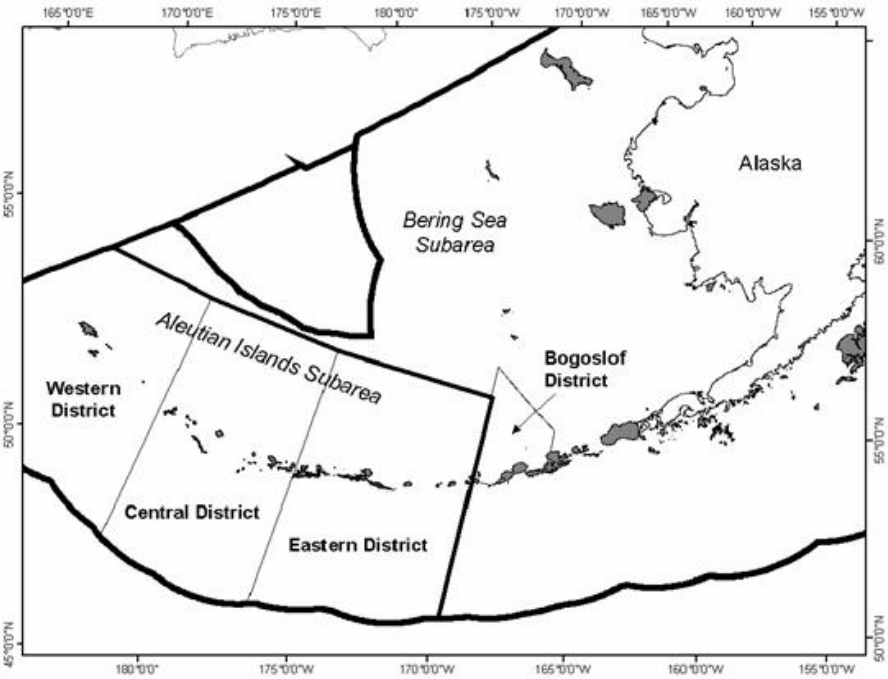
APPENDIX A

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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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 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). The ABC recommendations 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.

Background Information

Management Areas and Species

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

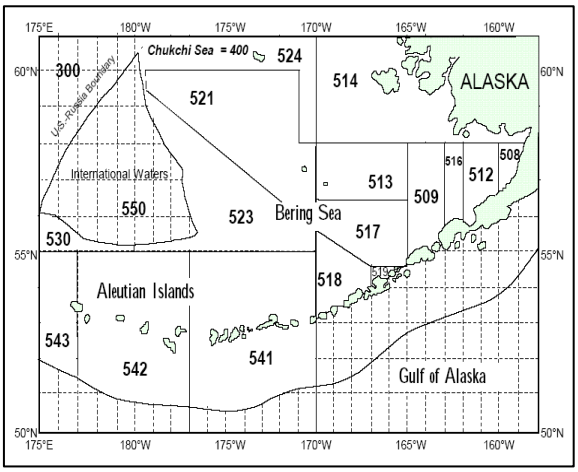

Figure 1. Bering Sea and Aleutian Islands statistical and reporting areas

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		
	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 the early period of these fisheries, 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. Walleye 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. Catches generally total about 10 percent below the cap. Catches in the EBS for 2008 (through November 8) totaled 1,410,000 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 other species. During the early years of exploitation, total AI groundfish catches peaked at 112,000 t in 1965. Atka mackerel is the largest fishery (53,700 t in 2007)

in the AI, followed by Pacific cod (34,000 t in 2007). Recent catches have been about 100,000 t annually, after peaking at 191,000 t in 1996. Total 2008 AI catches (through November 8) were 117,000 t.

Total 2008 BSAI catches were 1,529,000 t (83 percent of total groundfish TACs). Total catches since 1954 for the EBS and AI combined are in Table 4.

Recent Total Allowable Catches

Amendment 1 to the BSAI Groundfish FMP provides the framework to manage the groundfish resources as a complex. Maximum sustainable yield (MSY) for the BSAI groundfish complex was originally estimated at 1.8 to 2.4 million t. The optimum yield (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.

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.

For the non-specified reserve, both the trawl and non-trawl fisheries are prosecuted under a single TAC. The TAC specifications for the primary allocated species, and PSC specifications, are recommended by the Council at its December meeting. A portion of the TAC limits for sablefish in the trawl gear category, arrowtooth flounder, BS Greenland turbot, and those species not otherwise allocated to the CDQ Program are placed in a reserve. Apportionments to this reserve range from 4.3 percent 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 these reserves.

New Data Summary

Since the SAFE Report for 2008 was issued (NPFMC 2007), the following new information has been incorporated into the stock assessments:

1) Eastern Bering Sea Walleye pollock: 1) 2008 NMFS summer bottom-trawl survey (BTS) abundance at age estimates were computed and included for this assessment; 2) 2008 NMFS summer mid-water echo-integration trawl (EIT) survey conducted aboard the NOAA ship R/V Oscar Dyson were included. This was the second complete EIT survey conducted by this vessel in this region, and for the second 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 2008 BTS age-length key were included; 4) 2007 age composition estimates were updated using EIT age data (last year the BTS age-length key was used); 5) Observer data for age and size composition and average weight-at-age and total catch (from NMFS Alaska Region) were updated and included.

1a) Aleutian Islands Walleye pollock: catch from 2008.

1b) Bogoslof pollock: catch from 2008;

2) Pacific cod: 1) Updated catch data for 2007 and 2008; 2) Updated 2007 and preliminary 2008 commercial fisheries size composition data; 3) 2008 EBS shelf bottom trawl survey size composition data; 4) 2008 EBS shelf bottom trawl survey numeric abundance estimate ; 5) 2007 EBS shelf bottom

trawl survey age composition data; 6) Ageing error matrix was updated; 7) Updated 2007 seasonal catch per unit effort data for the trawl, longline, and pot fisheries and 2008 preliminary catch rates for the longline and pot fisheries; 8) recompiled 2000-2007 time series of Pacific cod catch rates from the International Pacific Halibut Commission (IPHC) longline surveys; 9) Pacific cod size composition data from the 2008 IPHC longline survey replaced 2007 data; and 10) recompiled time series of weight-at-length data.

3) Sablefish: 1) Relative abundance and length data from the 2008 longline survey, 2) relative abundance and length data from the 2007 longline and trawl fisheries, and 3) age data from the 2007 longline survey and longline fishery were added to the assessment model.
4) Yellowfin sole: 1) 1) 2007 fishery age composition; 2) 2007 survey age composition; 3) 2008 trawl survey biomass point estimate and standard error; 4) Estimate of the discarded and retained portions of the 2007 catch; 5) Estimate of total catch through 13 September 2008; 6) Survey and fishery age composition time-series were recalculated for each sex instead of combining both sexes. Same for the weight-at-age.
5) Greenland turbot: 1) 2007 and 2008 catch data were updated; 2) The Eastern Bering Sea (EBS) shelf survey 2008 biomass and length composition estimates were added; 3) An updated aggregated longline survey data index for the EBS and Aleutian Islands regions extending through 2008 was included; and 4) EBS slope survey estimates for 2008 were included
6) Arrowtooth flounder: 1) 2008 shelf survey size composition; 2) 2008 shelf survey biomass point-estimates and standard errors; 3) Estimate of catch and discards through 18, September 2008; 4) Estimate of retained and discarded portion of the 2007 catch; 5) 2008 estimate of the slope survey biomass point-estimates and standard errors; and 6) 2008 slope survey size composition.
7) Northern rock sole: 1) 1) 2007 fishery age composition; 2) 2007 survey age composition; 3) 2008 trawl survey biomass point estimate and standard error; 4) Estimate of catch (t) and discards through 18, September 2008; 5) Estimate of retained and discarded portions of the 2007 catch; 6) Fishery and survey age composition recalculated for each sex instead of combining both sexes; and 7) Weight at age also recalculated for males and females.
8) Flathead sole: 1) The 2007 catch data was updated and the 2008 catch through September 20, 2008 was added to the assessment; 2) The 2008 fishery length compositions, based on observer data, were added to the assessment. Fishery length compositions from previous years (1990-2007) were recalculated; 3) The estimated survey biomass and standard error from the 2008 EBS Trawl Survey were added to the assessment; 4) Sex-specific length compositions from the 2008 EBS Trawl Survey were added to the assessment. Survey length compositions from previous years were recalculated; 5) Sex-specific age compositions from the 2001 and 2005-2007 EBS Trawl Surveys were added to the assessment. Survey age compositions from other years were recalculated; 6) The mean bottom temperature from the 2008 EBS trawl survey was added to the assessment.
9) Alaska plaice: 1) The 2007 catch data was updated, and catch through 11 October, 2008 were included in the assessment; 2) The 2008 trawl survey biomass estimate and standard error, and the 2008 survey length composition were included in the assessment; and 3) The 2007 survey ages were read and the 2007 survey age composition was added to the assessment.
10) Other flatfish: 1) The 2008 catch (total and discarded) was updated, and catch through 11 October, 2008 were included in the assessment; 2) 2008 Eastern Bering Sea trawl survey biomass estimates and standard errors of other flatfish species are included in the assessment. A linear regression of the AI survey estimates was used to predict the AI biomass in 2008, when an AI survey did not occur.
11) Pacific ocean perch: 1) The harvest time series were revised and updated through August 30, 2008; 2) The 2006 AI survey age composition was included in the assessment; 3) The 2007 and 2008 age compositions from the Aleutian Islands fishery were included in the assessment; and (4) The historical Aleutian Islands survey data were updated based on the estimates provided by the AFSC/RACE Division.

12) Northern rockfish: 1) The harvest time series have revised and updated through August 30, 2008; 2) The 2006 Aleutian Islands (AI) survey age composition was included in the assessment; 3) The 2006 and 2007 fishery length compositions were included in the assessment; and 4) The historical Aleutian Islands survey data were updated based on the estimates provided by the AFSC/RACE Division.

13a) Shortraker rockfish: 1) The landings data have been revised and updated through October 18, 2008; and 2) The historical Aleutian Islands survey data were updated based on the estimates provided by the AFSC/RACE Division.

13b) Blackspotted rockfish: 1) Catch updated through October 18, 2008; 2) historical Aleutian Islands survey data were updated based on the estimates provided by the AFSC/RACE Division; and 3) age and length composition data from the BSAI fishery and AI trawl survey.

14) Other rockfish: 1) The 2007 landings have been revised and the 2008 landings through October 17, 2008 have been included in the assessment; 2) 2008 Eastern Bering Sea Slope survey data are included in this assessment; 3) Size composition data for Shortspine Thornyheads from the 2005-2007 EBS fishery and 2008 EBS slope survey are included in this assessment; and 4) Responses to SSC comments and Plan Team recommendations are included.

15) Atka mackerel: 1) Fishery catch data were updated; 2) 2007 fishery age composition data were included; 3) Survey biomass estimates from the southern Bering Sea were included; 4) 1986 U.S.-Japan cooperative survey biomass estimate was excluded; 5) 2007 fishery weight-at-age values were added; 6) Revised estimates of fishery catch- and weight-at-age values were incorporated; 7) Calculated rather than fixed sample sizes for the fishery catch-at-age data were utilized; and 8) 2008 selectivity vector (equivalent to the estimated vector for 1999-2007) was used for projections.

16) Squid: 1) Length composition data for squids caught incidentally in commercial fisheries; 2) Length data for squids caught in the 2008 slope bottom trawl survey; 3) An analysis of the spatial distribution of squid catches during 2000-2007; and 4) Results of a recent analysis of squid life history and stock structure

17) Skate: 1) Catch is updated with 2007 and partial 2008 data; 2) Biomass estimates from the 2008 EBS shelf and slope surveys are incorporated for all species; 3) catch and survey length composition data were updated, and 4-cm length bins were used instead of 5-cm length bins; 4) Length-at-age data from the 2007 EBS shelf survey are included; and 5) Sample size for length composition data was based on the number of hauls sampled, rather than the total number of length measurements.

18) Shark: 1) total catch weight for BSAI sharks is updated for 2008 (as of Oct 3, 2008); 2) Biomass estimates from the 2008 EBS shelf and slope surveys are incorporated; and 3) Life history and population demographic information has been updated with recent research results..

19) Octopus: 1) updated catch for 2007 and the first part of 2008; 2) 2008 Bering Sea shelf and slope trawl surveys has provided octopus specimen data identified to species; and 3) Condition of octopus during observer sampling.

20) Sculpin: 1) Catch data from 2007 and 2008 to data; 2) Information on total sculpin catch by target fishery and gear type for 2007; 3) Biomass estimates from the 2008 Bering Sea Shelf and Slope Surveys; 4) Size composition of the most abundant sculpin species are updated with 2008 survey data for the EBS Shelf and EBS slope; 5) Age and growth information for yellow Irish lord, great sculpin, plain sculpin and bigmouth sculpin are provided for the first time; 6) Information for recommending the splitting of the BSAI sculpin complex into a Bering Sea Shelf assemblage, a Bering Sea Slope assemblage and an Aleutian Island assemblage; 7) Updated estimates of natural mortality for five species from the EBS shelf.

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). 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 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 the following two harvest scenarios (Note for Tier 3 stocks, the MSY level is defined as $B_{35\%}$):

Overfished (listed in each assessment as 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 2008 or 2) above ½ of its MSY level in 2008 and above its MSY level in 2018 under this scenario, then the stock is not overfished.)

Approaching an overfished condition (listed in each assessment as scenario 7):

In 2008 and 2009, *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 2020 under this scenario, then the stock is not approaching an overfished condition.)

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.

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*
     - $F_{ABC} \leq \mu_H$, *the harmonic mean of the pdf*
   - 1b) Stock status: $\alpha < B/B_{MSY} \leq 1$
     - $F_{OFL} = \mu_A \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
     - $F_{ABC} \leq \mu_H \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
   - 1c) Stock status: $B/B_{MSY} \leq \alpha$
     - $F_{OFL} = 0$
     - $F_{ABC} = 0$
2) Information available: *Reliable point estimates of B, B_{MSY}, F_{MSY}, $F_{35\%}$, and $F_{40\%}$.*
   - 2a) Stock status: $B/B_{MSY} > 1$
     - $F_{OFL} = F_{MSY}$
     - $F_{ABC} \leq F_{MSY} \times (F_{40\%}/F_{35\%})$
   - 2b) Stock status: $\alpha < B/B_{MSY} \leq 1$
     - $F_{OFL} = F_{MSY} \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
     - $F_{ABC} \leq F_{MSY} \times (F_{40\%}/F_{35\%}) \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
   - 2c) Stock status: $B/B_{MSY} \leq \alpha$
     - $F_{OFL} = 0$
     - $F_{ABC} = 0$
3) Information available: *Reliable point estimates of B, $B_{40\%}$, $F_{35\%}$, and $F_{40\%}$.*
   - *3a) Stock status: $B/B_{40\%} > 1$*
     - $F_{OFL} = F_{35\%}$
     - $F_{ABC} \leq F_{40\%}$
   - *3b) Stock status: $\alpha < B/B_{40\%} \leq 1$*
     - $F_{OFL} = F_{35\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$
     - $F_{ABC} \leq F_{40\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$
   - *3c) Stock status: $B/B_{40\%} \leq \alpha$*
     - $F_{OFL} = 0$
     - $F_{ABC} = 0$
4) Information available: *Reliable point estimates of B, $F_{35\%}$, and $F_{40\%}$.*
   - $F_{OFL} = F_{35\%}$
   - $F_{ABC} \leq F_{40\%}$
5) Information available: *Reliable point estimates of B and natural mortality rate M.*
   - $F_{OFL} = M$
   - $F_{ABC} \leq 0.75 \times M$
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*
   - $ABC \leq 0.75 \times OFL$

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 2008 numbers at age. This vector is then projected forward to the beginning of 2009 using the schedules of natural mortality and selectivity described in the assessment and the best available estimate of total (year-end) catch for 2008. 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 2009, 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 2009 recommended in the assessment to the *max* F_{ABC} for 2009. (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 2003-2007 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 2008 or 2) above 1/2 of its MSY level in 2008 and above its MSY level in 2018 under this scenario, then the stock is not overfished.)
>
> *Scenario 7*: In 2009 and 2010, 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 2021 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 2009 and 2010 ABCs and OFLs are summarized in Tables 1, 5 and 6. The sum of the recommended ABCs for 2009 and 2010 are 2,190,000 t and 2,640,000 t, respectively. These are approximately 280,000 t below and 166,000 t above the sum of the 2008 ABCs.

Overall, the status of the stocks continues to appear relatively favorable, although many stocks are declining due to poor recruitment in recent years. The abundances of AI pollock, sablefish, all rockfishes, all flatfishes, and Atka mackerel are projected to be above target stock size. Total groundfish biomass for 2009 (15.0 million t) is less than last year's estimate of 16.6 million t. The abundances of EBS pollock and Pacific cod are projected to be below target stock size (Figure 2). Plan Team ABC recommendations recently have trended down for gadoids, but generally up for flatfishes.

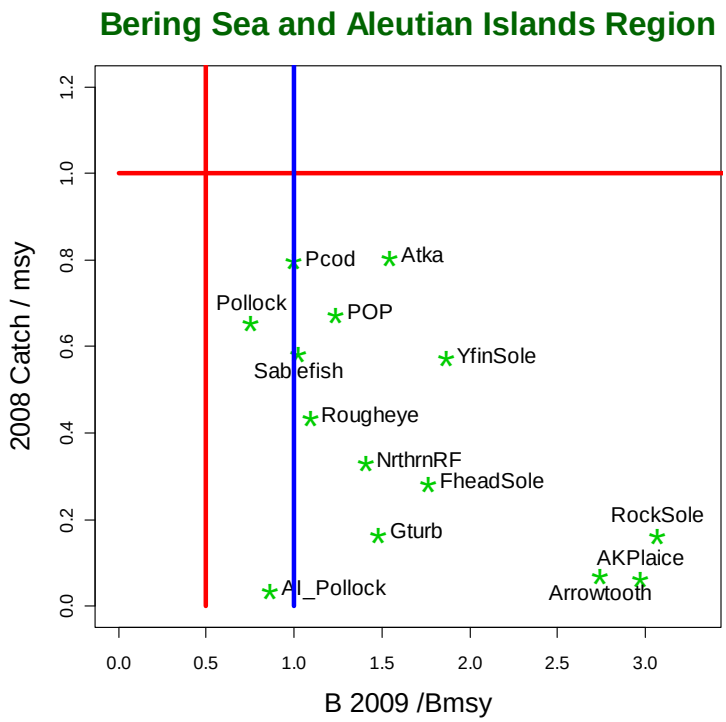

Figure 2. Summary status of age-structured BSAI species relative to 2008 catch levels (vertical axis) and projected 2009 spawning biomass relative to Bmsy levels. Note that the 2008 MSY level is taken as the 2008 OFL (which is defined as the catch at Fmsy).

The 2008 bottom trawl survey biomass estimate for pollock was 3.0 million t, down from 4.3 million t in 2007 but about equal to the 2006 estimate. This represents about 61% of the long-term 1982-2008 mean from this survey and is the second lowest during this period. In 2008 the echo-integration trawl (EIT) survey resulted in a biomass estimate of 0.94 million t, down from the 1.77 million t estimated during 2007 and 29% of the long-term mean for this survey series. The abundance of 2-year old pollock (the 2006 year class) was above average in the EIT survey, consistent with abundances of 1-year olds seen last year. Age 2 and older pollock survey abundance estimates (in numbers) have increased by over 20% in each year since 2006. Both surveys indicate that the 2006 year class is strong following 4-5 successively below-average year-classes. Compared to the 2008 ABC, the 2009 pollock ABC recommendation is down 18 percent and the 2010 ABC recommendation is down 2 percent.

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 have dropped consistently since 2005, producing all-time lows in 2007 and again in 2008. The 2008 biomass estimate was 403,000 t, down 5 percent from 2007. In numbers of fish, the estimate of 477 million fish was down about 35% from last year. The Pacific cod ABC recommendation is up 3 percent in 2009 and 13 percent in 2010, compared to 2008.

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 the EBS pollock, yellowfin sole, and northern rock sole assessments. 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 the two flatfish stocks 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.
- "Exploitation rate" refers to the ratio between catch (in numbers) and start-of-year stock size (also in numbers). Where information is lacking, the exploitation rate is sometimes multiplied by start-of-year biomass to compute ABC.
- 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 the past year 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 8, 2008.

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 during years when no groundfish surveys are conducted are limited. For example, 2007 was an off-year for the NMFS BSAI groundfish trawl survey so only summaries for these species were produced.

The second significant change is that the proposed and final specifications are to be specified for a period of up to two years. This requires providing ABC and OFL levels for 2009 and 2010 (Table 1). The proposed 2009 and 2010 specifications will become effective when final rulemaking occurs in February 2009. The 2010 specifications will already be in place to start the fishery on January 1, 2010, but will be replaced by final specifications set in December 2009 and implemented in February 2010. 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. The 2010 ABC and OFL values recommended in next year's SAFE report are likely to differ from this year's projections for 2010, for the same reasons that the 2009 projections in this SAFE report differ from those in September.

In the case of stocks managed under Tier 3, 2009 and 2010 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, 2010 projections are set equal to the Plan Team's recommended values for 2009.

Ecosystem Considerations

Ecosystem considerations are addressed in the stock assessment chapters. A full review of ecosystem status and trends is provided in the Ecosystem Considerations chapter.

Uncertainty

Statistical uncertainty is addressed in the individual assessments, and to some degree, by the tiers used to establish ABCs. Last year, statistical uncertainty or natural variability in the stock led the Plan Team to recommend 2008 and 2009 ABC values lower than the maximum permissible level for walleye pollock and Greenland turbot. The Plan Team's recommended 2009 and 2010 ABCs for AI pollock are 43 and 30 percent below the maximum permissible levels, respectively (Table 6). Bogoslof pollock ABCs were also reduced by 82 percent in both years. The Plan Team's recommended 2009 and 2010 ABCs for Pacific cod are 3 and 12 percent below the maximum permissible levels, respectively. The Plan Team's recommended ABCs for Greenland turbot are 38 and 34 percent below the maximum permissible levels for 2009 and 2010.

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. The Plan Teams make three recommendations: 1) increase funding so that surveys are not cancelled; 2) modify harvest rules so that more Tiers (especially 3 and 5) account for assessment uncertainty; 3) request that assessment authors present a measure of assessment uncertainty (specifically, the probability that female spawning biomass will fall below 20% of the unfished value in the next three to five years). For the 2009 assessment cycle, the Plan Team specifically is concerned about species affected by the cancellation of the 2008 Aleutian Islands trawl survey, including Atka mackerel, walleye pollock, Pacific cod and Pacific Ocean perch.

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 2009 and 2010 are those recommended by the Plan Team. Catch data are current through November 8, 2008.

Area	Year	Age 3+ Biomass	OFL	ABC	TAC	Catch
Eastern Bering Sea	2007	6,360,000	1,640,000	1,394,000	1,394,000	1,354,091
	2008	4,360,000	1,440,000	1,000,000	1,000,000	989,895
	2009	6,240,000	977,000	815,000	n/a	n/a
	2010	n/a	1,430,000	1,230,000	n/a	n/a
Aleutian Islands	2007	229,000	54,500	44,500	19,000	2,488
	2008	197,000	34,000	28,200	19,000	1,282
	2009	266,000	32,600	15,300	n/a	n/a
	2010	n/a	36,800	15,300	n/a	n/a
Bogoslof	2007	240,000	48,000	5,220	10	0
	2008	292,000	58,400	7,970	10	9
	2009	292,000	58,400	7,970	n/a	n/a
	2010	n/a	58,400	7,970	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 2007 and a preliminary estimate of the 2008 catch.
- Biomass estimates from the 2008 bottom trawl survey and the 2008 echo-integration trawl (EIT) survey. The estimate from the bottom trawl survey was 3.03 million t, down 30% from the 2007 estimate, and the third lowest point in the 1982-2008 time series. The estimate from the EIT survey was 0.942 million t, down 47% from last year's survey, and the lowest in the 1979-2008 time series.
- Age composition data from the 2008 bottom trawl survey, updated age composition data from the 2007 EIT survey, and preliminary age composition data from the 2008 EIT survey (based on the age-length key from this year's bottom trawl survey). The 2008 survey age compositions tend to confirm the strength of the large 2006 year class first observed in the 2007 surveys.
- Age and size composition data and weight-at-age data from the 2007 fishery.

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 has declined steadily since 2003 due to poor recruitment from the 2001-2005 year classes, with the age 3+ biomass for 2008 estimated to be the lowest in the time series since 1980. This string of five consecutive poor year classes is unprecedented in the known history of the stock. Spawning biomass is estimated to be 34% below B_{MSY} in 2008. The 2006 year class is reliably estimated to be well above average, however, so spawning biomass is projected to increase in the near future (25% below B_{MSY} in 2009 and near B_{MSY} in 2010, 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 1.919 million t, compared to 1.88 million t from last year's assessment. Projected spawning biomass for 2009 is 1.443 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 0.332, very close to last year's value of 0.341.

The harvest ratio of 0.332 is scaled according to the Tier 1b formula and then multiplied by the geometric mean of the projected fishable biomass for 2009 (3.321 million t) to obtain the maximum permissible ABC for 2009, which is 815,000 t. This ABC is 78% higher than the 2009 yield of 458,000 t that would correspond to a Tier 3b strategy based on a $B_{40\%}$ value of 2.43 million t.

The Plan Team supports the authors' recommendation to set 2009 ABC at the maximum permissible level of 815,000 t. The Team considered recommending a lower value, but concluded that the maximum permissible level is sufficiently conservative for the following reasons:

- A 2009 ABC of 815,000 t will keep the spawning exploitation rate within the range experienced during the 1979-2005 period, and below the comparatively high values experienced in 2006-2008.
- The Tier 1 harvest control rules already have a built-in precautionary adjustment for stocks that fall below B_{MSY}.
- Uncertainty is already factored into the Tier 1 harvest control rules.
- A 2009 ABC of 815,000 t constitutes a large (18%) reduction from the 2008 ABC of 1 million t and would result in greater short-term catch stability than a lower ABC.
- The strength of the 2006 year class, estimated for the first time in last year's assessment, has been confirmed after a second year of survey observations, and the confidence interval has tightened considerably in the present assessment. A strong 2006 year class following weak 2001-2005 year classes would also be consistent with the hypothesis that the 2006 year class was affected positively by both decreased temperature and increased copepod abundance.
- Under a 2009 ABC of 815,000 t, the stock is expected to return to near B_{MSY} by 2010 if the stock is fished at the maximum permissible level.

The Team also concurs with the authors' recommendation to set the preliminary ABC for 2010 at the maximum permissible level, which is 1.23 million t. However, the Team emphasizes that its recommendation next year for the final 2010 ABC will depend on the estimates of recent year class strengths contained in next year's stock assessment. For example, if the 2006 year class is only average (which appears unlikely based on the data presently available), this year's assessment indicates that the maximum permissible ABC for 2010 would be reduced to about 900,000 t. Next year's estimates of other incoming year classes will also factor into the recommendation for the final 2010 ABC.

The OFL harvest ratio under Tier 1a is 0.398, 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 2009 gives the OFL for 2009, which is 977,000 t. The current projection for OFL in 2010 given a 2009 catch of 815,000 t is 1.43 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 are available, similar information on euphausiids is presently lacking. However, ongoing research should provide more information on euphausiid abundance in the next couple of years. The weakness of the 2001-2005 year classes suggests that it has been harder than average for pollock to survive through their first year. Recent abundance of apex predators has been within the range of historic variability, though pelagic foragers (including pollock) have declined recently, perhaps due to reduced prey (e.g., copepod) abundance during the early part of this decade. Pribilof fur seal pup weights in 2008 were lower on those rookeries where females forage on the shelf than for off-shelf foragers. This may have been due to insufficient local availability of forage for nursing females, requiring them to make longer than normal foraging trips.

Response to SSC comments

The probability of the spawning biomass being below $B_{20\%}$ in 2008 is approximately 15%. In 2009, the probability decreases to less than 10%, given a 2009 catch of 815,000 t.

Aleutian Islands

Changes from previous assessment

The AI pollock assessment underwent an extensive peer review during the summer of this year, conducted by the Council of Independent Experts (CIE). In response to this review, many changes were made in the assessment model.

The only new data in the model consists of fishery catches in the area from 170-174°W, as recommended by the CIE reviewers.

Changes to the model, all recommended by the CIE reviewers, consisted of the following:

- A bootstrap method was used to compute annual catch at age, average weight at age, and input sample sizes for catch at age.
- A constant sample size of 100 was assumed for survey age compositions, except for the 1991 survey, which was given a lower sample size due to non-representative age structure sampling.
- The maturity schedule from the GOA pollock stock was used instead of the maturity schedule from the BS stock.
- Survey selectivity was forced to be constant across the entire time series, and fishery selectivity was forced to be constant within each of three time blocks (pre-1992, 1992-2005, and post-2005).
- Values of stock-recruitment parameters were assumed rather than estimated.
- The age range for which average catchability is forced to equal 1.0 was changed from 8-10 years to 5-12 years, and the range of years used to estimate average recruitment was changed from 1990-2007 to 1978-2006.
- To make projections, the selectivity curve estimated in the AI assessment model was used instead of the selectivity curve estimated in the EBS assessment model.

Spawning biomass and stock status trends

Relative to last year's assessment, the numerous revisions to this year's model resulted in a major change in the estimated trajectory of the stock relative to biomass reference points. In last year's assessment, the stock was estimated to have been well above $B_{40\%}$ for the entire time series. In contrast, this year's assessment estimates that spawning biomass reached a minimum level of about $B_{21\%}$ in 1999, increased steadily through 2006 to a level around $B_{30\%}$, then 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 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 2009 is projected to be 85,500 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, believing that the changes made this year in response to the CIE review have made a good model even better. The revised model estimates $B_{40\%}$ at a value of 113,000 t, placing the AI pollock stock in sub-tier "b" of Tier 3. Under Tier 3b, with $F_{40\%}$=0.29, the maximum permissible ABC for 2009 is 26,900 t. However, the Plan Team notes that this value is more than 10 times the maximum catch taken in the last decade. Given that the stock is well below$B_{35\%}$, that all cohorts presently in the population are estimated to be below average, and that the assessment model is in a state of transition, the Plan Team feels that it would be appropriate to set the 2009 ABC at some level lower than the maximum permissible. As an alternative to the maximum permissible ABC under Tier 3b, the assessment authors have provided the value corresponding to the maximum permissible ABC under Tier 5, which is 15,300 t (based on the model's estimated value of 0.22 for the natural mortality rate). The Plan Team recommends setting the 2009 and preliminary 2010 ABCs at this value. This recommendation should not be interpreted as a statement that the stock fails to qualify for Tier 3, but rather as a statement that a phased transition from recent actual catches to the higher catch levels associated with Tier 3 is advisable.

Following the Tier 3b formula with $F_{35\%}$=0.36, OFL for 2009 is 32,600 t. The projected OFL for 2010, given a 2009 catch of 2,000 t, is 36,800 t. The walleye pollock stock in the Aleutian Islands is not overfished and is not approaching an overfished condition.

Response to SSC comments

There is less than a 1% chance that the AI pollock stock will be below $B_{20\%}$ in 2009.

Bogoslof

Changes from previous assessment

This assessment has been placed on a biennial schedule, and Chapter 1b is basically a summary of last year's assessment. No survey took place this year.

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 198,000 t in 2003 to a high of 301,000 t in 2000. The 2007 estimate was the highest since the 2000 estimate.

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}=0.022 and a 2009 ABC of 7,970 t. The projected ABC for 2010 is the same.

Following the Tier 5 formula with M=0.20, OFL for 2009 is 58,400 t. The OFL for 2010 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 2009 and 2010 are those recommended by the Plan Team. Catch data are current through November 8, 2008.

Area	Year	Age 3+ Biomass	OFL	ABC	TAC	Catch
	2007	960,000	207,000	176,000	170,720	173,624
	2008	1,080,000	207,000	176,000	170,720	165,477
	2009	1,260,000	212,000	176,000	n/a	n/a
	2010	n/a	235,000	176,000	n/a	n/a

Changes from previous assessment

The assessment of the BSAI Pacific cod stock has been particularly challenging as more refinements are made to the modeling approaches and use of the data. The chapter described the evolution of analytical approaches. Following a series of modifications from 1993 through 1997, the base assessment model remained completely unchanged from 1997 through 2001. As data refinement and analytical techniques developed, a major change took place in 2005 when the model was migrated to the Stock Synthesis 2 (SS2) program. Difficulties encountered in the 2006 assessment resulted in a thorough review of various assessment models in April 2007 during a public workshop that brought together 44 participants. Many suggestions for changes and refinements of the analytical approaches were made. Refinements continued in the 2007 and 2008 assessments based on suggestions from the Plan Teams and SSC.

The assessment authors developed eight versions of the analytical model for the November 2008 assessment. The following points distinguish these eight models.

Model A1: This is the "reference" model requested by the SSC at the October 2008 meeting. It is very similar to Model 5 from the preliminary (September 2008) assessment, the main difference being that the lower bound on the descending "width" parameter of the selectivity curves is reduced so that it is never constraining. The other differences with respect to Model 5 are: 1) the distribution of mid-year length at age 1 is set equal to the distribution around the first mode of the long-term trawl survey size data; and 2) for each gear and season, individual selectivity parameters are allowed to vary between blocks of years only if the cost of the additional parameters is outweighed by a sufficient improvement in the model's fit to the data.

Model A2: This is identical to Model A1, except that age composition data are not included. This model was requested by the SSC.

Model B1: This is similar to Model A1, except that more fisheries are assumed to exhibit asymptotic selectivity. *This is the authors' preferred model.*

Model B2: This is identical to Model B1, except that age composition data are not included.

Model C1: This is identical to Model B1, except that the natural mortality rate *M* is estimated internally.

Model D2: This is identical to Model B1, except that age composition data are not included, the maturity schedule is defined as a function of length rather than age, and *M* is estimated iteratively. This model was requested by members of the public.

Model E2: This is identical to Model B1, except that age composition data are not included, the post-1981 trawl survey selectivity schedule is constrained to be asymptotic, and *M* is estimated internally. This model was requested by members of the public.

Model F2: This differs from the other models in several respects. It is identical to Model 4 from last year's assessment and this year's preliminary assessment, except that the starting year is set at 1977. This model was requested by members of the public.

Ten major items of new input data are all routine updates. Two new data sources stand out.

- a new biomass for Pacific cod was estimated at 403,000 t from the 2008 EBS shelf bottom trawl survey (this biomass is 5% lower than the 2007 survey estimate and is the all-time low in the time series); and
- the numbers of fish for 2008 was estimated by the survey at 477 million fish, down about 35% from the 2007 estimate. The addition of this new data point to the series of survey population numbers from 1979-2007 has a material impact on the projection of Pacific cod population numbers and biomass into the future.

Because all of the models seem to perform reasonably well in terms of fitting the data, the authors used the following four major criteria for selection of the best model to represent the dynamics of the stock.

- The model should estimate mean lengths for ages 1-3 that are close to the first three modes from the long-term average trawl survey size composition;
- The model should assume or estimate a reasonable value for M;
- The model should estimate a reasonable average for the product of trawl survey catchability and trawl survey selectivity for the 60-81 cm size range; and
- For models that satisfy the first three criteria above, the following "tie-breaker" criterion was used: Choose the model that implies the least drastic changes with respect to recent understanding regarding appropriate model structure and the size and productivity of the stock (i.e., do not make big changes in the model unless there is a compelling reason to do so).

Based on these criteria, Model B1 was selected by the authors to best represent the population dynamics of the BSAI Pacific cod stock. The Plan Team agrees with this selection and added the following comments:

- All selectivity curves estimated by Model B1 appear biologically reasonable. In addition, the authors describe a reasonable method for selecting which fisheries should exhibit asymptotic selectivity. In essence, this method assumes asymptotic selectivity for fisheries that capture relatively more large (> 70 cm) fish. In addition, at least one of the fisheries with asymptotic selectivity must be a "major" fishery, where "major" implies that the fishery accounts for a substantial fraction of the total Pacific cod catch and length samples. The method used to choose the set of fisheries exhibiting asymptotic selectivity in model B1 was based on "pick[ing] the highest ranked set of fisheries that consistently included at least one of the major fisheries". The threshold was chosen as follows. Three fisheries consistently ranked in the bottom three, regardless of length category considered. These three fisheries were excluded which also met the additional requirement that one major fishery was included. The implication of the method is that the fisheries that catch large fish most often (compared to other fisheries) were assigned asymptotic selectivity. In addition, the Plan Team recommends that the authors apply this method in next year's model(s) and examine whether assuming asymptotic selectivity also is appropriate for the shelf bottom trawl survey.
- Some of the models examined by the authors ignore age data. It makes little sense to discard data that provide information on relative cohort strength, even if the fit is "not very good". Relying on length data alone is not as informative as incorporating age data because there is not a one-to-one relationship between length and age, except for the youngest ages. The Plan Team recognizes that there are some differences between mean length-at-age for aged fish and the mean length-at-age implied from length frequencies. These differences may be due to overlap of lengths from adjacent ages that slightly shifts the modes in the length frequencies. Gear selection also may shift modes in length frequencies somewhat.
- Natural mortality (M) is estimated external to the assessment model. The best estimate of M is 0.34. It is based on a derivation from standard functional relationships for the life history of Pacific cod reported by Jensen (1996). Using the variance for the age at 50% maturity published

by Stark (0.0663), the 95% confidence interval for *M* extends from about 0.30 to 0.38. Models B1 (M fixed) and C1 (M estimated) meet this criterion.

- The Plan Team generally agrees with the authors' approach for model selection. The authors used four criteria (listed above) and additionally required that the model fit the data "reasonably well". Model B1 met these criteria and additionally fit the data "reasonably well". In addition, model B1 is a similar model to that recommended for the Gulf of Alaska.

As Model B1 (M=0.34) was selected, the ABC and other parameter values for 2009 and 2010 are provided by the model results shown in Table 2.18. In accepting these values, the Plan Team made the following observations:

- The 2009 ABC of 176,000 t is the same as the 2007 and 2008 ABC values of 176,000 t. This ABC pattern is not consistent with the 18% decline in the NMFS survey biomass from 2006 to 2007 and the 5% decline from 2007 to 2008, which currently is at its historic minimum. The Plan Team considered reducing the ABC below the authors' recommendation because of this decline. However the Plan Team felt there was sufficient conservatism in holding ABC constant (rather than decreasing ABC) and waiting for next year's observations to ascertain the strength of the possibly above average 2006 year class.
- Five consecutive year classes of the EBS Pacific cod stock from 2001-2005 (that ranged from 197-361 million age zero fish) are noticeably below the 30-year average year class strength (633 million age zero fish from 1977-2007) (Table 2.23b). However, the 2006 year class appears to be above average and currently is estimated at more than 1.6 times the average recruitment.
- The female spawning biomass for 2009 and 2010 are projected to be at about 34-35% of the unfished female spawning biomass and will remain within this range at least until the strong 2006 year class can contribute substantially to spawning after 2010.
- Model uncertainty exists in that different understandings of the population can occur without substantial differences in fit. Another uncertainty for the cod assessment is uncertainty about future changes in ecosystem productivity. There have been several years' of low recruitment which appear correlated with warmer conditions (2001-2005) followed by one year (so far) of higher recruitment that occurred during a cooler year (2006). Whether or not other strong year classes follow the 2006 year class may depend on more frequent positive conditions, noting that this likely did not occur in 2007 (the 2007 year class does not appear to be above average).

Spawning biomass and stock status trends

A standard set of projections is required for each stock managed under Tiers 1, 2 or 3. The authors evaluated 7 harvest scenarios to make projections of the biomass and status trends to satisfy Amendment 56, NEPA, and the MSFCMA. The Plan Team selected Scenario 2 as the most likely representation to determine how the spawning biomass and stock status would trend. Scenario 2 assumes that in all future years, F is set equal to 96.6% maximum F_{ABC} which is close to the Council's decisions in the past to set TACs at or close to the maximum ABCs.

Under Scenario 2, the spawning biomass is projected to continue a slow decline from 2009 to 2010 before the strong 2006 year class would boost the female spawning biomass from 363,000 t in 2010 to 401,000 t in 2012 (Table 2.26). This projected increase in biomass and upward trend of stock status are predicated on the continued strength and contributions of the 2006 year class. This 2006 year class indicator is still an early indicator and it must be tracked carefully as the year class follows through the population in time. The effect of such a strong year class following through is particularly important to the stock as it follows 5 consecutive weak year classes from 2001-2005 (Table 2.23b). The average recruitment of age zero fish for the 30-year time series (1977-2007) was 633 million fish. The 5 years of consecutive weak year classes from 2001-05 ranged from 197-361 million fish. The 2006 year class at age zero was estimated to be 1.029 billion fish, which though above average, is much weaker than the estimate from last year's assessment of 1.835 billion fish.

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 426,000 t, 0.28 and 0.34, respectively. Pacific cod specifically qualifies for management under sub-tier "b" of Tier 3 because the projected biomass for 2009 (373,000 t) is below $B_{40\%}$. Fishing at the adjusted Tier 3b rate of 0.24 is projected to result in a 2009 catch of 182,000 t, which is the maximum permissible ABC under Amendment 56.

The Plan Team recommends setting the 2009 ABC at 176,000, which is 3% below the maximum permissible value of 182,000 t. The Plan Team recommends the same ABC of 176,000 t in 2010 until the 2006 year class shows strong enough to substantially increase spawning biomass.

The OFL for 2009 under Tier 3b is 212,000 t (F_{OFL}=0.29) and the projected OFL for 2010 is 235,000 t.

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 several 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 2009 and 2010 are those recommended by the Plan Team. Catch data are current through November 8, 2008.

Area	Year	Age 4+ Biomass	OFL	ABC	TAC	Catch
EBS	2007	34,000	3,520	2,980	2,980	1,173
	2008	41,000	3,380	2,860	2,860	1,088
	2009	40,000	3,210	2,720	n/a	n/a
	2010	n/a	2,980	2,520	n/a	n/a
AI	2007	32,000	3,320	2,810	2,810	1,148
	2008	34,000	2,890	2,440	2,440	880
	2009	33,000	2,600	2,200	n/a	n/a
	2010	n/a	2,410	2,040	n/a	n/a

Changes from previous assessment

Sablefish are assessed as a single stock in the BSAI and GOA using a split-sex age-structured model. The split-sex model approach was fully implemented beginning in 2006 and was deemed appropriate given differences in growth between males and females. The assessment model incorporates the following new data into the model: relative abundance and length data from the 2008 longline survey, relative abundance and length data from the 2007 longline and trawl fisheries, and age data from the 2007 longline survey and longline fishery. When moving to a sex-specific model in 2006, the number of selectivity parameters was greatly increased. These parameters were estimated with high correlation and low precision. For this year, simpler selectivity functions were used and some selectivity curves linked to improve parameter estimation without greatly affecting model fit or trends. This reduced the total parameters by thirteen with minimal effects on the overall model fit. The survey abundance index decreased 2% from 2007 to 2008, which follows a 14% decrease between 2006 and 2007. The fishery abundance index was up 5% from 2006 to 2007 (2008 data not yet available).

Spawning biomass and stock status trends

The spawning biomass is projected to be similar from 2008 to 2009, but is expected to decline through 2012. The projected 2009 spawning biomass is 36% of unfished biomass compared with about 29% of unfished biomass estimated during the 1998 to 2001 period. The 1997 year class has been an important contributor to the population but has been reduced and comprises 13% of 2008 spawning biomass. The 2000 year class now appears to be larger than the 1997 year class, but is only 85% mature and should also comprise 23% of spawning biomass in 2009.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

This stock qualifies for management under Tier 3. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from this assessment are 115,000 t (combined across the EBS, AI, and GOA), 0.095, and 0.113, respectively. Projected spawning biomass (combined areas) for 2009 is 103,000 t (90% of $B_{40\%}$), placing sablefish in sub-tier "b" of Tier 3. The maximum permissible value of F_{ABC} under Tier 3b is 0.085, which translates into a 2009 catch (combined areas) of 16,080 t and is the Plan Team's recommended combined 2009 ABC. The recommended 2009 ABC is approximately 11% lower than the 2008 ABC of 18,030 t. The OFL fishing mortality rate under Tier 3b is 0.10. This fishing mortality rate translates into a 2009 OFL (combined areas) of 19,000 t. Alaska sablefish are not overfished nor are they approaching an overfished condition.

Additional Plan Team recommendations

The combined ABC has been apportioned to regions using a weighted moving average method since 1993. Since 2000, both survey and fishery data have been used to apportion ABC. The current method is to compute 5-year exponential weightings for each index which are then combined, with the survey data weighted twice as heavily as the fishery data.

The team discussed sperm whale depredation during the longline survey. The degree of depredation during the survey has not been quantified; the team asked how those data could be applied to estimates given that the fleet avoided sperm whale depredation by moving to whale-free areas, which is an option not open to the survey. The team had no recommendations to address this discrepancy in terms of adjustments to survey and fishery catch estimates, but encouraged the authors to consider this issue further.

Area apportionment

A 5-year exponential weighting of longline survey and fishery relative abundance indices (the survey index is weighted double the fishery index) may be used to apportion the combined 2009 ABC among regions, resulting in the following values: 2,720 t for EBS, 2,200 t for AI, and 11,160 t for GOA. The 2008 OFL also was apportioned among regions and results in the following values: 3,210 t for EBS, 2,600 t for AI, and 13,190 t for GOA. Relative to 2008, all area apportionments of OFLs and ABCs decreased.

Responses to SSC Comments

The authors responded to each of the SSC comments.

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 2009 and 2010 are those recommended by the Plan Team. Catch data are current through November 8, 2008.

Area	Year	Age 2+ Bio.	OFL	ABC		TAC	Catch
BSAI	2007	2,000,000	240,000	225,000	136,000	121,027	
	2008	2,150,000	265,000	248,000	225,000	141,431	
	2009	1,870,000	224,000	210,000	n/a	n/a	
	2010	n/a	210,000	198,000	n/a	n/a	

Changes from previous assessment

Changes to the input data for this year's assessment are the inclusion of 2007 fishery and survey age compositions, the 2008 trawl survey biomass point estimate and standard error, estimates of the discarded and retained portions of the 2007 catch and catch through 13 September 2008. A split-sex model was implemented for yellowfin sole this year. Sex specific weight-at-age and survey and fishery age composition time-series were recalculated instead of combining sexes.

This year's EBS bottom trawl survey resulted in a biomass estimate of 2,100,000 t, compared to last year's survey biomass of 2,150,000 t.

Spawning biomass and stock status trends

The projected female spawning biomass estimate for 2009 is 614,000 t. Based on the most recent time series of estimated female spawning biomass the projected 2009 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 $B_{40\%}$ in the near future.

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 329,000 t. The 1978-2003 spawner recruit data were used this year as the basis to determine the Tier 1 harvest recommendation. This provided an $F_{ABC} = F_{\text{harmonic mean Fmsy}} = 0.12$. The $F_{OFL} = F_{MSY} = 0.13$. The product of the harmonic mean of F_{MSY} and the geometric mean of the 2009 biomass estimate produced the author- and Plan Team-recommended ABC of 210,000 t and OFL of 224,000 t.

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

The authors hope to make further progress on management strategy evaluation soon.

The split-sex model was implemented.

The assumption of constant selectivity will be examined next year.

A typographical error in the ecosystem considerations table was corrected.

Notational errors in Table 4.10 (analogous to Table 4.9 in last year's assessment) have been corrected.

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 2009 and 2010 are those recommended by the Plan Team. Catch data are current through November 8, 2008.

Year	Area	Age 1+ Bio.	OFL	Subarea	ABC	TAC	Catch
2007	BSAI	119,000	15,600		2,440	2,440	1,839
				EBS	1,680	1,680	1,317
				AI	760	760	522
2008	BSAI	104,100	15,600		2,540	2,540	2,727
				EBS	1,750	1,750	1,905
				AI	790	790	822
2009	BSAI	105,000	14,900		7,380	n/a	n/a
				EBS	5,090	n/a	n/a
				AI	2,290	n/a	n/a
2010	BSAI	n/a	14,400		7,130	n/a	n/a
				EBS	4,920	n/a	n/a
				AI	2,210	n/a	n/a

Changes from previous assessment

This year's Greenland turbot assessment model included updated 2007 and 2008 catch data, EBS shelf survey 2008 biomass and length composition estimates, and aggregated longline survey data index for the EBS and Aleutian Islands regions through 2008.

EBS slope survey estimates for 2008 were included. As was done last year, a simplified Tier 5 approach was also provided for contrast to the Stock Synthesis 2 model results. Also as in last year's assessment, the slope-trawl survey was assumed to index 75% of the Greenland turbot stock inhabiting US waters.

Spawning biomass and stock status trends

The current estimate of 2009 female spawning biomass is 56,400 t. Compared to the 2008 spawning biomass of 58,100 t this represents a slight decrease, consistent with the general decline prevalent since the mid 1970s.

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. Updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from the present assessment are 43,700 t, 0.46, and 0.57, respectively. Projected spawning biomass for 2009 is 58,200 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 2009 ABC of 11,900 t.

Marked differences in the survey and model estimates were noted, and the Team considered possible reasons for the differences. Unavailability of the entire biomass (e.g., large females) to the survey was advanced as a contributor to the discrepancy. For 2010 the authors intend to further evaluate possible reasons for the differences between survey and model biomass estimates.

Given the recent slope survey and continuing signs of favorable recruitments, the authors recommended an increase in the ABC over last year. The Team concurred with an increase; however, because of

differences noted in biomass estimates, coupled with continuing uncertainties in stock trends, the Team recommended a stair-step procedure for increasing the ABC up to the maximum permissible ABC, assuming that there is a 2010 survey. If no survey occurs in 2010 the team recommends maintaining the 2009 ABC for 2010. The step for 2009 would yield an ABC that is 60% of the maximum permissible ABC, or 7,380 t, which corresponds to a full selection fishing mortality rate of 0.27. The OFL fishing mortality rate is computed under Tier 3a, $F_{OFL} = F_{35\%} = 0.57$, and translates into a 2009 OFL of 14,900 t.

Responses to SSC comments

Results of analyses presented during a February 2008 workshop on the Atlantic stock of Greenland turbot are compared and contrasted.

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 2008 and 2009 are those recommended by the Plan Team. Catch data are current through November 8, 2008.

Area	Year	Age 1+ Bio.	OFL	ABC	TAC	Catch
BSAI	2007	1,280,000	193,000	158,000	20,000	11,607
	2008	1,780,000	297,000	244,000	75,000	21,417
	2009	1,140,000	190,000	156,000	n/a	n/a
	2010	n/a	196,000	161,000	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 18 September 2008, new data were also included for the 2008 shelf and slope trawl survey size composition and biomass point-estimates and standard errors. Estimates of retained and discarded portions of the 2007 catch were added.

Last year's stock assessment was expanded to include the 10 Aleutian Islands surveys and the survey size composition for arrowtooth flounder. Formerly 87% of the stock was from the shelf survey. With AI data added after 2006, only 72% of the stock is estimated from the Bering Sea shelf, 18% from the Aleutian Islands, and 10% from the Bering Sea slope. Also, a reformulation of catchability in the assessment model now allows an estimate of the constant or time-independent estimate of q. This reformulation resulted in an estimate of average q = 1.1 and has the effect of reducing the estimates of female spawning biomass and total biomass from the 2007 assessment.

Spawning biomass and stock status trends

The 2008 stock assessment model resulted in a 2009 biomass projection of 1,140,000 t. This is a decrease from the value of 1,780,000 t projected in last year's assessment for 2008, but a slight increase from the current assessment's 2008 biomass estimate of 1,070,000 t. 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 in 1990s, but has been steadily increasing since then.

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.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The Plan Team concurred with the authors that there are issues with this model that should 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 255,000 t, 0.24, and 0.29, respectively. Given that the projected 2009 spawning biomass of 802,000 t exceeds $B_{40\%}$, the Team's ABC and OFL recommendations for 2009 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 2009 ABC of 156,000 t. The OFL fishing mortality rate under Tier 3a is $F_{35\%}$ (0.29), which translates to a 2009 OFL of 190,000 t.

As there is little to no fishery for arrowtooth flounder the model is mostly driven by the survey data. More female arrowtooth flounder are caught than males during the fisheries and the surveys, resulting in estimates of differential mortality for males and females. With fixed female M=0.2, the run with male M=0.34 provides a reasonable fit to all the data components and is consistent with observations of differences in sex ratios observed from trawl surveys. The maximum shelf survey selectivity for males occurs at 0.9 for age 8 fish. The base model includes Aleutian Islands data again this year.

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, these occasionally recorded events translate 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 arrowtooth flounder by 10% decreased arrowtooth flounder adults and juveniles, slightly increased flathead sole and produced a negligible effect on pollock. However, it should be noted that those results were for a 10% decrease. If arrowtooth flounder 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.

Comment from Plan Team

The authors' choice of female M=0.2 and male M=0.34 and the estimate of K is consistent with the expected ratio of 1.5. Examination of the hypothesized different life spans of male and female fish and the change in sex ratio with time is needed. Specifically, the Plan Team would like to know if the apparent differential mortality of male and female arrowtooth flounder is real or perceived, i.e., are there sex-specific changes in the behavior of arrowtooth flounder that render males unavailable to sampling. Further exploration of the overlapping spatial distribution of arrowtooth flounder and pollock may be needed in the future.

Response to SSC comments

The authors varied the proportions of biomass available to the three components of the stock (shelf, slope and Aleutian Islands) with the aim to increase the proportion of biomass on the shelf (and decrease the others) in order to better fit the shelf survey estimates of the mid-1990s. Proportions on the shelf were allowed to vary from 85% to 95% of the total stock biomass (base model used 72% on the shelf) but still did not closely fit the survey biomass estimates in 1994-1998. The level of recruitment estimated for the late 1980s appears to have been enough to increase the stock from a low to a high and stable level, but not enough to bring the stock to the level indicated by those surveys. Subsequent recruitment in the early 2000s has brought the stock to a higher abundance level.

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 2009 and 2010 are those recommended by the Plan Team. Catch data are current through November 8, 2008.

Area	Year	Age 2+ Bio	OFL	ABC	TAC	Catch
BSAI	2007	1,670,000	200,000	198,000	55,000	37,013
	2008	1,880,000	304,000	301,000	75,000	51,063
	2009	1,630,000	301,000	296,000	n/a	n/a
	2010	n/a	314,000	310,000	n/a	

Changes from previous assessment

Northern rock sole (*Lepidopsetta polyxystra*) is the dominant rock sole species in the Bering Sea. Only 2% of the commercial catch is estimated to be southern rock sole (*Lepidopsetta bilineata*). Therefore this assessment for 2009 is for northern rock sole only. No attempt was made to correct past catch or survey data by species.

Changes to input data in this analysis include the addition of 2007 rock sole fishery age composition, 2007 northern rock sole survey age composition, and 2008 northern rock sole trawl survey biomass point estimate and standard error. Only Bering Sea survey data (no Aleutian Islands data, 3% of total rock sole survey biomass) were used in calculations. Another change to the input data was inclusion of an estimate of retained and discarded portions of the 2007 rock sole catches.

A split-sex component was added to the model.

Spawning biomass and stock status trends

The stock assessment model resulted in a 2009 age-2+ biomass projection of 1,630,000 t. This was a decrease from the value of 1,880,000 t projected for 2008 in last year's assessment. The rock sole stock is expected to remain stable through 2010. However, good recruitment in 2001 through 2004 should increase the stock biomass at the beginning of the next decade.

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 the proximity of arithmetic and harmonic means of the F_{msy}, resulting in extremely close recommendations of ABC and OFL. This results from estimates of F_{msy} that are highly certain.

The Team agreed with the authors' implementation of a split-sex model. The associated Tier 1 2009 ABC harvest recommendation is 296,000 t ($F_{ABC} = 0.181$) and a 2009 OFL of 301,000 t ($F_{OFL} = F_{MSY} = 0.183$). Note that with this Tier 1 assessment, there is only a 4,000 t difference between the ABC and OFL levels, the same difference as there was for the 2008 assessment. This will require a more tightly managed fishery if catches approach the ABC value. The 2010 projection also uses Tier 1 methodology.

M and q were fixed within the recommended model (Model A): female M=0.15, male M=0.15, q=1.5, which were used in past assessments.

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 8 November 2008, 51,063 t were caught, for an exploitation rate of 0.04. This is an increase from 2007, but it is not alarming. The Amendment 80 cooperative fishery remains open at this time; therefore the full catch for 2008 is not accounted for in the total catch reported here.

Response to SSC comments

A split-sex model was implemented.

Time-varying selectivity will be addressed in next year's assessment in an attempt to reflect more accurately the level of uncertainty in F_{MSY}.

Table 7.9 (the analogue to last year's Table 7.8) has been updated to include 2007 data.

Notational errors in 7.10 (the analogue to last year's Table 7.9) have been corrected.

A standard form for the potential temperature:catchability relationship was used.

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 2009 and 2010 are those recommended by the Plan Team. Catch data are current through November 8, 2008.

Area	Year	Age 3+ Bio.	OFL	ABC	TAC	Catch
BSAI	2007	875,000	95,300	79,200	30,000	18,744
	2008	820,000	86,000	71,700	50,000	24,230
	2009	834,000	83,800	71,400	n/a	n/a
	2010	n/a	81,800	69,800	n/a	n/a

Changes from previous assessment

The present assessment is a straightforward update of last year's assessment. It includes updated 2007 catch data and the 2008 catch through September 20, 2008. The 2008 fishery length compositions, based on observer data, were added to the assessment and fishery length compositions from previous years (1990-2007) were recalculated. Sex-specific length compositions, mean bottom temperatures, and estimated survey biomass and standard error from the 2008 EBS trawl surveys were added. Sex-specific age compositions from the 2001 and 2005-2007 EBS Trawl Surveys were added to the assessment. Survey age compositions from other years were recalculated.

Reference fishing mortality rates (e.g., $F_{40\%}$ and $F_{35\%}$) were removed as estimable parameters from the overall minimization of the model objective function (the negative log-likelihood). These quantities are now estimated using a simple minimization routine that does not affect the model objective function. Although the previous approach appears to have worked satisfactorily, the new approach is somewhat more rigorous and, under some circumstances, may avoid problems with model convergence.

Several options regarding initial age compositions were added to the assessment model architecture. Runs incorporating these options were evaluated as alternatives to using last year's model. The configuration used last year was again selected as the best. An experimental option that used a lagged version of survey bottom temperatures to model temperature-dependent survey catchability was added to the model architecture. Lagging bottom temperature by one year resulted in a highly significant improvement in model fit to the survey biomass time series, although the resultant reference points were very similar, when compared with last year's model. Further research during the coming year is required to validate this result, assess its wider validity among other flatfish stocks, and determine plausible biological mechanisms behind it. As such, the lagged-temperature model is regarded as preliminary. With the exception of the changes to the calculation of reference fishing mortality rates noted above, the selected assessment model is identical to that for 2007.

Spawning biomass and stock status trends

In the current assessment, the projected age 3+ biomass for 2009 is 834,000 t, slightly higher than the value of 820,000 t projected last year for 2008. This year's survey biomass was 554,000 t, compared to 571,000 t in 2007.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The SSC has determined that reliable estimates of $B_{40\%}$ (139,000 t), $F_{40\%}$, (0.28) and $F_{35\%}$ (0.34) exist for this stock, thereby qualifying the stock for management under Tier 3. Given that the projected 2009

spawning biomass of 246,000 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2009 were calculated under sub-tier "a" of Tier 3. The Plan Team recommends setting F_{ABC} at the $F_{40\%}$ (0.28) level, which is the maximum permissible level under Tier 3a. Projected harvesting at the $F_{40\%}$ level gives a 2009 ABC of 71,400 t. The OFL was determined from the Tier 3a formula, where an $F_{35\%}$ value of 0.34 gives a 2009 OFL of 83,800 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Additional Plan Team recommendations

In response to SSC and Plan Team comments, the author examined the distribution of Bering flounder with respect to the flathead sole/Bering flounder complex fishery. The northerly distribution of the species did not seem to overlap the spatial distribution of the fishery. It was noted that it is difficult to distinguish the two species in the field, especially for observers. The Plan Team recommended treating Bering flounder as belonging to a flathead sole/Bering flounder complex in future assessments.

Response to SSC comments

The author has worked on a management strategy evaluation, but it has not been implemented in the assessment yet.

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 2009 and 20010 are those recommended by the Plan Team. Catch data are current through November 8, 2008.

Area	Year	Age 3 + Bio.	OFL	ABC	TAC	Catch
BSAI	2007	1,340,000	241,000	190,000	25,000	19,411
	2008	1,850,000	248,000	194,000	50,000	19,427
	2009	1,500,000	298,000	232,000	n/a	n/a
	2010	n/a	354,000	275,000	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 2008 catch data and inclusion of fishery catch through 11 October 2008. The 2008 trawl survey biomass estimate and standard error, and 2008 length composition of survey catch also were added to the model. The 2007 survey ages were read from otoliths and the 2007 survey age composition was added to the assessment.

Spawning biomass and stock status trends

The female spawning biomass trend is similar to the overall biomass trend. It was slowly decreasing from 1985 to 2005 and has been increasing since then. The increase in total biomass is expected to continue. The shelf survey biomass has been fairly steady since the mid 1980s. Above-average recruitment year classes since 1998, with an exceptionally strong year class in 2003, will support the increasing trend in this stock.

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 $B_{40\%}$ = 148,000 t, $F_{40\%}$ = 0.62, and $F_{35\%}$ = 0.86. 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 2009 spawning biomass of 385,000 t exceeds $B_{40\%}$, the ABC and OFL recommendations for 2009 were calculated under sub-tier "a" of Tier 3. Projected harvesting at the $F_{40\%}$ level gives a 2009 ABC of 232,000 t. The OFL was determined from the Tier 3a formula, which gives a 2009 OFL of 298,000 t.

The total estimated biomass of Alaska plaice is down slightly, but it is expected to increase because of the above average 1997 and 1998 year classes.

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

The SSC asked the authors to examine the relationship between bottom temperature and q for this species as for all other flatfish species. As no relationship was found when this was previously examined (Spencer et al. SAFE Chapter 9, 2004), no additional examination was conducted. (See Figure 9.3 of the assessment).

The authors plan to implement a split-sex model for the fall 2009 assessment.

10. Other flatfish complex

Status and catch specifications (t) of other flatfish 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 8, 2008.

	Year	Total Bio.	OFL	ABC	TAC	Catch
BSAI	2007	121,000	28,500	21,400	10,000	5,838
	2008	149,000	28,800	21, 600	21,600	3,616
	2009	121,000	23,100	17,400	n/a	n/a
	2010	n/a	23,100	17,400	n/a	n/a

Changes from previous assessment

With the removal of Alaska plaice from this category in 2002, the species currently collected in the "other flatfish" category in the Eastern Bering Sea survey are Arctic flounder, butter sole, curlfin sole, deepsea sole, Dover sole, English sole, longhead dab, Pacific sand dab, petrale sole, rex sole, roughscale sole, sand sole, slender sole, starry flounder, and Sakhalin sole. The species currently collected in the "other flatfish" category in the Aleutian Islands survey are Dover sole, rex sole, starry flounder, butter sole and English sole. Starry flounder, rex sole and butter sole comprise the majority of the species caught with a negligible amount of other species caught. Starry flounder continues to dominate the shelf survey biomass in the EBS and rex sole is the most abundant "other" flatfish in the Aleutian Islands.

The present assessment is a straightforward update of last year's assessment. The assessment incorporates 2008 total catch and discard; catch through 11 October 2008 and 2008 EBS trawl survey information. As there was no AI survey in 2008, a linear regression was used to predict AI biomass for 2008. Together the 2008 EBS bottom trawl survey and AI prediction resulted in a biomass estimate of 121,000 t, a value slightly below the 2007 value.

Spawning biomass and stock status trends

Because this complex is managed under Tier 5, no models are available from which to predict future trends.

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. Projected harvesting at the 0.75 *M* level (F_{ABC} = 0.13), gives 2009 and 2010 ABCs of 17,400 t for the "other flatfish" species. The corresponding 2009 and 2010 OFLs (= 0.17) are 23,100 t.

Status determination

It is not possible to determine whether the "other flatfish" complex is overfished or approaching an overfished condition because it is Tier 5 and not managed under Tiers 1-3. Insufficient information about

these species makes model analysis impossible. This group of fisheries is usually closed prior to attainment of TAC because of the bycatch of Pacific halibut, a prohibited species. With the implementation of Amendment 80, a higher TAC for other flatfishes was assigned for 2008, though there has not been a higher catch taken to date. The vessels fishing in the Amendment 80 cooperative were expected to stop fishing in November. Total catch of "other" flatfish is somewhat similar annually, though there was a 32% drop in catch from 2007 to 2008. Of note is that the 2008 catch of butter sole (614 t) exceeded the estimated 2008 biomass of butter sole (541 t total; 418 t, cv=0.44 in the EBS), resulting in an implied exploitation rate of 1.14. As butter sole is at the northern edge of its range and only captured in six tows in 2008, it is extremely difficult to reliably estimate the biomass, thus making interpretation of the exploitation rate problematic.

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 2008 estimate of 418 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 74,000 tons in 2008. 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 11,000 t. 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).

Response to SSC comments

No progress was made on the assessment of bottom temperature effect on catchability of other flatfish species.

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 2009 and 2010 are those recommended by the Plan Team. Catch data are current through November 8, 2008.

Year	Area	Age 3+ Bio	OFL	Subarea	ABC	TAC	Catch
2007	BSAI	457,000	26,100		21,900	19,900	18,451
				EBS	4,160	2,160	870
				Eastern AI	4,970	4,970	5,097
				Central AI	5,050	5,050	4,660
				Western AI	7,720	7,720	7,824
2008	BSAI	453,000	25,700		21,700	21,700	17,440
				EBS	4,200	4,200	513
				Eastern AI	4,900	4,900	4,698
				Central AI	4,990	4,990	4,812
				Western AI	7,610	7,610	7,417
2009	BSAI	402,000	22,300		18,800	n/a	n/a
				EBS	3,820	n/a	n/a
				Eastern AI	4,200	n/a	n/a
				Central AI	4,260	n/a	n/a
				Western AI	6,520	n/a	n/a
2010	BSAI	n/a	22,100		18,600	n/a	n/a
				EBS	3,780	n/a	n/a
				Eastern AI	4,160	n/a	n/a
				Central AI	4,210	n/a	n/a
				Western AI	6,450	n/a	n/a

Changes from previous assessment

Previous to this year, the last full assessment for Pacific ocean perch (POP) was presented to the Plan Team in 2006. Changes in input included catch through August 30, 2008, the 2006 AI survey age composition, 2007 and 2008 AI fishery age compositions, and updates to historical Aleutian Islands survey data. There were no changes in the assessment methodology.

Spawning biomass and stock status trends

The estimated spawning biomass is projected to decline slightly from 137,000 t in 2008 to 133,000 t in 2009. Note that this represents an overall decline in the magnitude of the entire time trend of biomass from the 2006 assessment due to new estimates; for example the 2006 spawning biomass was assessed at 155,000 t by the 2006 assessment while the 2006 spawning biomass is assessed at 140,000 by the current assessment, so the magnitude of the overall spawning biomass estimate has dropped by over 10%. This change is primarily related to an increase in estimated catchability.

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 2009 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 ABC associated with the $F_{40\%}$ level of 0.057 is 18,800 t. Model projections indicate that this stock is neither overfished nor approaching an overfished condition. For 2009, the recommended ABC is 18,800 t, and the OFL is 22,300 t.

Area apportionment

The Team agrees with the author's recommendation that ABCs be set regionally based on the proportions in combined survey biomass as follows: BS = 3,820 t, Eastern Aleutians (Area 541) = 4,200 t, Central Aleutians (Area 542) = 4,260 t, Western Aleutians (Area 543) = 6,520 t. The OFL fishing mortality rate is computed under Tier 3a as 22,300 t, which is the author's and Team's recommended OFL for the BSAI. The OFL is not regionally apportioned.

Response to SSC comments

Average recruitment is computed from the 1980-2005 year classes.

The response to the 2006 CIE review is available online (see chapter for URL).

Model sensitivity to natural mortality estimates in relation to time-varying selectivity was examined.

Model sensitivity to alternative priors for natural mortality was examined.

External estimates of natural mortality were examined and compared to model estimates.

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 2009 and 2010 are those recommended by the Plan Team. Catch is reported through November 8, 2008.

Area	Year	Age 3+ Bio.	OFL	ABC	TAC	Catch
BSAI	2007	212,000	9,750	8,190	8,190	4,021
	2008	212,000	9,740	8,180	8,180	3,290
	2009	200,000	8,540	7,160	n/a	n/a
	2010	n/a	8,580	7,190	n/a	n/a

Changes from previous assessment

The only change to the model was a decrease in the coefficient of variation for the prior distribution on natural mortality which helped stabilize the model. This resulted in a lower estimate of natural mortality and a lower estimate of $F_{40\%}$. New data included 2008 catch data, 2006 AI survey age composition, 2006 and 2007 fishery length compositions, and updated historical AI survey biomass estimates.

Spawning biomass and stock status trends

Age 3+ biomass has increased steadily since 2002. Spawning biomass is projected to be 68,200 t in 2009.

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 68,200 t is greater than $B_{40\%}$, sub-tier "a" is applicable, with $F_{ABC} = F_{40\%}$ and $F_{OFL} = F_{35\%}$. Under Tier 3a, the maximum permissible ABC is 7,160 t, which is the authors' and Plan Team's recommendation for the 2009 ABC. The lower estimated natural mortality is largely responsible for this decrease from an ABC of 8,180 t in 2008. Under Tier 3a, the 2009 OFL is 8,540 t for the Bering Sea/Aleutian Islands combined. The Team continues to recommend setting a combined BSAI OFL and ABC. As the TAC has routinely been lower than the ABC, the TAC of the previous year was assumed as the 2009 catch, in order to make projections to 2010. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Responses to SSC comments

Average recruitment is computed from the 1980-2005 year classes.

The response to the 2006 CIE review is available online (see chapter for URL).

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 2009 and 2010 are those recommended by the Plan Team. Catch data are current through November 8, 2008.

Area	Year	Survey Bio.	OFL	ABC	TAC	Catch
BSAI	2007	18,900	564	424	424	323
	2008	18,900	564	424	424	151
	2009	17,200	516	387	n/a	n/a
	2010	n/a	516	387	n/a	n/a

Changes from previous assessment

Shortraker rockfish has been separated from the blackspotted and rougheye rockfish complex this year. In previous years, the shortraker and rougheye rockfish were assessed with a two-species surplus production model that accounted for potential covariance in catch estimates. This assessment now applies a single-species surplus production model to BSAI shortraker rockfish. Previous to this year, the last full assessment for shortraker rockfish was presented to the Plan Team in 2006, and an updated assessment was presented in 2007. New data included new catch estimates for 2007 and 2008, and updated survey biomass estimates for the Aleutian Islands. There was no Aleutian Islands survey in 2008.

Spawning biomass and stock status trends

The projection of 2009 shortraker total biomass is 17,200 t, down less than 1% from the current assessment's estimate of 2008 total biomass.

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 2009 is 17,200 t for shortraker rockfish, leading to a BSAI OFL of 516 t and an ABC of 387 t. 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

There were no SSC comments relevant to this assessment.

13B. Blackspotted and 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 2009 and 2010 are those recommended by the Plan Team. Catch data are current through November 8, 2008.

Species	Area	Year	Total Bio.	OFL	ABC	TAC	Catch
RE/BS	BSAI	2007	10,800	269	202	202	167
		2008	10,800	269	202	202	207
		2009	19,000	660	539	n/a	n/a
		2010	n/a	640	522	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 has now been separated from shortraker rockfish and is assessed with an age-structured assessment for the first time. The current information on these two species is not

sufficient to support species-specific assessments, so they are combined in this assessment. The Team also received genetic, growth, and demographic information pertinent to whether the blackspotted and rougheye complex in the BS should be considered a distinct complex from that in the AI. The rougheye complex primarily consists of blackspotted rockfish in the AI. The Team disagreed with the authors' recommendation and does not recommend splitting rougheye complex management between the BS and AI at this time. However, the team recommended scheduling a more in depth discussion of the genetics data at the September 2009 Plan Team meeting and inviting AFSC geneticists to participate.

Spawning biomass and stock status trend

Age 3+ biomass for 2007-2008 was estimated at a value of 10,800 in the 2006-2007 assessments, but the projected age 3+ biomass for 2008 is 76% higher. The substantial increase in biomass between the last full assessment and this year's assessment is almost entirely due to the adoption of an age-structured model with a selectivity curve that implies that fish are not caught by the survey until they are relatively old. Because the complex is now assessed with an age-structured model, there is an estimate of spawning biomass for 2009 of 6,540 t which is expected to remain stable.

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 6,540 t is less than $B_{40\%}$, (6,723 t), sub-tier "b" would be applicable, with an adjusted $F_{40\%}=F_{ABC}$ =0.038 and an adjusted $F_{35\%}$ = F_{OFL} = 0.047. Under Tier 3b, the maximum permissible ABC is 539 t, which is the authors' and Plan Team's recommendation for the 2009 ABC. Under Tier 3b, the 2009 OFL is 660 t for the Bering Sea/Aleutian Islands combined. The Plan Team continues to recommend setting a combined BSAI OFL and ABC. As the TAC has routinely been lower than the ABC, the catch of the previous year was assumed as the 2009 catch, in order to make projections to 2010. Model projections indicate that this stock is neither overfished nor approaching an overfished condition.

Responses to SSC comments

Average recruitment is computed from the 1980-2005 year classes.

The response to the 2006 CIE review is available online (see chapter for URL).

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 2009 and 2010 are those recommended by the Plan Team. Catch data are current through November 8, 2008. The 2009 and 2010 values are shown with and without dark rockfish, to reflect the removal of dark rockfish from the other rockfish complex per Amendment 77 to the BSAI FMP.

Area	Year	Survey Biomass	OFL	ABC	TAC	Catch
BSAI	2007	36,700	1,330	999	999	651
	2008	36,700	1,330	999	999	586
w/ dark rockfish	2009	39,700	1,420	1,070	n/a	n/a
no dark rockfish	2009	39,200	1,380	1,040	n/a	n/a
w/ dark rockfish	2010	n/a	1,420	1,070	n/a	n/a
no dark rockfish	2010	n/a	1,380	1,040	n/a	n/a
EBS	2007	18,100	n/a	414	414	218
	2008	18,100	n/a	414	414	199
w/ dark rockfish	2009	21,100	n/a	481	n/a	n/a
no dark rockfish	2009	21,100	n/a	481	n/a	n/a
w/ dark rockfish	2010	n/a	n/a	481	n/a	n/a
no dark rockfish	2010	n/a	n/a	481	n/a	n/a
AI	2007	18,600	n/a	585	585	433
	2008	18,600	n/a	585	585	387
w/ dark rockfish	2009	18,600	n/a	585	n/a	n/a
no dark rockfish	2009	18,200	n/a	555	n/a	n/a
w/ dark rockfish	2010	n/a	n/a	585	n/a	n/a
no dark rockfish	2010	n/a	n/a	555	n/a	n/a

Changes from previous assessment

The BSAI "other rockfish" assessment considers the eight species that have been caught at least once during AFSC research surveys or appeared in more than 1% of observed fishery hauls between 1990 and 2001. The 2008 Eastern Bering Sea Slope survey data are included in this year's assessment. Catches in 2007 have been revised and the 2008 catch through 10/08/08 has been included composition data for shortspine thornyheads from the 2005-2007 EBS fishery and the 2008 EBS slope survey. Separate estimates of natural mortality (M) and biomass for shortspine thornyheads (SST; M=0.03), the most common species in the other rockfish complex, and the remaining species (M=0.09 based on dusky rockfish) in the complex were used.

Spawning biomass and stock status trends

Trends in spawning biomass are unknown. Stock biomass, as measured by trawl surveys of the EBS slope and in the Aleutian Islands, has increased since 1997.

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 585 t in the AI. 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 Ms and adding the results, which yields an OFL of 1,420 t for 2009 and 2010.

For 2009 dark rockfish is expected to be removed from the other rockfish complex by regulatory change with Amendment 77. Excluding dark rockfish the 2009 and 2010 ABC in the EBS is 481 t, and in the AI is 555 t. The 2009 and 2010 OFL in the BSAI = 1,380 t. 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 2009 and 2010 are those recommended by the Plan Team. Catch data are current through November 8, 2008.

Area	Year	Sub-Area	Age 3+ Biomass	OFL	ABC	TAC	Catch
BSAI	2007		364,000	86,900	74,000	63,000	58,763
BSAI	2008		323,000	71,400	60,700	60,700	58,471
BSAI	2009		411,000	99,400	83,800	n/a	n/a
		EAI/EBS			27,000	n/a	n/a
		CAI			33,500	n/a	n/a
		WAI			23,300	n/a	n/a
BSAI	2010		n/a	84,400	71,100	n/a	n/a
		EAI/EBS			22,900	n/a	n/a
		CAI			28,500	n/a	n/a
		WAI			19,700	n/a	n/a

Changes from previous assessment

In response to issues raised during the 2008 Center for Independent Experts (CIE) review of the Aleutian Islands Atka mackerel assessment, a number of aspects of the input data were changed and refinements were made to the model configuration.

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

- Fishery catch data were updated.
- The 2007 fishery age composition data were included.
- Survey biomass estimates from the southern Bering Sea were included.
- The 1986 U.S.-Japan cooperative survey biomass estimate was excluded.
- 2007 fishery weight-at-age values were added.
- Revised estimates of fishery catch- and weight-at-age values were incorporated; these are now stratified by management area to account for observed differences in size at age
- Calculated rather than fixed sample sizes for the fishery catch-at-age data were utilized.

The following changes were made in the assessment model methodology from that reviewed in 2007:

- The age+ bin was lowered from 15+ to 11+.
- Ageing error was incorporated with an age misclassification matrix.
- Four time periods during which selectivity is constant were established. Previous assessments allowed for annually varying selectivity with a moderate constraint. The four time periods correspond to different eras of fishery management. For example, the last period corresponds to the time period of trawl exclusion zones around Steller sea lion rookeries.
- The 2008 selectivity vector (equivalent to the estimated vector for 1999-2007) was used for projections.

- As a result, the selected model has substantially fewer parameters than last year's model.

Spawning biomass and stock status trends

The projected female spawning biomass for 2009 under an $F_{40\%}$ harvest strategy is estimated at 132,000 t which is 54% of unfished spawning biomass and above $B_{40\%}$ (97,800 t). The 2009 estimate of spawning biomass is up about 20% from last year's estimate for 2008.

The projected age 3+ biomass at the beginning of 2009 is estimated at 411,000 t, up about 27% from last year's estimate for 2008. This is due to the large increase in the estimated magnitude of the 2004 year class. While this year class appeared relatively strong as 2-year olds in the 2006 Aleutian Islands bottom trawl survey, there have been no subsequent surveys to confirm this observation; its increased size in the current assessment relative to last year's is based on fishery catch-at-age information. As such, there is concern that the fishery could target on this incoming year-class, which has been observed only in a single fishery-independent survey, thus resulting in overestimates of population abundance and year class strength. If this occurred, harvest rates would be set too high and more fish caught than advisable. *The Team strongly recommends that an Aleutian Islands bottom trawl survey be conducted in 2010 as scheduled to avoid this potential bias.*

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 54% of unfished spawning biomass in 2009 and above $B_{40\%}$, thereby placing BSAI Atka mackerel in Tier 3a**.** The projected 2009 yield (ABC) at $F_{40\%}$= 0.39 is 83,800 t, up about 38% from last year's estimate for 2008. The projected 2009 overfishing level at $F_{35\%}$ (F = 0.48) is 99,400 t, up about 39% from last year's estimate for 2008. The stock is not currently overfished, nor is it approaching an overfished condition.

Atka mackerel female spawning biomass in 2010 (108,000 t) is projected to remain above $B_{40\%}$. The projected 2010 yield (ABC) under Tier 3a ($F_{40\%}$= 0.39) is 71,100 t; the projected 2010 overfishing level at $F_{35\%}$ (F = 0.48) is 84,400 t. The population is projected to be below $B_{40\%}$ from 2011-2015.

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 the populations 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. 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 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 2009 and 2010 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

Evaluation of probability that Atka mackerel will drop below the $B_{20\%}$ threshold: Atka mackerel are not projected to drop below tier 3a in 2009 or 2010.

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 2009 and 2010 are those recommended by the Plan Team. Catch data are current through November 8, 2008.

Squid	Area	Year	Biomass	OFL	ABC	TAC	Catch
	BSAI	2007	n/a	2,620	1,970	1,970	1,188
		2008	n/a	2,620	1,970	1,970	1,542
		2009	n/a	2,620	1,970	n/a	n/a
		2010	n/a	2,620	1,970	n/a	n/a
Other species	**Area**	**Year**	**Biomass**	**OFL**	**ABC**	**TAC**	**Catch**
	BSAI	2007	734,000	91,700	68,800	37,355	26,444
		2008	822,000	104,000	78,100	50,000	28,489
	.	2009		80,800	63,700	n/a	n/a
		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		80,700	63,700	n/a	n/a
		Sharks	n/a	596	447	n/a	n/a
		Skates	n/a	38,200	32,000	n/a	n/a
		Sculpins	n/a	41,600	31,000	n/a	n/a
		Octopus	n/a	311	233	n/a	n/a

Changes from previous assessment

There were no changes in assessment methods for the squid and other species complex, except that the Stock Synthesis 2 assessment framework was used for Alaska skate within the skate complex. Catch and survey data were updated in these assessments.

Spawning biomass and stock status trends

The biomass of the skate and sculpin assemblages as a whole are increasing; however, since 2004 the skate spawning biomass has declined. No spawning biomass trend is available for sharks, octopus, or squid.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Squid - Using Tier 6 criteria, the recommended ABC for BSAI squid for 2009-2010 is calculated as 0.75 times the average catch from 1978-1995, or 1,970 t; the recommended overfishing level for squid in 2009-2010 is calculated as the average catch from 1978-1995, or 2,620 t. The groundfish surveys do not provide a reliable biomass estimate. The authors further extended the understanding of biological aspects of the stock by reporting length composition of squids in commercial fisheries and the slope bottom-trawl fishery, an analysis of the spatial distribution of squid catches during 2000-2007, and the results of a recent analysis of squid life history and stock structure.

Sharks – The Plan team recommended Tier 6 ABC (447 t) and OFL (596 t) for 2009 and 2010. The 2008 chapter has been updated with 2008 catch, life history information, and population demographic information. There are no changes to the assessment methodology. Although an 11 year timeline from 1997 to 2007 is used instead of a 9 year timeline from 1997 to 2005.

Sculpin – For the Tier 5 assessment in 2007, the authors applies distinct M estimates from the literature and species or species group biomass estimates for the five most predominate sculpin species/species groups. Since further life-history information has become available due to ongoing research, for the 2008 assessments 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; the Plan Team agreed with the authors in recommending that the "most conservative" (lowest) M estimate should be used for each species, and recommended that a review of the methods for calculating M be presented at the September 2009 Plan Team meeting. The total sculpin ABC and OFL for 2009 – 2010 under these per-species conservative M values is estimated to be to be 31,000 t and 41,600 t, respectively.

Octopus – The author states the octopus biomass estimate is not reliable and therefore does not support a Tier 5 assessment. The author also noted the Tier 6 estimate based on average catch likely underestimates the population and would unnecessarily constrain primarily the pot fishery for Pacific cod if octopus were managed as a single species group or if it were broken out into two groups external from the 'other species' category. At least seven species of octopus are found in the BSAI. The author recommended a revised Tier 6 based on recent average catch. Ongoing research includes species identification and discard mortality estimates. The Team recommended using a Tier 6 average for ABC 223 t and OFL 311 t calculation.

Skate – The authors modified five components in the 2008 age-structured model for Alaska skates to address SSC concerns from 2007: 1) the steepness of the Beverton-Holt stock-recruit relationship was fixed at 1.0; 2) the standard deviation of log recruitment was fixed at 0.4; 3) selectivity at age was modeled as a logistic function; 4) independent estimates of survey selectivity were incorporated; and 5) survey catchability was fixed at 1.0 and a logistic function for survey length selectivity was fixed so that the selectivity matched the results of an independent analysis of skate capture probability. In 2007 the SSC rejected the age structured model particularly due to concerns about the lack of fit of the model to survey biomass trends and growth. The Team accepted the revised model, as it did in 2007, with Alaska skates under Tier 3a. The Plan Team agreed with the authors' recommendation to continue to assess 'other skate' component within Tier 5.

Responses to SSC Comments

An analysis of the spatial distribution of squid catches from 2000 to 2007 was performed.

Possible use of a Richards growth function was explored in the skate assessment, but software limitations on admissible parameter values currently preclude incorporation of this functional form into the assessment. Other changes have improved the fit to length at age somewhat.

A likelihood profile analysis of σ_R was performed in the skate assessment.

Additional information on the duration of the egg case stage was included in the skate assessment.

Bounds on selectivity parameters were addressed in the skate assessment. No parameters reached the specified bounds.

The authors of the shark assessment concur with the SSC's determination that this assemblage should be managed under Tier 6.

Appendix 1: Grenadiers

An executive summary assessment of grenadier species is provided in Appendix 1. This assessment 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 trawl surveys. Although grenadier species are currently considered "non-specified" under both BSAI and GOA FMPs, the Team recommends that this complex be moved into a managed category so that separate specifications (such as region-specific ABCs and catches) can be established.

No management measures have been implemented for these species and no official catch statistics exist. However, catches have been estimated for 1997-2008 (through 10/03/2008) based upon data from the North Pacific Groundfish Observer Program. Average annual catches over this time period have been 2,901 t in the EBS, 2,244 t in the Aleutian Islands (AI), and 10,789 t in the GOA. Most of the catch occurs in longline and pot fisheries.

Biomass estimates (sampling to 1,000 m in GOA and to 1,200 m in EBS) were based on deep-water trawl surveys in each area and resulting in an estimated 488,414 t for the GOA and 518,778 t for the EBS. Two survey indices were used to indirectly estimate biomass in the AI (979,256 t). These values were then used to compute the OFLs and ABC values. Catches, particularly in EBS and AI, are much less than the ABCs so that conservation concerns are minimal at this time.

Recent data (collected by observers in 2007) on giant grenadier ages suggest a natural mortality rate of 0.078; the previous estimate was 0.074. This new study yielded an estimated maximum age of 58 years and also provided growth parameters in GOA giant grenadiers (female age- and size-at-50%-maturity were computed at 22.9 years and 26 cm pre-anal fin length, respectively). In 2007 the observers identified giant grenadiers to species and were able to provide data for these studies.

Appendix 2: Pacific Halibut Discard Mortality Rates

Halibut discard mortality rates (DMRs) are set by the Council on a 3-year cycle for non-CDQ fisheries based on an average of the past 10 years and annually for CDQ fisheries based on available data. Rates for non-CDQ fisheries for 2009 are included in rates previously adopted by the Council for use in 2007-2009. International Pacific Halibut Commission staff recommendations for DMRs for the BSAI CDQ fisheries for 2009 were reviewed by the BSAI Plan Team during its November 2008 meeting. The Team endorsed the IPHC recommendations for revised halibut DMRs for the CDQ fisheries. The Council is expected to adopt these rates for 2009 during its December 2008 meeting. In September 2009 the team will review the rates for the CDQ and non-CDQ fisheries for 2010-2012 based on the average discard mortality for the previous ten years for each sector. This will be repeated in 2012 for 2013-2015.

Recommended Pacific halibut discard mortality rates (DMRs) for 2009 CDQ fisheries.

Gear/Target	2008 Discard Mortality Rate	2009 Recommendation
Trawl		
Atka mackerel	**85**	**85**
Bottom pollock	**86**	**85**
Rockfish	**82**	**82**
Flathead sole	**87**	**84**
Pelagic pollock	**90**	**90**
Rock sole	**86**	**88**
Yellowfin sole	**84**	**84**
Pot		
Sablefish	**35**	**34**
Longline		
Pacific cod	**10**	**10**
Turbot	**4**	**4**

Table 1. Bering Sea Aleutian Islands Groundfish Plan Team OFL and ABC Recommendations for the 2009-2010 Fisheries

Species	Area	2008				2009			2010		
		OF	ABC	TAC	Catch	OF	ABC	TAC	OF	ABC	TAC
Pollock	EBS	1,440,000	1,000,000	1,000,000	989,895	977,000	815,000		1,430,000	1,230,000	
	AI	34,000	28,200	19,000	1,282	32,600	15,300		36,800	15,300	
	Bogoslof	58,400	7,970	109		58,400	7,970		58,400	7,970	
Pacific cod	BSA	207,000	176,000	170,727	165,478	212,000	176,000		235,000	176,000	
Sablefish	BS	3,380	2,860	2,860	1,087	3,210	2,720		2,980	2,520	
	AI	2,890	2,440	2,440	880	2,600	2,200		2,410	2,040	
Atka mackerel	Total	71,400	60,700	60,700	58,471	99,400	83,800		84,400	71,100	
	EAI/BS		19,500	19,500	19,471		27,000			22,900	
	CAI		24,300	24,300	22,350		33,500			28,500	
	WAI		16,900	16,900	16,640		23,300			19,700	
Yellowfin sole	BSA	265,000	248,000	225,000	141,432	224,000	210,000		210,000	198,000	
Northern rock sole	BSA	304,000	301,000	75,000	51,061	301,000	296,000		314,000	310,000	
Greenland turbot	Total	15,600	2,540	2,540	2,727	14,800	7,380		14,400	7,130	
	BS		1,750	1,750	1,907		3,090			2,920	
	AI		790	790	822		2,290			2,210	
Arrowtooth flounder	BSA	297,000	244,000	75,000	21,410	190,000	156,000		196,000	161,000	
Flathead sole	BSA	86,000	71,700	50,000	24,237	83,800	71,400		81,800	69,800	
Other flatfish	BSA	28,800	21,600	21,600	3,610	23,100	17,400		23,100	17,400	
Alaska plaice	BSA	248,000	194,000	50,000	19,426	298,000	232,000		354,000	275,000	
Pacific Ocean perch	BSA	25,700	21,700	21,700	17,447	22,300	18,800		22,100	18,600	
	BS		4,200	4,200	513		3,820			3,780	
	EAI		4,900	4,900	4,694		4,200			4,160	
	CAI		4,990	4,990	4,817		4,260			4,210	
	WAI		7,610	7,610	7,417		6,520			6,450	
Northern rockfish	BSA	9,740	8,180	8,180	3,297	8,540	7,160		8,580	7,190	
Shortraker	BSA	564	424	424	151	516	387		516	387	
Blackspotted/ Roughey	BSA	269	202	202	207	660	539		640	552	
Other rockfish	BSA	1,330	999	999	586	1,420	1,040		1,420	1,040	
	BS		414	414	199		485			485	
	AI		585	585	387		555			555	
Squid	BSA	2,620	1,970	1,970	1,540	2,620	1,970		2,620	1,970	
Other species	BSA	104,000	78,100	50,000	28,482	80,800	63,700		80,700	63,700	
Total	BSA	3,205,693	2,472,583	1,838,345	1,532,719	2,636,766	2,186,766		3,159,866	2,636,699	

2008 catches through November 8 from AKR Catch Accounting including CDQ.

Notes: Other rockfish exludes dark rockfish, pending Secretarial approval of BSAI Amendment 77 (add 30 t to AI to get total other rockfish ABC of 555 t).

Table 2. Groundfish catches (metric tons) in the eastern Bering Sea, 1954-2008.

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				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	180,592	1,039	81,050	2,565	13,667	36,375	17,507	10,118	1,391					336	6,362	1,246	26,986	1,871,273
2004	1,480,543	183,283	1,038	75,501	1,805	17,327	47,862	22,109	7,888		731	116	119	24	318	7,157	1,000	27,493	1,874,315
2005	1,483,274	182,797	1,075	94,382	2,120	13,404	36,814	20,640	11,194		879	112	108	12	178	3,538	1,168	28,041	1,879,735
2006	1,486,413	167,725	1,055	99,064	1,440	11,852	35,874	21,029	17,309		1,039	246	46	7	157	3,170	1,401	24,627	1,872,455
2007	1,354,109	139,579	1,173	121,027	1,317	10,862	36,007	24,525	19,426		872	69	113	10	218	3,021	1,175	24,393	1,737,896
2008/d	989,926	134,937	1,088	141,431	1,905	18,924	50,731	27,791	16,665		513	23	51	27	201	361	1,494	26,086	1,412,154

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 statisti Note: Numbers don't include fish taken for research.
d/ Data through November 8, 2008.

Table 3. Groundfish catches (metric tons) in the Aleutian Islands, 1954-2008.

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	22,627	1,475	2	439	829	548	59	0		9,548	3,852	61	78	286	58,474	17	1,401	101,315
2006	1,735	24,181	1,130	4	525	1,450	578	75	0		11,817	3,577	162	196	422	58,708	15	1,935	106,510
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/d	1,282	30,540	880	0	822	2,513	342	64	0		16,927	3,267	100	180	387	57,720	49	2,264	117,337

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 statist Note: Numbers don't include fish taken for research.
d/ Data through November 8, 2008.

Table 4. Groundfish catches (metric tons) in the Bering Sea and Aleutian Islands, 1954-2008.

Year	Pollock	Pacific Cod	Sable Fish	Yellowfin Sole	Greenland Turbot	Arrowtooth Flounder/a	Rock Sole/c	Flathead Sole	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	na	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	na	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	na	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	na	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	na	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	na	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	na	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	na	30,379	0	15,854	0	0	0	0	952	45,294	1,344	28,619	1,937,386
2003	1,493,692	212,785	2,048	81,050	3,530	14,580	37,339	na	17,583	10,118	20,156	0	0	0	0	737	59,350	1,282	28,312	1,982,562
2004	1,481,701	212,152	1,993	75,510	2,219	18,133	48,680	na	22,180	7,888		11,896	4,684	240	208	655	60,562	1,014	29,344	1,979,058
2005	1,484,895	205,424	2,550	94,384	2,559	14,233	37,361	na	20,699	11,194		10,426	3,964	169	90	464	62,012	1,185	29,442	1,981,050
2006	1,488,148	191,906	2,185	99,068	1,965	13,302	36,452	na	21,104	17,309		12,856	3,823	208	203	579	61,878	1,416	26,562	1,978,964
2007	1,356,628	173,624	2,322	121,029	1,839	11,697	36,770	na	24,586	19,426		18,470	4,021	323	167	651	58,831	1,188	26,443	1,858,015
2008/d	991,208	165,477	1,968	141,431	2,727	21,437	51,073	na	27,855	16,665		17,440	3,290	151	207	588	58,081	1,543	28,350	1,529,491

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 8, 2008.
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 2009 and 2010. "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.

Species or Complex	Area	2009					2010			
		Biomass	OFL	ABC	F_{OFL}	F_{ABC}	OFL	ABC	F_{OFL}	F_{ABC}
Pollock	EBS	6,240,000	977,000	815,000	0.29	0.25	1,430,000	1,230,000	0.29	0.25
	Aleutian Islands	266,000	32,600	15,300	0.36		36,800	15,300	0.38	
	Bogoslof District	292,000	58,400	7,970	0.02	0.017	58,400	7,970	0.02	0.017
Pacific cod	BSAI	1,260,000	212,000	176,000	0.29	0.24	235,000	176,000	0.29	0.24
Sablefish	BS	39,000	3,210	2,720	0.11	0.10	2,980	2,520	0.11	0.10
	AI	28,000	2,600	2,200	0.11	0.10	2,410	2,040	0.11	0.10
Atka mackerel	Total	411,000	99,400	83,800	0.48	0.39	84,400	71,100	0.48	0.39
Yellowfin sole	BSAI	1,870,000	224,000	210,000	0.13	0.12	213,000	200,000	0.13	0.12
Greenland turbot	Total	105,000	14,800	7,380	0.57	0.46	14,400	7,130	0.57	0.46
Arrowtooth flounder	BSAI	1,140,000	190,000	156,000	0.29	0.24	196,000	161,000	0.29	0.24
Northern rock sole	BSAI	1,630,000	301,000	296,000	0.18	0.18	314,000	310,000	0.18	0.18
Flathead sole	BSAI	834,000	83,800	71,400	0.34	0.28	81,800	69,800	0.34	0.28
Alaska plaice	BSAI	1,500,000	298,000	232,000	0.86	0.62	354,000	275,000	0.86	0.62
Other flatfish	BSAI	121,000	23,100	17,400	.17/.085/.20	.13/.06/.15	23,100	17,400	.17/.085/.2	.13/.06/.15
Pacific Ocean perch	BSAI	402,000	22,300	18,800	0.068	0.057	22,100	18,600	0.068	0.057
Northern rockfish	BSAI	200,000	8,540	7,160	0.051	0.043	8,580	7,190	0.051	0.043
Shortraker	BSAI	17,200	516	387	0.030	0.023	516	387	0.03	0.023
Roughey	BSAI	19,000	660	539	0.047	0.038	640	552	0.047	0.038
Other rockfish	BSAI	39,700	1,420	1,040	.03/.09	.023/.068	1,420	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	822,000	80,800	66,700			80,700	63,700		
Total	BSAI	17,235,900	2,636,766	2,189,766			3,162,866	2,638,699		

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 maximum permissible value of ABC (max ABC), the Plan Team's recommended ABC, and the percentage reduction (% Red.) between max ABC and the Plan Team's recommended ABC for 2009-2010. Stock-specific max ABC and ABC are in metric tons, reported to three significant digits (four significant 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.

Species or Complex	Area	2009						2010					
		Tier	max F_{ABC}	F_{ABC}	max ABC	ABC	% Red.	Tier	max	F_{ABC}	max ABC	ABC	% Red.
Pollock	Aleutian Islands	3a	0.29		26,900	15,300	43%	3a	0.31		22,000	15,300	30%
Pollock	Bogoslof District	5	0.017	0.017	43,800	7,970	82%	5	0.017	0.017	43,800	7,970	82%
Pacific cod	BSAI	3b	0.24	0.24	182,000	176,000	3%	3b	0.24	0.24	199,000	176,000	12%
Greenland turbot	Total	3a	0.46	0.46	11,900	7,380	38%	3a	0.46	0.46	10,800	7,130	34%