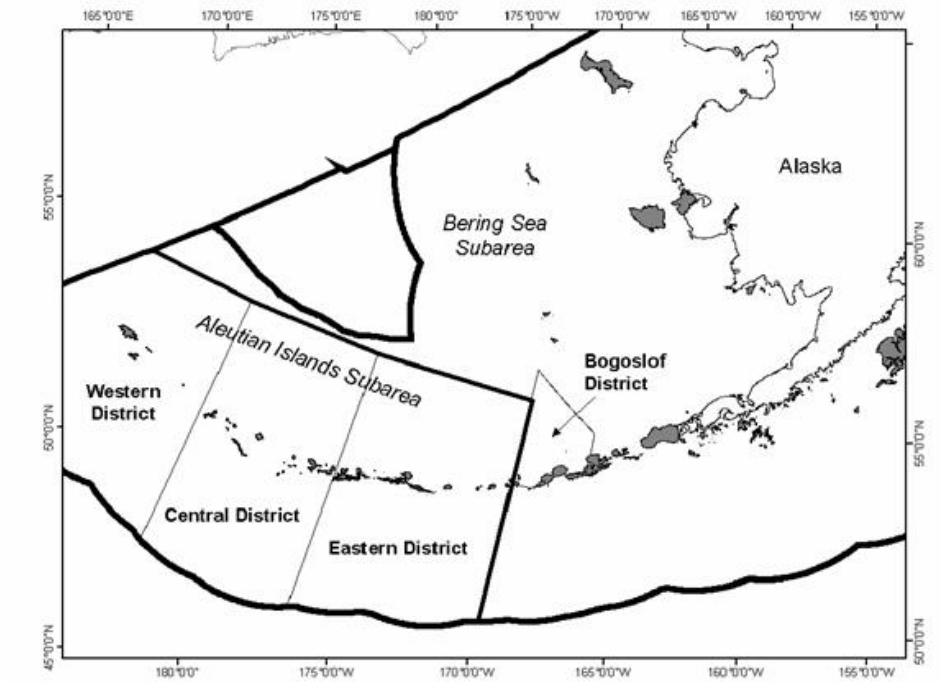
APPENDIX A

STOCK ASSESSMENT AND FISHERY EVALUATION REPORT FOR THE GROUNDFISH RESOURCES OF THE BERING SEA/ALEUTIAN ISLANDS REGIONS

Compiled by

The Plan Team

for the Groundfish Fisheries of the Bering Sea and Aleutian Islands



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North Pacific Fishery Management Council
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Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Region

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Summary

By

The Plan Team for the Groundfish Fisheries of the Bering Sea and Aleutian Islands

Introduction

The *National Standard Guidelines for Fishery Management Plans* published by the National Marine Fisheries Service (NMFS) require that a stock assessment and fishery evaluation (SAFE) report be prepared and reviewed annually for each fishery management plan (FMP). The SAFE report summarizes the best available scientific information concerning the past, present, and possible future condition of the stocks, marine ecosystems, and fisheries that are managed under Federal regulation. It provides information to the Councils for determining annual harvest levels from each stock, documenting significant trends or changes in the resource, marine ecosystems, and fishery over time, and assessing the relative success of existing state and Federal fishery management programs. For the FMP for the Groundfish Fishery of the Bering Sea and Aleutian Islands (BSAI) Area, the SAFE report is published in three sections: a "Stock Assessment" section, which comprises the bulk of this document, and "Economic Status of Groundfish Fisheries off Alaska" and "Ecosystem Considerations" sections, which are bound separately.

The BSAI Groundfish FMP requires that a draft of the SAFE report be produced each year in time for the December meeting of the North Pacific Fishery Management Council. Each stock or stock complex is represented in the SAFE report by a chapter containing the latest stock assessment. New or revised stock assessment models are generally previewed at the September Plan Team meeting, and considered again by the Plan Team at its November meeting for recommending final specifications for the following two fishing years. This process is repeated annually.

This Stock Assessment section of the SAFE report for the BSAI groundfish fisheries is compiled by the BSAI Groundfish Plan Team from chapters contributed by scientists at NMFS Alaska Fisheries Science Center (AFSC). These chapters include a recommendation by the author(s) for overfishing level (OFL) and acceptable biological catch (ABC) for each stock and stock complex managed under the FMP. This introductory section includes the recommendations of the Plan Team (Table 1), along with a summary of each chapter.

The ABC recommendations by the Plan Team are reviewed by the Scientific and Statistical Committee (SSC), which may confirm the Plan Team recommendations. The Plan Team and SSC recommendations, together with social and economic factors, are considered by the Council in determining total allowable catches (TACs) and other measures used to manage the fisheries. Neither the author(s), Plan Team, nor SSC recommends TACs.

Members of the BSAI Plan Team who compiled this SAFE report were Loh-lee Low (chair), Mike Sigler (vice chair), Jane DiCosimo (BSAI FMP coordinator), Grant Thompson, Kerim Aydin, David Barnard, David Carlile, Henry Cheng, Lowell Fritz, Mary Furuness, Dana Hanselman, Alan Haynie, Brenda Norcross, and Leslie Slater.

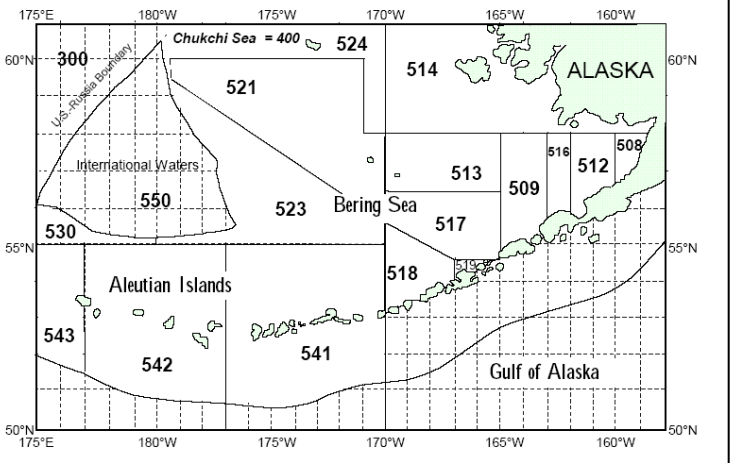

Figure 1. Bering Sea/Aleutian Islands statistical and reporting areas.

Background Information

The BSAI management area lies within the 200-mile U.S. Exclusive Economic Zone (EEZ) of the US (Figure 1). International North Pacific Fisheries Commission (INPFC) statistical areas 1 and 2 comprise the EBS. The Aleutian Islands (AI) region is INPFC Area 5.

Five categories of finfishes and invertebrates have been designated for management purposes (see below). They are prohibited species (species that must be returned to the sea when caught), target species (species for which an individual TAC is established), other species (species for which an aggregate TAC is established), forage fish (species for which targeted harvest is prohibited, with a maximum of 2 percent retainable bycatch allowed), and non-specified species (all species not included in one of the other categories). This SAFE report describes the status of the stocks in the target species and "other species" categories only. The finfish species categories, other than non-specified species, are listed below:

Prohibited Species	Target Species	Other Species	Forage Fish
Salmon	Walleye pollock	Sculpins	Eulachon
Pacific halibut	Pacific cod	Sharks	Capelin
Pacific herring	Sablefish	Skates	Sandlance
Steelhead trout	Yellowfin sole		Myctophids
	Greenland turbot		Bathylagids
	Arrowtooth flounder		Sandfish
	Northern rock sole		Pholids
	Flathead Sole		Stichaeids
	Alaska plaice		Gonostomatids
	Other flatfish		
	Pacific Ocean perch		
	Northern rockfish		
	Shortraker rockfish		
	Blackspotted/Rougheye rockfish		
	Other rockfish		
	Atka mackerel		

The invertebrate species categories, other than non-specified species, are listed below:

Prohibited Species	Target Species	Other Species	Forage Fish
King crab		Squid	
Tanner crab		Octopus	

Historical Catch Statistics

Catch statistics since 1954 are shown for the Eastern Bering Sea (EBS) subarea in Table 2. The initial target species was yellowfin sole. During this period, total catches of groundfish peaked at 674,000 t in 1961. Following a decline in abundance of yellowfin sole, other species (principally walleye pollock) were targeted, and total catches peaked at 2.2 million t in 1972. Pollock is now the principal fishery, with recent catches approximately 1.4-1.5 million t due to years of high recruitment. After the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) was adopted in 1976, catch restrictions and other management measures were placed on the fishery and total groundfish catches have since varied from one to two million t. In 2005, Congress implemented a statutory cap on TACs for BSAI groundfish of 2 million t, which had previously been a policy implemented by the Council. Catches generally total about 10 percent below the 2 million t optimal yield (OY) cap. Catches in the EBS for 2008 totaled 1,428,000 t; catches through November 7, 2009 totaled 1,183,000 t.

Catches in the Aleutian Islands (AI) subarea have always been much smaller than in the EBS. Target species have also differed (Table 3). Pacific Ocean perch (POP) was the initial target species. As POP abundance declined, the fishery diversified to different species. During the early years of exploitation,

total AI groundfish catches peaked at 112,000 t in 1965. Atka mackerel is the largest fishery (57,700 t in 2008; 72,100 t through November 7, 2009) in the AI, followed by Pacific cod (31,000 t in 2008; 27,800 t through November 7, 2009). Recent catches peaked at 191,000 t in 1996. Total 2008 AI catches were 118,000 t; catches through November 7, 2009 totaled 135,000 t.

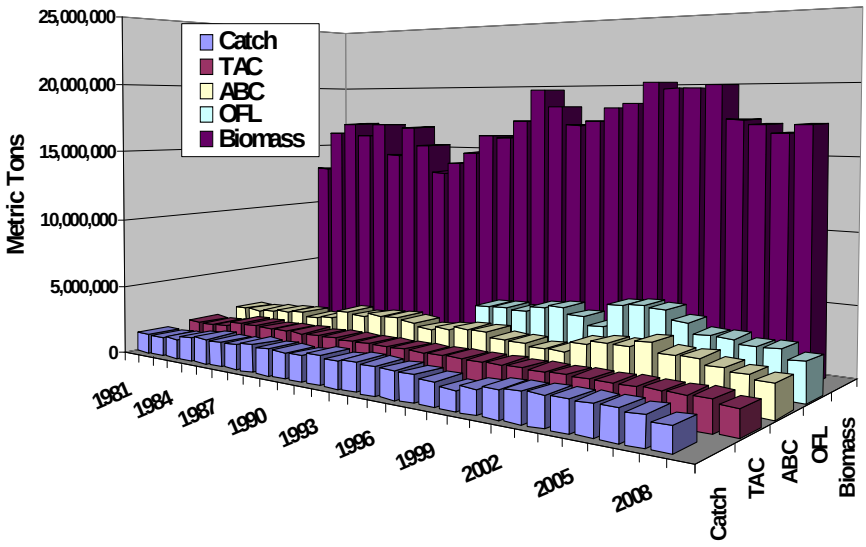

Figure 2. Biomass, Overfishing Level, Acceptable Biological Catch, Total Allowable Catch, and Catch, 1981-2008

Total catches since 1954 for the BSAI, combined, are in Table 4. Total 2008 BSAI catches were 1,550,000 t (84 percent of total groundfish TACs); catches through November 7, 2009 totaled 1,320,000 t. The relationship of biomass, overfishing level, acceptable biological catch, total allowable catch, and catch is depicted in Figure 2.

Recent Total Allowable Catches

Amendment 1 to the BSAI Groundfish FMP provided the framework to manage the groundfish resources as a complex. Maximum sustainable yield (MSY) for the BSAI groundfish complex was estimated at 1.8 to 2.4 million t. The OY range was set at 85% of the MSY range, or 1.4 to 2.0 million t. The sum of the TACs equals OY for the complex, which is constrained by the 2.0 million t cap. Due to recent declines in biomass of walleye pollock and Pacific cod the cap has not been met. The BSAI groundfish TACs totaled 1,840,000 t in 2008 and dropped further to 1,682,000 t for 2009.

Establishment of the Western Alaska Community Development Quota (CDQ) Program annual groundfish reserves is concurrent with the annual BSAI groundfish harvest specifications. Once annual BSAI groundfish TACs are established, certain species categories are allocated to the CDQ Program. This includes 10 percent of the BS and AI pollock TACs, 20 percent of the fixed gear sablefish TAC, and 7.5 percent of the sablefish trawl gear allocation. It also receives 10.7 percent of the TACs (up from 7.5 percent prior to 2008) for Pacific cod, yellowfin sole, rock sole, flathead sole, Atka mackerel, AI Pacific ocean perch, arrowtooth flounder, and BS Greenland turbot. The program also receives allocations of prohibited species quotas.

The TAC specifications for the primary allocated species, and PSC limit specifications, are recommended by the Council at its December meeting. For the non-specified reserve, 15 percent of the TAC for each target species or ‘‘other species’’ category, except for pollock, the hook-and-line and pot gear allocation of sablefish, and the Amendment 80 species (Pacific cod, Atka mackerel, flathead sole, rock sole, yellowfin sole, and Aleutian Islands Pacific ocean perch), are placed in a non-specified reserve. Apportionments to this reserve range from 4.3 to 15 percent of applicable TAC limits. The reserve is used for(1) correction of operational problems in the fishing fleets, (2) to promote full and efficient use of groundfish resources, (3) adjustments of species TACs according to changing conditions of stocks during fishing year, and (4) apportionments. The initial TAC (ITAC) for each species is the remainder of the TAC after the subtraction of the reserves.

New Data Summary

Since the previous SAFE Report was issued (NPFMC 2008), the following new information has been incorporated into the stock assessments:

1) Eastern Bering Sea Walleye pollock: 1) The 2009 NMFS summer bottom-trawl survey (BTS) abundance at age estimates were computed and included for this assessment; 2) The 2009 NMFS summer mid-water echo-integration trawl (EIT) survey conducted aboard the NOAA Ship Oscar Dyson were included. This was the third consecutive complete EIT survey conducted by this vessel in this region, and for the third straight year the survey extended into the Russian zone and covered part of the Navarin Basin; 3) Age composition estimates for the EIT survey derived from the population-at-length estimates using the 2009 BTS age-length key were included. To help cover ages that are less common in the BTS survey, about 100 samples from the EIT survey were included with the bottom trawl survey ages to help construct a more complete age-length key; 4) The 2008 age composition estimates were updated using EIT age data (last year the age-length key used was derived solely from the 2008 BTS age data); 5) Observer data for age and size composition and average weight-at-age and total catch (from NMFS Alaska Region) were updated and included; 6) Past approaches used to estimate mean weight-at-age in the fishery for the current and future years were re-evaluated using an age-specific biomass-weighted goodness of fit criterion, which resulted in a recommendation to modify past practices for specifying mean-weights at age for these years.

1a) Aleutian Islands Walleye pollock: updated catch for 2003 through 2008 and 2009 catch estimates;

1b) Bogoslof pollock: 2009 catch estimates;

2) Pacific cod: 1) revised catch data for 1991-2008 and preliminary catch data for 2009; 2) updated 2008 and preliminary 2009 commercial fishery size composition data; 3) 2009 EBS shelf bottom trawl survey size composition data; 4) 2009 EBS shelf bottom trawl survey numeric abundance estimate; 5) 2008 EBS shelf bottom trawl survey age composition data; 6) 2008 January-May longline fishery age composition data; 7) 1994-2008 EBS shelf bottom trawl survey mean length at age data; 8) 2008 January-May longline fishery mean length at age data; 9) updated variances in the ageing error matrix; 10) updated 2008 seasonal catch per unit effort (CPUE) data for the trawl, longline, and pot fisheries, and preliminary 2009 catch rates for the trawl, longline, and pot fisheries; 11) 2008 International Pacific Halibut Commission (IPHC) longline survey Pacific cod catch rate; and 12) 2009 IPHC longline survey size composition data.

3) Sablefish: 1) relative abundance and length data from the 2009 longline survey; 2) relative abundance and length data from the 2008 longline and trawl fisheries; 3) age data from the 2008 longline survey and trawl fishery were added to the assessment model; 4) sablefish biomass estimate and associated lengths from 2009 GOA trawl survey.

4) Yellowfin sole: 1) 2008 fishery age composition; 2) 2008 survey age composition; 3) 2009 trawl survey biomass point estimate and standard error; 4) estimate of the discarded and retained portions of the 2008 catch; 5) estimate of total catch made through the end of 2009.

5) Greenland turbot: 1) 2008 and 2009 catch data were updated; 2) EBS shelf survey 2009 biomass and length composition estimates; 3) age samples were included from the 2007 shelf survey.

6) Arrowtooth flounder: 1) 2009 shelf survey size composition; 2) 2009 shelf survey biomass point-estimates and standard errors; 3) estimate of catch and discards through October 3, 2009; 4) estimate of retained and discarded portion of the 2008 catch.

7) Northern rock sole: 1) 2008 fishery age composition; 2) 2008 survey age composition; 3) 2009 trawl survey biomass point estimate and standard error; 4) estimate of catch and discards through September 26, 2009; 5) estimate of retained and discarded portions of the 2008 catch; 6) new female maturity schedule; 7) weight at age also recalculated for males and females to model time-varying growth.

8) Flathead sole: 1) 2008 fishery catch data was updated and the 2009 catch through September 26, 2009; 2) 2009 fishery sex-specific size compositions and 2008 fishery size compositions; 3) 2006 and 2007 fishery sex-specific age compositions; 4) 2009 EBS trawl survey estimated survey biomass and

standard error; 5) 2009 EBS trawl survey sex-specific size compositions from the; 6) 2008 EBS trawl survey sex-specific age compositions; 7) 2009 EBS trawl survey mean bottom temperature.

9) Alaska plaice: 1) 2008 catch data was updated, and catch through 10 October, 2009; 2) 2009 trawl survey biomass estimate and standard error and 2009 survey length composition; 3) 2008 survey age composition.
10) Other flatfish: 1) 2009 total and discarded catch; 2) 2009 EBS trawl survey biomass estimates and standard errors.
11) Pacific ocean perch: final 2008 catch and preliminary estimate of 2009 catch.
12) Northern rockfish: final 2008 catch and preliminary estimate of 2009 catch.
13a) Shortraker rockfish: final 2008 catch and preliminary estimate of 2009 catch.
13b) Blackspotted/rougheye rockfish: final 2008 catch and preliminary estimate of 2009 catch.
14) Other rockfish: final 2008 catch and preliminary estimate of 2009 catch.
15) Atka mackerel: 1) fishery catch data; 2) 2008 fishery age composition data; 3) 2008 fishery catch- and weight-at-age values; 4) calculated, rather than fixed, sample sizes for the fishery catch-at-age data; 5) 2009 selectivity vector was used for projections.
16) Squid: 1) updated 2008 and 2009 catch data; 2) estimates of 1997-2009 retention rates; 3) 2009 EBS shelf survey biomass estimates; 4) 2008 commercial fisheries length composition.
17) Skate: 1) updated 2008 and 2009 catch data; 2) 2009 EBS shelf survey biomass estimates; 3) catch and survey length composition data; 4) maps of Alaska skate and Bering skate distribution updated with 2007 & 2008 trawl survey data.
18) Shark: 1) updated 2003-2008 catch data; 2) total catch for 2009; 3) biomass estimates from the 2009 EBS shelf survey updated.
19) Octopus: 1) updated 2003-2008 catch data; 2) total catch for 2009; 3) updated 2009 EBS shelf survey biomass estimates.
20) Sculpin: 1) Updated 2003-2008 catch data; 2) total catch for 2009; 3) species composition; 4) biomass estimates and length compositions.

Biological Reference Points

A number of biological reference points are used in this SAFE report. Among these are the fishing mortality rate (F) and stock biomass level (B) associated with MSY (F_{MSY} and B_{MSY}, respectively), and the fishing mortality rates reduce the level of spawning biomass per recruit to some percentage P of the pristine level ($F_{P\%}$). The fishing mortality rate used to compute ABC is designated F_{ABC}, and the fishing mortality rate used to compute the overfishing level (OFL) is designated F_{OFL}.

Definition of Acceptable Biological Catch and the Overfishing Level

Amendment 56 to the BSAI Groundfish FMP, which was implemented in 1999, defines ABC and OFL for the BSAI groundfish fisheries. The new definitions are shown below, where the fishing mortality rate is denoted *F*, stock biomass (or spawning stock biomass, as appropriate) is denoted *B*, and the *F* and *B* levels corresponding to MSY are denoted F_{MSY} and B_{MSY} respectively.

Acceptable Biological Catch is a preliminary description of the acceptable harvest (or range of harvests) for a given stock or complex. Its derivation focuses on the status and dynamics of the stock, environmental conditions, other ecological factors, and prevailing technological characteristics of the fishery. The fishing mortality rate used to calculate ABC is capped as described under "overfishing" below.

Overfishing is defined as any amount of fishing in excess of a prescribed maximum allowable rate. This maximum allowable rate is prescribed through a set of six tiers which are listed below in descending

order of preference, corresponding to descending order of information availability. The SSC will have final

Tier

1) Information available: *Reliable point estimates of B and B_{MSY} and reliable pdf of F_{MSY}.*
   - 1a) Stock status: $B/B_{MSY} > 1$
     $F_{OFL} = \mu_A$, *the arithmetic mean of the pdf*
     $F_{ABC} \le \mu_H$, *the harmonic mean of the pdf*
   - 1b) Stock status: $\alpha < B/B_{MSY} \le 1$
     $F_{OFL} = \mu_A \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
     $F_{ABC} \le \mu_H \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
   - 1c) Stock status: $B/B_{MSY} \le \alpha$
     $F_{OFL} = 0$
     $F_{ABC} = 0$
2) Information available: *Reliable point estimates of B, B_{MSY}, F_{MSY}, $F_{35\%}$, and $F_{40\%}$.*
   - 2a) Stock status: $B/B_{MSY} > 1$
     $F_{OFL} = F_{MSY}$
     $F_{ABC} \le F_{MSY} \times (F_{40\%}/F_{35\%})$
   - 2b) Stock status: $\alpha < B/B_{MSY} \le 1$
     $F_{OFL} = F_{MSY} \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
     $F_{ABC} \le F_{MSY} \times (F_{40\%}/F_{35\%}) \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
   - 2c) Stock status: $B/B_{MSY} \le \alpha$
     $F_{OFL} = 0$
     $F_{ABC} = 0$
3) Information available: *Reliable point estimates of B, $B_{40\%}$, $F_{35\%}$, and $F_{40\%}$.*
   - *3a) Stock status:* $B/B_{40\%} > 1$
     $F_{OFL} = F_{35\%}$
     $F_{ABC} \le F_{40\%}$
   - *3b) Stock status:* $\alpha < B/B_{40\%} \le 1$
     $F_{OFL} = F_{35\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$
     $F_{ABC} \le F_{40\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$
   - *3c) Stock status:* $B/B_{40\%} \le \alpha$
     $F_{OFL} = 0$
     $F_{ABC} = 0$
4) Information available: *Reliable point estimates of B, $F_{35\%}$, and $F_{40\%}$.*
   $F_{OFL} = F_{35\%}$
   $F_{ABC} \le F_{40\%}$
5) Information available: *Reliable point estimates of B and natural mortality rate M.*
   $F_{OFL} = M$
   $F_{ABC} \le 0.75 \times M$
6) Information available: *Reliable catch history from 1978 through 1995.*
   OFL = the average catch from 1978 through 1995, unless an alternative value is established by the SSC on the basis of the best available scientific information
   $ABC \le 0.75 \times OFL$

authority for determining whether a given item of information is reliable for the purpose of this definition, and may use either objective or subjective criteria in making such determinations. For tier (1), a pdf refers to a probability density function. For tiers (1-2), if a reliable pdf of B_{MSY} is available, the preferred point estimate of B_{MSY} is the geometric mean of its pdf. For tiers (1-5), if a reliable pdf of B is available, the preferred point estimate is the geometric mean of its pdf. For tiers (1-3), the coefficient α is set at a default value of 0.05, with the understanding that the SSC may establish a different value for a specific stock or stock complex as merited by the best available scientific information. For tiers (2-4), a designation of the form "$F_{X\%}$" refers to the F associated with an equilibrium level of spawning per recruit (SPR) equal to X% of the equilibrium level of spawning per recruit in the absence of any fishing. If reliable information sufficient to characterize the entire maturity schedule of a species is not available, the SSC may choose to view SPR calculations based on a knife-edge maturity assumption as reliable. For tier (3), the term $B_{40\%}$ refers to the long-term average biomass that would be expected under average recruitment and $F=F_{40\%}$.

Overfished or approaching an overfished condition is determined for all age-structured stock assessments by comparison of the stock level in relation to its MSY level according to harvest scenarios 6 and 7 described in the next section (for Tier 3 stocks, the MSY level is defined as $B_{35\%}$). For stocks in Tiers 4-6, no determination can be made of overfished status or approaching an overfished condition as information is insufficient to estimate the MSY stock level.

Standard Harvest and Recruitment Scenarios and Projection Methodology

A standard set of projections is required 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 an estimated vector of 2009 numbers at age. This vector is then projected forward to the beginning of 2010 using the schedules of natural mortality and selectivity described in the assessment and the best available estimate of total (year-end) catch for 2009. 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 2010, 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 2010 recommended in the assessment to the *max* F_{ABC} for 2010. (Rationale: When F_{ABC} is set at a value below *max* F_{ABC}, it is often set at the value recommended in the stock assessment.)

Scenario 3: In all future years, F is set equal to the 2004-2008 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 4: In all future years, the upper bound on F_{ABC} is set at $F_{60\%}$. (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 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 2009 or 2) above 1/2 of its MSY level in 2009 and above its MSY level in 2019 under this scenario, then the stock is not overfished.)

Scenario 7: In 2010 and 2011, 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 2022 under this scenario, then the stock is not approaching an overfished condition.)

Overview of "Stock Assessment" Section

The current status of individual groundfish stocks managed under the FMP is summarized in this section. Plan Team recommendations for 2010 and 2011 ABCs and OFLs are summarized in Tables 1, 5, and 6. The sum of the recommended ABCs for 2010 and 2011 are 2,120,000 t and 2,457,000 t, respectively. These are 89,000 t below and 248,000 t above the sum of the 2009 ABCs (2,209,000 t), indicating an anticipated rebound in stock status in 2011, after a slight drop in 2010.

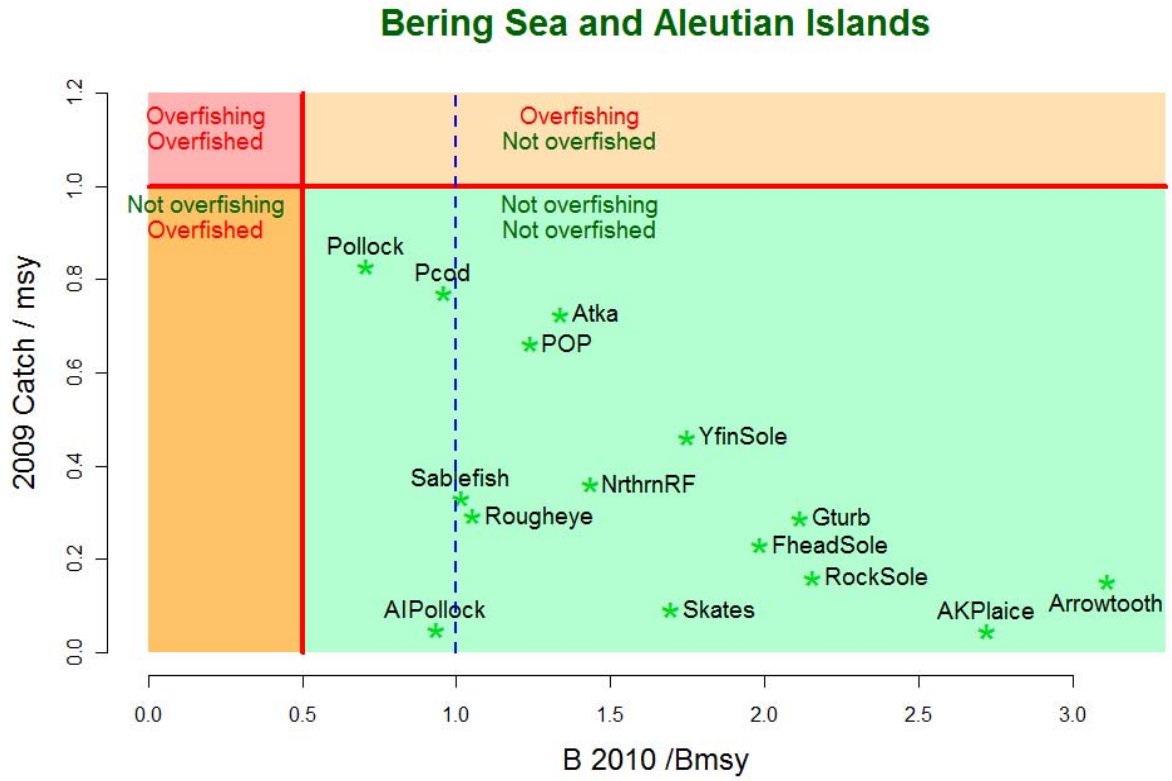

Figure 3. Summary status of age-structured BSAI species relative to 2009 catch levels (vertical axis) and projected 2010 spawning biomass relative to B_{msy} levels. Note that the 2009 MSY level is defined as the 2009 catch at F_{msy}.

Overall, the status of the stocks continues to appear relatively favorable. No groundfish stocks are overfished (defined, with some exceptions, as a spawning biomass below 1/2 B_{MSY}) or experiencing overfishing, as shown in lower right quadrant of Figure 2. In fact, most stocks are above B_{MSY} or the B_{MSY} proxy of $B_{35\%}$, although many stocks are declining due to poor recruitment in recent years. The abundances of AI pollock, sablefish, all rockfishes managed under Tier 3, all flatfishes managed under Tiers 1 or 3, and Atka mackerel are projected to be above B_{MSY} or the B_{MSY} proxy of $B_{35\%}$ *in 2010*. The abundance of EBS pollock is projected to be below B_{MSY} in 2010 and the abundance of Pacific cod is projected to be slightly below $B_{35\%}$ in 2010.

Total groundfish biomass for 2010 (15.9 million t) is the same as last year's estimate. Groundfish ABCs recently have trended down for gadoids, but generally up for flatfishes. The 2009 bottom trawl survey biomass estimate for pollock was 2.28 million t, down 25% from the 2008 estimate, and the lowest point in the 1982-2009 time series. The estimate from the EIT survey was 0.924 million t, down 7% from last

year's survey, and the lowest point in the 1979-2009 time series. The 2006 year class is above-average, though not as strong as estimated previously. The 2010 pollock ABC recommendation of 813,000 t is about equal to the 2009 ABC (815,000 t); the 2011 ABC recommendation is 1,100,000 t, anticipating recruitment of the 2006 year class.

Following the highest observation in 1994, the Pacific cod bottom trawl survey biomass estimate declined steadily through 1998. The estimates remained around 600,000 t from 2002 through 2005. However, the estimates dropped consistently from 2005 through 2008. The 2009 survey biomass estimate was 421,000 t, up 4% from 403,000 t in 2008. The numeric abundance estimate from the 2009 EBS shelf bottom trawl survey of 717 million fish was up about 50% from the 2008 estimate. The 2008 year class, which has been observed only once, appears to be extremely large, although this estimate is accompanied by a large confidence interval. The 2006 year class, which appeared exceptionally strong in the 2007 survey, still appears to be above average. However, the 2006 year class follows a string of five consecutive sub-par year classes spawned from 2001-2005. The Pacific cod ABC recommendation is down 4 percent in 2010 compared to 2009 and up 18 percent in 2011 compared to 2009.

Summary and Use of Terms

Stock status is summarized and OFL and ABC recommendations are presented on a stock-by-stock basis in the remainder of this section, with the following conventions observed:

- "Fishing mortality rate" refers to the full-selection F (i.e., the rate that applies to fish of fully selected sizes or ages), except in the cases of stocks managed under Tier 1 (EBS pollock, yellowfin sole, and northern rock sole). For these stocks, the fishing mortality rate consists of the ratio between catch (in biomass) and biomass at the start of the year. EBS pollock uses "fishable biomass" whereas yellowfin sole and northern rock sole use age 6+ biomass for this calculation.
- "Projected age+ biomass" refers to the total biomass of all cohorts of ages greater than or equal to some minimum age, as projected for January 1 of the coming year. The minimum age varies from species to species. When possible, the minimum age corresponds to the age of recruitment listed in the respective stock assessment. Otherwise, the minimum age corresponds to the minimum age included in the assessment model, or to some other early age traditionally used for a particular species. When a biomass estimate from the trawl survey is used as a proxy for projected age+ biomass, the minimum age is equated with the age of recruitment, even though the survey may not select that age fully and undoubtedly selects fish of younger ages to some extent.
- Projected ABC, OFL, and biomass levels are typically reported to three significant digits, except when quoting a Council-approved value with more than three significant digits or when a stock-specific ABC is apportioned among areas on a percentage basis, in which case four significant digits may be used if necessary to avoid rounding error. Fishing mortality rates are typically reported to two significant digits.
- The reported ABCs and OFLs for past years correspond to the values approved by the Council. Projected ABCs and OFLs listed for the next two years are the Plan Team's recommendations.
- Reported catches are as of November 7, 2009.

Two-Year OFL and ABC Projections

Amendment 48 to the BSAI Groundfish FMPs, implemented in 2005, made two significant changes with respect to the stock assessment process. First, annual assessments are no longer required for rockfishes since new data are limited during years when no groundfish surveys are conducted. For example, 2009 was an off-year for the NMFS AI groundfish trawl survey, so only summaries for these species were produced.

The second significant change is that proposed and final specifications are adopted annually, for a two year period. This requires the Team to provide OFLs and ABCs for 2010 and 2011 in this cycle (Table 1). The proposed 2010 and 2011 specifications will become effective when final rulemaking occurs in

February 2010. The 2011 specifications will already be in place to start the fishery on January 1, 2011, but these will be replaced by final specifications recommended by the Council in December 2010 and implemented in February 2011. This process allows the Council to use the most current survey and fishery data in stock assessment models for setting the next year's quotas, while having no gap in specifications. The 2011 ABC and OFL values recommended in next year's SAFE report are likely to differ from this year's projections for 2011 because of new information that is incorporated into the assessments.

In the case of stocks managed under Tier 3, 2010 and 2011 ABC and OFL projections are typically based on the output for Scenarios 1 or 2 from the standard projection model using assumed (best estimates) of actual catch levels. For stocks managed under Tiers 4-6, 2011 projections are set equal to the Plan Team's recommended values for 2010.

Ecosystem Considerations

A summary of the ecosystem considerations chapter, which highlights recent EBS ecosystem trends, is provided here. Additional information is available in individual stock assessment chapters and the ecosystem considerations chapter.

The ecosystem considerations chapter consists of three sections: ecosystem assessment, ecosystem status indicators, and ecosystem-based management indices and information. The ecosystem assessment section, introduced in 2003, combines information from the stock assessment chapters with the two other sections of this chapter to summarize the climate and fishery effects. Trends highlighted in the 2009 chapter of specific relevance to the EBS include:

- 2009 was a cold year in the Bering Sea, with extensive winter ice cover, and the largest summer cold pool measured since 1999.
- An El Nino (ENSO 3.4 index) is developing (Fall 2009). There is a strong consensus of the available forecast models that this El Nino will persist, and probably strengthen, into 2010. This is liable to bring about a positive state for the Pacific Decadal Oscillation (PDO). The Arctic Oscillation (AO; measuring the strength of the polar vortex) is negative. The response of the North Pacific to ENSO is enhanced during periods of negative AO, so it is predicted that the upcoming El Nino will have relatively dramatic impacts on North Pacific air-sea interactions.
- In part due to these trends, seasonal projections from the NCEP coupled forecast system model (CFS03) for SST indicates an overall warming along the west coast of North America. Specifically, by late winter/early spring of 2010, it projects near normal temperatures (return towards average after recent cold years) on the eastern Bering Sea shelf, and significantly warmer than normal temperatures in the northeastern portion of the North Pacific, particularly off the coast of southeast Alaska.
- Jellyfish biomass in the 2009 AFSC bottom trawl survey jumped from low values for the past several years to high values comparable to the late 1990s.
- A new analysis shows a shift of groundfish survey biomass to the northwest over the last several years. This shift to the northwest has persisted even through recent colder years.
- Coccolithophores bloomed in the EBS this year. Cloudy conditions prevented satellite images from documenting the full course of this bloom.
- Very few indicator trends are currently tracked or available for the Aleutian Islands.

Analysis of stock assessment and survey trends, focusing on 5-year (2005-2009) trends by guild shows:

- A modest recent decline in total apex predator biomass primarily due to the assessed decline in Pacific cod biomass; Northern fur seals and several bird species show either declining or stable trends. Productivity of some declining bird populations has increased; indicating a possible density dependent response.
- Benthic forager biomass (primarily smaller flatfish) remains stable in total biomass.

- Pelagic foragers (forage fish) biomass remains lower than it has been at any time since 1982. This is primarily driven by assessed declines in walleye pollock biomass but is also contributed to by lower than average survey biomasses for several forage fish (e.g. capelin, eulachon, and sandlance).
- Structural epifauna (e.g. HAPC) biomass from surveys shows increases in total, primarily driven by increases in survey biomass of urochordates. Changes in survey methodology may be partly responsible for this trend.
- Catches of all guilds except pelagic foragers remain within 1 s.d. of the 1977-2009 averages. 2009 pelagic forager catch is lowest since 1977 (due to declines in pollock catch).
- Fishing exploitation rates of all guilds remain within 1 s.d. of the 1977-2009 averages. The exploitation rate of pelagic foragers was greater than 1 s.d. above its long-term average during 2005-2007, but has decreased to be within the range in 2008-2009 due to the decrease in walleye pollock fishing mortality as governed by its management control rule.

Uncertainty

Statistical uncertainty is addressed in the individual assessments, and to some degree, by the tiers used to establish ABCs. In the past, statistical uncertainty or natural variability in the stock has led the Plan Team to recommend ABC values lower than the maximum permissible level for walleye pollock, Pacific cod, and Greenland turbot. The Plan Team's recommended 2010 and 2011 ABCs for Bogoslof pollock are reduced by 99 percent in both years, in accord with the SSC approach (Table 6).

Effects of Cancelled Surveys

Except under Tier 1, current harvest rules do not automatically adjust for assessment uncertainty. Assessment uncertainty is increasing in Alaska groundfish assessments because some recent surveys have been cancelled due to decreased funding. Lacking an uncertainty adjustment, ABC recommendations may risk long-term fishery sustainability. To address this uncertainty , the Plan Team recommends: 1) increase funding so that surveys are not cancelled; and 2) modify harvest rules so that more Tiers (especially 3 and 5) account for assessment uncertainty. Some authors have complied with a 2008 request to present the probability that female spawning biomass will fall below 20 percent of the unfished value in the next three to five years. The Plan Team specifically is concerned about species affected by potential cancellation of the 2010 Aleutian Islands trawl survey, including Atka mackerel, walleye pollock, Pacific cod, and Pacific Ocean perch.

Economic Summary of the BSAI Commercial Groundfish Fisheries in 2007-08

According to data taken from the 2009 Economics SAFE report, first-wholesale revenues from the processing and production of Alaska groundfish in the Bering Sea Aleutian Islands (BSAI) rose from $1.8 billion in 2007 to $2.0 billion in 2008, a difference of $162.4 million. During that same time-period, the total quantity of groundfish products from the BSAI decreased from 673.3 thousand metric tons to 603.9 thousand metric tons, a difference of 69.4 thousand metric tons. In general, a decrease in production can be accompanied by an increase in revenues if (i) prices increase, for example, as a demand-side response to the decrease in production, or (ii) the pattern of production changes to favor higher-valued species or products. This section reports on the change in groundfish revenues in 2007-08, across species and products, to identify where the largest changes, both positive and negative, occurred. Further details of the analysis are included in an appendix to this report.

By species, decreases in the Total Allowable Catch (TAC) in 2007-08 for pollock dominate the results of the first-wholesale revenue decomposition with negative quantity effects in the BSAI (e.g., from 1.4 million tons to 1.0 million tons in the Eastern Bering Sea). In the BSAI, there are only minor compensatory (i.e., positive) quantity effects for other species groups. However, the positive price effects for BSAI pollock were more than strong enough to compensate for the negative quantity effects. The net effect was $133.8 million for BSAI pollock, which is consistent with the law of demand in economics.

By product group, negative quantity effects on pollock are divided fairly evenly among fillets, surimi, and roe in the BSAI. The negative quantity effect for each of these pollock product groups is accompanied by a positive price effect. The price and quantity effects for fillets and roe are largely offsetting in the BSAI. The net negative effects for these product groups in the BSAI is on the order of -$25.0 million.

The decrease in BSAI pollock TACs in 2008 contributed to a global whitefish shortage in that year, which along with competition for fillet products, put pressure on surimi markets that responded by roughly doubling the market price. This textbook economic response in surimi markets produced very strong positive price effects for 2007-08 that dominate results for the BSAI and lead to a positive net effect for surimi of $196.3 million.

In addition, the positive quantity effect for flatfish in the BSAI contributed another $37.9 million to the positive net effect there. Price and quantity effects for the whole head & gut group in the BSAI exhibited a pattern with a relatively weak negative price effect and a strong positive quantity effect that resulted in a positive net effect in the BSAI of $20.2 million. Overall, the BSAI had negative quantity and positive price effects in the decomposition of the 2007-08 change in first-wholesale revenues. To summarize, the positive net effects were $162.4 million in the BSAI, which implies that 87.1% of the total increase of $186.5 million in Alaska groundfish first-wholesale revenues in 2007-08 is attributable to the BSAI.

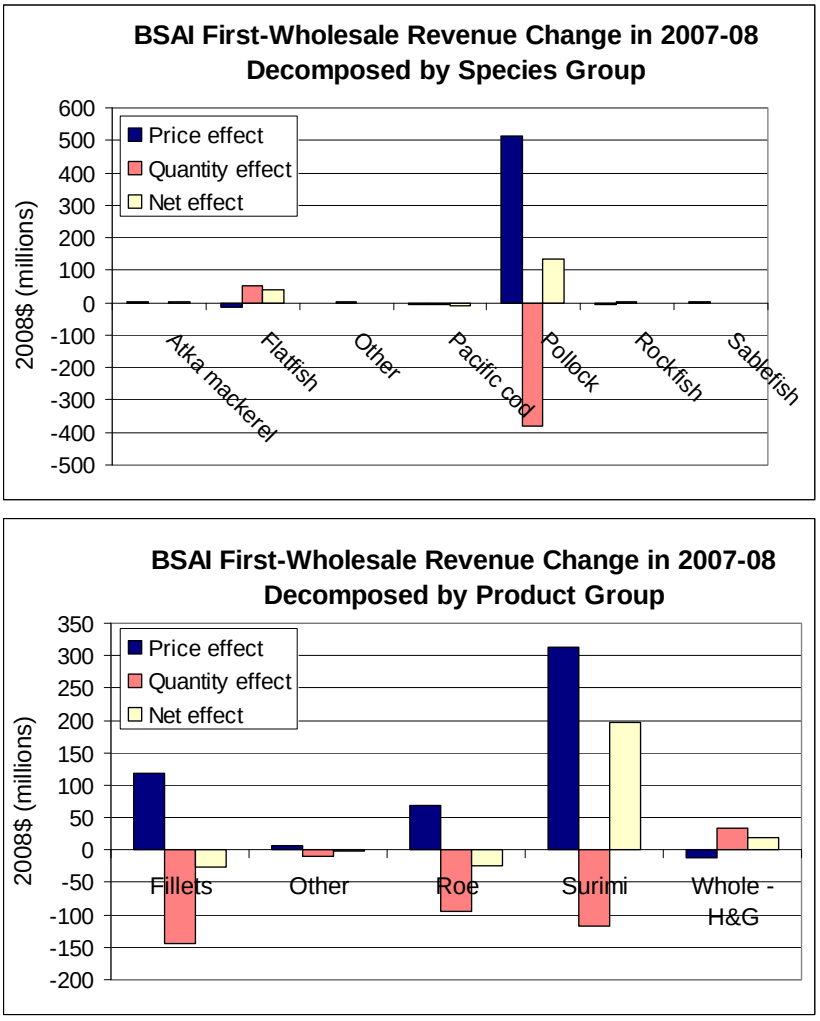

Fig. 3: Decomposition of the change in first-wholesale revenues from 2007-08 in the BSAI area.

The first decomposition is by the species groups used in the Economics SAFE report, and the second decomposition is by product group. The price effect refers to the change in revenues due to the change in the first-wholesale price index (2008 dollars

per metric ton) for each group. The quantity effect refers to the change in revenues due to the change in production (in tons) for each group. The net effect is the sum of price and quantity effects.

Stock Status Summaries

1. Walleye Pollock

Status and catch specifications (t) of walleye pollock in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2010 and 2011 are those recommended by the Plan Team. Catch data are current through November 7, 2009.

Area	Year	Age 3+ Biomass	OFL	ABC	TAC	Catch
Eastern Bering Sea	2008	4,360,000	1,440,000	1,000,000	1,000,000	989,895
	2009	6,240,000	977,000	815,000	815,000	810,052
	2010	4,620,000	918,000	813,000	n/a	n/a
	2011	n/a	1,220,000	1,110,000	n/a	n/a
Aleutian Islands	2008	229,000	54,500	44,500	19,000	2,488
	2009	197,000	34,000	28,200	19,000	1,282
	2010	307,000	40,000	33,100	n/a	n/a
	2011	n/a	39,100	32,200	n/a	n/a
Bogoslof	2008	240,000	48,000	5,220	10	0
	2009	292,000	58,400	7,970	10	9
	2010	110,000	22,000	156	n/a	n/a
	2011	n/a	22,000	156	n/a	n/a

Eastern Bering Sea

Changes from previous assessment

New data in this year's assessment include the following:

- Updated total catch for 2008 and a preliminary estimate of the 2009 catch.
- Biomass estimates from the 2009 bottom trawl survey and the 2009 echo-integration trawl (EIT) survey. The estimate from the bottom trawl survey was 2.28 million t, down 25% from the 2008 estimate, and the lowest point in the 1982-2009 time series. The estimate from the EIT survey was 0.924 million t, down 7% from last year's survey, and the lowest point in the 1979-2009 time series.
- Age composition data from the 2009 bottom trawl survey, updated age composition data from the 2008 EIT survey, and preliminary age composition data from the 2009 EIT survey (based on the age-length key from this year's bottom trawl survey, supplemented with 100 otoliths from this year's EIT survey). The 2009 survey age compositions confirm that the 2006 year class is of above-average strength, though not as strong as estimated previously.
- Age and size composition data and weight-at-age data from the 2008 fishery (in addition, age composition data from the first part of the 2009 fishery were used in sensitivity testing).

There were no substantive changes to the stock assessment model this year.

Spawning biomass and stock status trends

Consistent with the estimates produced in last year's assessment, age 3+ biomass of EBS walleye pollock declined steadily from 2003-2008 due to poor recruitment from the 2002-2005 year classes, with the age 3+ biomass for 2008 estimated to be the lowest in the time series since 1980 (one change from last year's assessment is that the 2001 year class, formerly estimated to be below average, is now estimated to be average). Spawning biomass is estimated to be 29% below B_{MSY} in 2009. The 2006 year class is reliably estimated to be above average, however, so spawning biomass is projected to increase in the near future (15% below B_{MSY} in 2010 and near B_{MSY} by 2012, if the stock is fished at the maximum permissible ABC).

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The SSC has determined that reliable estimates of B_{MSY} and the probability density function for F_{MSY} exist for EBS walleye pollock. Therefore, it qualifies for management under Tier 1. The Plan Team concurs with the assessment authors' conclusion that the Tier 1 reference points continue to be reliably estimated.

The updated estimate of B_{MSY} from the present assessment is 1.86 million t, compared to 1.92 million t from last year's assessment. Projected spawning biomass for 2010 is 1.32 million t, placing EBS walleye pollock in sub-tier "b" of Tier 1. As in recent assessments, the maximum permissible ABC harvest rate was based on the ratio between MSY and the equilibrium biomass corresponding to MSY. The harmonic mean of this ratio from the present assessment is 0.373, up from last year's value of 0.332.

The harvest ratio of 0.373 is scaled according to the Tier 1b formula and then multiplied by the geometric mean of the projected fishable biomass for 2010 (3.152 million t) to obtain the maximum permissible ABC for 2010, which is 813,000 t. This ABC is 88% higher than the 2010 yield of 433,000 t that would correspond to a Tier 3b strategy based on a $B_{40\%}$ value of 2.35 million t.

Team discussion on a recommended ABC focused on two alternatives: the maximum permissible value based on the assumption that the strengths of all year classes through 2008 are equal to the estimates from the present assessment (giving a 2010 ABC of 813,000 t), and the maximum permissible value based on the assumption that the strength of the 2006 year class is equal to the long-term average (giving a 2010 ABC of 738,000 t).

Arguments in favor of a 2010 ABC of 738,000 t (2006 year class = average) included the following:

1) The estimated strength of the 2006 year class has dropped considerably from last year's assessment, and may drop again.
2) Last year's assessment projected that the stock would recover to B_{MSY} by 2010, but this year's assessment indicates that this will not occur until 2012.
3) Recent survey biomass estimates have been low and the model projects that next year's bottom trawl survey biomass estimate will be the lowest in the time series.
4) The estimate of the 2006 year class is still fairly uncertain.
5) Even if the 2006 year class is above average, all of the other year classes currently in the fishery since the 2001 year class have all been below average (the 2008 year class has not yet recruited to the fishery).
6) There have been relatively few previous instances in which this stock has been so dependent on one year class. In other years when the stock was extremely dependent on a single year class, the dominant year class was an extremely strong one, whereas in the present case, the dominant year class is much closer to average in strength.
7) The stock-recruitment relationship is uncertain.

Arguments in favor of a 2010 ABC of 813,000 t (2006 year class = model estimate) included the following:

1) The Team agreed that the model is appropriate for making harvest specifications, and there is no reason to believe that the model's estimate of the 2006 year class is biased.
2) Reducing the ABC from 813,000 t to 738,000 t will have no discernible effect on the time the stock will take to recover to B_{MSY}.
3) The 2008 year class appears to be above average (in last year's minutes, the Team indicated that this year's recommendation for the 2010 ABC would be based in part on evidence of an additional strong year class).
4) Setting the 2006 year class equal to the long-term average value lacks statistical justification; a similar assumption could be applied to weak year classes as well.
5) While the stock is highly dependent on the 2006 year class, the extent of this dependence is not unprecedented.

6) A 2010 catch of 813,000 t would maintain the spawning exploitation rate below 20%, which has been used as a reference point in past Team recommendations.

Following discussion, the Plan Team recommended (by a one-vote margin) a 2010 ABC of 813,000 t. Given this decision, the Team recommended a 2011 ABC of 1.10 million t (equal to the maximum permissible value).

The OFL harvest ratio under Tier 1a is 0.421, the arithmetic mean of the ratio between MSY and the equilibrium fishable biomass corresponding to MSY. The product of this ratio, rescaled according to the Tier 1b formula, and the geometric mean of the projected fishable biomass for 2010 gives the OFL for 2010, which is 918,000 t. The current projection for OFL in 2011 given a 2010 catch of 813,000 t is 1.22 million t. The walleye pollock stock in the EBS is not overfished and is not approaching an overfished condition.

Ecosystem considerations

Both copepods and euphausiids are present in the diet of pollock in all years. While estimates of copepod abundance have been available for some time, similar information on euphausiids has previously been lacking. However, a recent analysis of EIT survey backscatter data from 2004-present has provided an index of euphausiid abundance on the Bering Sea shelf. The 2004-2009 time series shows that euphausiid backscatter has increased more than three-fold. Qualitatively, this trend matches those from other recent data sets. It is unknown whether the apparent inverse correlation between euphasiids and pollock in recent years reflects an increase in prey abundance resulting from a decrease in predator abundance, or whether the trends reflect independent responses to changes in environmental conditions.

The weakness of the 2002-2005 year classes suggests that, for this period of time, it was harder than average for pollock to survive through their first year.

Response to SSC comments

The probability that spawning biomass will fall below $B_{20\%}$ in 2010 (based on estimation uncertainty alone) is 18%, decreasing thereafter. An alternative method, similar in concept to "management strategy evaluation," estimates the probability that a future assessment will result in a point estimate of spawning biomass lower than the point estimate of $B_{20\%}$ from the same assessment. Using this alternative method, the probability of falling below $B_{20\%}$ in 2011 is less than 5%.

Aleutian Islands

Changes from previous assessment

The only new data in the model consists of updated catch information -- 2009 catch estimates and updated values for 2003 through 2008. Following a CIE review in 2007, several models were presented in last year's assessment. The Plan Team and SSC chose a reference model from these models. In this year's assessment, the reference model and another model were presented. Their only difference is that the latter model excludes fisheries data from the area east of 174°W (that may be from the eastern Bering Sea stock).

Spawning biomass and stock status trends

This year's assessment estimates that spawning biomass reached a minimum level of about $B_{21\%}$ in 1999, then increased steadily through 2006 to a level around $B_{30\%}$, and remained fairly close to that level through the present. The increase in spawning biomass since 1999 has resulted more from a dramatic decrease in harvest and an assumption of average recruitment rather than from good recruitment, as there have been no above-average year classes spawned since 1983. However, it should be noted that the average recruitment for this stock is almost twice the median level. The 2000 year class was the first to exceed the median level since the 1989 year class. Spawning biomass for 2010 is projected to be 97,500 t.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The SSC has determined that this stock qualifies for management under Tier 3. The Plan Team concurs and supports continued use of the reference model (Model 2) for evaluating stock status and recommending ABC. The reference model estimates $B_{40\%}$ at a value of 119,000 t, placing the AI pollock stock in sub-tier "b" of Tier 3. Under Tier 3b, with $F_{40\%}$=0.33, the maximum permissible ABC is 33,100 t for 2010 and 32,200 for 2011. The Plan Team recommends setting ABC at these levels. Following the Tier 3b formula with $F_{35\%}$=0.41, OFL for 2010 is 40,000 t. The projected OFL for 2011, given a 2010 catch of 19,000 t, is 39,100 t. If the 2010 catch is only 1,350 t (i.e., equal to the five year average), the 2011 maximum permissible ABC would be 38,900 and the 2011 OFL would be 47,000 t. The walleye pollock stock in the Aleutian Islands is not overfished and is not approaching an overfished condition.

Response to SSC comments

Two models were presented in the 2009 assessment: Model 1 (excluding catches east of 174°W) and the reference model, Model 2 (including all data). Assuming that Model 2's estimate of B20% is exact, there is less than a 1 percent chance that the AI pollock stock will be below B20% in 2010.

Bogoslof

Changes from previous assessment

The 2009 Bogoslof pollock echo integration-trawl (EIT) survey resulted in the lowest estimate of biomass (110,000 t) in the region since the EIT survey began in 1988.

Spawning biomass and stock status trends

Survey biomass estimates since 2000 have all been lower than estimates prior to 2000, ranging from a low of 110,000 t in 2009 to a high of 301,000 t in 2000.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The SSC has determined that this stock qualifies for management under Tier 5. Traditionally, the ABC for this stock has been set using a formula similar to the Tier 3 formula, but substituting a reference biomass level of 2 million t for $B_{40\%}$. The Plan Team concurs with the authors' recommendation to continue this practice. Given $F_{40\%}$=0.27, this results in F_{ABC}=0.0014 and a 2010 ABC of 156 t. The projected ABC for 2011 is the same.

Following the Tier 5 formula with M=0.20, OFL for 2010 is 22,000 t. The OFL for 2011 is the same. As a Tier 5 stock, it is not possible to determine whether Bogoslof pollock is overfished or is approaching an overfished condition.

2. Pacific Cod

Status and catch specifications (t) of Pacific cod in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2010 and 2011 are those recommended by the Plan Team. Catch data are current through November 7, 2009.

Area	Year	Age 3+ Biomass	OFL	ABC	TAC	Catch
	2008	1,080,000	207,000	176,000	170,720	166,136
	2009	1,260,000	212,000	182,000	176,540	163,587
	2010	1,140,000	205,000	174,000	n/a	n/a
	2011	n/a	251,000	214,000	n/a	n/a

Changes from previous assessment

New data in this year's assessment included the swept area estimate of abundance from the 2009 bottom trawl survey (717 million fish, a 50% increase over 2008), 2009 survey length data, 2008 survey age data,

and the latest fishery catch, catch composition and catch per effort data. The estimated variances in the internal ageing error matrix were also updated.

The assessment of the BSAI Pacific cod stock has gone through a series of changes in the last few years. A major change took place in 2005 when the model was migrated to the Stock Synthesis 2 program. Difficulties encountered in the 2006 assessment resulted in a thorough review of various assessment models in April 2007 during a public workshop. Many suggestions for changes and refinements of the analytical approaches were made. Refinements continued in the 2007, 2008, and 2009 assessment cycles based on suggestions from the plan teams, SSC, and the public.

The accuracy of age readings for this stock has been a continuing concern in this assessment. The chief symptom of the problem is the lack of agreement between the first few well-defined modes of the survey length compositions and the mean lengths at ages 1-2-3 based on age readings. At the September 2009 team meeting Tom Helser, NMFS Alaska Fisheries Science Center, presented some age reading data and analysis that, while not conclusive, suggested greater uncertainty about the age readings. The team minutes from September recommended attempting bias correction within the assessment as a short-term remedy. The minutes also recommended attempting to estimate a growth schedule for each cohort rather than a single schedule.

Three groups of models were presented at the November meeting. The first group (Models A1, A2, and A3) fitted the chosen 2008 model to different data sets. The features of these models, which had evolved over the course of the last two assessment cycles, are: fixed natural mortality rate M=0.34, double normal selectivity functions with freely estimated parameters except for some fisheries that are required to be asymptotic, selectivity parameters estimated for blocks of years where appropriate, trawl survey catchability estimated, mean and standard deviation of length at age estimated internally. Model A1 was fitted using all available age composition data, Model A2 using only length composition data, and Model A3 using all available age data except readings from the 2008 January-May longline fishery. These were the first readings of otoliths from the commercial fishery (all other age data are from the trawl survey), and they showed a highly anomalous abundance of one age group.

The second group of models (Model B1 and its variants) used all available age data and implemented several recommendations while maintaining almost all features of the base model A1. First, a bias term of 0.4 years at all ages was added to the internal ageing error matrix. This value was found in trials to improve the likelihood most. Second, cohort-specific growth was estimated. This required using external estimates of mean length at age estimated from the biased age readings, with the bias accounted for by the ageing error matrix. Third, the product of survey catchability and selectivity averaged over the 60-81 cm length range was required to equal 0.47, based on archival tag data on vertical distribution. This feature has the effect of pegging the abundance estimates to the trawl survey results, at least for this length group. Fourth, no selectivity deviations were estimated for the last two surveys, so those schedules used the expected values. Fifth, the standard deviation of length at age was estimated externally to avoid the somewhat perverse internal estimates located by the minimizer.

Model D1 was the same as Model B1 except that it does not estimate selectivity at maximum age or length as a parameter of the double normal selectivity; instead this value is determined by the right-side mean and variance parameters. In Model E1 this value is required to be the same for all fleets. In Model G1 no survey selectivity deviations are estimated, so a single survey selectivity is estimated and applied in all years. All of these variants were requested of the author by various reviewers.

The last group of models (Models B2, D2, E2 and G2) were fitted to length composition data only. In addition there was a length-based model named F2 proposed by members of the public in 2007, 2008, and 2009 that differed from Models A2 and B2 in a number of ways. It made trawl survey selectivity asymptotic and estimated natural mortality internally (M=0.48).

All of the models fitted the data adequately. The authors' recommended model was B1, chosen because it achieved the best fit among all the models that made use of the age data and implemented the

recommended changes. A majority of the team also preferred Model B1, and for the same reasons. A minority, concerned about the age data and skeptical of the bias correction applied in Model B1 (and even in Model B2 for the purpose of fitting mean length at age), favored Model A2.

Spawning biomass and stock status trends

The estimate of 2010 spawning biomass from Model B1 is 345,000 t, projected to rise to 370,000 t in 2011, while $B_{40\%}$ is 411,000 t. The 2009 catch was well below OFL. The stock is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

The 2008 year class, which has been observed only once, appears to be extremely large, although this estimate is accompanied by a large confidence interval. The 2006 year class, which appeared exceptionally strong in the 2007 survey, still appears to be above average. However, the 2006 year class follows a string of five consecutive sub-par year classes spawned from 2001-2005.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

According to criteria set by the SSC, this stock qualifies for management under Tier 3, where reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for the stock. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 411,000 t, 0.29, and 0.35, respectively. Pacific cod specifically qualifies for management under sub-tier "b" of Tier 3 because the projected biomass for 2010 is below $B_{40\%}$. Fishing at the adjusted Tier 3b rate of 0.24 is projected to result in a 2010 catch of 174,000 t, which is the maximum permissible ABC under Amendment 56.

The Plan Team recommends setting the 2010 ABC at 174,000 t, which is the maximum permissible. ABC is projected to increase to 214,000 t in 2011. The corresponding OFL levels under Tier 3b (F_{OFL}=0.29) are 205,000 t and 251,000, respectively.

The stock is not overfished nor approaching an overfishing condition.

Ecosystem Considerations summary

The Pacific cod chapter included a discussion of "ecosystem considerations." No special ecosystem features were identified that would require adjustments to the estimated ABCs and their attendant reference population parameters.

Area apportionment

At present, ABC of the BSAI pacific cod is not allocated by area. However, the biomass distribution analysis made in 2006 using the Kalman filter approach estimated the biomass distribution at 84% in the EBS and 16% in the AI. The SSC has recommended that the stock be managed under a combined BSAI OFL and separate BS and AI ABCs in the near future.

Responses to SSC comments

The author responded to many SSC and Plan Team comments. These responses are documented in the stock assessment.

3. Sablefish

Status and catch specifications (t) of sablefish in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2010 and 2011 are those recommended by the Plan Team. Catch data are current through November 7, 2009.

Area	Year	Age 4+ Biomass	OFL	ABC	TAC	Catch
Bering Sea	2008	41,000	3,380	2,860	2,860	1,119
	2009	39,000	3,210	2,720	2,720	890
	2010	38,000	3,310	2,790	n/a	n/a
	2011	n/a	2,970	2,500	n/a	n/a
Aleutian Islands	2008	34,000	2,890	2,440	2,440	876
	2009	28,000	2,600	2,200	2,200	1,055
	2010	27,000	2,450	2,070	n/a	n/a
	2011	n/a	2,200	1,860	n/a	n/a

Changes from previous assessment

The assessment model incorporates the following new data into the model: relative abundance and length data from the 2009 longline survey, relative abundance and length data from the 2008 longline and trawl fisheries, and age data from the 2008 longline survey and longline fishery. A NMFS GOA trawl survey was conducted in 2009 and its biomass estimate and associated lengths were also added. The survey abundance index increased 2% from 2008 to 2009 and follows a 16% decrease between 2006 and 2008. The fishery abundance index was up 5% from 2007 to 2008 (2009 data not yet available). Relative abundance from the domestic longline survey in 2009 is level with 2000 and is near the all-time low.

Spawning biomass and stock status trends

Spawning biomass has increased from a low of 30% of unfished biomass in 2001 to a projected 35% in 2010. The 1997 year class has been an important contributor to the population but has been reduced and should comprise 12% of the 2010 spawning biomass. The 2000 year class appears to be larger than the 1997 year class, and is now 92% mature and should comprise 23% of the spawning biomass in 2010.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Sablefish are managed under Tier 3 of NPFMC harvest rules. Reference points are calculated using recruitments from 1979-2007. The updated point estimates of B40%, F40%, and F35% from this assessment are 113,000 t (combined across the EBS, AI, and GOA), 0.095, and 0.114, respectively. Projected spawning biomass (combined areas) for 2010 is 99,900 t (89% of B40%), placing sablefish in sub-tier "b" of Tier 3. The maximum permissible value of FABC under Tier 3b is 0.084 which translates into a 2010 ABC (combined areas) of 15,230 t. The OFL fishing mortality rate is 0.100 which translates into a 2010 OFL (combined areas) of 18,030 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

The Plan Teams agree with the authors' recommended 2010 ABC of 15,230 t (combined areas). This represents a 5% decrease from the 2009 ABC of 16,080 t. This decrease is supported by three low years in the domestic longline survey abundance estimate and two subsequent low trawl survey abundance estimates. There is also little evidence of any large incoming year classes. Spawning biomass is projected to decline through 2013, and then is expected to increase, assuming average recruitment is achieved. Because of the lack of recent strong year classes, the maximum permissible ABC is projected to be 13,658 t in 2011 (using estimated catches, instead of maximum permissible), which is the Plan Teams' recommended ABC for 2011.

In December 1999, the Council apportioned the 2000 ABC and OFL based on a 5-year exponential weighting of the survey and fishery abundance indices. The same algorithm was used to apportion the recommended 2010 ABC and OFL.

Responses to SSC comments specific to the sablefish assessment

The December 2008 SSC minutes included the following comments:

"The SSC agrees that at the current time the IFQ CPUE data does not significantly influence the 2009 stock assessment results. However, over time as this index continues to deviate from the trend of other data sources, inclusion of this data may become more influential. The SSC asks the author to continue to examine the influence of the IFQ CPUE index on model results and consider the implications of removing it from the assessment."

The CIE panel suggested that the authors continue to use the fishery index in the model (see Appendix 3C of the assessment). The Plan Team believes that, in its current form, this index may not be informative about relative abundance. However, the Plan Team agrees with the panel that, if the data are modeled more appropriately (considering spatial dynamics, vessel effects, and targeting), the data may be more informative for future assessments. The authors will be pursuing this in a workshop in 2010.

"The SSC encourages the authors to conduct a retrospective analysis of the predicted biomass distribution resulting from the weighting scheme relative to observed biomass distributions. If time permits, the SSC encourages the author to examine the predicted regional biomass distribution derived from knowledge of age specific sablefish migration. The SSC also encourages the author to continue to explore the impact of sperm whale depredation."

The authors conducted additional retrospective analyses for the CIE review and found that the retrospective pattern was apparent under all data weighting schemes to some extent. The only configuration that succeeded in removing this pattern was to fix catchability and selectivity parameters, which has not been an option under active consideration. In the last several years, the retrospective pattern has diminished, which suggests that perhaps the pattern was data induced, and the model has now "caught up" with the trend.

4. Yellowfin Sole

Status and catch specifications (t) of yellowfin sole in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2010 and 2011 are those recommended by the Plan Team. Catch data are current through November 7, 2009.

Area	Year	Age 2+ Bio.	OFL	ABC	TAC	Catch
BSAI	2008	2,150,000	265,000	248,000	225,000	148,894
	2009	1,870,000	224,000	210,000	210,000	103,808
	2010	1,960,000	234,000	219,000	n/a	n/a
	2011	n/a	227,000	213,000	n/a	n/a

Changes from previous assessment

Changes to the input data for this year's assessment are the inclusion of 2008 fishery and survey age compositions, the 2009 trawl survey biomass point estimate and standard error, estimates of the discarded and retained portions of the 2008 catch, and an estimate of total catch through the end of 2009. This year's EBS bottom trawl survey resulted in a biomass estimate of 1,740,000 t, compared to last year's survey biomass of 2,100,000 t (a decrease of 17%).

Spawning biomass and stock status trends

The projected female spawning biomass estimate for 2010 is 582,000 t. Based on the most recent time series of estimated female spawning biomass, the projected 2010 female spawning biomass estimate continues the general monotonic decline in model estimates of spawning biomass exhibited since 1994.

Above average recruitment from the 1995 and 1999 year-classes is expected to maintain the abundance of yellowfin sole at a level above $B_{40\%}$ for the next several years.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The SSC has determined that reliable estimates of B_{MSY} and the probability density function for F_{MSY} exist for this stock. Accordingly, yellowfin sole qualify for management under Tier 1. The estimate of B_{MSY} from the present assessment is 333,000 t. The 1978-2003 spawner recruit data were used this year as the basis to determine the Tier 1 harvest recommendation. This provided an FABC = Fharmonic mean Fmsy = 0.12. The $F_{OFL} = F_{MSY} = 0.13$. The product of the harmonic mean of FMSY and the geometric mean of the 2010 biomass estimate produced the author- and Plan Team-recommended 2010 ABC of 219,000 t and 2011 OFL of 234,000 t. For 2011, the corresponding quantities are 213,000 t and 227,000 t, respectively.

Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Ecosystem Considerations summary

The assessment contains an ecosystem component by representing catchability of the EBS shelf trawl survey as an exponential function of average annual bottom temperature during the EBS shelf trawl survey.

Responses to SSC comments

In response to recommendations to continue work on an MSE analysis and to evaluate the assumption of time-invariant selectivities, the authors:

- made some progress on model coding for the MSE analysis but had no results to share in this year's SAFE report.
- did not explicitly model time-varying selectivity in the 2009 assessment. However, given the concern regarding the small buffer between ABC and OFL, they did provide an example of how the uncertainty in selectivity propagates through the assessment to determine its role in overall uncertainty. Although time-varying selectivity was not included in the model, this omission is not expected to have a significant impact on the buffer relative to the current analysis of selectivity.

5. Greenland turbot

Status and catch specifications (t) of Greenland turbot in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2010 and 2011 are those recommended by the Plan Team. Catch data are current through November 7, 2009.

Year	Area	Age 1+ Bio.	OFL	Subarea	ABC	TAC	Catch
2008	BSAI	104,100	15,600		2,540	2,540	2,740
				EBS	1,750	1,750	1,916
				AI	790	790	824
2009	BSAI	105,000	14,900		7,380	7,380	4,284
				EBS	5,090	5,090	2,074
				AI	2,290	2,290	2,210
2010	BSAI	61,100	7,460		6,120	n/a	n/a
				EBS	4,220	n/a	n/a
				AI	1,900	n/a	n/a
2011	BSAI	n/a	6,860		5,370	n/a	n/a
				EBS	3,700	n/a	n/a
				AI	1,670	n/a	n/a

Changes from previous assessment

This year's Greenland turbot assessment model included updated 2008 and 2009 catch data, EBS shelf survey 2009 biomass (11,000 t, down 19% from 2008) and length composition estimates, and

approximately 300 age samples from the 2007 shelf survey (previously, age data from only 1994 and 1998 were used)

In contrast to last year when Stock Synthesis 2 was used, this year the updated Stock Synthesis 3 (SS3) was used for modeling the Greenland turbot population.

Spawning biomass and stock status trends

The projected 2010 female spawning biomass is 40,000 t. Compared to the 2009 spawning biomass of 44,900 t this represents a decrease, consistent with the general decline prevalent since the mid 1970s. Recruitment appears to have improved somewhat in recent years, particularly the 2008 year class.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The SSC has determined that reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock. Greenland turbot therefore qualifies for management under Tier 3.

There was discussion about the large differences in model-estimated time series of Age 1+ biomass between the previous and current year's assessments, which used SS2 and SS3 respectively. These differences, along with variation in fishery- and sex-specific selectivities, contributed to uncertainties in interpreting the results of the model. Because of these uncertainties and the inability to differentiate the influence of factors such as the varying sex specific selectivities and the use of the SS3 (vs. SS2) model itself, the team discussed the merits of using the ABC results of the current model vs. using results from last year's model and rolling over the ABC from last year or using the projected 2010 ABC from last year's assessment.

There was also some discussion about the merits of using results of the current model or going with a Tier 5 designation. The Team decided to accept the current model results and recommend the maximum permissible ABC from this year's model, abandoning the stair-step approach recommended last year.

Accordingly, updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 24,300 t, 0.26, and 0.32, respectively. Projected spawning biomass for 2010 is 40,000 t, placing Greenland turbot in sub-tier "a" of Tier 3. The maximum permissible value of F_{ABC} under this tier translates into a maximum permissible ABC of 6,120 t for 2010 and 5,370 t for 2011. In keeping with past management, the Plan Team agrees with the authors that ABC be apportioned on the basis of 69% EBS and 31% AI. The OFLs for 2010 and 2011 under the Tier 3a formula are 7,460 t and 6,860 t, respectively.

Responses to SSC comments

To address lack-of-fit issues, the newest version of the SS software was used and attempts were made to improve fits to all data. However, shifts in Greenland turbot sex-ratios within surveys and between fisheries made fitting the data very difficult.

The slope survey is critical because it covers the habitat range of Greenland turbot and, unlike the longline survey, the results are not potentially compromised by killer whale depredation. In the event that the slope trawl survey is cancelled, future ABCs would likely be reduced because of increased uncertainty. Because a significant component of the population occurs in the Aleutian Islands, regular surveys of that region would also be beneficial.

6. Arrowtooth Flounder

Status and catch specifications (t) of arrowtooth flounder in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2009 and 2010 are those recommended by the Plan Team. Catch data are current through November 7, 2009.

Area	Year	Age 1+ Bio.	OFL	ABC	TAC	Catch
BSAI	2008	1,780,000	297,000	244,000	75,000	21,860
	2009	1,140,000	190,000	156,000	75,000	28,931
	2010	1,120,000	191,000	156,000	n/a	n/a
	2011	n/a	191,000	157,000	n/a	n/a

Changes from previous assessment

The present assessment is a straightforward update of last year's assessment. Input data were updated with the inclusion of fishery catch and discards through 3 Oct. 2009. New data also included the 2009 shelf survey size composition and shelf survey biomass point estimate (454,000 t, down 22% from 2008) and standard error. Estimates of the retained and discarded portions of the 2008 catch were also added.

Spawning biomass and stock status trends

The 2009 stock assessment model resulted in a 2010 total biomass projection of 1,120,000 t. This is a slight decrease from the value of 1,140,000 t projected in last year's assessment for 2009. The projected 2010 spawning biomass is 807,000 t, up just slightly from the 2009 projection (802,000 t) contained in last year's assessment. There is a long-term trend of increasing arrowtooth flounder biomass in the EBS. This trend is expected to continue for the next few years as strong recruitment was observed in the early part of this decade. Arrowtooth flounder in the AI leveled off from 1994-2000, but has been mostly increasing since then.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The Plan Team concurred with the authors that there are issues with this model needing to be resolved before arrowtooth flounder can be changed to Tier 1 status. Therefore, according to a previous SSC determination that reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, arrowtooth flounder was assessed for management under Tier 3. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 297,000 t, 0.24, and 0.30, respectively. Given that the projected 2010 spawning biomass of 807,000 t exceeds $B_{40\%}$, the Team's ABC and OFL recommendations for 2010 were calculated under sub-tier "a" of Tier 3. The Team recommends setting F_{ABC} at the $F_{40\%}$ (0.24) level, which is the maximum permissible level under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2010 ABC of 156,000 t. The OFL fishing mortality rate under Tier 3a is $F_{35\%}$ (0.30), which translates to a 2010 OFL of 191,000 t. The corresponding values for 2011 are 157,000 t (ABC) and 191,000 t (OFL).

The authors noted that the ABC recommendation is for the combined harvest of arrowtooth flounder and Kamchatka flounder, which are difficult to distinguish and had similar biomass trends from the EBS trawl survey since 1991. Though Kamchatka flounder can now be identified and separated from arrowtooth flounder on AFSC surveys, the two species are not distinguished in Bering Sea longline fisheries. Therefore, the estimate is for one *Atheresthes* spp. assemblage.

Status determination

Arrowtooth flounder is a largely unexploited stock in the BSAI. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Ecosystem Considerations summary

As opposed to the Gulf of Alaska, arrowtooth flounder are not at the top of the food chain on the eastern Bering Sea shelf. Arrowtooth flounder in the Bering Sea are an occasional prey in the diets of groundfish

in the Bering Sea, being eaten by Pacific cod, walleye pollock, Alaska skates, and sleeper sharks. However, given the large biomass of these species in the Bering Sea overall, predation by these species translates into considerable total mortality for the population in the Bering Sea ecosystem.

A 30-yr ecosystem simulation provided interesting results. Examining the effects of arrowtooth flounder on other species showed that a decrease of 10% in the arrowtooth flounder survival rate decreased the biomass of both arrowtooth flounder adults and juveniles, slightly increased flathead sole biomass and produced a negligible effect on pollock biomass. However, it should be noted that those results were for a 10% decrease. If arrowtooth flounder survival increased by 50%, the result could be significantly different, as seen in the GOA simulation. Currently both Pacific cod and arrowtooth flounder are negatively affecting pollock.

Response to SSC comments

There were no SSC comments specific to arrowtooth flounder.

7. Northern Rock sole

Status and catch specifications (t) of rock sole in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2010 and 2011 are those recommended by the Plan Team. Catch data are current through November 7, 2009.

Area	Year	Age 2+ Bio	OFL	ABC	TAC	Catch
BSAI	2008	1,880,000	304,000	301,000	75,000	51,063
	2009	1,630,000	301,000	296,000	90,000	48,593
	2010	1,770,000	243,000	240,000	n/a	n/a
	2011	n/a	245,000	242,000	n/a	n/a

Changes from previous assessment

Changes to input data in this analysis include the addition of 2008 fishery age composition, 2008 survey age composition, 2009 trawl survey biomass point estimate and standard error, and a new maturity ogive. Only Bering Sea survey data (no Aleutian Islands data, 3% of total survey biomass) were used in calculations. Analysis was conducted with fishery catch and discard data through 26 September 2009.

The major changes to the model are: 1) how weight at age is calculated; and 2) incorporation of the results from a new northern rock sole maturity study, which changed the perception of the productivity of the stock. Instead of keeping constant weight at age, the authors incorporated a 3-yr running average of weight at age that capture time-varying differences in growth. The new length-based relationship for maturity (Stark in press) was used as it was shown to be more accurate than the relationship used in the past.

Spawning biomass and stock status trends

The stock assessment model resulted in a 2010 geometric mean age-6+ biomass estimate of 1,570,000 t. This is a decrease from the 2009 estimate of 1,630,000 t contained in last year's assessment. Spawning biomass declined steadily from a high of 774,000 t in 2000 to a low of 480,000 t in 2008, but is estimated to have increased in 2009 and is projected to increase further in 2010 to 518,000 t and remain stable in 2011. All year classes spawned from 2000-2003 are estimated to be above average in strength.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The SSC has determined that northern rock sole qualifies as a Tier 1 stock. One difficulty with applying the Tier 1 rate to rock sole is that the arithmetic and harmonic means of the F_{msy} are extremely close, resulting in extremely close recommendations of maximum permissible ABC and OFL. This closeness results from estimates of F_{msy} that are highly certain.

The Plan Team agreed with the authors' implementation of time-varying length at age, and with the authors' recommendation to set ABC at the maximum permissible value in 2010 and 2011. The associated Tier 1 2010 ABC harvest recommendation is 240,000 t (F_{ABC} = 0.153) and a 2009 OFL of 243,000 t (F_{OFL} = F_{MSY} = 0.155). Note that with this Tier 1 assessment there is only a 3,000 t difference between the ABC and OFL levels, similar to the difference from the 2009 assessment. This will require close attention by fishery managers if catches approach the ABC value. The 2011 projection also uses Tier 1 methodology. The 2011 recommendations are 242,000 t (ABC) and 245,000 t (OFL).

The authors were concerned that ABC and OFL are close, so they revisited several models examined in previous years. These are the same models as examined in past, but with the new weight-at-age and maturity inputs. The results were similar to those obtained in the past, so the recommended model was unchanged.

Status determination

This is a stable fishery that lightly exploits the stock because it is constrained by prohibited species catch limits and the BSAI optimum yield limit. Usually the fishery only takes a small portion of the rock sole ABC. Model projections indicate that this stock is neither overfished nor approaching an overfished condition. As of November 7, 2009, 48,593 t were caught for an exploitation rate of 0.03. The Amendment 80 cooperative fishery remains open at this time; therefore the full catch for 2009 is not accounted for in the total catch reported here.

Response to SSC comments

Some progress was made in terms of model coding for management strategy evaluation (MSE) under Tier 1. The authors have not yet incorporated time-varying selectivity into the model, but plan to in the future.

8. Flathead Sole

Status and catch specifications (t) of flathead sole in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2010 and 2011 are those recommended by the Plan Team. Catch data are current through November 7, 2009.

Area	Year	Age 3+ Bio.	OFL	ABC	TAC	Catch
BSAI	2008	820,000	86,000	71,700	50,000	24,539
	2009	834,000	83,800	71,400	60,000	19,424
	2010	785,000	83,100	69,200	n/a	n/a
	2011	n/a	81,800	68,100	n/a	n/a

Changes from previous assessment

New data in this year's assessment include the following:

- The 2008 fishery catch data was updated and the 2009 catch through September 26, 2009 was added to the assessment.
- Sex-specific size compositions from the 2009 fishery, based on observer data, were added to the assessment. Fishery size compositions from 2008 were updated.
- Sex-specific age compositions from the 2006 and 2007 fisheries, based on observer-collected otoliths, were added to the assessment.
- The estimated survey biomass and standard error from the 2009 EBS trawl survey were added to the assessment.
- Sex-specific size compositions from the 2009 EBS trawl survey were added to the assessment.
- Sex-specific age compositions from the 2008 EBS trawl survey were added to the assessment.
- The mean bottom temperature from the 2009 EBS trawl survey was added to the assessment.

An experimental option added to the model last year that used a time-lagged version of survey bottom temperatures to model the effects of temperature-dependence on survey catchability (temperature-dependent catchability, or TDQ) was tested again this year. Lagging bottom temperature by one year in

the assessment model again resulted in a highly significant improvement in model fit to the survey biomass time series when compared with the unlagged model. A short analysis of the potential for time-lagged TDQ effects for 5 Bering Sea flatfish stocks is included in Appendix B to this chapter. While not conclusive, this analysis suggests that Alaska plaice may also exhibit a time-lagged TDQ effect while arrowtooth flounder, northern rock sole and yellowfin sole do not. This remains an area for future research and, as such, the time-lagged TDQ model is still regarded as preliminary. The selected assessment model is identical to that selected in last year's assessment.

Spawning biomass and stock status trends

Spawning biomass has declined continuously from a high of 332,000 t in 1997 to a projected 2010 value of 233,000 t, and is projected to continue declining for several years thereafter. The 2001 and 2003 year classes are estimated to be above average, but recruitments from 1994-2006 on average have been much lower than recruitments from 1974-1989.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The SSC has determined that that reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, thereby qualifying flathead sole for management under Tier 3. The current values of these reference points are $B_{40\%}$=137,000 t, $F_{40\%}$=0.28, and $F_{35\%}$=0.34. Because projected spawning biomass for 2010 (233,000 t) is above $B_{40\%}$, flathead sole is in sub-tier "a" of Tier 3. The authors and Plan Team recommend setting ABCs for 2010 and 2011 at the maximum permissible values under Tier 3a, which are 69,200 t and 68,100 t, respectively. The 2010 and 2011 OFLs under Tier 3a are 81,800 t and 72,500 t, respectively.

Status determination

Flathead sole is neither overfished nor approaching an overfished condition.

Response to SSC comments

The principal author regrets that he has not yet completed the MSE framework needed to address the SSC's requests for management strategy evaluations of flatfish species in general and for the flathead sole complex in particular (to determine whether the current management approach provides adequate protection of Bering flounder), but continues to work on it.

9. Alaska plaice

Status and catch specifications (t) of Alaska plaice in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2010 and 2011 are those recommended by the Plan Team. Catch data are current through November 7, 2009.

Area	Year	Age 3 + Bio	OFL	ABC	TAC	Catch
BSAI	2008	1,850,000	248,000	194,000	50,000	19,427
	2009	1,500,000	298,000	232,000	50,000	13,698
	2010	2,260,000	278,000	224,000	n/a	n/a
	2011	n/a	314,000	248,000	n/a	n/a

Changes from previous assessment

Input data were updated with 2009 catch data and inclusion of fishery catch through 10 October 2009. The 2009 trawl survey biomass estimate and standard error, and 2009 length composition of survey catch also were added to the model. The 2008 survey ages were read from otoliths and the 2008 survey age composition was added to the assessment.

The assessment model was changed from a combined-sex model to a split-sex model this year.

Spawning biomass and stock status trends

The female spawning biomass trend is similar to the overall biomass trend. Spawning biomass decreased steadily from 1985 to 2005, after which it has increased steadily to a projected value of 454,000 t in 2010.

Total (age 3+) biomass decreased steadily from 1982 to 2001, after which it has increased steadily to a projected value of 2,260,000 t in 2010. The shelf survey biomass has been fairly steady since the mid-1980s. Very strong year classes were spawned in 2001 and 2002. Following a projected downturn in spawning biomass after 2010, these year classes should cause spawning biomass to increase again once they reach maturity.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, therefore qualifying it for management under Tier 3 of the BSAI Groundfish FMP. The updated point estimates are $B_{40\%}$ = 205,000 t, $F_{40\%}$ = 0.58, and $F_{35\%}$ = 0.77. These are high values for flatfishes, but these values are the consequence of Alaska plaice maturing before recruiting to the fishery. Given that the projected 2010 spawning biomass of 487,000 t exceeds $B_{40\%}$, the maximum permissible ABC and OFL recommendations for 2010 were calculated under sub-tier "a" of Tier 3. The Plan Team recommends setting ABC at the maximum permissible value. Projected harvesting at the $F_{40\%}$ level gives a 2010 ABC of 224,000 t. The OFL was determined from the Tier 3a formula, which gives a 2010 OFL of 278,000 t. The recommended ABC and OFL for 2011 under Tier 3a are 248,000 t and 314,000 t, respectively.

The estimated spawning biomass of Alaska plaice is now higher than in the past because female weight at age, which is used in the present assessment, is higher than combined-sex weight at age, which was used in previous assessments.

Status determination

Model projections indicate that this species is neither overfished nor approaching an overfished condition. There is not a targeted fishery for this species as there is no market. The total exploitation rate is quite low for Alaska plaice as it is caught only as bycatch and is mostly discarded.

Response to SSC comments

A split-sex model was implemented per SSC request.

10. Other flatfish complex

Status and catch specifications (t) of Alaska plaice in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2010 and 2011 are those recommended by the Plan Team. Catch data are current through November 7, 2009.

	Year	Total Bio.	OFL	ABC	TAC	Catch
BSAI	2008	149,000	28,800	21, 600	21,600	3,616
	2009	121,000	23,100	17,400	17,400	2,155
	2010	121,000	23,000	17,300	n/a	n/a
	2011	121,000	23,000	17,300	n/a	n/a

Changes from previous assessment

The present assessment is a straightforward update of last year's assessment. The assessment incorporates 2009 total catch and discards through 7 November 2009 and 2009 EBS trawl survey information. As there was no AI survey in 2009, a linear regression was used to predict AI biomass for 2009. Together the 2009 EBS bottom trawl survey and AI prediction resulted in a biomass estimate of 121,000 t, a value equal to that which resulted from the 2008 survey.

Spawning biomass and stock status trends

Because this complex is managed under Tier 5, no models are available from which to predict future trends. However, with the exception of 2005, all EBS shelf trawl survey biomass estimates since 2004 have been higher than any during the period 1983-2003.

Changes in estimated biomass per species are noted over time. There is no consistent trend in estimated biomass of butter sole over time. The 1982 estimate was 182 t compared to the 2009 estimate of 532 t, with fluctuations as high as 6,300 t in 1986 and as low as 37 t in 1983. Starry flounder biomass increased from 7,700 t in 1982 to 79,000 tons in 2009. This estimate has fluctuated over time, though there has been an upward trend. Conversely, since 1982 longhead dab has decreased from 104,000 t to 5,000 t in 2009. Habitat and depth preference may affect the apparent changes in abundance, i.e., longhead dab are found in inshore waters that are not normally sampled by the survey. Thus distributional changes, onshore-offshore or north-south might affect the survey biomass estimates (Table 10.5).

Tier determination/Plan Team discussion and resulting ABCs and OFLs

With the removal of Alaska plaice from this category in 2002, the SSC reclassified "other flatfish" as a Tier 5 species complex with harvest recommendation calculated from estimates of biomass and natural mortality. Natural mortality values for rex (0.17) and Dover sole (0.085) in the GOA SAFE document are used. For all other species, a natural mortality rate of 0.20 is assumed. The Plan Team recommends setting ABC at the maximum permissible level. Projected harvesting at the 0.75 *M* level ($F_{ABC} = 0.13$), gives a 2010 maximum permissible ABC of 17,300 t. The corresponding 2010 OFL is 23,000 t. Because projections of biomass are not possible, the 2011 values are the same as the 2010 values.

Status determination

It is not possible to determine whether the "other flatfish" complex is overfished or approaching an overfished condition because it is not managed under Tiers 1-3. Insufficient information about these species makes model analysis impossible.

With the implementation of Amendment 80, a higher TAC for other flatfishes was assigned for 2008, though there was not a higher catch taken in 2008 or 2009, and the fishery is still open in 2009.

Response to SSC comments: The assessment does not reference any SSC comments.

11. Pacific Ocean Perch (POP)

Status and catch specifications (t) of Pacific ocean perch. Biomass corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2010 and 2011 are those recommended by the Plan Team. Catch data are current through November 7, 2009.

Year	Area	Age 3+ Bio	OFL	Subarea	ABC	TAC	Catch
2008	BSAI	453,000	25,700		21,700	21,700	17,430
				EBS	4,200	4,200	510
				Eastern AI	4,900	4,900	4,695
				Central AI	4,990	4,990	4,808
				Western AI	7,610	7,610	7,417
2009	BSAI	402,000	22,300		18,800	18,800	14,780
				EBS	3,820	3,820	623
				Eastern AI	4,200	4,200	3,867
				Central AI	4,260	4,260	3,879
				Western AI	6,520	6,520	6,411
2010	BSAI	403,000	22,400		18,860	n/a	n/a
				EBS	3,830	n/a	n/a
				Eastern AI	4,220	n/a	n/a
				Central AI	4,270	n/a	n/a
				Western AI	6,540	n/a	n/a
2011	BSAI	n/a	22,200		18,680	n/a	n/a
				EBS	3,790	n/a	n/a
				Eastern AI	4,180	n/a	n/a
				Central AI	4,230	n/a	n/a
				Western AI	6,480	n/a	n/a

Changes from previous assessment

Beginning in 2005, Pacific ocean perch assessments are conducted on a two year cycle to coincide with planned Aleutian Islands surveys. There has not been a new survey since 2006. Catch data were updated and the projection model was run using results from the 2008 assessment model as the starting point.

Spawning biomass and stock status trends

Age 3+ biomass for 2010 is up slightly from 2009. According to last year's assessment, spawning biomass has trended slightly downward since 2002. Spawning biomass is projected to be 133,000 t in 2010 and decline slightly to 131,000 t in 2011.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The SSC has determined that reliable estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ exist for this stock, thereby qualifying Pacific ocean perch for management under Tier 3. The current estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ are 123,000 t, 0.057, and 0.068 respectively. There are reliable estimates of the 2010 spawning biomass (B), $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$; and $B>B_{40\%}$ (133,000 t > 123,000 t). Therefore the POP reference fishing mortality is defined in Tier 3a. For this tier, F_{ABC} is constrained to be $\leq F_{40\%}$, and F_{OFL} is constrained to be equal to $F_{35\%}$. The 2010 and 2011 ABCs associated with the $F_{40\%}$ level of 0.057 are 18,860 t and 18,680 t, respectively, which are the Plan Team's recommended values. The 2010 and 2011 OFLs under Tier 3a are 22,400 t and 22,200 t, respectively

Area apportionment

The Team agrees with the author's recommendation that ABCs be set regionally based on the proportions in combined survey biomass. For 2010, this procedure apportions the ABC as follows: BS = 3,830 t, Eastern Aleutians (Area 541) = 4,220 t, Central Aleutians (Area 542) = 4,270 t, Western Aleutians (Area 543) = 6,540 t. For 2011, the same procedure apportions the ABC as follows: BS = 3,790 t, Eastern Aleutians (Area 541) = 4,180 t, Central Aleutians (Area 542) = 4,230 t, Western Aleutians (Area 543) = 6,480 t. The OFL is not regionally apportioned.

Status determination

Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Response to SSC comments

Estimation of the probability that the stock will fall below $B_{20\%}$ within 3-5 years will be addressed in the next full assessment.

12. Northern Rockfish

Status and catch specifications (t) of Northern rockfish. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2010 and 2011 are those recommended by the Plan Team. Catch is reported through November 7, 2009.

Area	Year	Age 3+ Bio.	OFL	ABC	TAC	Catch
BSAI	2008	212,000	9,740	8,180	8,180	3,287
	2009	200,000	8,540	7,160	7,160	3,087
	2010	203,000	8,640	7,240	n/a	n/a
	2011	n/a	8,700	7,290	n/a	n/a

Changes from previous assessment

Beginning in 2005, northern rockfish assessments are being conducted on a two year cycle to coincide with planned Aleutian Islands surveys. There has not been a new survey since 2006. Catch data were updated and the projection model was run using results from the 2008 assessment model as the starting point.

Spawning biomass and stock status trends

Age 3+ biomass has been on an upward trend since 2002. According to last year's assessment, spawning biomass has been increasing slowly since 1977. Spawning biomass is projected to be 69,300 t in 2010.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The SSC has determined that this stock qualifies for management under Tier 3 due to the availability of reliable estimates for $B_{40\%}$ (55,300 t), $F_{40\%}$ (0.043), and $F_{35\%}$ (0.051). Because the female spawning biomass of 69,300 t is greater than $B_{40\%}$, sub-tier "a" is applicable, with maximum permissible $F_{ABC} = F_{40\%}$ and $F_{OFL} = F_{35\%}$. Under Tier 3a, the maximum permissible ABC is 7,240 t, which is the authors' and Plan Team's recommendation for the 2010 ABC. Under Tier 3a, the 2010 OFL is 8,640 t for the Bering Sea/Aleutian Islands combined. The Team continues to recommend setting a combined BSAI OFL and ABC. As the catch has routinely been lower than the ABC, a catch of 4,500 t was assumed as the 2010 catch, in order to make projections to 2011. The recommended ABC and OFL for 2011 are 7,290 t and 8,700 t, respectively.

Status determination

Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Responses to SSC comments

Estimation of the probability that the stock will fall below $B_{20\%}$ within 3-5 years will be addressed in the next full assessment.

13A. Shortraker Rockfish

Status and catch specifications (t) of shortraker rockfish in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2010 and 2011 are those recommended by the Plan Team. Catch data are current through November 7, 2009

Area	Year	Survey Bio.	OFL	ABC	TAC	Catch
BSAI	2008	18,900	564	424	424	154
	2009	17,200	516	387	387	198
	2010	17,200	516	387	n/a	n/a
	2011	n/a	516	387	n/a	n/a

Changes from previous assessment

Shortraker rockfish assessment was separated from the blackspotted and rougheye rockfish complex in 2008. Prior to 2008, shortraker and rougheye rockfish were assessed with a two-species surplus production model that accounted for potential covariance in catch estimates. The 2008 assessment applied a single-species surplus production model to BSAI shortraker rockfish.

Beginning in 2005, rockfish assessments are being conducted on a two year cycle to coincide with planned Aleutian Islands surveys. There has not been a new survey since 2006. Since shortraker rockfish are in Tier 5 and there has been no new survey biomass estimate, the results are the same as in 2008.

Spawning biomass and stock status trends

Shortraker rockfish survey biomass is 17,200 t, which is the same as the 2008 assessment. In last year's assessment, total biomass was estimated to have trended slowly downward since 1984.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The SSC has previously determined that reliable estimates only of biomass and natural mortality exist for shortraker rockfish, qualifying the species for management under Tier 5. The Tier 5 biomass estimate is based on the surplus production model. At the present time, the Plan Team recommends that the SSC retain Tier 5 management for these stocks. The Plan Team recommends setting F_{ABC} at the maximum permissible level under Tier 5, which is 75% of *M*. The accepted value of *M* for these stocks is 0.030 for shortraker rockfish, resulting in an F_{ABC} value of 0.023.

The biomass estimate for 2010 is 17,200 t for shortraker rockfish, leading to a BSAI OFL of 516 t and an ABC of 387 t.

Status determination

It is not possible to determine whether these species are overfished or whether they are approaching an overfished condition because they are managed under Tier 5.

Responses to SSC comments

Estimation of the probability that the stock will fall below $B_{20\%}$ within 3-5 years will be addressed when an age-structured model is developed for shortraker rockfish.

13B. Blackspotted/Rougheye rockfish complex

Status and catch specifications (t) of rougheye and blackspotted rockfish in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2010 and 2011 are those recommended by the Plan Team. Catch data are current through November 7, 2009.

Area	Year	Total Bio.	OFL	ABC	TAC	Catch
BSAI	2008	10,800	269	202	202	212
	2009	19,000	660	539	539	194
	2010	21,200	669	547	n/a	n/a
	2011	n/a	650	531	n/a	n/a

Changes from previous assessment

Fish previously referred to as rougheye rockfish are now recognized as consisting of two species, the rougheye rockfish (*Sebatses aleutianus*) and blackspotted rockfish (*Sebastes melanostictus*). The blackspotted and rougheye complex assessment was separated from shortraker rockfish and assessed with an age-structured model in 2008.

Beginning in 2005, rockfish assessments are being conducted on a two year cycle to coincide with planned Aleutian Islands surveys. There has not been a new survey since 2006. Catch data were updated and the projection model was run using results from the 2008 assessment model as the starting point.

Spawning biomass and stock status trend

Total biomass for 2010 was estimated at a value of 21,200 t, up slightly from 2009. In last year's assessment, spawning biomass was estimated to have trended slowly upward since 1998, but was projected to decline slightly after 2009. Projected spawning biomass for 2010 (AI only) is 6,570 t.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The Plan Team recommends that this stock qualifies for management under Tier 3 due to the availability of reliable estimates for $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$. Because the female spawning biomass of 6,570 t is less than $B_{40\%}$, (6,720 t, AI only), sub-tier "b" would be applicable, with an adjusted $F_{40\%}$=maxF_{ABC} =0.039 and an adjusted $F_{35\%} = F_{OFL}$ = 0.047. Under Tier 3b, the maximum permissible ABC is 547 t (EBS and AI combined), which is the authors' and Plan Team's recommendation for the 2010 ABC. Under Tier 3b, the 2010 OFL is 669 t for the Bering Sea/Aleutian Islands combined. The Plan Team continues to recommend setting a combined BSAI OFL and ABC. Since the catch has routinely been lower than the ABC, the catch of the previous year was assumed as the 2010 catch, in order to make projections to 2011. The recommended ABC and OFL for 2011 are 531 t and 650, respectively (both values are BSAI-wide).

Status determination

Model projections indicate that this stock complex is neither overfished nor approaching an overfished condition.

Responses to SSC comments

The authors responded to an SSC request to consider the implications of adopting area-specific ABCs for this stock complex. The age-structured assessment model for blackspotted/rougheye was first accepted by the BSAI Plan Team in 2008. At that time, the ABCs which would result from a single BSAI model as well as an AI-only model were presented, as well as information on stock structure and a comparison of potential area-specific ABCs to recent area-specific catches. More progress has been made on the issue of stock structure in 2009, including: 1) a symposium at the February, 2009 SSC meeting on genetic techniques pertaining to stock structure; 2) the formation of an SSC-Plan Team working group charged with developing guidelines for determining stock structure; and 3) the presentation of the report of the working group at the September, 2009 Plan Team meeting. The working group report identified various types of data to be considered when evaluating stock structure. The current status is that the template outlined in the working group report will be applied to BSAI blackspotted/rougheye and presented to the Plan Team in September, 2010.

Estimation of the probability that the stock will fall below $B_{20\%}$ within 3-5 years will be addressed in the next full assessment.

14. Other Rockfish Complex

Status and catch specifications (t) of other rockfish (primarily thornyheads) in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2010 and 2011 are those recommended by the Plan Team. Catch data are current through November 7, 2009.

Area	Year	Survey Biomass	OFL	ABC	TAC	Catch
BSAI	2008	36,700	1,330	999	999	597
	2009	39,200	1,380	1,040	1,040	586
	2010	39,200	1,380	1,040	n/a	n/a
	2011	n/a	1,380	1,040	n/a	n/a
EBS	2008	18,100	n/a	414	414	209
	2009	21,100	n/a	485	485	193
	2010	21,100	n/a	485	n/a	n/a
	2011	n/a	n/a	485	n/a	n/a
AI	2008	18,600	n/a	585	585	388
	2009	18,100	n/a	555	555	393
	2010	21,100	n/a	555	n/a	n/a
	2011	n/a	n/a	555	n/a	n/a

Changes from previous assessment

As of 2009, dark rockfish are no longer included in the other rockfish complex. Catch in 2008 has been revised and the estimated 2009 catch has been included.

Beginning in 2005, rockfish assessments are being conducted on a two year cycle to coincide with planned Aleutian Islands surveys. There has not been a new survey since 2006. Since the other rockfish complex is in Tier 5, and there has been no new Aleutian Islands trawl survey, the results are the same as in 2008.

Spawning biomass and stock status trends

Trends in spawning biomass are unknown. Stock biomass, as measured by trawl surveys of the EBS slope is the same as in 2008.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The Team agrees with the approach recommended by the author of setting F_{ABC} at the maximum allowable under Tier 5 ($F_{ABC} = 0.75 \times M$). Multiplying these rates with the best estimates of SST and other "other rockfish" biomass yields 2008 ABCs of 481 t in the EBS and 554 t in the AI. The Plan Team recommends that OFL be set for the entire BSAI area, which under Tier 5 is calculated by multiplying the best estimates of total biomass for the area by the separate natural mortality values and adding the results, which yields an OFL of 1,380 t for 2010 and 2011.

Status determination

As a Tier 5 complex, it is not possible to determine whether "other rockfish" are overfished or approaching an overfished condition.

Response to SSC comments

There were no SSC comments relevant to this assessment.

15. Atka mackerel

Status and catch specifications (t) of Atka mackerel in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2010 and 2011 are those recommended by the Plan Team. Catch data are current through November 7, 2009.

Area	Year	Sub-Area	Age 3+ Biomass	OFL	ABC	TAC	Catch
BSAI	2008		323,000	71,400	60,700	60,700	58,471
BSAI	2009		411,000	99,400	83,800	76,400	72,274
BSAI	2010		389,000	88,200	74,000	n/a	n/a
		EAI/EBS			23,800	n/a	n/a
		CAI			29,600	n/a	n/a
		WAI			20,600	n/a	n/a
BSAI	2011		n/a	76,200	65,000	n/a	n/a
		EAI/EBS			20,900	n/a	n/a
		CAI			26,000	n/a	n/a
		WAI			18,100	n/a	n/a

Changes from previous assessment

The following changes were made to the input data used in this assessment model:

- Fishery catch data were updated.
- The 2008 fishery age composition data were included.
- 2008 fishery weight-at-age values were added.

Spawning biomass and stock status trends

The projected female spawning biomass for 2010 under an $F_{40\%}$ harvest strategy is estimated at 111,000 t, which is 47% of unfished spawning biomass and above $B_{40\%}$ (95,100 t). The 2010 estimate of spawning biomass is down about 16% from last year's estimate for 2009.

The projected age 3+ biomass at the beginning of 2010 is estimated at 389,000 t, down about 5% from last year's estimate for 2009. This is due to a decrease (-29% from 2008 assessment) in the estimated magnitude of the 2004 year class, and an increase (+120%) in the 2006 year class after the addition of the 2008 fishery age data into the model. Since there has been no Aleutian Islands bottom trawl survey since 2006, determination of the magnitude of incoming year classes has been dependent on fishery age data. As such, there is concern that the fishery could target on incoming year-classes, which for 2010, have only been seen once or never in a fishery-independent survey.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The projected female spawning biomass under an $F_{40\%}$ harvest strategy is estimated to be 47% of unfished spawning biomass in 2010 and above $B_{40\%}$, thereby placing BSAI Atka mackerel in Tier 3a**.** The projected 2010 yield (maximum permissible ABC) at $F_{40\%}$= 0.42 is 74,000 t, down about 12% from last year's estimate for 2009. The projected 2010 overfishing level at $F_{35\%}$ (F = 0.51) is 88,200 t, down about 11% from last year's estimate for 2009. Atka mackerel female spawning biomass in 2011 (97,000 t) is projected to remain above $B_{40\%}$. The projected 2011 yield (maximum permissible ABC) under Tier 3a ($F_{40\%}$= 0.42) is 65,000 t; the projected 2011 overfishing level at $F_{35\%}$ (F = 0.51) is 76,200 t. The Plan Team recommends setting 2010 and 2011 ABCs at the maximum permissible levels. The population is projected to be below $B_{40\%}$ from 2012-2017.

Status determination

The stock is not currently overfished, nor is it approaching an overfished condition.

Ecosystem Considerations

Food habits data (from analysis of scats) from the Aleutian Islands indicate that Atka mackerel is the most common prey item of the endangered western Steller sea lion throughout the year. Analyses of historic fishery CPUE revealed that the fishery may create temporary localized depletions of Atka mackerel, and fishery harvest rates in localized areas may have been high enough to affect prey availability of Steller sea lions. The objectives of having areas closed to Atka mackerel fishing around Steller sea lion haulouts and rookeries, and time-area ABC allocations are to maintain sufficient prey for the recovery of Steller sea lions in the Aleutian Islands while also harvesting Atka mackerel. The stock assessment indicates that the abundance of Atka mackerel is decreasing. While abundance is decreasing, it recently peaked due to four back-to-back strong year classes and an extraordinarily strong 1999 year class which still persists in the population. Atka mackerel are very productive and remain at high biomass levels. Nevertheless, Steller sea lion surveys conducted in 2008 indicate that counts of adults and juveniles in the central and western Aleutian Islands (west of Samalga Pass) declined 16% and 30%, respectively, between 2004 and 2008. This contrasts to populations in the eastern Aleutian Islands (between Samalga and Unimak Passes) which increased 7% in this same time period. Pup production (most recently assessed in 2009) continues to decline at rookeries west of 178°W (Tanaga Island), while to the east, it has either been stable or has increased since 2005. The Atka mackerel fishery is prohibited from fishing inside sea lion critical habitat east of 178°W, while up to 60% of the 542 and 543 TACs can be taken within critical habitat west of 178°W. The continued decline in sea lion populations throughout much of the Aleutian Islands remains a concern to the Team.

Area apportionment

Amendment 28 of the Bering Sea/Aleutian Islands Fishery Management Plan divided the Aleutian Islands subarea into 3 districts at 177° E and 177° W longitude, providing the mechanism to apportion the Aleutian Atka mackerel TACs. The Council used a 4-survey (2000, 2002, 2004, and 2006) weighted average to apportion the 2007 ABC, and the authors recommend using the same method to apportion the 2010 and 2011 ABCs. The recommended ABC apportionment by subarea for both 2009 and 2010 is 32.2% for Area 541, 40.0% for 542, and 27.8% for Area 543.

Responses to SSC Comments

The probability that Atka mackerel will drop below $B_{20\%}$ within the next five years is negligible.

Recommendations

The Team strongly recommends that an Aleutian Islands bottom trawl survey be conducted in 2010 as scheduled.

16 – 20. Squid and Other Species Complex

Status and catch specifications (t) of squid and other species in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2010 and 2011 are those recommended by the Plan Team. Catch data are current through November 7, 2009.

Squid	**Area**	**Year**	**Biomass**	**OFL**	**ABC**	**TAC**	**Catch**
	BSAI	2008	n/a	2,620	1,970	1,970	1,544
		2009	n/a	2,620	1,970	1,970	353
		2010	n/a	2,620	1,970	n/a	n/a
		2011	n/a	2,620	1,970	n/a	n/a
Other species	**Area**	**Year**	**Biomass**	**OFL**	**ABC**	**TAC**	**Catch**
	BSAI	2008	822,000	104,000	78,100	50,000	29,244
		2009		80,800	66,700	50,000	26,653
	.	Sharks	n/a	596	447	n/a	n/a
		Skates	634,000	38,300	32,000	n/a	n/a
		Sculpins	234,000	41,600	31,000	n/a	n/a
		Octopus	n/a	311	233	n/a	n/a
		2010		88,200	61,100	n/a	n/a
		Sharks	n/a	598	449	n/a	n/a
		Skates	608,000	36,000	30,200	n/a	n/a
		Sculpins	226,000	51,300	30,200	n/a	n/a
		Octopus	n/a	311	233	n/a	n/a
		2011		88,100	60,900	n/a	n/a
		Sharks	n/a	598	449	n/a	n/a
		Skates	n/a	35,900	30,000	n/a	n/a
		Sculpins	n/a	51,300	30,200	n/a	n/a
		Octopus	n/a	311	233	n/a	n/a

Changes from previous assessment

For all species, catches were updated for the years 2003-2009; changes in catches for years prior to 2009 were due to changes made in the Catch Accounting System in 2009. In general, EBS shelf survey biomass estimates were added to all assessments. The Plan Team recommends keeping the Tier 6 catch reference period for sharks and octopus as 1997-2007. The sculpin assessment authors selected new natural mortality estimates for calculations of maxABC and OFL, as discussed below. Other species-specific information added for informational purposes is discussed below.

Spawning biomass and stock status trends

Biomass trends are not reliable for the Tier 6 species (squid, sharks, and octopus). 2009 EBS shelf survey biomass for Alaska skate was similar to 2008, and both years were considerably lower than 2007, leading to a slightly lower ABC and OFL for Alaska skate. Total sculpin biomass in the EBS shelf survey declined by 25% from 2008 to 2009. However, since the biomass estimate used for calculating the Tier 5 ABCs and OFLs is a 2004-2009 average (so as to include EBS slope and AI surveys), the ABC remained nearly unchanged and the OFL increased by 23% due to the change in M estimates used as discussed below.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Squid - Using Tier 6 criteria, the recommended ABC for BSAI squid for 2010-2011 is the maximum permissible level, calculated as 0.75 times the average catch from the reference period of 1978-1995, or 1,970 t; the recommended OFL for squid in 2010-2011 is calculated as the average catch from 1978-1995, or 2,620 t. The groundfish surveys do not provide a reliable biomass estimate. To improve the understanding of squid biology and their interaction with fisheries, the authors added estimates of retention rates for 1997-2009 and added length composition data for squids caught in commercial fisheries during 2008. The length composition data contain two modes and suggest either multiple yearly cohorts or two distinct major species in the fishery (*B. magister* and *G. borealis*).

Other species (general) – Because ABC and OFL are specified for the complex as a whole, the Plan Team recommends setting a "proto-ABC" at the respective tier-specific maximum permissible level for each of the constituent groups and summing to get the recommended ABC for the complex. Similarly, the Plan Team recommends setting a "proto-OFL" at the respective tier-specific level for each of the constituent groups and summing to get the recommended OFL for the complex.

Sharks – The authors and the Plan Team support Tier 6 management for this species. The Plan Teams, following discussion in September and November 2009, recommend retaining the fixed 11-year time period of 1997-2007 for computing average catch. Based on this time period, the authors and Plan Team recommend an ABC of 449 t and an OFL of 598 t for 2010 and 2011. The 2009 chapter has been updated with 2009 catch, life history information, and population demographic information.

Skate – In 2008, the SSC accepted a new age-structured model for Alaska Skate. The same model was used in 2009. The "other skate" species remain within Tier 5. In addition to catch and 2009 EBS shelf survey updates, the authors updated catch and survey length compositions, and updated skate distribution maps based on recent survey data. The Team accepted the model with Alaska skates under Tier 3a ($F_{ABC} = F_{40\%} = 0.069$ for an ABC of 24,000 t; $F_{OFL} = F_{35\%} = 0.080$ for an OFL of 27,800 t). The Plan Team agreed with the authors' recommendation to continue to assess the "other skate" component within Tier 5 (ABC = 6,170 t and OFL = 8,220 t based on an M of 0.10). Skate OFLs for 2010 and 2011 total 36,000 t and 35,900 t, respectively. Skate ABCs total 30,200 t and 30,000 t, respectively.

Sculpin – Since further life-history information has become available due to ongoing research, the authors have recommended the use of separate M estimates for 7 species, and different M estimates for the EBS and AI. Several methods of calculating M resulted in a range of values for each species. This year, the authors recommended using a "risk neutral" value of M (using Hoeing's method) for calculating OFL and maxABC, but using the most conservative (lowest) M for calculating the recommended ABC. The Plan Team concurred with this recommendation. The total sculpin recommended ABC and OFL for 2010 – 2011 are 30,200 t and 51,300 t, respectively.

Octopus – The Plan Team supports the recommendation for using Tier 6 criteria using 1997-2007 for octopus, accepting that the biomass estimate for octopus from the trawl survey is not reliable. The author noted the Tier 6 estimate based on average catch likely underestimates the population and would unnecessarily constrain the pot fishery for Pacific cod if octopus were managed as a single species group. The Team recommended using a Tier 6 average for ABC = 233 t and OFL = 311 t calculation. Observers

continue to improve their species identification. The Teams encouraged further development of studies and data collection to document octopus mortality rates.

Appendix 1: Grenadiers

An executive summary assessment of the grenadier assemblage is provided in Appendix 1. This is an update of a full assessment that was provided in the 2006 SAFE report. The grenadier assessment covers both the BSAI and GOA management areas. Seven species of grenadiers are known to occur in Alaska. The giant grenadier is the most abundant and has the shallowest depth distribution on the continental slope. The assessment focused on the giant grenadier as it is the most common grenadier caught in both the commercial fishery and longline and trawl trawl surveys. Pacific and popeye grenadiers are occasionally caught. Grenadier species are currently considered "non-specified" under both BSAI and GOA Groundfish FMPs; however, the Teams recommend that the grenadier assemblage, which would include giant grenadier as the indicator species, along with popeye grenadier and Pacific grenadier be moved into a managed category so that annual catch limits can be established. The remaining four grenadier species would remain non-specified.

No management measures have been implemented for grenadiers and no official catch statistics exist because reporting for this assemblage is not required. However, catches have been estimated based on observer data or the NMFS Alaska Region Catch Accounting System from 2003 through October 7, 2009. Average annual catches over this time period have been 2,877 t in the EBS, 2,371 t in the Aleutian Islands (AI), and 10,544 t in the GOA. Most of the catch occurs in longline and pot fisheries.

The Team accepted a tier 5 approach for determining OFL and ABC under a proposed FMP amendment to set annual catch limits for the grenadier assemblage (using giant grenadiers as a proxy for the assemblage).

Appendix 2: Pacific Halibut Discard Mortality Rates

Halibut discard mortality rates (DMRs) are set by the Council on a 3-year cycle based on recommendations by International Pacific Halibut Commission staff. Current rates will expire at the end of 2009; new rates are needed for 2010 -2012. An average of annual DMRs from the previous 10 years are adopted for the non-Community Development Quota (CDQ) fisheries. Rates for non-CDQ fisheries have been set annually though 2009 because 10 years of data had not been available. Recommendations for the CDQ fisheries now follow the protocol for non-CDQ fisheries.

Recommended Pacific halibut discard mortality rates (DMRs) for 2010-2012 BSAI CDQ and non-CDQ fisheries.

Non-CDQ

Gear/Target	Recommendation
Trawl	
Atka mackerel	76
Bottom pollock	73
Pacific cod	71
Other Flatfish	72
Rockfish	81
Flathead sole	74
Midwtr pollock	89
Rock sole	82
Sablefish	75
Turbot	67
Arrowtooth fldr	76
Yellowfin sole	81
Pot	
Pacific cod	8
Longline	
Pacific cod	10
Rockfish	9
Turbot	11

CDQ

Gear/Target	Recommendation
Trawl	
Atka mackerel	85
Bottom pollock	85
Pacific cod	90
Rockfish	84
Flathead sole	84
Midwtr pollock	90
Rock sole	87
Turbot	88
Yellowfin sole	85
Pot	
Sablefish	32
Longline	
Pacific cod	10
Turbot	4

The team endorsed IPHC staff recommendations for DMRs for the BSAI CDQ and non-CDQ fisheries for 2010 - 2012 were reviewed by the BSAI Plan Team. The Council is expected to adopt these rates during its December 2009 meeting. This procedure will be repeated in 2012 for 2013-2015.

Appendix 3: Vulnerability

To aid in the classification of stocks within an FMP and provide advice for the structuring of stock complexes, a national working group from NOAA fisheries developed a vulnerability analysis tool with broad application to U.S. fisheries. Staff from the Alaska Fisheries Science Center used this methodology to produce a preliminary analysis of vulnerability for selected species (all non-target species and some target species) in the BSAI and GOA. The tool compares productivity attributes of a stock (mostly life history information) to attributes of the stock's susceptibility to fishing activity. The results are displayed graphically and by generating a vulnerability score that is the Euclidean distance from the origin, which corresponds to the lowest vulnerability score. There is also an assessment of the quality of the data used in the analysis of each stock. The appendix contains the results of these analyses.

Main preliminary results include:

1) Productivity varies considerably among stocks in both regions; vulnerability is less variable.
2) The main target stocks (e.g., pollock and Pacific cod) in each region have the highest vulnerability scores.
3) There are no clear divisions among stocks in the PSA, i.e. there appears to be a continuum of vulnerability rather than distinct levels of vulnerability.
4) Squids and forage fishes have the lowest vulnerability.
5) The vulnerability scores for sculpins and grenadiers are in the range of the included target stocks.
6) Skates and sharks have high vulnerability scores.

The appendix includes a discussion of the implications of these results for compliance with the revised National Standard guidelines.

Table 1. Bering Sea Aleutian Islands Groundfish Plan Team OFL and ABC Recommendations for the 2010-2011 Fisheries

Species	Area	2009				2010			2011		
		OFL	ABC	TAC	Catch	OFL	ABC	TAC	OFL	ABC	TAC
Pollock	EBS	977,000	815,000	815,000	810,052	918,000	813,000		1,220,000	1,100,000	
	AI	34,000	28,200	19,000	1,282	40,000	33,100		39,100	32,200	
	Bogoslof	58,400	7,970	10	9	22,000	156		22,000	156	
Pacific cod	BSAI	212,000	182,000	176,540	163,587	205,000	174,000		251,000	214,000	
Sablefish	BS	3,210	2,720	2,720	876	3,310	2,790		2,970	2,500	
	AI	2,600	2,200	2,200	1,055	2,450	2,070		2,200	1,860	
Atka mackerel	Total	99,400	83,800	76,400	72,274	88,200	74,000		76,200	65,000	
	EAI/BS		27,000	27,000	26,433		23,800			20,900	
	CAI		33,500	32,500	29,541		29,600			26,000	
	WAI		23,300	16,900	16,300		20,600			18,100	
Yellowfin sole	BSAI	224,000	210,000	210,000	103,808	234,000	219,000		227,000	213,000	
Northern rock sole	BSAI	301,000	296,000	90,000	48,593	243,000	240,000		245,000	242,000	
Greenland turbot	Total	14,900	7,380	7,380	4,284	7,460	6,120		6,860	5,370	
	BS		5,090	5,090	2,074		4,220			3,700	
	AI		2,290	2,290	2,210		1,900			1,670	
Arrowtooth flounder	BSAI	190,000	156,000	75,000	28,931	191,000	156,000		191,000	157,000	
Flathead sole	BSAI	83,800	71,400	60,000	19,424	83,100	69,200		81,800	68,100	
Other flatfish	BSAI	23,100	17,400	17,400	2,155	23,000	17,300		23,000	17,300	
Alaska plaice	BSAI	298,000	232,000	50,000	13,698	278,000	224,000		314,000	248,000	
Pacific Ocean perch	BSAI	22,300	18,800	18,800	14,780	22,400	18,860		22,200	18,680	
	BS		3,820	3,820	623		3,830			3,790	
	EAI		4,200	4,200	3,867		4,220			4,180	
	CAI		4,260	4,260	3,879		4,270			4,230	
	WAI		6,520	6,520	6,411		6,540			6,480	
Northern rockfish	BSAI	8,540	7,160	7,160	3,087	8,640	7,240		8,700	7,290	
Shortraker	BSAI	516	387	387	198	516	387		516	387	
Blackspotted/ Rougheye	BSAI	660	539	539	194	669	547		650	531	
Other rockfish	BSAI	1,380	1,040	1,040	586	1,380	1,040		1,380	1,040	
	BS		485	485	193		485			485	
	AI		555	555	393		555			555	
Squid	BSAI	2,620	1,970	1,970	353	2,620	1,970		2,620	1,970	
Other species	BSAI	80,800	66,700	50,000	26,653	88,200	61,100		88,100	60,900	
Total	BSAI	2,638,226	2,208,666	1,681,546	1,315,879	2,462,945	2,121,880		2,826,296	2,457,284	

2009 catches through November 7 from AKR Catch Accounting including CDQ.

Table 2. Groundfish catches (metric tons) in the eastern Bering Sea, 1954-2006.

Year	Pollock	Pacific Cod	Sable Fish	Yellowfin Sole	Greenland Turbot	Arrowtooth Flounder/a	Rock Sole/c	Other Flatfish	Alaska Plaice	Pacific Ocean Perch	Northern Rockfish	Shortraker Rockfish	Rougheye Rockfish	Other Rockfish	Atka Mackerel	Squid	Other Species	Total (All Species)
1954				12,562														12,562
1955				14,690														14,690
1956				24,697														24,697
1957				24,145														24,145
1958	6,924	171	6	44,153													147	51,401
1959	32,793	2,864	289	185,321													380	221,647
1960			1,861	456,103	36,843				6,100									500,907
1961			15,627	553,742	57,348				47,000									673,717
1962			25,989	420,703	58,226				19,900									524,818
1963			13,706	85,810	31,565			35,643	24,500									191,224
1964	174,792	13,408	3,545	111,177	33,729			30,604	25,900								736	393,891
1965	230,551	14,719	4,838	53,810	9,747			11,686	16,800								2,218	344,369
1966	261,678	18,200	9,505	102,353	13,042			24,864	20,200								2,239	452,081
1967	550,362	32,064	11,698	162,228	23,869			32,109	19,600								4,378	836,308
1968	702,181	57,902	4,374	84,189	35,232			29,647	31,500								22,058	967,083
1969	862,789	50,351	16,009	167,134	36,029			34,749	14,500								10,459	1,192,020
1970	1,256,565	70,094	11,737	133,079	19,691	12,598		64,690	9,900								15,295	1,593,649
1971	1,743,763	43,054	15,106	160,399	40,464	18,792		92,452	9,800								13,496	2,137,326
1972	1,874,534	42,905	12,758	47,856	64,510	13,123		76,813	5,700								10,893	2,149,092
1973	1,758,919	53,386	5,957	78,240	55,280	9,217		43,919	3,700								55,826	2,064,444
1974	1,588,390	62,462	4,258	42,235	69,654	21,473		37,357	14,000								60,263	1,900,092
1975	1,356,736	51,551	2,766	64,690	64,819	20,832		20,393	8,600								54,845	1,645,232
1976	1,177,822	50,481	2,923	56,221	60,523	17,806		21,746	14,900								26,143	1,428,565
1977	978,370	33,335	2,718	58,373	27,708	9,454		14,393	2,654					311		4,926	35,902	1,168,144
1978	979,431	42,543	1,192	138,433	37,423	8,358		21,040	2,221					2,614	831	6,886	61,537	1,302,509
1979	913,881	33,761	1,376	99,017	34,998	7,921		19,724	1,723					2,108	1,985	4,286	38,767	1,159,547
1980	958,279	45,861	2,206	87,391	48,856	13,761		20,406	1,097					459	4,955	4,040	34,633	1,221,944
1981	973,505	51,996	2,604	97,301	52,921	13,473		23,428	1,222					356	3,027	4,182	35,651	1,259,666
1982	955,964	55,040	3,184	95,712	45,805	9,103		23,809	224					276	328	3,838	18,200	1,211,483
1983	982,363	83,212	2,695	108,385	43,443	10,216		30,454	221					220	141	3,470	15,465	1,280,285
1984	1,098,783	110,944	2,329	159,526	21,317	7,980		44,286	1,569					176	57	2,824	8,508	1,458,299
1985	1,179,759	132,736	2,348	227,107	14,698	7,288		71,179	784					92	4	1,611	11,503	1,649,109
1986	1,188,449	130,555	3,518	208,597	7,710	6,761		76,328	560					102	12	848	10,471	1,633,911
1987	1,237,597	144,539	4,178	181,429	6,533	4,380		50,372	930					474	12	108	8,569	1,639,121
1988	1,228,000	192,726	3,193	223,156	6,064	5,477		137,418	1,047					341	428	414	12,206	1,810,470
1989	1,230,000	164,800	1,252	153,165	4,061	3,024		63,452	2,017					192	3,126	300	4,993	1,630,382
1990	1,353,000	162,927	2,329	80,584	7,267	2,773		22,568	5,639					384	480	460	5,698	1,644,109
1991	1,268,360	165,444	1,128	94,755	3,704	12,748	46,681	30,401	4,744					396	2,265	544	16,285	1,647,455
1992	1,384,376	163,240	558	146,942	1,875	11,080	51,720	34,757	3,309					675	2,610	819	29,993	1,831,954
1993	1,301,574	133,156	669	105,809	6,330	7,950	63,942	28,812	3,763					190	201	597	21,413	1,674,406
1994	1,362,694	174,151	699	144,544	7,211	13,043	60,276	29,720	1,907					261	190	502	23,430	1,818,628
1995	1,264,578	228,496	929	124,746	5,855	8,282	54,672	34,861	1,210					629	340	364	20,928	1,745,890
1996	1,189,296	209,201	629	129,509	4,699	13,280	46,775	35,390	2,635					364	780	1,080	19,717	1,653,355
1997	1,115,268	209,475	547	166,681	6,589	8,580	67,249	42,374	1,060					161	171	1,438	20,997	1,640,590
1998	1,101,428	160,681	586	101,310	8,303	14,985	33,221	39,940	1,134					203	901	891	23,156	1,486,739
1999	889,589	134,647	646	67,307	5,205	9,827	39,934	33,042	609					135	2,008	393	17,045	1,200,387
2000	1,132,736	151,372	742	84,057	5,888	12,071	49,186	36,813	704					239	239	375	23,098	1,497,520
2001	1,387,452	142,452	863	63,563	4,252	12,836	28,949	27,693	1,148					296	264	1,761	23,148	1,694,677
2002	1,481,815	166,552	1,143	74,956	3,150	10,821	40,700	30,229	858					401	572	1,334	26,639	1,839,170
2003	1,492,039	164,302	1,039	81,050	2,565	13,667	36,375	17,507	10,118	1,391				336	6,362	1,246	26,986	1,854,983
2004	1,480,543	183,283	1,038	75,501	1,825	17,333	47,862	22,109	7,888	731	116	119	24	318	7,159	1,000	27,496	1,874,344
2005	1,483,286	182,938	1,064	94,382	2,140	13,408	36,814	20,641	11,194	879	112	108	12	178	3,540	1,170	28,066	1,879,931
2006	1,486,648	168,265	1,036	99,134	1,452	11,911	35,878	21,057	17,318	1,042	247	48	7	157	3,175	1,403	24,865	1,873,643
2007	1,354,492	140,100	1,173	120,966	1,481	11,082	36,364	25,056	19,522	870	69	113	10	219	3,021	1,175	24,779	1,740,492
2008	990,571	139,578	1,125	148,894	1,925	19,357	50,935	28,100	17,376	513	22	59	29	209	398	1,493	27,064	1,427,648
2009/d	810,121	137,911	877	103,804	2,073	19,218	48,023	21,513	13,699	623	47	81	12	172	214	264	24,376	1,183,028

a/ Arrowtooth flounder included in Greenland turbot catch statistics, 1960-69.

b/ Includes POP shortraker, rougheye, northern and sharpchin.

c/ Rock sole prior to 1991 is included in other flatfish catch statistics.

d/ Data through November 7, 2009.

Note: Numbers don't include fish taken for research.

Table 3. Groundfish catches (metric tons) in the Aleutian Islands, 1954-2006.

Year	Pollock	Pacific Cod	Sable Fish	Yellowfin Sole	Greenland Turbot	Arrowtooth Flounder/a	Rock Sole/c	Other Flatfish	Alaska Plaice	Pacific Ocean Perch Complex/b	Pacific Ocean Perch	Northern Rockfish	Shortraker Rockfish	Rougheye Rockfish	Other Rockfish	Atka Mackerel	Squid	Other Species	Total (All Species)
1954																			0
1955																			0
1956																			0
1957																			0
1958																			0
1959																			0
1960																			0
1961																			0
1962										200									200
1963			664		7					20,800									21,471
1964		241	1,541		504					90,300								66	92,652
1965		451	1,249		300					109,100								768	111,868
1966		154	1,341		63					85,900								131	87,589
1967		293	1,652		394					55,900								8,542	66,781
1968		289	1,673		213					44,900								8,948	56,023
1969		220	1,673		228					38,800								3,088	44,009
1970		283	1,248		285	274				66,900						949		10,671	80,610
1971		2,078	2,936		1,750	581				21,800								2,973	32,118
1972		435	3,531		12,874	1,323				33,200						5,907		22,447	79,717
1973		977	2,902		8,666	3,705				11,800						1,712		4,244	34,006
1974		1,379	2,477		8,788	3,195				22,400						1,377		9,724	49,340
1975		2,838	1,747		2,970	784				16,600						13,326		8,288	46,553
1976		4,190	1,659		2,067	1,370				14,000						13,126		7,053	43,465
1977	7,625	3,262	1,897		2,453	2,035				8,080					3,043	20,975	1,808	16,170	67,348
1978	6,282	3,295	821		4,766	1,782				5,286					921	23,418	2,085	12,436	61,092
1979	9,504	5,593	782		6,411	6,436				5,487					4,517	21,279	2,252	12,934	75,195
1980	58,156	5,788	274		3,697	4,603				4,700					420	15,533	2,332	13,028	108,531
1981	55,516	10,462	533		4,400	3,640				3,622					328	16,661	1,763	7,274	104,199
1982	57,978	1,526	955		6,317	2,415				1,014					2,114	19,546	1,201	5,167	98,233
1983	59,026	9,955	673		4,115	3,753				280					1,045	11,585	510	3,675	94,617
1984	81,834	22,216	999		1,803	1,472				631					56	35,998	343	1,670	147,022
1985	58,730	12,690	1,448		33	87				308					99	37,856	9	2,050	113,310
1986	46,641	10,332	3,028		2,154	142				286					169	31,978	20	1,509	96,259
1987	28,720	13,207	3,834		3,066	159				1,004					147	30,049	23	1,155	81,364
1988	43,000	5,165	3,415		1,044	406				1,979					278	21,656	3	437	77,383
1989	156,000	4,118	3,248		4,761	198				2,706					481	14,868	6	108	186,494
1990	73,000	8,081	2,116		2,353	1,459				14,650					864	21,725	11	627	124,886
1991	78,104	6,714	2,071	1,380	3,174	938		88		2,545					549	22,258	30	91	117,942
1992	54,036	42,889	1,546	4	895	900	236	68		10,277					3,689	46,831	61	3,081	164,513
1993	57,184	34,234	2,078	0	2,138	1,348	318	59		13,375					495	65,805	85	2,540	179,659
1994	58,708	22,421	1,771	0	3,168	1,334	308	55		16,959					301	69,401	86	1,102	175,614
1995	64,925	16,534	1,119	6	2,338	1,001	356	47		14,734					220	81,214	95	1,273	183,862
1996	28,933	31,389	720	654	1,677	1,330	371	61		20,443					278	103,087	87	1,720	190,750
1997	26,872	25,166	779	234	1,077	1,071	271	39		15,687					307	65,668	323	1,555	139,049
1998	23,821	34,964	595	5	821	694	446	54		13,729					385	56,195	25	2,448	134,182
1999	965	27,714	565	13	422	746	577	53		17,619					630	51,636	9	1,633	102,582
2000	1,244	39,684	1,048	13	1,086	1,157	480	113		14,893					601	46,990	8	3,010	110,327
2001	824	34,207	1,074	15	1,060	1,220	526	97		15,587					610	61,296	5	4,029	120,550
2002	1,177	30,801	1,118	29	485	1,032	1,165	150		14,996					551	44,722	10	1,980	98,216
2003	1,653	32,193	1,009	0	965	913	964	76		18,765					401	52,988	36	1,326	111,289
2004	1,158	28,869	955	9	414	806	818	71	0		11,165	4,567	121	184	337	53,405	14	1,851	104,744
2005	1,621	22,694	1,475	2	439	829	548	59	0		9,548	3,852	61	78	286	58,474	17	1,401	101,383
2006	1,735	24,210	1,130	4	525	1,450	578	75	0		11,817	3,577	162	196	422	58,708	15	1,935	106,539
2007	2,519	34,045	1,149	2	522	835	763	61	0		17,598	3,952	210	157	433	55,810	13	2,050	120,119
2008	1,278	31,037	894	0	827	2,527	342	65	0		16,923	3,265	107	185	388	57,690	49	2,312	117,887
2009/d	1,606	27,808	1,062	1	2,210	9,696	570	64	0		14,156	3,041	115	183	393	72,059	89	2,299	135,352

a/ Arrowtooth flounder included in Greenland turbot catch statistics, 1964-69.

b/ Includes POP shortraker, rougheye, northern and sharpchin rockfish until 2004.

c/ Rocksole prior to 1991 is included in other flatfish catch statistics. Note: Numbers don't include fish taken for research.

d/ Data through November 7, 2009

Table 4. Groundfish catches (metric tons) in the Bering Sea and Aleutian Islands, 1954-2006.

Year	Pollock	Pacific Cod	Sable Fish	Yellowfin Sole	Greenland Turbot	Arrowtooth Flounder/a	Rock Sole/c	Other Flatfish	Alaska Plaice	Pacific Ocean Perch Complex/b	Pacific Ocean Perch	Northern Rockfish	Shortraker Rockfish	Rougheye Rockfish	Other Rockfish	Atka Mackerel	Squid	Other Species	Total (All Species)
1954	0	0	0	12,562	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12,562
1955	0	0	0	14,690	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14,690
1956	0	0	0	24,697	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24,697
1957	0	0	0	24,145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24,145
1958	6,924	171	6	44,153	0	0	0	0	0	0	0	0	0	0	0	0	0	147	51,401
1959	32,793	2,864	289	185,321	0	0	0	0	0	0	0	0	0	0	0	0	0	380	221,647
1960	0	0	1,861	456,103	36,843	0	0	0	0	6,100	0	0	0	0	0	0	0	0	500,907
1961	0	0	15,627	553,742	57,348	0	0	0	0	47,000	0	0	0	0	0	0	0	0	673,717
1962	0	0	25,989	420,703	58,226	0	0	0	0	20,100	0	0	0	0	0	0	0	0	525,018
1963	0	0	14,370	85,810	31,572	0	0	35,643	0	45,300	0	0	0	0	0	0	0	0	212,695
1964	174,792	13,649	5,086	111,177	34,233	0	0	30,604	0	116,200	0	0	0	0	0	0	0	802	486,543
1965	230,551	15,170	6,087	53,810	10,047	0	0	11,686	0	125,900	0	0	0	0	0	0	0	2,986	456,237
1966	261,678	18,354	10,846	102,353	13,105	0	0	24,864	0	106,100	0	0	0	0	0	0	0	2,370	539,670
1967	550,362	32,357	13,350	162,228	24,263	0	0	32,109	0	75,500	0	0	0	0	0	0	0	12,920	903,089
1968	702,181	58,191	6,047	84,189	35,445	0	0	29,647	0	76,400	0	0	0	0	0	0	0	31,006	1,023,106
1969	862,789	50,571	17,682	167,134	36,257	0	0	34,749	0	53,300	0	0	0	0	0	0	0	13,547	1,236,029
1970	1,256,565	70,377	12,985	133,079	19,976	12,872	0	64,690	0	76,800	0	0	0	0	0	949	0	25,966	1,674,259
1971	1,743,763	45,132	18,042	160,399	42,214	19,373	0	92,452	0	31,600	0	0	0	0	0	0	0	16,469	2,169,444
1972	1,874,534	43,340	16,289	47,856	77,384	14,446	0	76,813	0	38,900	0	0	0	0	0	5,907	0	33,340	2,228,809
1973	1,758,919	54,363	8,859	78,240	63,946	12,922	0	43,919	0	15,500	0	0	0	0	0	1,712	0	60,070	2,098,450
1974	1,588,390	63,841	6,735	42,235	78,442	24,668	0	37,357	0	36,400	0	0	0	0	0	1,377	0	69,987	1,949,432
1975	1,356,736	54,389	4,513	64,690	67,789	21,616	0	20,393	0	25,200	0	0	0	0	0	13,326	0	63,133	1,691,785
1976	1,177,822	54,671	4,582	56,221	62,590	19,176	0	21,746	0	28,900	0	0	0	0	0	13,126	0	33,196	1,472,030
1977	985,995	36,597	4,615	58,373	30,161	11,489	0	14,393	0	10,734	0	0	0	0	3,354	20,975	6,734	52,072	1,235,492
1978	985,713	45,838	2,013	138,433	42,189	10,140	0	21,040	0	7,507	0	0	0	0	3,535	24,249	8,971	73,973	1,363,601
1979	923,385	39,354	2,158	99,017	41,409	14,357	0	19,724	0	7,210	0	0	0	0	6,625	23,264	6,538	51,701	1,234,742
1980	1,016,435	51,649	2,480	87,391	52,553	18,364	0	20,406	0	5,797	0	0	0	0	879	20,488	6,372	47,661	1,330,475
1981	1,029,021	62,458	3,137	97,301	57,321	17,113	0	23,428	0	4,844	0	0	0	0	684	19,688	5,945	42,925	1,363,865
1982	1,013,942	56,566	4,139	95,712	52,122	11,518	0	23,809	0	1,238	0	0	0	0	2,390	19,874	5,039	23,367	1,309,716
1983	1,041,389	93,167	3,368	108,385	47,558	13,969	0	30,454	0	501	0	0	0	0	1,265	11,726	3,980	19,140	1,374,902
1984	1,180,617	133,160	3,328	159,526	23,120	9,452	0	44,286	0	2,200	0	0	0	0	232	36,055	3,167	10,178	1,605,321
1985	1,238,489	145,426	3,796	227,107	14,731	7,375	0	71,179	0	1,092	0	0	0	0	191	37,860	1,620	13,553	1,762,419
1986	1,235,090	140,887	6,546	208,597	9,864	6,903	0	76,328	0	846	0	0	0	0	271	31,990	868	11,980	1,730,170
1987	1,266,317	157,746	8,012	181,429	9,599	4,539	0	50,372	0	1,934	0	0	0	0	621	30,061	131	9,724	1,720,485
1988	1,271,000	197,891	6,608	223,156	7,108	5,883	0	137,418	0	3,026	0	0	0	0	619	22,084	417	12,643	1,887,853
1989	1,386,000	168,918	4,500	153,165	8,822	3,222	0	63,452	0	4,723	0	0	0	0	673	17,994	306	5,101	1,816,876
1990	1,426,000	171,008	4,445	80,584	9,620	4,232	0	22,568	0	20,289	0	0	0	0	1,248	22,205	471	6,325	1,768,995
1991	1,346,464	172,158	3,199	96,135	6,878	13,686	46,681	30,489	0	7,289	0	0	0	0	945	24,523	574	16,376	1,765,397
1992	1,438,412	206,129	2,104	146,946	2,770	11,980	51,956	34,825	0	13,586	0	0	0	0	4,364	49,441	880	33,074	1,996,467
1993	1,358,758	167,390	2,747	105,809	8,468	9,298	64,260	28,871	0	17,138	0	0	0	0	685	66,006	682	23,953	1,854,065
1994	1,421,402	196,572	2,470	144,544	10,379	14,377	60,584	29,775	0	18,866	0	0	0	0	562	69,591	588	24,532	1,994,242
1995	1,329,503	245,030	2,048	124,752	8,193	9,283	55,028	34,908	0	15,944	0	0	0	0	849	81,554	459	22,201	1,929,752
1996	1,218,229	240,590	1,349	130,163	6,376	14,610	47,146	35,451	0	23,078	0	0	0	0	642	103,867	1,167	21,437	1,844,105
1997	1,142,140	234,641	1,326	166,915	7,666	9,651	67,520	42,413	0	16,747	0	0	0	0	468	65,839	1,761	22,552	1,779,639
1998	1,125,249	195,645	1,181	101,315	9,124	15,679	33,667	39,994	0	14,863	0	0	0	0	588	57,096	916	25,604	1,620,921
1999	890,554	162,361	1,211	67,320	5,627	10,573	40,511	33,095	0	18,228	0	0	0	0	765	53,644	402	18,678	1,302,969
2000	1,133,980	191,056	1,790	84,070	6,974	13,228	49,666	36,926	0	15,597	0	0	0	0	840	47,229	383	26,108	1,607,847
2001	1,388,276	176,659	1,937	63,578	5,312	14,056	29,475	27,790	0	16,735	0	0	0	0	906	61,560	1,766	27,177	1,815,227
2002	1,482,992	197,353	2,261	74,985	3,635	11,853	41,865	30,379	0	15,854	0	0	0	0	952	45,294	1,344	28,619	1,937,386
2003	1,493,692	196,495	2,048	81,050	3,530	14,580	37,339	17,583	10,118	20,156	0	0	0	0	737	59,350	1,282	28,312	1,966,272
2004	1,481,701	212,152	1,993	75,510	2,239	18,139	48,680	22,180	7,888		11,896	4,684	240	208	655	60,564	1,014	29,347	1,979,088
2005	1,484,907	205,632	2,539	94,384	2,579	14,237	37,361	20,700	11,194		10,426	3,964	169	90	464	62,014	1,187	29,467	1,981,313
2006	1,488,383	192,475	2,166	99,138	1,977	13,361	36,456	21,132	17,318	0	12,859	3,824	210	203	579	61,883	1,418	26,800	1,980,182
2007	1,357,011	174,145	2,322	120,968	2,003	11,917	37,127	25,117	19,522		18,468	4,021	323	167	652	58,831	1,188	26,829	1,860,611
2008	991,849	170,615	2,018	148,894	2,751	21,884	51,277	28,165	17,376		17,436	3,287	166	214	597	58,088	1,542	29,376	1,545,536
2009/d	811,727	165,719	1,939	103,805	4,283	28,914	48,593	21,577	13,699		14,779	3,088	196	195	565	72,273	353	26,675	1,318,380

a/ Arrowtooth flounder included in Greenland turbot catch statistics, 1960-69.

b/ Includes POP, shortraker, rougheye, northern and sharpchin.

c/ Rock sole prior to 1991 is included in other flatfish catch statistics.

d/ Data through November 7, 2009.

Note: Numbers don't include fish taken for research.

Table 5. Summary of stock abundance (biomass), overfishing level (OFL), acceptable biological catch (ABC), the fishing mortality rate corresponding to ABC (F_{ABC}), and the fishing mortality rate corresponding to OFL (F_{OFL}) for the eastern Bering Sea (EBS), Aleutian Islands (AI), and Bogoslof district as projected for 2010 and 2011. "Biomass" corresponds to projected January abundance for the age+ range reported in the summary. Stock-specific biomass, OFL, and ABC are in metric tons, reported to three significant digits (four digits are used when a stock-specific ABC is apportioned among areas on a percentage basis). Fishing mortality rates are reported to two significant digits.

		2010					2011			
Species or Complex	**Area**	**Biomass**	**OFL**	**ABC**	**F_{OFL}**	**F_{ABC}**	**OFL**	**ABC**	**F_{OFL}**	**F_{ABC}**
Pollock	EBS	4,620,000	918,000	813,000	0.42	0.37	1,220,000	1,100,000	0.42	0.37
	Aleutian Islands	307,000	40,000	33,100	0.41	0.33	39,100	32,200	0.4	0.32
	Bogoslof District	97,500	22,000	156	0.02	0.017	22,000	156	0.02	0.017
Pacific cod	BSAI	1,140,000	205,000	174,000	0.29	0.24	251,000	214,000	0.29	0.26
Sablefish	BS	38,000	3,310	2,790	0.10	0.08	2,970	2,500	0.10	0.08
	AI	27,000	2,450	2,070	0.10	0.08	2,200	1,860	0.10	0.08
Atka mackerel	Total	388,000	88,200	74,000	0.51	0.42	76,200	65,000	0.51	0.42
Yellowfin sole	BSAI	1,960,000	234,000	219,000	0.13	0.12	227,000	213,000	0.13	0.12
Greenland turbot	Total	61,100	7,460	6,120	0.32	0.26	6,860	5,370	0.32	0.26
Arrowtooth flounder	BSAI	1,120,000	191,000	156,000	0.30	0.24	191,000	157,000	0.30	0.24
Northern rock sole	BSAI	1,770,000	243,000	240,000	0.15	0.15	245,000	242,000	0.15	0.15
Flathead sole	BSAI	785,000	83,100	69,200	0.34	0.28	81,800	68,100	0.34	0.28
Alaska plaice	BSAI	2,260,000	278,000	224,000	0.77	0.58	314,000	248,000	0.77	0.58
Other flatfish	BSAI	121,000	23,000	17,300	.17/.085/.20	.13/.06/.15	23,000	17,300	.17/.085/.20	.13/.06/.15
Pacific Ocean perch	BSAI	403,000	22,400	18,860	0.068	0.057	22,200	18,680	0.068	0.057
Northern rockfish	BSAI	203,000	8,640	7,240	0.051	0.043	8,700	7,290	0.051	0.043
Shortraker	BSAI	17,200	516	387	0.030	0.023	516	387	0.03	0.023
Blackspotted/ Rougheye	BSAI	21,200	669	547	0.047	0.039	650	531	0.046	0.038
Other rockfish	BSAI	39,200	1,380	1,040	.03/.09	.023/.068	1,380	1,040	.03/.09	.023/.068
Squid	BSAI	n/a	2,620	1,970	n/a	n/a	2,620	1,970	n/a	n/a
Other species	BSAI	834,000	88,200	61,100			88,100	60,900		
Total	BSAI	16,212,200	2,462,945	2,121,880			2,826,296	2,457,284		

Table 6. Summary of groundfish tier designations under Amendment 56, maximum permissible ABC fishing mortality rate (max F_{ABC}), the Plan Team's recommended tier designation, ABC fishing mortality rate (F_{ABC}), the

		2010						2011					
Species or Complex	**Area**	**Tier**	**max F_{ABC}**	**F_{ABC}**	**max ABC**	**ABC**	**% Red.**	**Tier**	**max F_{ABC}**	**F_{ABC}**	**max ABC**	**ABC**	**% Red.**
Pollock	Bogoslof District	5	0.017	0.017	16,500	156	99%	5	0.017	0.017	16,500	156	99%

Table 7. Species included in assessments for the 2009 BSAI SAFE Report.

Chapter	Common name	Scientific name	Count
1	**Walleye Pollock**		1
2	**Pacific cod**		1
3	**Sablefish**		1
4	**Yellowfin sole**	Limanda aspera	1
5	**Greenland turbot**	Reinhardtius hippoglossoides	1
6	**Arrowtooth flounder**	Atherestes stomias	2
	Kamchatka flounder	Atherestes evermanni	
7	**Northern rock sole**	Lepidopsetta polyxystra n. sp.	2
	Southern rock sole	Lepidopsetta bilineata	
8	**Flathead sole**	Hippoglossoides classodon	2
	Bering flounder	Hippoglossoides robustus	
9	**Alaska plaice**	Pleuronectes quadrituberculatus	1
10	**Other flatfish**		15
	Arctic flounder	Liopsetta glacialis	
	butter sole	Isopsetta isolepis	
	curlfin sole	Pleuronectes decurrens	
	deepsea sole	Embassichths bathybius	
	Dover sole	Microstomus pacificus	
	English sole	Parophrys vetulus	
	longhead dab	Limanda proboscidea	
	Pacific sanddab	Citharichthys sordidus	
	petrale sole	Eopsetta jordani	
	rex sole	Glyptocephalus zachirus	
	roughscale sole	Clidodoerma asperrimum	
	sand sole	Psettichthys melanostictus	
	slender sole	Lyopsetta exilis	
	starry flounder	Platichthys stellatus	
	Sakhalin sole	Pleuronectes sakhalinensis	
11	**Pacific Ocean perch**	Sebastes alutus	1
12	**Northern rockfish**	Sebastes polyspinus	1
13	Blackspotted/Rougheye		2
	Blackspotted rockfish		
	Rougheye rockfish	Sebastes aleutianus	
14	Shortraker rockfish	Sebastes borealis	1
15	**Other rockfish***		
	Shortspine thornyhead	Sebastolobus alascanus	7
	Dusky rockfish	Sebastes variabilis	
	Red banded rockfish	Sebastes babcocki	
	Redstripe rockfish	Sebastes proriger	
	Harlequin rockfish	Sebastes variegatus	
	Sharpchin rockfish	Sebastes zacentrus	
	Yelloweye rockfish	Sebastes ruberrimus	
16	**Atka mackerel**	Pleurogrammus monopterygius	1

Chapter	Common name	Scientific name	Count
17	**Squids**		14
		Chiroteuthis calyx	
	"glass squids"	Belonella borealis	
		Galiteuthis phyllura	
	minimal armhook squid	Berryteuthis anonychus	
	magistrate armhook squid	Berryteuthis magister	
		Eogonatus tinro	
	boreopacific armhook squid	Gonatopsis borealis	
	Berry armhook squid	Gonatus berryi	
		Gonatus madokai	
		Gonatus middendorffi	
	clawed armhook squid	Gonatus onyx	
	robust clubhook squid	Moroteuthis robusta	
	boreal clubhook squid	Onychoteuthis borealijaponicus	
	North Pacific bobtail squid	Rossia pacifica	
18a	**Skates**		15
	deepsea skate	Bathyraja abyssicola	
	Aleutian skate	Bathyraja aleutica	
	Bering skate (complex?)	Bathyraja interrupta	
	Commander skate	Bathyraja lindbergi	
	whiteblotched skate	Bathyraja maculata	
	butterfly skate	Bathyraja mariposa	
	whitebrow skate	Bathyraja minispinosa	
	Alaska skate	Bathyraja parmifera	
	“Leopard” parmifera	Bathyraja sp. cf. parmifera	
	mud skate	Bathyraja taranetzi	
	roughtail skate	Bathyraja trachura	
	Okhotsk skate	Bathyraja violacea	
	big skate	Raja binoculata	
	roughshoulder skate	Amblyraja badia	
	longnose skate	Raja rhina	
18b	**Sharks**		8
	brown cat shark	Apristurus brunneus	
	White shark	Carcharodon carcharias	
	basking shark	Cetorhinus maximus	
	sixgill shark	Hexanchus griseus	
	salmon shark	Lamna ditropis	
	blue shark	Prionace glauca	
	Pacific sleeper shark	Somniosus pacificus	
	Spiny dogfish	Squalus acanthias	
18c	**Octopuses**		8
	flapjack devilfish	Opisthoteuthis cf californiana	
	pelagic octopus	Japetella diaphana	
	smooth octopus	Benthoctopus leioderma	
		Benthoctopus oregonensis	
		Benthoctopus salebrosus	
	giant octopus	Enteroctopus dofleini	
		Granelodone boreopacifica	
	stubby octopus	Octopus n. sp.	

Chapter	Common name	Scientific name	Count
18d	**Sculpins**		48
	Scaled sculpin	Archistes biseriatus	
	Bride sculpin	Artediellus miacanthus	
	Pacific hookear sculpin	Artediellus pacificus	
	Broadfin sculpin	Bolinia euryptera	
	Antlered sculpin	Enophrys diceraus	
	Leister sculpin	Enophrys lucasi	
	Purplegray sculpin	Gymnocanthus detrisus	
	Armorhead sculpin	Gymnocanthus galeatus	
	Threaded sculpin	Gymnocanthus pistilliger	
	Arctic staghorn sculpin	Gymnocanthus tricuspis	
	Banded Irish lord	Hemilepidotus gilberti	
	Red Irish Lord	Hemilepidotus hemilepidotus	
	Yellow Irish Lord	Hemilepidotus jordani	
	Butterfly sculpin	Hemilepidotus papilio	
	Longfin Irish lord	Hemilepidotus zapus	
	Northern sculpin	Icelinus borealis	
	Blacknose sculpin	Icelus canaliculatus	
	Wide-eye sculpin	Icelus euryops	
	Spatulate sculpin	Icelus spatula	
	Thorny sculpin	Icelus spiniger	
	Uncinate sculpin	Icelus uncinalis	
	Longfin sculpin	Jordania zonope	
	Pacific staghorn sculpin	Leptocottus armatus	
	Plain sculpin	Myoxocephalus jaok	
	Great sculpin	Myoxocephalus polyacanthocephalus	
	Fourhorn sculpin	Myoxocephalus quadricornis	
	Warty sculpin	Myoxocephalus verrucocus	
	Slim sculpin	Radulinus asprellus	
	Roughskin sculpin	Rastrinus scutiger	
	Sponge sculpin	Thyriscus anoplus	
	Scissortail sculpin	Triglops forficatus	
	Roughspine sculpin	Triglops macellus	
	Crescent-tail sculpin	Triglops metopias	
	Ribbed sculpin	Triglops pingelii	
	Spectacled sculpin	Triglops septicus	
	Scalybreasted sculpin	Triglops xenostethus	
	Flabby sculpin	Zesticelus profundorum	
	Crested sculpin	Blepsias bilobus	
	Bigmouth sculpin	Hemitripterus bolini	
	Sailfin sculpin	Nautichthys oculofasciatus	
	Eyeshade sculpin	Nautichthys pribilovius	
	Spinyhead sculpin	Dasycottus setiger	
	Smoothcheek sculpin	Eurymen gyrinus	
	Darkfin sculpin	Malacoccottus zonurus	
	Blackfin sculpin	Malacocottus kincaidi	
	Tadpole sculpin	Psychrolutes paradoxus	
	Blob sculpin	Psychrolutes phrictus	
	Grunt sculpin	Rhamphocottus richardsoni	
	Total Species		**133**