and the second was an evaluation of the effect of uncertainty in key parameters on the estimate of the harmonic mean of F_{MSY}. The results of these analyses indicated that 1) the Tier 1 harvest policy is conservative with respect to underlying changes in stock productivity (at least for flatfish recruitment dynamics), and 2) F_{MSY} is fairly well estimated in the yellowfin sole stock assessment model. These analyses give support for applying a Tier 1 harvest policy for this stock. However, the Team concurred with the authors that a Tier 1 harvest policy for this stock is not appropriate for setting harvest specifications because:

1) while the stock was more productive at lower biomasses in the late 1960s and early 1970s(low biomass resulted from high Japanese fishery catches), we have only seen a single recruitment recovery occur and it is uncertain that in the future we would be in the same productive environmental regime;

2) the recommended Tier 1 harvest is sensitive to which spawner-recruit time series is used;

3) In a Management Strategy evaluation (MSE), productivity regimes were very narrow – we would need to wait 50 years to see the same down cycle again; and it may not be representative of productivity regimes in the future. Dorn et al. (2004) reported that the current harvest strategy where environmental change is not explicitly modeled is robust to underlying changes in stock productivity. The team commended the authors for evaluating Tier 1 and encourages continued exploration of the approach. A review is planned for spring 2007 for all BSAI and GOA flatfishes by the Center for Independent Experts, and a review of Tier 1 for yellowfin sole could be further examined by the panel. Tier 1 appears to be conservative and would likely underharvest the stock. The Team agreed with the authors' recommendations for OFLs and ABCs for all the flatfish assessments.

An update of last year's *arrowtooth flounder* assessment was accepted by the Team. Kerim Aydin summarized ecosystem issues for Arrowtooth flounder, and noted strong diet interactions with pollock, particularly in the BS. While this is not seen in the GOA, they are a top predator in the AI.

An update of last year's *northern rock sole* assessment was accepted by the Team. The SSC requested an MSE to explore the consequences of a non-stationary spawner-recruit relationship. An analysis of Tier 1 spawner-recruit considerations gave results similar to the yellowfin sole analysis discussed above where a Tier 1 harvest policy would drive the stock to a low level (B_{MSY}) where the stock was productive in the past but has only been observed once. Rock sole recruitment appears to relate to environmental fluctuations of a relatively short time scale. This stock, given the current time-series of assessment information, is not considered appropriate for Tier 1 management.

Buck Stockhausen examined a new model for flathead sole which disaggregated age classes. The Team recommended use of the improved model. In response to SSC comments, he examined the distribution of Bering flounder with respect to the fishery. The northerly distribution of the species did not seem to overlap the spatial distribution of the fishery, although mismatch in seasonal timing of the survey versus the fishery means that this is not conclusive.

Rockfish Paul Spencer presented a revised *Pacific ocean perch* assessment. A number of CIE comments were addressed in this assessment. The team reviewed the three proposed models. Difference between Models 1 and 2 is varying selectivities. Rebuilding of the AI POP is occurring to a greater degree than in the GOA. The Team concurred with the author's recommendation. Model 3 is similar to that used for POP in the GOA. The Teams accepted model results for the remaining rockfish stocks.

Atka mackerel Since 2001, year-class size is forecast to be below average. The Team discussed the continued decline of Steller sea lions in the western AI and its concern that fishing effort for Atka mackerel continues to be spatially distributed. Subarea ABCs and seasonal apportionments, critical habitat catch limits, rookery and haul-out trawl exclusion zones are designed to minimize the likelihood of localized depletion of SSL prey resources.

Squid and other species The Team recommended that squid, an important forage species, continue to be managed under Tier 6, and the remaining other species to be managed under the sum of ABCs for the four groups. A six-year average biomass for sculpins was used for ABC and OFL calculations. Starting in 2008, BS and AI observers will identify Hemitripteridae to species in observed catches. The fishery takes large sculpins in the AI Atka mackerel fishery, and in the BS and AI Pacific cod longline and bottom trawl fisheries. In the EBS, The survey has expanded north almost to St. Lawrence, and may result in changed abundances. The survey also does good job of assessing biomass, particularly for the more abundant species.

The authors were concerned about the high variability of octopus and shark biomass estimates based on trawl surveys and provided alternative Tier 6 approaches. There was not enough data to develop distribution maps by octopus species, although some depth gradation was noted. Liz Connors recommended not applying either Tier 5 or 6 for cephalopods. Incidental catch is predominantly taken by pot gear linked with cod allocations. Ivan Vining reported that the State is looking at developing an octopus fishery in state waters. She developed a new tier 6 calculation and recommended setting TAC < ABC to allow for an experimental fishery. Trawl gear is not accurate for octopus. Because the biomass is higher than sampled, Tier 5 would be conservative. But the ABC should be set on true biomass. The Team considers the average survey biomass as a likely minimum estimate of sharks and octopus since the majority of catch consists of smaller individuals. The Team continues to support a proposed plan amendment in 2007 to manage these at the group level.

Dean Courtney reviewed the shark assessment. An alternative tier 6 approach was investigated because of the inadequacy of using Tier 6. Last year, the Team reported that the biomass estimate is unreliable (low) because only small sharks are caught in trawl gear, so because the estimate is a conservative minimum, it is consistent with our approach.

Gerald Hoff summarized his study on skate nurseries along the shelf-slope interface. This environment and the stable slope temperature provide the critical physical criteria necessary for successful protracted reproductive cycles and embryo development times. The constant water current prevents egg cases from being covered by sediments and provides a mechanism to remove waste products while supplying oxygen to the developing embryos. After hatching the neonates move to the middle shelf region, utilizing this habitat during the juvenile life stage until maturation, upon which they move back to deeper water. Beth Matta presented the skate assessment. She intends to incorporate a number of additions to next year's assessment.

The Team adopted IPHC recommendations for 2007-2009 non-CDQ fishery halibut discard mortality rates and 2007 CDQ fishery DMRs in September 2006.

D1e - BSAI SPECS

December 11, 2006

Good morning Madam Chair and members of the Council. My name is Ed Richardson, and I'm speaking on behalf of the Pollock Conservation Cooperative, an association of seafood companies that catches and processes about half of the BSAI pollock TAC.

Madam Chair, our member companies support that BSAI TAC sheet that has been provided to you by the AP. The AP supports the BSAI ABCs that the SSC has provided, and also supports setting the 2007 pollock TAC at the ABC.

Madam Chair, The AP TAC sheet is simply the latest version of the "Alaska Model" of sustainable fisheries management that was so justifiably celebrated last night on the occasion of the Council's 30th anniversary. The stock assessment models on which the OFLs and ABCs are based incorporate all of the elements in the ~~NMFS~~ National Standard One guidelines, most of which were placed into law by the 1996 Sustainable Fisheries Act. These assessment models represent the state of the art as regards a precautionary approach to fisheries management.

Now as the Council also knows, all of the models and the results they generate receive extensive peer review, starting with an internal review by NMFS stock assessment scientists. Then there is a second round of review at the NPFMC-sponsored Plan Team meetings. The second-round review brings in stock assessment experts from regional and state-level institutions. Finally, the model and its results are reviewed by the Council's own SSC, on which sit fishery management experts from the wider university community and from throughout the US.

Now speaking specifically about the model used to assess the eastern Bering Sea pollock stock, the model has been shown year in and year out to track the EBS pollock biomass well. And then this year new backward-looking analysis shows that its one- and two-year out biomass projections are typically biased-low, thus providing conservative future short-term ABC recommendations.

Even though the stock biomass has begun to decline, the decline started from levels that represent that highest age 3+ biomasses in the history of the assessment. Even with the maximum permissible 1.5 million ton harvest for 2007, the stock is projected to remain above its target size, which is the biomass that is associated with the maximum sustainable yield. The Figure on page six of the SSC minutes shows this, although the axis labels do not show the correct year.

Madam Chair, I'd like to focus now with the remainder of my time on some of the perhaps confusing aspects of the Plan Team presentation. And the first item is the management TIER. The management TIER provides an important guidepost in understanding what the pollock model is telling us, and EBS pollock are managed in TIER 1. So when TIER 3 numbers are put up on the screen they are simply irrelevant, and serve only to confuse. The SSC decides the management TIER. The SSC expects Plan Team advice about this. The Plan Team advised that EBS pollock is a TIER 1 stock. The SSC agreed, and is in fact has been managing EBS pollock as a TIER 1 stock for five years.

Now the guidepost is the TIER 1 maximum permissible ABC, and this is based on an Fmsy harvest strategy. This ABC is 1.512 million tons. As Dr. Ianelli stated yesterday, this number is precautionary. Its precautionary because over the past ten years the SSC has supervised the construction of a very precautionary stock assessment model. Its a model that gives you a precautionary harvest at the maximum permissible level, and the SSC knows this.

Madam Chair, largely due to concerns about unusual environmental conditions in the Bering Sea during 2006, the SSC this year chose to set the ABC based on an F40 harvest strategy. Its more precautionary than the Fmsy strategy. This ABC is 1.394 million tons, and reduced an already precautionary model-generated maximum permissible ABC by about 120,000 tons. So the SSC has provided a double-dose of precaution with its recommendation for 2007. With regard to the stock spawning biomass, both the Plan Team and the SSC noted that reducing the

harvest by a further 100,000 tons, which would approximate an F50 harvest strategy, and was suggested by Dr. Ianelli, would have virtually no effect on the spawning biomass in the out years.
An F50 harvest strategy is one that might be considered for rockfish!

Madam Chair, there was also a question from Mr. Oliver that I think did not receive a good response, and I think the situation led to further concerns on the part of Mr. Rassmusen about the level of precaution that the assessment provides. And this question went I think something like,

With the stock biomass coming down, and with the low water-column survey, I don't see where the ABC is coming down in a commensurate way.

Now Madam Chair, to see how the 2007 ABC has come down, you have to make an apples-to-apples comparison, and to do this you need to go back to this time last year and get the maximum permissible TIER 1 ABC that the model projected for 2007 -- next year. And this number was 1.79 million tons. Now we move ahead to today, we put new data from the 2005 fishery in the model, and then also the 2006 surveys, which included a lower-than-predicted water column survey. And what we get from the model is a maximum permissible TIER 1 ABC that is 1.512 million tons. There Madam Chair is the effect of the low 2006 EIT survey -- a reduction in the TIER 1 guidepost of about 280,000 tons.

Madam Chair, there was also an observation from Mr. Twight that may not have come across in a clear way. And the observation was that as the maximum permissible pollock ABC comes down from very high levels -- levels too high to be harvested under the 2 million ton OY cap -- we would expect that fishing mortality rates on the spawning stock will be increased. And this is because a much larger fraction of the maximum permissible TIER 1 ABC can be harvested. And this is correct. The only further comment I would make is that the fishing mortality rate on the exploitable stock will also increase. And Madam Chair, this is how we manage our fisheries here in Alaska. We set a harvest strategy based on the entire exploitable biomass. Spawning stock fishing mortality rates are not part of our harvest control rules. In fact, Dr. Ianelli's assessment is the only one where you will find this index. Now it may be something to keep track of, but as the SSC said in its discussion, there is really nothing special about fishing on the spawning stock at a rate of 20 verses 23 percent.

So to quickly summarize Madam Chair, we believe that every year there are concerns about changes in the observed environment in the Bering Sea. In some cases, these changes may justify further precaution in the setting of the EBS pollock ABC. But in most cases, the simple existence of theories or hypotheses about negative future impacts of fishing on the pollock stock are very-well addressed by the precautionary nature of the model structure and the harvest control rules. Our companies support the development of precautionary models. But the downside is that people tend to forget the maximum permissible ABCs that the models produce are precautionary. For EBS pollock, the F40 harvest strategy recommended by the SSC contains a double-dose of precaution. The F50 strategy suggested by Dr. Ianelli heaps precaution on top of precaution on top of precaution.

Madam Chair, its understandable that the Council seeks to be precautionary. But Madam Chair, the SSC has beat you to the punch.

Madam Chair, thanks for the opportunity to provide our views.

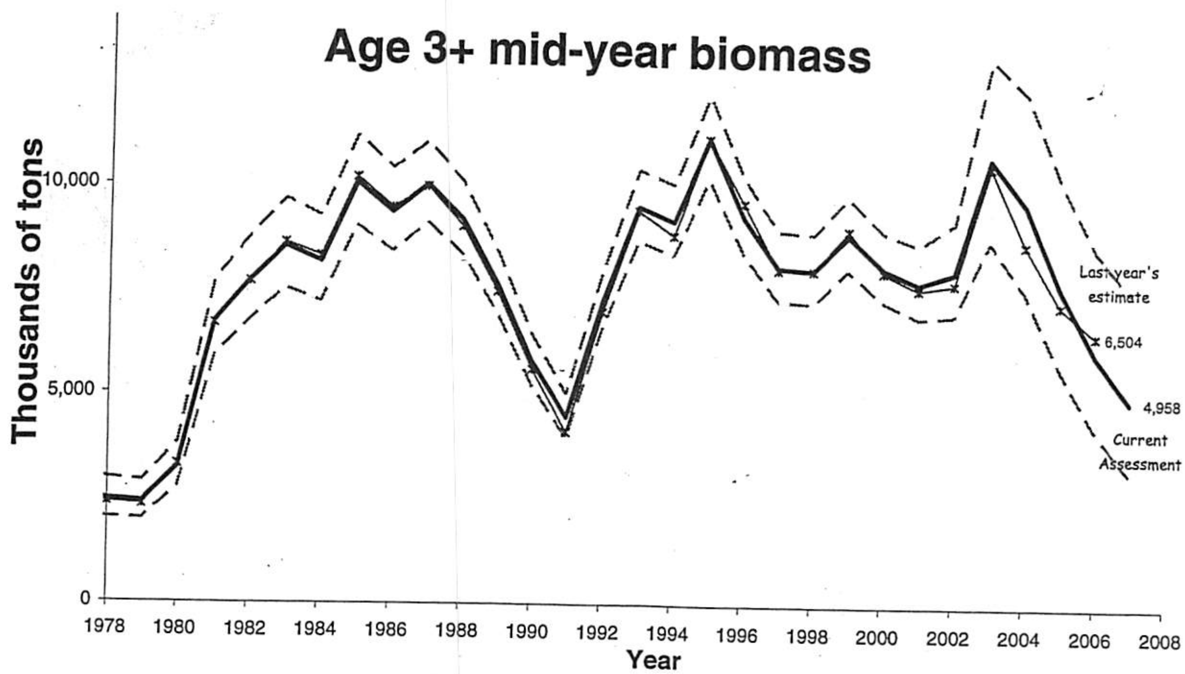

Figure 1.39. Estimated age 3+ EBS mid-year walleye pollock biomass under Model 2, 1978-2007. Approximate upper and lower 95% confidence limits are shown by dashed lines. Superimposed is the estimate of mid-year age 3+ biomass from last year's assessment

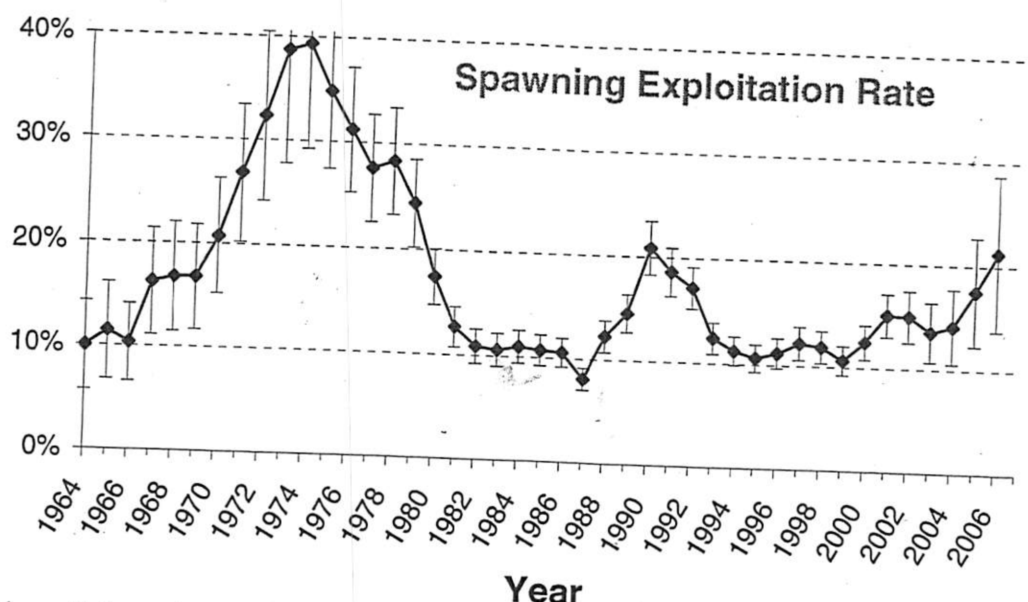

Figure 1.41. Estimated spawning exploitation rate (defined as the annual percent removals of spawning females due to the fishery) for EBS walleye pollock, Model 2. Error bars represent two standard deviations from the estimate.

Table 1.23 Tier 1 and Tier 3 EBS pollock ABC and OFL projections from Model 2 for 2007 and for 2008 under various 2007 assumed catches. Tier 1 levels use projected age-3+ biomass levels and the associated harmonic mean F_{msy} value.

Units are thousands of tons.

		Tier 1		Tier 3	
Year		ABC	OFL	ABC	OFL
2007		**1,512**	**1,641**	1,394	1,680
	Assumed 2007 catch	ABC	OFL	ABC	OFL
2008	1,488	1,257	1,365	877	1,072
2008	1,394	1,318	1,431	913	1,115
2008	1,300	1,380	1,498	950	1,159
2008	1,200	1,447	1,570	990	1,206