APPENDIX B

STOCK ASSESSMENT AND FISHERY EVALUATION REPORT

FOR THE GROUNDFISH RESOURCES
OF THE GULF OF ALASKA

Compiled by

The Plan Team for the Groundfish Fisheries of the Gulf of Alaska

Gulf of Alaska

with contributions by

T. A'mar, J. Armstrong, K. Aydin, E. Conners, C. Conrath, M. Dalton, O. Davis, M. Dorn, K. Echave, C. Faunce, N. Friday, K. Green, D. Hanselman, J. Heifetz, P. Hulson, J. Ianelli, D. Jones, M. Jaenicke, A. Kingham, K. V. Kirk, S. Lowe, C. Lunsford, A. McCarthy, C. McGilliard, S. Meyer, R. Narita, D. Nichol, O. Ormseth, W. Palsson, C. Rodgveller, J. Rumble, K. Shotwell, L. Slater, K. Spalinger, P. Spencer, I. Spies, J. Stahl, I. Stewart, M. Stichert, W. Stockhausen, D. Stram, T. TenBrink, C. Tribuzio, J. Turnock, T. Wilderbuer

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Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Gulf of Alaska

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Summary

by

The Plan Team for the Groundfish Fisheries of the Gulf of Alaska

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 reports are intended to summarize the best available scientific information concerning the past, present, and possible future condition of the stocks and fisheries under federal management. The FMPs for the groundfish fisheries managed by the Council require that drafts of the SAFE reports be produced each year in time for the December North Pacific Fishery Management Council (Council) meetings.

The SAFE report for the Gulf of Alaska (GOA) groundfish fisheries is compiled by the Plan Team for the Gulf of Alaska Groundfish FMP from chapters contributed by scientists at NMFS Alaska Fisheries Science Center (AFSC) and the Alaska Department of Fish and Game (ADF&G). The stock assessment section includes recommended acceptable biological catch (ABC) levels for each stock and stock complex managed under the FMP. The ABC recommendations, together with social and economic factors, are considered by the Council in determining total allowable catches (TACs) and other management strategies for the fisheries.

The GOA Groundfish Plan Team met in Seattle on November 16-20, 2015 to review the status of stocks of twenty three species or species groups that are managed under the FMP. The Plan Team review was based on presentations by ADF&G and NMFS AFSC scientists with opportunity for public comment and input. Members of the Plan Team who compiled the SAFE report were James Ianelli (co-chair), Jon Heifetz (co-chair), Craig Faunce, Sandra Lowe, Chris Lunsford, Jon Heifetz, Kristen Green, Janet Rumble, Mark Stichart, Mike Dalton, Nancy Friday, Ian Stewart, Paul Spencer, Jim Armstrong, Obren Davis, and Leslie Slater.

Management Areas and Species

The Gulf of Alaska (GOA) management area lies within the 200-mile U.S. Exclusive Economic Zone (EEZ) of the United States (Fig. 1). Formerly, five categories of finfishes and invertebrates were designated for management purposes: target species, other species, prohibited species, forage fish species and non-specified species. Effective for the 2011 fisheries, these categories have been revised in Amendments 96 and 87 to the FMPs for Groundfish of the Bering Sea/Aleutian Islands (BSAI) and Gulf of Alaska (GOA), respectively. This action was necessary to comply with requirements of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) to prevent overfishing, achieve optimum yield, and to comply with statutory requirements for annual catch limits (ACLs) and accountability measures (AMs). Species and species groups must be identified "in the fishery" for which ACLs and AMs are required. An ecosystem component (EC) is also included in the FMPs for species and species groups that are not:
1) targeted for harvest
2) likely to become overfished or subject to overfishing, and
3) generally retained for sale or personal use.

The effects of the action amended the GOA and BSAI groundfish FMPs to:
1) identify and manage target groundfish stocks "in the fishery"
2) eliminate the "other species" category and manage (GOA) squids, (BSAI and GOA) sculpins, (BSAI and GOA) sharks, and (BSAI and GOA) octopuses separately "in the fishery";
3) manage prohibited species and forage fish species in the ecosystem component category; and
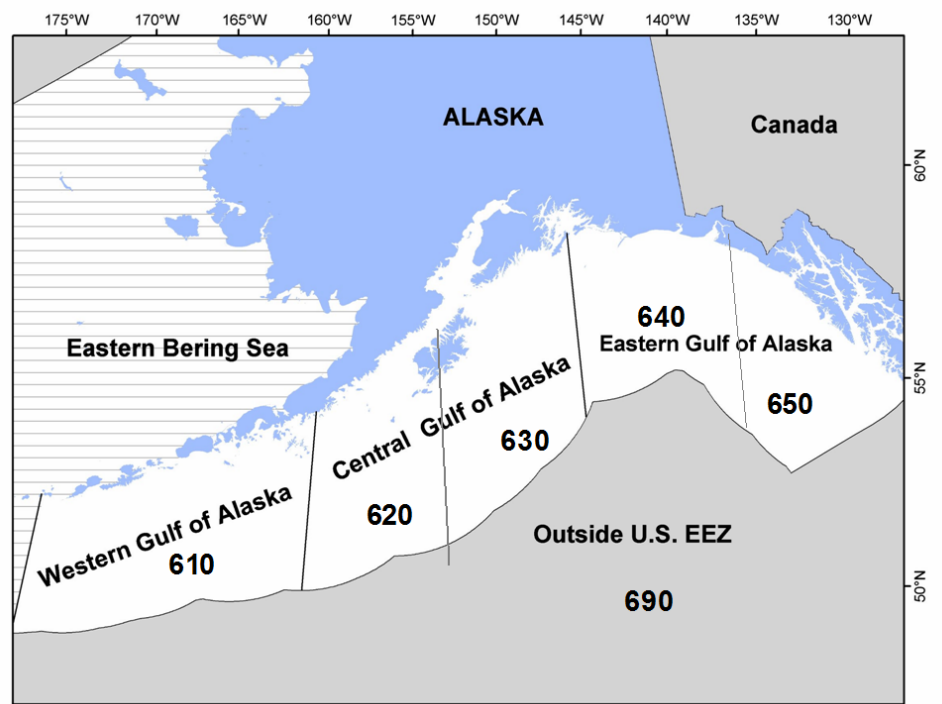4) remove the non-specified species outside of the FMPs.

Figure 1.   Gulf of Alaska statistical and reporting areas.

Species may be split or combined within the "target species" category according to procedures set forth in the FMP. The three categories of finfishes and invertebrates that have been designated for management purposes are listed below.

In the Fishery:

1) Target species – are those species that support a single species or mixed species target fishery, are commercially important, and for which a sufficient data base exists that allows each to be managed on its own biological merits. Accordingly, a specific total allowable catch (TAC) is established annually for each target species or species assemblage. Catch of each species must be recorded and reported. This category includes walleye pollock, Pacific cod, sablefish, shallow and deep water flatfish, northern and southern rock sole, rex sole, flathead sole, arrowtooth flounder, Pacific ocean perch, shortraker rockfish, rougheye/blackspotted rockfish, northern rockfish, "other" rockfish, dusky rockfish, demersal shelf rockfish, thornyhead rockfish, Atka mackerel, squid, sculpin, sharks, octopus, big skates, longnose skates, and other skates.

Ecosystem Component:

2) Prohibited Species–are those species and species groups the catch of which must be avoided while fishing for groundfish, and which must be immediately returned to sea with a minimum of injury except when their retention is authorized by other applicable law. Groundfish species and species groups under the FMP for which the quotas have been achieved shall be treated in the same manner as prohibited species.

3) Forage fish species–are those species listed in the table below, which are a critical food source for many marine mammal, seabird and fish species. The forage fish species category is established to allow for the management of these species in a manner that prevents the development of a commercial directed fishery for forage fish. Management measures for this

species category will be specified in regulations. These may include measures prohibiting directed fishing, limiting allowable bycatch retention, or limiting commercial exchange and the processing of forage fish in a commercial facility.

4) <u>Grenadiers</u> – The grenadier complex (family Macrouridae), also known as "rattails", are comprised of at least seven species of grenadier known to occur in Alaskan waters, but only three are commonly found at depths shallow enough to be encountered in commercial fishing operations or in fish surveys: giant grenadier (*Albatrossia pectoralis*), Pacific grenadier (*Coryphaenoides acrolepis*), and popeye grenadier (*Coryphaenoides cinereus*).

The following lists the GOA stocks within these FMP species categories:

In the Fishery	
Target Species[1]	Walleye pollock, Pacific cod, Sablefish, Flatfish (shallow-water flatfish, deep-water flatfish, northern and southern rock sole, rex sole, flathead sole, arrowtooth flounder), Rockfish (Pacific ocean perch, northern rockfish, shortraker rockfish, rougheye/blackspotted rockfish, other rockfish, dusky rockfish, demersal shelf rockfish[3], thornyhead rockfish), Atka mackerel, Skates (big skates, longnose skates, and other skates), Squids, Sculpins, Sharks, Octopus
Ecosystem Component	
Prohibited Species[2]	Pacific halibut, Pacific herring, Pacific salmon, Steelhead trout, King crab, Tanner crab
Forage Fish Species[4]	Osmeridae family (eulachon, capelin, and other smelts), Myctophidae family (lanternfishes), Bathylagidae family (deep-sea smelts), Ammodytidae family (Pacific sand lance), Trichodontidae family (Pacific sand fish), Pholidae family (gunnels), Stichaeidae family (pricklebacks, warbonnets, eelblennys, cockscombs, and shannys), Gonostomatidae family (bristlemouths, lightfishes, and anglemouths), Order Euphausiacea (krill)
Grenadiers[5]	Macrouridae family (grenadiers)

[1] TAC for each listing. Species and species groups may or may not be targets of directed fisheries
[2] Must be immediately returned to the sea
[3] Management delegated to the State of Alaska
[4] Management measures for forage fish which are an Ecosystem Component are established in regulations implementing the FMP
[5] The grenadier complex was added to both FMPs as an Ecosystem Component in 2014

This SAFE report describes stock status of target and non-target species in the fishery. Amendments 100/91 added grenadiers to the GOA and BSAI FMPs as an Ecosystem Component in 2014.

A species or species group from within the fishery category may be split out and assigned an appropriate harvest level. Similarly, species in the fishery category may be combined and a single harvest level assigned to the new aggregate species group. The harvest level for demersal shelf rockfish in the Eastern Regulatory Area is specified by the Council each year. However, management of this fishery is deferred to the State of Alaska with Council oversight.

The GOA FMP recognizes single species and species complex management strategies. Single species specifications are set for stocks individually, recognizing that different harvesting sectors catch an array of species. In the Gulf of Alaska these species include pollock, Pacific cod, sablefish, Pacific ocean perch, flathead sole, rex sole, arrowtooth flounder, northern rockfish, shortraker rockfish, dusky rockfish, Atka mackerel, big skates, and longnose skates. Other groundfish species that are usually caught in groups have been managed as complexes (also called assemblages). For example, other rockfish, rougheye and blackspotted rockfish, demersal shelf rockfish, thornyhead rockfish, deep water flatfish, shallow water flatfish, and other skates have been managed as complexes.

Beginning in 2011, squids, sculpins, octopus, and sharks are managed as individual complexes (previously they were managed as "other species"). Also in 2011, the rockfish categories were reorganized: widow and yellowtail rockfish were removed from the pelagic shelf rockfish complex leaving dusky rockfish as a single species category. Widow and yellowtail rockfish were added to the 15 species that were part of the former "other slope" rockfish group to form a new category in the Gulf of Alaska, "other rockfish". Previously, yellowtail and widow rockfish were part of the "pelagic shelf" rockfish group in the Gulf of Alaska, which no longer exists (for assessment purposes) since 2012. Both shortraker rockfish and "other rockfish" were presented as separate SAFE chapters in 2013. Separating these two chapters responds to recommendations from the Gulf of Alaska Plan Team and the NPFMC Scientific and Statistical Committee.

The FMP authorizes splitting species, or groups of species, from the complexes for purposes of promoting the goals and objectives of the FMP. Atka mackerel was split out from "other species" beginning in 1994. In 1998, black and blue rockfish were removed from the GOA FMP and management was conferred to the ADF&G. In 2008, dark rockfish were similarly removed from the GOA FMP with sole management taken over by the ADF&G. Beginning in 1999, osmerids (eulachon, capelin and other smelts) were removed from the "other species" category and placed in a separate forage fish category. In 2004, Amendment 63 to the FMP was approved which moved skates from the other species category into a target species category whereby individual OFLs and ABCs for skate species and complexes could be established.

Groundfish catches are managed against TAC specifications for the EEZ and near coastal waters of the GOA. State of Alaska internal water groundfish populations are typically not covered by NMFS surveys and catches from internal water fisheries generally not counted against the TAC. The Team has recommended that these catches represent fish outside of the assessed region, and should not be counted against an ABC or TAC. Beginning in 2000, the pollock assessment incorporated the ADF&G survey pollock biomass, therefore, the Plan Team acknowledged that it is appropriate to reduce the Western (W), Central (C) and West Yakutat (WY) combined GOA pollock ABC by the anticipated Prince William Sound (PWS) harvest level for the State fishery. The 2001 through 2016 W/C/WY pollock ABCs have been reduced by the PWS GHL as provided by ADF&G, before area apportionments were made. At the 2012 September Plan Team meeting, ADFG presented a proposal to set the PWS GHL in future years as a fixed percentage of the W/C/WY pollock ABC of 2.5%. That value is the midpoint between the 2001-2010 average GHL percentage of the GOA ABC (2.44%) and the 1996 and 2012 levels (2.55%). The Plan Team accepted this proposal, but noted concern regarding the lack of a biomass-based allocation in PWS. The Team continues to encourage the State to work with the AFSC in order to provide a biomass-based evaluation for PWS prior to fixing a percentage in regulation. In the interim, the Plan Team will deduct a value for the 2016 and 2017 PWS GHL (equal to 2.5% of the recommended 2016 and 2017 W/C/WY pollock ABCs) from the recommended 2016 and 2017 W/C/WY pollock ABCs (listed in the summary table), before area apportionments are made. It is important to note that the value of the PWS GHL is dependent on the final specified W/C/WY pollock ABC. The values used by the Plan Team to derive the 2016 and 2017 W/C/WY pollock apportioned ABCs are listed in the pollock summary under *Area apportionment*.

The Plan Team has provided subarea ABC recommendations on a case-by-case basis since 1998 based on the following rationale. The Plan Team recommended splitting the EGOA ABC for species/complexes that would be disproportionately harvested from the West Yakutat area by trawl gear. The Team did not split EGOA ABCs for species that were prosecuted by multi-gear fisheries or harvested as bycatch. For those species where a subarea ABC split was deemed appropriate, two approaches were examined. The point estimate for WY biomass distribution based on survey results was recommended for seven species/complexes to determine the WY and East Yakutat/Southeast Outside subarea ABC splits. For some species/complexes, a range was recommended bounded by the point estimate and the upper end of the 95% confidence limit from all three surveys. The rationale for providing a range was based on a desire to incorporate the variance surrounding the distribution of biomass for those species/complexes that could potentially be constrained by the recommended ABC splits.

No Split	Split, Point Estimate	Split, Upper 95% Cl
Pacific cod	Pollock	Pacific ocean perch
Atka mackerel	Sablefish	Dusky rockfish
Shortraker rockfish	Deep-water flatfish	
Rougheye/blackspotted rockfish	Shallow-water flatfish	
Thornyhead	Rex sole	
Northern rockfish	Arrowtooth flounder	
Demersal shelf rockfish	Flathead sole	
All skates	Other rockfish	

Biological Reference Points

A number of biological reference points are used in this SAFE. 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 GOA Groundfish FMP, approved by the Council in June 1998, defines ABC and OFL for the GOA 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 stock 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 $F=F_{40\%}$.

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*
        $ABC \leq 0.75 \times OFL$

<u>Overfished or approaching an overfished condition</u> 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 2015 or 2) above ½ of its MSY level in 2015 and above its MSY level in 2025 under this scenario, then the stock is not overfished.)

Approaching an overfished condition (listed in each assessment as scenario 7):
    In 2016 and 2017, 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 1) above its MSY level in 2017 or 2) above 1/2 of its MSY level in 2017 and expected to be above its MSY level in 2027 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.

Overview of Stock Assessments

The status of individual groundfish stocks managed under the FMP is summarized in this section. The abundances of pollock, Pacific cod, Dover sole, flathead sole, northern and southern rock sole, arrowtooth flounder, Pacific ocean perch, rougheye and blackspotted rockfish, northern rockfish, and dusky rockfish are above target stock size (Fig. 2). The abundance of sablefish is below target stock size. The target biomass levels for deep-water flatfish (excluding Dover sole), shallow-water flatfish (excluding northern and southern rocksole), rex sole, shortraker rockfish, other rockfish, demersal shelf rockfish, thornyhead rockfish, Atka mackerel, skates, sculpins, squid, octopus, and sharks are unknown.
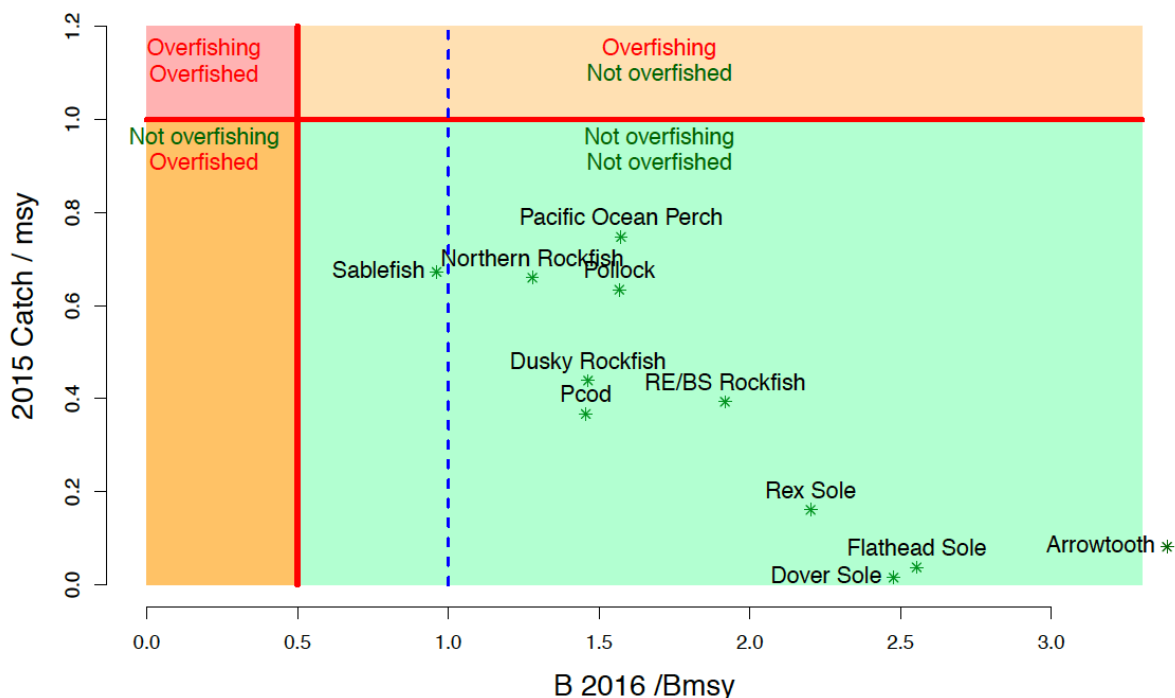
Figure 2.   Summary of Gulf of Alaska stock status next year (spawning biomass relative to B_{msy}; horizontal axis) and current year catch relative to fishing at F_{msy} (vertical axis).

Summary and Use of Terms

Tables 1 and 2 provide a summary of the status of the groundfish stocks, including catch statistics, ABCs, and TACs for 2015, and recommendations for ABCs and overfishing levels (OFLs) for 2016 and 2017. Fishing mortality rates (*F*) and OFLs used to set these specifications are listed in Table 3. ABCs and TACs are specified for each of the Gulf of Alaska regulatory areas illustrated in Figure 1. Table 4 provides a list of species for which the ABC recommendations are below the maximum permissible. Table 5 provides historical groundfish catches in the GOA, 1956-2015.

The sums of the preliminary 2016 and 2017 ABCs for target species are 728,769 and 709,714 t respectively which are within the FMP-approved optimum yield (OY) of 116,000 - 800,000 t for the Gulf of Alaska. The sums of the 2016 and 2017 OFLs are 894,412 and 817,323 t, respectively. The Team notes that because of halibut bycatch mortality considerations in the high-biomass flatfish fisheries, an overall OY for 2016 will be considerably under this upper limit. For perspective, the sum of the 2015 TACs was 536,158

t, and the sum of the ABCs was 685,597 t (and catch through November 7th, 2015 was just below 290,000 t).

The following conventions in this SAFE are used:

1) "Fishing mortality rate" refers to the full-selection F (i.e., the rate that applies to fish of fully selected sizes or ages). A full-selection F should be interpreted in the context of the selectivity schedule to which it applies.

2) For consistency and comparability, "exploitable biomass" refers to projected age+ biomass, which is the total biomass of all cohorts greater than or equal to some minimum age. The minimum age varies from species to species and generally corresponds to the age of recruitment listed in the stock assessment. Trawl survey data may be used as a proxy for age+ biomass. The minimum age (or size), and the source of the exploitable biomass values are defined in the summaries. These values of exploitable biomass may differ from listed in the corresponding stock assessments if the technical definition is used (which requires multiplying biomass at age by selectivity at age and summing over all ages). In those models assuming knife-edge recruitment, age+ biomass and the technical definitions of exploitable biomass are equivalent.

(3) The values listed as 2014 and 2015 ABCs correspond to the values (in metric tons, abbreviated "t") approved by NMFS. The Council TAC recommendations for pollock were modified to accommodate revised area apportionments in the measures implemented by NMFS to mitigate pollock fishery interactions with Steller sea lions and for Pacific cod removals by the State water fishery of not more than 25% of the Federal TAC. The values listed for 2016 and 2017 correspond to the Plan Team recommendations.

(4) The exploitable biomass for 2014 and 2015 that are reported in the following summaries were estimated by the assessments in *those* years. Comparisons of the projected 2016 biomass with previous years' levels should be made with biomass levels from the revised hindcast reported in each assessment.

(5) The catches listed in the following summary tables are those reported by the Alaska Regional Office Catch Accounting System (alaskafisheries.noaa.gov/sustainablefisheries/catchstats.htm) unless otherwise noted.

(6) The values used for 2016 and 2017 were either updated directly with new survey data (typically for Tiers 4-6), or based on updated model projections including new survey data. Note that projection values often assume catches and hence their values are likely to change (as are the Tiers 4-6 numbers when new data become available).

Two year OFL and ABC Determinations

Amendment 48/48 to the GOA and 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 rockfish, flatfish, and Atka mackerel since new data during years when no groundfish surveys are conducted are limited. Full assessments were provided in 2015 to coincide with new survey data available from the 2015 GOA trawl and longline surveys.

The second significant change is that the proposed and final specifications are for a period of at least two years. This requires providing ABC and OFL levels for 2016 and 2017 (Table 1). In the case of stocks managed under Tier 3 and for which a modified assessments was produced, 2016 and 2017 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 total year catch levels. For stocks managed under Tiers 4 and 5, the latest survey data (2015) was used. Tier 6 stocks may have alternatives based on updated catch information.

The 2017 ABC and OFL values recommended in next year's SAFE report are likely to differ from this year's projections for 2017 because data from the 2017 surveys are anticipated and a re-evaluation on the status of stocks will improve on the current available information for recommendations.

Economic Summary of the GOA commercial groundfish fisheries in 2013-14

The ex-vessel value of all Alaska domestic fish and shellfish catch, including the estimated value of fish caught almost exclusively by catcher/processors, decreased from $1950.6 million in 2013 to $1845.8 million in 2014. The first wholesale value of 2014 groundfish catch was $2345.6 million. The 2014 total groundfish catch increased by 4.2% and the total first-wholesale value increased by 7.6% relative to 2013.

The groundfish fisheries accounted for the largest share (50.8%) of the ex-vessel value of all commercial fisheries off Alaska, while the Pacific salmon (*Oncorhynchus spp.*) fishery was second with $546.0 million or 29.6% of the total Alaska ex-vessel value. The value of the shellfish fishery amounted to $244.1 million or 13.2% of the total for Alaska and exceeded the value of Pacific halibut (*Hippoglossus stenolepis*) with $106.7 million or 5.8% of the total for Alaska.

The Economic SAFE report (appendix bound separately) contains detailed information about economic aspects of the groundfish fisheries, including figures and tables, catch share fishery indicators, product price forecasts, a summary of the Alaskan community participation in fisheries, an Amendment 80 fishery economic data report (EDR) summary, market profiles for the most commercially valuable species, a summary of the relevant research being undertaken by the Economic and Social Sciences Research Program (ESSRP) at the Alaska Fisheries Science Center (AFSC) and a list of recent publications by ESSRP analysts. The figures and tables in the report provide estimates of total groundfish catch, groundfish discards and discard rates, prohibited species catch (PSC) and PSC rates, the ex-vessel value of the groundfish catch, the ex-vessel value of the catch in other Alaska fisheries, the gross product value of the resulting groundfish seafood products, the number and sizes of vessels that participated in the groundfish fisheries off Alaska, vessel activity, and employment on at-sea processors. Generally, the data presented in this report cover the years 2010 through 2014, but limited catch and ex-vessel value data are reported for earlier years in order to illustrate the rapid development of the domestic groundfish fishery in the 1980s and to provide a more complete historical perspective on catch. Several series were discontinued and new price/revenue tables from an alternative source are presented in Appendix A: Ex-vessel Economic Data Tables: alternative pricing based on CFEC fish tickets.

The Economic SAFE report updates the data associated with the market profiles for pollock, Pacific cod, sablefish, and yellowfin sole that display the markets for these species in terms of pricing, volume, supply and demand, and trade. In addition, the Economic SAFE contains links to data on some of the external factors that impact the economic status of the fisheries. Such factors include foreign exchange rates, the prices, and price indices, of products that compete with products from these fisheries, domestic per capita consumption of seafood products, and fishery imports.

The Economic SAFE report also updates a section that analyzes economic performance of the groundfish fisheries using indices. These indices are created for different sectors of the North Pacific, and relate changes in value, price, and quantity across species, product, and gear types to aggregate changes in the market. The data behind the tables from this and past Economic SAFE reports are available online at http://www.afsc.noaa.gov/refm/Socioeconomics/SAFE/default.php.

Decomposition of the change in first-wholesale revenues from 2013-14 in the GOA

The following brief analysis summarizes the overall changes that occurred between 2013-14 in the quantity produced and revenue generated from GOA groundfish. According to data reported in the 2015 Economic SAFE report, the ex-vessel value of GOA groundfish increased from $181.0 million in 2013 to $207.6 million in 2014 (Figure 3), and first-wholesale revenues from the processing and production of groundfish in the Gulf of Alaska (GOA) grew from $329.3 million in 2013 to $387.9 million in 2014, an increase of 17.8% (Figure 4). At the same time, the total quantity of groundfish products from the GOA increased from 99.4 thousand metric tons to 131.1 thousand metric tons, a difference of 31.7 thousand metric tons. These changes in the GOA account for part of the change in first-wholesale revenues from Alaska groundfish fisheries overall which increased by $165.1 million, a relative difference of 7.6%, in 2014 compared to 2013 levels.
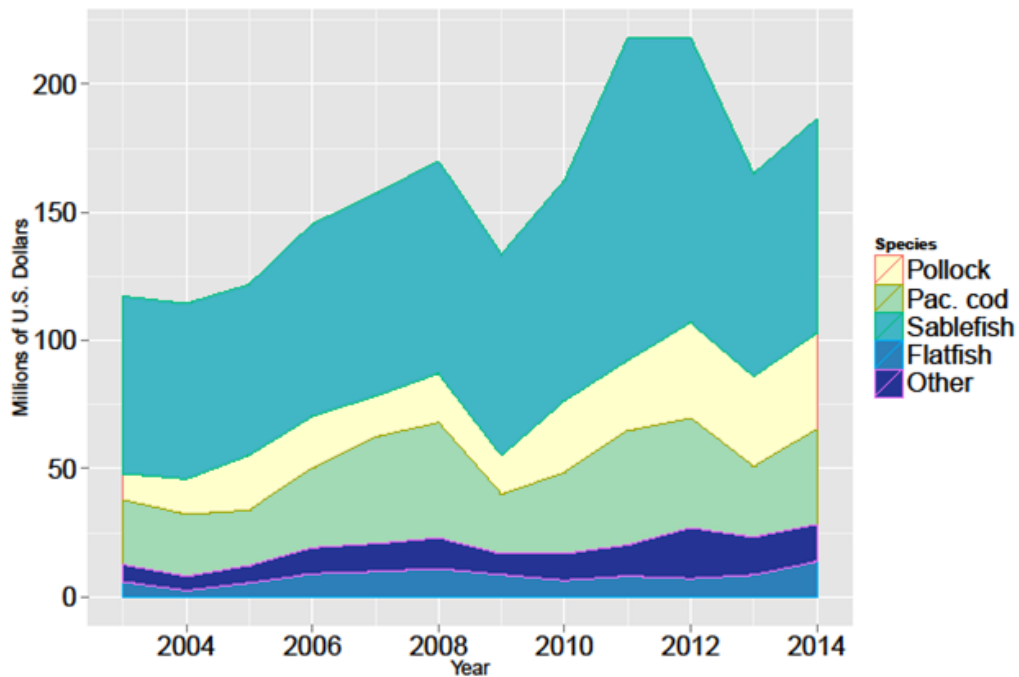
Figure 3. Real ex-vessel value of the groundfish catch in the domestic commercial fisheries in the GOA area by species, 2003-2014 (base year = 2014).
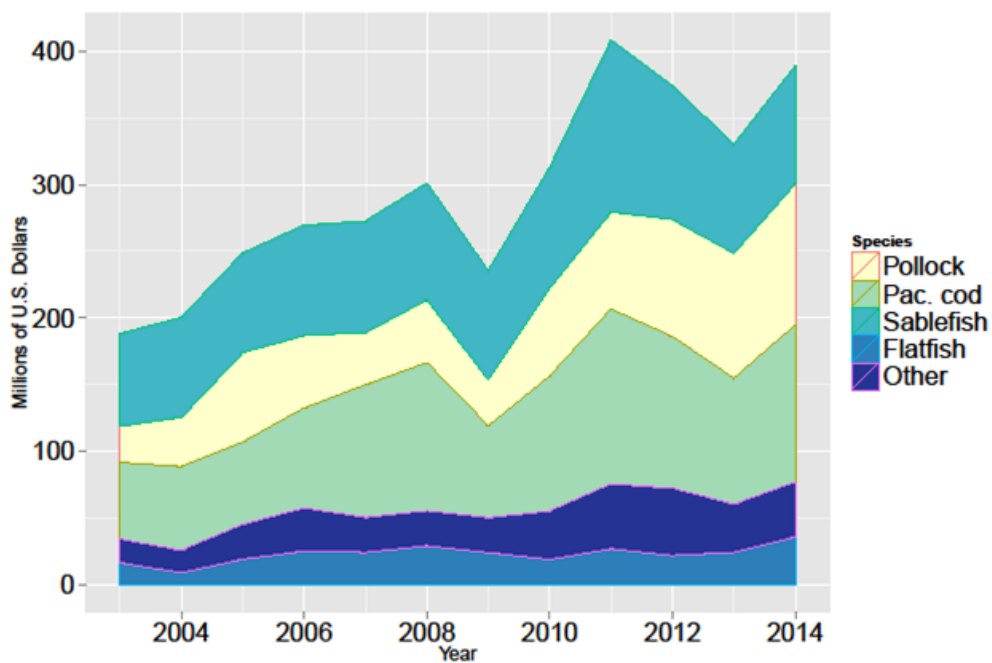
Figure 4. Real gross product value of the groundfish catch in the GOA area by species, 2003-2014 (base year = 2014).

By species group, a positive price and quantity effects combined for a net effect of $23.9 million for cod which was the largest change in first-wholesale revenues from the GOA for 2013-14 Figure 5). Pollock experienced a large quantity effect of $34.3 million, but that effect was mostly offset by a negative price effect of $22.2 million, and the net effect for pollock was $12.1 million, which was only slightly higher than the net effect for flatfish. For sablefish, a relatively strong price effect of $16.9 million exceeded the negative price effect of $9.6 million for a positive net effect of $7.2 million. By product group, positive price and quantity effects were concentrated in the whole head & gut category in the GOA first-wholesale revenue decomposition for 2013-14.

In summary, first-wholesale revenues from the GOA groundfish fisheries increased by $58.6 million from 2013-14. The main driver of this increase was positive quantity effects for pollock, cod, and to a lesser degree, flatfish. These positive quantity effects were highest in the head & gut product group though fillets, roe, and surimi also contributed. In comparison, first-wholesale revenues increased by $106.5 million from 2013-14 in the BSAI due to a large quantity effect for pollock, and a large price effect for cod.
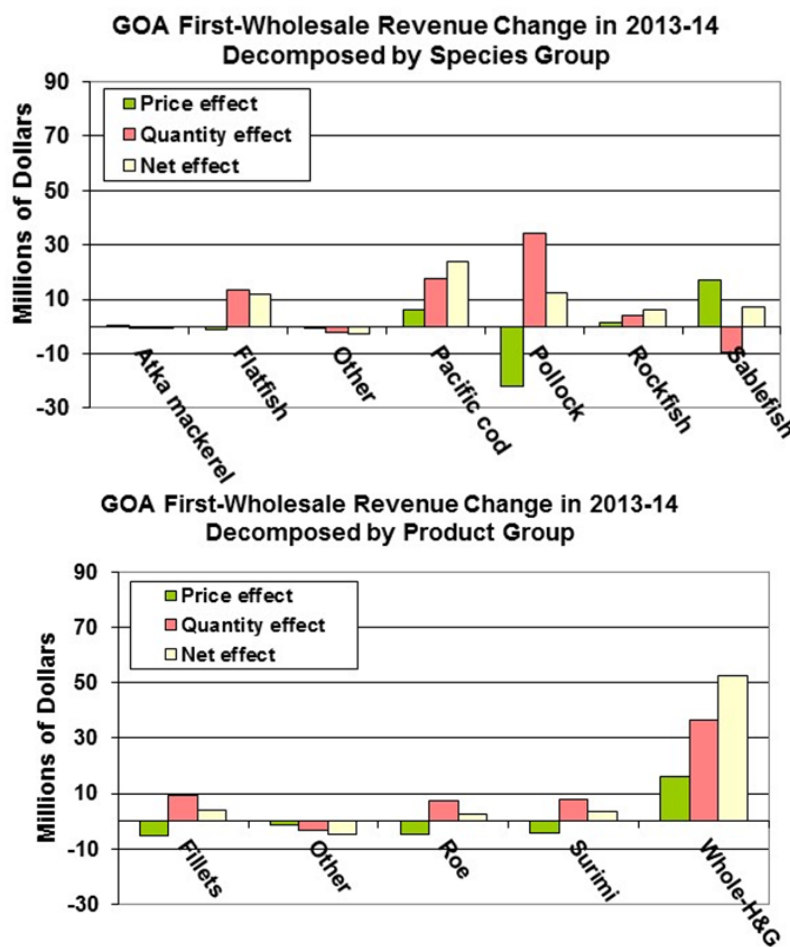
Figure 5. Decomposition of the change in first-wholesale revenues from 2013-14 in the GOA area. The first decomposition is by the species groups used in the Economic SAFE report, and the second decomposition is by product group. The price effect refers to the change in revenues due to the change in the first-wholesale price index (current dollars per metric ton) for each group. The quantity effect refers to the change in revenues due to the change in production (in metric tons) for each group. The net effect is the sum of price and quantity effects. Year to year changes in the total quantity of first-wholesale groundfish products include changes in total catch and the mix of product types (e.g., fillet vs. surimi).

Ecosystem Considerations summary

The *Ecosystem Considerations 2015: Status of Alaska's Marine Ecosystems* chapter consists of four sections:

1) ecosystem report cards,
2) executive summary of recent trends,
3) ecosystem assessment, and ecosystem status and
4) management indicators.

The ecosystem assessment section combines information from the stock assessment chapters with the indicators followed in this chapter to summarize the climate and fishery effects on the ecosystem. A new Gulf of Alaska ecosystem assessment following the procedure and format of the Eastern Bering Sea and Aleutian Island assessments was presented including a 2015 Gulf of Alaska Report Card which includes the following ten indicators:

1. *Pacific Decadal Oscillation* which reached the highest recorded winter value extending back to 1990.
2. *Fresh water input* estimated at the GAK1 station with a variable, but recently increasing, trend.
3. *Mesozooplankton biomass* measured by the continuous plankton recorder with a biennial trend since 2009 with higher biomass during even-numbered years.
4. *Copepod community size* which has been declining in recent years.
5. *Motile epifauna biomass* which has been above its long-term mean since 2001.
6. *Capelin captured by tufted puffins* at the Barren Islands—have been at or below the mean since 2008.
7. *Apex fish survey biomass* which is currently below its 30-year mean.
8. *Black-legged kittiwake reproductive success* in the Semidi Islands which has been poor in recent years except 2014.
9. *Steller sea lion non-pup estimates* for the total Gulf of Alaska—approaching the long term mean.
10. *Human populations in the Gulf of Alaska* coastal towns of Homer, Kodiak, Sitka, and Yakutat are above the 25-year mean.

It is expected that these indicators will evolve over time as indicators are refined and new indicators are developed. Current indicators were reviewed with the Plan Team and alternative indicators were discussed. The current indicators will be reviewed by the GOA IERP in 2016 and feedback from the Plan Team and SSC will be incorporated. The possibility of splitting the Gulf into at least two areas (east and west) will be explored. There are three types of trends examined: 1) physical and environmental, 2) ecosystem, and 3) fishery.

The dominant feature of the physical ocean this year was strong positive sea surface temperature (SST) anomalies which are predicted to continue during the upcoming winter. The Pacific Decadal Oscillation (PDO) was positive during the past year, especially during the winter months, and the North Pacific Gyre Oscillation (NPGO) was moderately negative. The climate models used for seasonal weather predictions are indicating strong El Niño conditions for the winter of 2015-16, and its usual impacts on the mid-latitude atmospheric circulation, which should serve to maintain a positive state for the PDO. The upper ocean in Gulf of Alaska was less saline than usual with a relatively strong pycnocline. Eddy Kinetic Energy (EKE) levels in the western Gulf of Alaska were particularly weak in summer of 2014. Thus, the phytoplankton biomass was likely more confined to the shelf and cross-shelf transport of heat, salinity and nutrients were probably weak. In the northern Gulf, relatively high eddy kinetic energy was observed in the summer of 2014.

This past year was marked by other changes in the ecosystem. Notable among these is that small copepods were more abundant than large copepods or euphausiids. Large copepods were more abundant east of the Shumagin Islands. Euphausiids were more abundant on the southeastern side of Kodiak. There was a small decline in the abundance of euphausiids in 2015 relative to 2013. Jellyfish CPUE in the bottom trawl survey remained low in the western GOA. In contrast, catches in the central GOA during the last two surveys have been the highest since 1990, and jellyfish biomass during 2014 GOA IERP surveys was the largest relative

to the previous four years. The total number of salmon harvested in 2014 was 44% of the record peak harvest in 2013. Ecosystem indicators predict a low 2015 pink salmon harvest in southeast Alaska of about 54 M fish, somewhat above the historical average. However, as of October 2015, harvests have been only 34 M fish, with lower than expected returns particularly in the southern portion. "Mushy" halibut were reported during the 2015 fishing season.

Trends in the fishery include relatively stable groundfish discards in the past few years with the exception of fixed gear, in which discard rates jumped from 4% in 2012 to 14% in 2013 and remained high at 10% in 2014. Improved observer coverage on vessels less than 60' long and on vessels targeting IFQ halibut may account for the increase. There seems to be a generally decreasing trend in seabird bycatch since the new estimation procedures began in 2007.

There were three hot topics noted for the GOA this year:
1) ***Whether the water temperature is too warm for larval walleye pollock survival in 2015.*** The 2015 Eco-FOCI larval survey found few age-0 pollock during their May 14 to June 5 cruise.
2) ***Very few age-0 pollock were found in late summer, 2015.*** There were fewer age-0 walleye pollock in the Eco-FOCI index area in 2015 than in any other year in the time series. Geographically, age-0 walleye pollock were more abundant in the Eco-FOCI index area than off east Kodiak Island. In addition to the low abundance of age-0 pollock, very few age-1 individuals were collected (ca. 14-20 cm SL) as evident in the size composition.
3) ***There was an unusual mortality event for marine mammals.*** Since May 2015, elevated numbers of large whale mortalities (declared as an Unusual Mortality Event (UME) occurred in the western Gulf of Alaska, encompassing the areas around Kodiak Island, Afognak Island, Chirikof Island, the Semidi Islands, and the southern shoreline of the Alaska Peninsula. One suspected cause is a harmful algal bloom.

Stock summaries

1. Walleye pollock

Status and catch specifications (t) of pollock and projections for 2016 and 2017. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2016 and 2017 are those recommended by the Plan Team. Catch data are current through November 7th, 2015. **The GOA-wide and W/C/WYAK ABCs listed in this table are before reductions for the Prince William Sound GHL**. However, the federal TACs from earlier years reflect reductions from the ABC due to State waters GHL. State waters GHL is presently computed as 2.5% of the total W/C/WYAK ABC.

Area	Year	Age 3+ Bio.	OFL	ABC	TAC	Catch
GOA	2014	1,028,861	228,831	179,139	174,976	140,260
	2015	1,940,031	273,378	203,934	199,151	162,700
	2016	1,981,987	336,084	264,230		
	2017		303,163	260,464		
W/C/WYAK	2014	972,750	211,998	166,514	162,351	140,259
	2015	1,883,920	256,545	191,309	186,526	162,700
	2016	1,937,900	322,858	254,310		
	2017		289,937	250,544		
SEO	2014	56,111	16,833	12,625	12,625	1
	2015	56,111	16,833	12,625	12,625	0
	2016	44,087	13,226	9,920		
	2017		13,226	9,920		

Changes from the previous assessment

The age-structured assessment model used for GOA W/C/WYAK pollock assessment implemented two model changes relative to the model used for the 2014 assessment. These changes were necessary to include the summer acoustic survey in the assessment, and to estimate a power coefficient for the age-1 winter acoustic survey index catchability. The 2015 assessment compared the following models to the 2014 model with the new data, each added to sequential models in a cumulative manner: 1) adding the summer acoustic survey data, 2) adding a power term for age-1 winter acoustic catchability, and 3) revising the Shelikof Strait acoustic survey estimates for net selectivity. Last year's base model used iterative re-weighting for composition data based on the harmonic mean of effective sample size. An initial "tuning" step was conducted after incorporating new data. However, to facilitate model comparison, subsequent models were not tuned until a potential base model was identified, and then a final tuning step was done for that model. To add the summer acoustic data as a new survey time series, the authors used simple approach for modeling selectivity due to the limited amount of data; this approach will need to be revisited as additional data become available. Adding a power term for age-1 significantly improved the model fit and is the authors' recommended model. Adding a power term for age-2 resulted in a value close to zero and failed to improve the model fit so was excluded. Improvement to the model fit by revising the Shelikof Strait acoustic survey estimates for net selectivity was equivocal. Before using the net-selectivity corrected estimates, the Team noted that the method should be fully documented and reviewed. The Plan Team accepted the authors' recommended final model configuration that incorporated the summer acoustic survey data and a power term for age-1 winter acoustic catchability.

This year's pollock assessment features the following new data: 1) 2014 total catch and catch-at-age from the fishery, 2) 2015 biomass and age composition from the Shelikof Strait acoustic survey, 3) 2015 biomass and length composition from NMFS bottom trawl survey, 4) 2015 biomass and 2014 age

composition from the ADFG crab/groundfish trawl survey, and 5) 2013 and 2015 biomass estimates, 2013 age composition, and 2015 length composition from the summer acoustic survey.

Model fits to fishery age composition data appeared to be reasonable in most years. The largest residuals tended to be at ages 1-2 in the NMFS bottom trawl survey due to inconsistencies between the initial estimates of abundance and subsequent information about year class size. Model fits to biomass estimates are similar to previous assessments, and general trends in survey time series are fit reasonably well. It is difficult for the model to fit the rapid increase in the Shelikof Strait acoustic survey and the NMFS bottom trawl survey in 2013 since an age-structured pollock population cannot increase as rapidly as is indicated by these surveys. The model is unable to fit the extreme low value for the ADFG survey in 2015, though otherwise the fit to this survey is quite good. The fit to the age-1 and age-2 Shelikof acoustic indices appeared adequate though variable.

Spawning biomass and stock trends

The model estimate of spawning biomass in 2016 is 321,626 t, which is 42.9% of unfished spawning biomass (based on average post-1977 recruitment) and above the $B_{40\%}$ estimate of 300,000 t.

The 2015 Shelikof Strait acoustic survey estimate of age-3+ pollock is 1.64 billion, which is the largest age-3+ estimate in the time series. There was a large and unexplained decline in pollock biomass in the 2015 ADFG survey (58% decline), which is a concern, especially since this time series has shown relatively little variability compared to the others. The 2012 year class still appears to be very strong based on recent information. The estimated abundance of mature fish is projected to peak in 2017, and then decline as the strong 2012 year class passes through the population. Over the years 2009-2013 stock size has shown a strong upward trend from 25% to 50% of unfished stock size, but declined to 33% of unfished stock size in 2015. The spawning stock is projected to increase again in 2016 as the strong 2012 year class starts maturing.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The Plan Team accepted the author's recommendation to reduce F_{ABC} from the maximum permissible using the "constant buffer" approach (first accepted in the 2001 GOA pollock assessment). Because the model projection of female spawning biomass in 2016 is above $B_{40\%}$, the W/C/WYAK Gulf of Alaska pollock stock is in Tier 3a. The projected 2016 age-3+ biomass estimate is 1,937,900 t (for the W/C/WYAK areas). Markov Chain Monte Carlo analysis indicated the probability of the stock dropping below $B_{20\%}$ will be negligible in all years.

The 2016 ABC for pollock in the Gulf of Alaska west of 140° W longitude (W/C/WYAK) is 254,310 t which is an increase of 33% from the 2015 ABC. In 2017, the ABC based on an adjusted $F_{40\%}$ harvest rate is 250,544 t. The OFL is 322,858 t in 2016 and 289,937 t in 2017. The 2016 Prince William Sound (PWS) GHL is 6,358 t (2.5% of the 2016 ABC of 254,310 t); the 2017 PWS GHL is 6,264 t (2.5% of the 2017 ABC of 250,544 t).

For pollock in southeast Alaska (East Yakutat and Southeastern areas), the ABC for both 2016 and 2017 is 9,920 t and the OFL for both 2016 and 2017 is 13,226 t. These recommendations are based on placing southeast Alaska pollock in Tier 5 of the NPFMC tier system, and basing the ABC and OFL on natural mortality (0.3) and the biomass estimate from the random effects model in 2015 (44,087 t).

Status determination

The Gulf of Alaska pollock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition.

Area apportionment

The assessment was updated to include the most recent data available for area apportionments within each season (Appendix C of the GOA pollock chapter). The NMFS bottom trawl, typically extending from mid-

May to mid-August, was considered the most appropriate survey time series for apportioning the TAC during the summer C and D seasons. Previously apportionment of pollock TAC was based on an unweighted average of four most recent NMFS summer surveys. However, in 2014 assessment the authors used random effects models to fit smoothed biomass trends for each management area following the recommendation of the survey averaging working group. In the current assessment, the performance of the random effects model appeared satisfactory, but led to an estimated biomass distribution that was more strongly influenced by the most recent survey, unlike the 4-survey average that had been used previously. The authors also noted that in 2015 the spatial distribution of biomass from the NMFS bottom trawl survey was markedly different from the spatial distribution from the NMFS summer acoustic survey. To account for these differences, the Plan Team is recommending that the apportionments for the C and D seasons be calculated by averaging the results of the random effects model and the spatial distribution from the 2015 NMFS summer acoustic survey. This is intended as a one-time approach to the summer apportionment, but moving forward it should be anticipated that both the NMFS bottom trawl and acoustic survey will be used in these calculations. Area apportionments, reduced by 2.5% of the ABC (6,358 t in 2016 and 6,264 t in 2017) for the State of Alaska managed pollock fishery in Prince William Sound, are as follows:

Area apportionments (**with ABCs reduced by Prince William Sound GHL**) for 2016 and 2017 pollock ABCs for the Gulf of Alaska (t).

Year	610 Western	620 Central	630 Central	640 WYAK	650 SEO	Total
2016	56,494	124,927	57,183	9,348	9,920	257,872
2017	55,657	123,078	56,336	9,209	9,920	254,200

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 2016 and 2017 are those recommended by the Plan Team. Catch data are current through November 7th, 2015.

Year	Age 0+ biomass	OFL	ABC	TAC	Catch
2014	422,000	107,300	88,500	64,738	62,223
2015	583,800	140,300	102,850	75,202	51,497
2016	518,800	116,700	98,600		
2017		100,800	85,200		

Changes from the previous assessment

The fishery catch data series was updated for 2014 and 2015 (projected for 2015 expected total year catch). Fishery size composition data were updated for 2014, and preliminary fishery size composition were included for 2015. Estimates of biomass, numbers, and length compositions from the 2015 bottom trawl survey were also included. The 2015 trawl survey biomass estimate was 50% lower than the 2013 estimate.

The assessment evaluated three models. Model 1 is identical to the final model configuration from 2014. Model 2 and 3 differed from Model 1 by using only the 27 cm plus trawl survey abundance, length, and age compositions, 4 blocks of survey selectivity instead of 3, capping sample sizes for fishery length composition data at 400, and lowering likelihood weights for fishery length compositions.

Model 3 differed from Model 2 by including an additional block for fishery selectivity-at-length for 2013 through 2015 for all gear-season combinations except for pot gear in season three (data were limited in that category). This selectivity change was made to account for possible changes in the characteristics of the

fishery length data since the fishery observer program was restructured in 2013. The authors recommended Model 3.

Spawning biomass and stock trends

According to Model 3, $B_{40\%}$ for this stock is estimated to be 130,000 t, and projected spawning biomass in 2016 is 165,600 t. The estimated recruitment was well above average for the 2005-2008 year classes and mostly below average for the 2009-2014 year classes. Spawning biomass is expected to decline in the near term.

Tier determination/ Plan Team discussion and resulting ABC and OFL recommendations

Models 2 and 3 with the likelihood weight on fishery length compositions reduced from 1 to 0.25 were preferred over Model 1 because Models 2 and 3 fit the trawl survey abundance index better than Model 1 or other Model 2 and 3 configurations with higher weights on fishery length data. Model 3 fit the survey index and most fishery length compositions better than Model 2. The Plan Team accepted the author's recommendation to use Model 3 (with 0.25 weight on fishery length data) as the preferred model.

Since 2016 spawning biomass is estimated to be greater than $B_{40\%}$, this stock is in Tier 3a. The estimates of $F_{35\%}$ and $F_{40\%}$ are 0.495 and 0.407, respectively. The maximum permissible ABC estimate (98,600 t) is a 4% decrease from the 2015 ABC of 102,850 t.

Status determination

The stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition.

Area apportionment

Since the 2014 assessment, the random effects model has been used for Pacific cod apportionment. Using this method with the trawl survey biomass estimates through 2015, the area-apportioned ABCs are:

Year	Western	Central	Eastern	Total
2016	40,503	49,312	8,785	98,600
2017	34,998	42,610	7,592	85,200

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 2016 and 2017 are those recommended by the Plan Team. Catch data are current through November 7th, 2015.

Year	Age 4+ biomass	OFL	ABC	TAC	Catch
2014	149,000	12,500	10,572	10,572	10,422
2015	130,000	12,425	10,522	10,522	10,206
2016	122,000	10,326	9,087		
2017		9,825	8,307		

Changes from the previous assessment

There were no model changes but the following data were added relative to the 2014 assessment: relative abundance and length data from the 2015 longline survey, relative abundance and length data from the 2014 longline fisheries, length data from the 2014 trawl fisheries, age data from the 2014 longline survey and 2014 fixed gear fishery, the 2015 Gulf of Alaska trawl survey abundance and length compositions, and updated catch for 2014 and projected 2015-2017 catches.

Spawning biomass and stock trends

The longline survey abundance index decreased 21% from 2014 to 2015 following a 15% increase from 2013 to 2014 and is at the lowest point of the time series. The fishery abundance index increased 6% from 2013 to 2014 (the 2015 data are not available yet). The Gulf of Alaska trawl survey index was at its lowest point in 2013 but increased 12% in 2015. Spawning biomass is projected to decrease from 2016 to 2019, and then stabilize.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Sablefish are managed under Tier 3 of NPFMC harvest rules. Reference points are calculated using recruitments from 1977-2012. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from this assessment are 102,807 t (combined across the EBS, AI, and GOA), 0.094, and 0.112, respectively. Projected female spawning biomass (combined areas) for 2016 is 86,471 t (84% of $B_{40\%}$), placing sablefish in sub-tier "b" of Tier 3. The maximum permissible value of F_{ABC} under Tier 3b is 0.078, which translates into a 2016 ABC (combined areas) of 11,795 t. The OFL fishing mortality rate is 0.093 which translates into a 2016 OFL (combined areas) of 13,397 t.

Status determination

Sablefish is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

Area apportionment

Apportionments have been held constant since the 2013 fishery. The Teams recommend retaining these apportionments for another year while alternative strategies undergo evaluation:

Region	2015				2016		2017	
	OFL	ABC	TAC	Catch*	OFL	ABC	OFL	ABC
W	--	1,473	1,473	1,012	--	1,272	--	1,163
C	--	4,658	4,658	4,570	--	4,023	--	3,678
**WYAK	--	1,708	1,708	1,802	--	1,475	--	1,348
SEO	--	2,682	2,682	2,822	--	2,317	--	2,118
GOA	12,425	10,522	10,522	10,206	10,326	9,087	9,825	8,307
BS	1,574	1,333	1,333	209	1,304	1,151	1,241	1,052
AI	2,128	1,802	1,802	431	1,766	1,557	1,681	1,423
Total	16,127	13,657	13,657	10,846	13,396	11,795	12,747	10,782

* Catch through November 7th 2015.
** 95:5 split in the EGOA following the trawl ban in SEO

4. Shallow water flatfish

Status and catch specifications (t) of shallow water flatfish and projections for 2016 and 2017. The shallow water complex is comprised of northern rock sole, southern rock sole, yellowfin sole, butter sole, starry flounder, English sole, sand sole and Alaska plaice. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are through November 7th, 2015.

Year	Biomass	OFL	ABC	TAC	Catch
2014	384,134	50,007	40,805	33,679	4,748
2015	287,534	54,207	44,205	35,381	3,232
2016	303,299	54,520	44,364		
2017		50,220	40,764		

Changes from the previous assessment

A full assessment for shallow water flatfish was presented which included updated 2014 and 2015 catch estimates. The 2015 trawl survey biomass estimates were also used for tuning the rock sole models and random effects model was used for apportionments and the tier 5 components of this complex.

Specific changes to the rock sole assessment models included adding catch-at-length for 2015 and adding GOA bottom trawl survey biomass and length composition data from 2015. The model was the same as in 2014 (stock synthesis version 3.24S).

Spawning biomass and stock trends

The rock sole assessment model estimates are used for trend and spawning biomass estimates whereas the remaining species in this complex are based solely on the NMFS bottom trawl surveys. The complex total current biomass estimate is 303,299 t an increase from the 2015 value of 287,534 t due primarily to an increase in the model estimate of southern rock sole and 2015 survey estimates that were higher for yellowfin sole and butter sole (estimated from the random effects model). The random effects model estimates for current biomass of Starry flounder, English sole, Sand sole, Alaska plaice were lower than estimated for 2015 in the 2014. The model estimate of current biomass for northern rock sole was lower than last year as well.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Northern and southern rock sole are in Tier 3a while the other species in the complex are in Tier 5. The GOA Plan Team agrees with authors' recommended ABC for the shallow water flatfish complex which was equivalent to maximum permissible ABC. For the shallow water flatfish complex, ABC and OFL for southern and northern rock sole are combined with the ABC and OFL values for the rest of the shallow water flatfish complex. This yields a combined ABC of 44,364 t and OFL of 54,520 t for 2016.

Status determination

Information is insufficient to determine stock status relative to overfished criteria for the complex as a whole. For the rock sole species, the assessment model indicates they are not overfished nor are they approaching an overfished condition. Catch levels for this complex remain below the TAC and below levels where overfishing would be a concern.

Area apportionment

The recommended apportionment percentages based on the random effects model applied to survey biomass estimates.

Year	Western	Central	WYAK	SEO	Total
2016	20,851	19,242	3,177	1,094	44,364
2017	19,159	17,680	2,919	1,006	40,764

5. Deepwater flatfish complex (Dover sole and others)

Status and catch specifications (t) of deepwater flatfish (Dover sole and others) and projections for 2016 and 2017. Biomass for each year is for Dover sole only and corresponds to the model estimate associated with the ABC for that year. Catch data in this table are current through November 7, 2015.

Year	Biomass	OFL	ABC	TAC	Catch
2014	182,727	16,159	13,472	13,472	355
2015	182,160	15,993	13,334	13,344	242
2016	141,824	11,102	9,226		
2017		11,168	9,280		

Changes from the previous assessment

The deepwater flatfish complex is comprised of Dover sole, Greenland turbot, and deepsea sole. This complex is assessed on a biennial schedule to coincide with the timing of survey data. Dover sole are assessed as a Tier 3a species. The 2015 model was updated to include the most recent data and implemented several model changes relative to the model used for the 2013 assessment. Length and age composition data were iteratively re-weighted using a new methodology, effective sample sizes were changed to equal the number of hauls samples were taken from, and fishery selectivity was estimated using an asymptotic selectivity curve rather than dome-shaped.

Greenland turbot and deepsea sole fall under Tier 6. ABCs and OFLs for Tier 6 species are based on historical catch levels and therefore these quantities are not updated. ABCs and OFLs for the individual species in the deepwater flatfish complex are determined as an intermediate step and then summed for calculating complex-level OFLs and ABCs.

Dover sole apportionment was computed using the random effects model and included the 2015 NMFS bottom trawl survey biomass distributions. Greenland turbot and deepsea sole apportionments were computed using historical survey biomass distributions of both species.

Spawning biomass and stock trends

The model estimate of 2016 spawning stock biomass for Dover sole is 49,179 t, which is well above $B_{40\%}$ (22,692 t). Spawning stock biomass and total biomass are expected to remain stable through 2017. Stock trends for Greenland turbot and deepsea sole are unknown.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Starting in 2013, the Dover sole stock has been assessed using an age-structured model and is determined to be in Tier 3a. Both Greenland turbot and deepsea sole are determined to be in Tier 6. The 2016 and 2017 Dover sole ABCs are 9,043 t and 9,097 t, respectively. The Tier 3a calculations for Dover sole result in 2016 and 2017 OFLs of 10,858 t and 10,924 t, respectively. The Tier 6 calculation (based on average catch from 1978–1995) for the remaining species in the deepwater flatfish complex ABC is 183 t and the OFL is 244 t for 2016 and 2017. The GOA Plan Team agrees with the authors' recommendation to use the combined ABC and OFL for the deepwater flatfish complex for 2016 and 2017. This equates to a 2016 maximum permissible ABC of 9,226 t and OFL of 11,102 t for the deepwater flatfish complex.

Status determination

Gulf of Alaska Dover sole is not being subjected to overfishing and is neither overfished nor approaching an overfished condition. Information is insufficient to determine stock status relative to overfished criteria for Greenland turbot and deepsea sole. Catch levels for this complex remain well below the TAC and below levels where overfishing would be a concern.

Area apportionment

The recommended apportionment for the deepwater flatfish complex is based on the random effects model applied to survey biomass (percentage by area for all survey years) of Dover sole and the historical survey. This approach results in apportionments based on the relative abundance (biomass) of each species in the stock complex in each management area.

Area apportionments of deepwater flatfish ABCs for 2016 and 2017 based on the fraction of the survey biomass in each area for Greenland turbot, and deepsea sole (1984-2015 combined) and from random effects model by area for Dover sole.					
Year	**Western**	**Central**	**WYAK**	**SEO**	**Total**
	2.0%	37.9%	32.5%	27.6%	100.0%
2016	186	3,495	2,997	2,548	9,226
2017	187	3,516	3,015	2,563	9,280

6. Rex Sole

Status and catch specifications (t) of rex sole and projections for 2016 and 2017. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 7th, 2015.					
Year	Biomass	OFL	ABC	TAC	Catch
2014	84,702	12,207	9,341	9,341	3,577
2015	82,972	11,957	9,150	9,150	1,869
2016	67,941	9,791	7,493		
2017		9,810	7,507		

Changes from the previous assessment

Rex sole are assessed on a biennial schedule to coincide with the timing of survey data. This year a full assessment was conducted; the most recent full assessment was from 2011. The software used for the model was stock synthesis (version 3.24u) which differed from the previous stock-specific age structured program that had been written by the previous author. Apportionments were computed using the random effects model and included the 2015 NMFS bottom trawl survey biomass distributions.

Spawning biomass and stock trends

The model estimate of female spawning biomass for 2016 is 43,808 t, well above $B_{40\%}$ (22,738 t). The estimated 2015 total mature biomass estimates (age 3+) from the 2014 assessment decreased from 82,972 t to the 2016 estimate of 67,941 t.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

In 2005, the Plan Team adopted a Tier 5 approach (using model estimated adult biomass) for rex sole ABC recommendations due to unreliable estimates of $F_{40\%}$ and $F_{35\%}$. In the new assessment presented this year this approach was continued. Therefore, the Team recommended ABC and OFL calculation as before using

$F_{ABC} = 0.75M = 0.128$ results in a 2016 ABC of 7,493 t and OFL of 9,791 t. The Plan Team concurred with the author's recommended maximum permissible ABCs for 2016 and 2017.

Status determination

The Gulf of Alaska rex sole is not being subjected to overfishing and is neither overfished nor approaching an overfished condition. Catches are well below TACs and below levels where overfishing would be a concern.

Area apportionment

Area apportionments of rex sole ABC's for 2016 and 2017 are based on the random effects model applied to GOA bottom trawl survey biomass in each area.

Year	Western	Central	WYAK	SEO	Total
2016	1,315	4,445	766	967	7,493
2017	1,318	4,453	767	969	7,507

7. Arrowtooth flounder

Status and catch specifications (t) of arrowtooth flounder and projections for **!Undefined Bookmark, CURRENTYR** and **!Undefined Bookmark, CURRENTYR**. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data current through November 7th, 2015.

Year	Biomass	OFL	ABC	TAC	Catch
2014	1,978,340[1]	229,248	195,358	103,300	36,290
2015	1,957,970[1]	226,390	192,921	103,300	18,473
2016	2,103,860[2]	219,430	186,188		
2017		196,714	189,332		

[1] Age 3+ biomass from the age-structured projection model.
[2] Age 1+ biomass from the age-structured projection model.

Changes from the previous assessment

Several improvements were made to the input data and the model structure. Fishery length composition data was updated for all years from 1977-2015, which included adding the length compositions for 1982 and 1983. The age-length transition matrix and weight at age vector were re-estimated based on data from 1977-2015, and the maturity-at-age ogive was updated based on the most recent GOA arrowtooth maturity study. Model changes included development of a generalized ADMB model used for both the BSAI and GOA arrowtooth flounder assessments, which resulted in the modeled ages for the GOA arrowtooth flounder changing from 3-15+ to 1-21+, with selectivity estimated non-parametrically for ages 1-19.

Spawning biomass and stock trends

Arrowtooth flounder biomass estimates from the current model are very similar to those estimated in the last full assessment in 2013. The generalized model estimates biomass for two additional ages, ages 1 and 2. The model estimates of total (age 1+) biomass increased from a low of 390,626 t in 1970 to a high of 2,109,820 t in 2009 and slight decrease to 2,103,860 t in 2016. Female spawning biomass in 2016 was estimated at 1,175,240 t, which is above $B_{40\%}$, and represents a 1% decrease from the 2015 estimate in last year's assessment.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Arrowtooth flounder is estimated to be in Tier 3a. The 2016 ABC ($F_{40\%}$=0.171) is 186,188 t, which is a small decrease from the 2015 ABC of 192,921 t. The 2016 OFL ($F_{35\%}$=0.204) is 219,430 t.

Status determination

The stock is not overfished nor approaching an overfished condition. Catch levels for this stock remain below the TAC and below levels where overfishing would be a concern.

Area apportionment

The recommended area apportionment by the random effects model was used by the Team to provide apportionments for the 2016 and 2017 ABCs. Percentages and area apportionments of arrowtooth flounder for 2016 and 2017, based on the fraction of the 2015 survey biomass from the random effects model are:

	Western	**Central**	**WYAK**	**SEO**	**Total**
Year	15.1%	58%	20.1%	6.8%	100%
2016	28,183	107,981	37,368	12,656	186,188
2017	28,659	109,804	37,999	12,870	189,332

8. Flathead sole

Status and catch specifications (t) of flathead sole and projections for **!Undefined Bookmark, CURRENTYR** and **!Undefined Bookmark, CURRENTYR**. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 7th, 2015.

Year	Biomass	OFL	ABC	TAC	Catch
2014	252,361	50,664	41,231	27,746	2,556
2015	254,602	50,792	41,349	27,756	1,907
2016	265,088	42,840	35,020		
2017		43,060	35,187		

Changes from the previous assessment

Flathead sole are assessed on a biennial schedule to coincide with the timing of survey data. This year a full assessment was conducted and updated the most recent model presented in 2013 and includes the 2015 NMFS bottom trawl survey data. Minor changes included iteratively re-weighting length and age composition data using a new methodology and effective sample sizes were changed to equal the number of hauls samples were taken from.

Apportionments were computed using the random effects model and included the 2015 NMFS bottom trawl survey biomass distributions.

Spawning biomass and stock trends

The 2016 spawning biomass estimate (82,375 t) is above $B_{40\%}$ (36,866 t) and projected to be stable through 2017. Total biomass (3+) for 2016 is 265,088 t and is projected to increase in 2017.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Flathead sole are determined to be in Tier 3a. For 2016 the Plan Team concurred with the authors' recommendation to use the maximum permissible ABC of 35,020 t which is down from the 2015 ABC (41,349 t). The F_{OFL} is set at $F_{35\%}$ (0.40) which corresponds to an OFL of 42,840 t.

Status determination

The Gulf of Alaska flathead sole stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition. Catches are well below TACs and below levels where overfishing would be a concern.

Area apportionment

Area apportionments of flathead sole ABC's for 2016 and 2017 are based on the random effects model applied to GOA bottom trawl survey biomass in each area.

Year	Western	Central	WYAK	SEO	Total
2016	11,027	20,211	2,930	852	35,020
2017	11,080	20,307	2,944	856	35,187

9.   Pacific ocean perch

Status and catch specifications (t) of Pacific ocean perch and projections for **!Undefined Bookmark, CURRENTYR** and **!Undefined Bookmark, CURRENTYR**. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2016 and 2017 are those recommended by the Plan Team. Catch data are current through November 7th, 2015.

Year	Biomass	OFL	ABC	TAC	Catch
2014	410,712	22,319	19,309	19,309	17,663
2015	416,140	24,360	21,012	21,012	18,214
2016	457,768	28,431	24,437		
2017		28,141	24,189		

Changes from the previous assessment

Pacific ocean perch (POP) are assessed on a biennial schedule to coincide with the timing of survey data. This year a full assessment model with updated assessment and projection model results are presented. Changes in the input data include updated survey biomass estimates for 2015, survey age compositions for 2013, and final catch for 2014 and preliminary catch and projected catches for 2015-2017.

Spawning biomass and stock trends

There was a 16% increase in ABC and 11% increase in spawning biomass from 2015 to 2016 and is projected to increase in 2017. Total biomass has been increasing since the early 1980s.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The GOA Pacific ocean perch stock is in Tier 3a. The Team accepted the author recommended model resulting in an estimated maximum permissible ABC of 24,437 t ($F_{ABC} = F_{40\%}$ of 0.102). The F_{OFL} is specified to be equal to the $F_{35\%}$ (0.119) and results in an OFL of 28,431 t.

Status determination

The stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition.

Area apportionment

From 1996 to 2014, apportionment of ABCs was based on a 4:6:9 weighted average of biomass distribution for each area using the three most recent trawl survey estimates. The random effects model for apportionment results in 11.2% for the Western area, 69.7% for the Central area, and 19.1% for the Eastern area for 2016.

Amendment 41 prohibited trawling in the Eastern area east of 140° W longitude. The ratio of biomass still obtainable in the W. Yakutat area (between 147° W and 140° W) is smaller than the 2014 assessment at 0.61, a decrease from 0.71. Note that the random effects model combined the WYAK and EYAK/SEO regions. The weighting method of using upper 95% confidence of the ratio in survey biomass between these two areas used in previous assessments was continued. The OFL apportionment method recommended for 2016 is the same as last year:

Year	Quantity	Western	Central	WYAK	SEO	Total
2016	ABC	2,737	17,033	2,847	1,820	24,437
2017	ABC	2,709	16,860	2,818	1,802	24,189
	Quantity	Western/Central/WYAK			SEO	Total
2016	OFL	26,313			2,118	28,431
2017	OFL	26,045			2,096	28,141

10. 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 2016 and 2017 are those recommended by the Plan Team. Catch data are current through November 7th, 2015. Note that for management purposes, the northern rockfish from the EGOA ABC is combined with other rockfish. The ABC for 2016 and 2017 listed below deducts 4 t.

Year	Age 2+ biomass	OFL	ABC	TAC	Catch
2014	102,893	6,349	5,324	5,324	4,276
2015	98,409	5,961	4,999	4,999	3,935
2016	77,596	4,783	4,004		
2017		4,501	3,768		

Changes from the previous assessment

Rockfish are assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. This year the 2013 assessment model was updated to incorporate new length-stratified growth estimates, an updated ageing error matrix, and an extension of the plus age group. New data added to the assessment include 2015 trawl survey biomass estimates and survey age compositions for 2013. Other updated input data are fishery catch for 2014 and 2015, fishery age compositions from 2012, and fishery size compositions for 2013.

Spawning biomass and stock trends

The 2016 spawning biomass estimate (31,313 t) is above $B_{40\%}$ (27,983 t) and projected to decrease to 29,033 t in 2017. Total biomass (2+) for 2016 is 77,596 t and is projected to decrease in 2017.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Northern rockfish are estimated to be in Tier 3a. The Plan Team agreed with the authors' recommendation to use the maximum permissible 2016 ABC and OFL values of 4,008 t and 4,783 t, respectively.

Status determination

The stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition.

Area apportionment

Area apportionments of northern rockfish ABC's for 2016 and 2017 are based on the random effects model applied to GOA bottom trawl survey biomass for the Western, Central, and Easter Gulf of Alaska resulting in the following percentage area apportionments: Western 11.40%, Central 88.50% and Eastern 0.01%.

Note that the small northern rockfish ABC apportionments from the Eastern Gulf are combined with other rockfish for management purposes. Northern rockfish area apportionments for ABCs in 2016-2017:

Year	Western	Central	Eastern	Total
2016	457	3,547	4	4,008
2017	430	3,338	4	3,772

11. Shortraker rockfish

Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2016 and 2017 are those recommended by the Plan Team The OFL and ABC Catch data are current as of November 7th, 2015.

Year	Biomass	OFL	ABC	TAC	Catch
2014	58,797	1,764	1,323	1,323	682
2015	58,797	1,764	1,323	1,323	567
2016	57,175	1,715	1,286		
2017		1,715	1,286		

Changes from the previous assessment

Shortraker rockfish are assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. This is the first full assessment for Gulf of Alaska shortraker rockfish since 2011. Methodology for calculating exploitable biomass has changed to the use of a random effects model applied to the trawl survey data. New data included in the assessment are 2015 Gulf of Alaska survey biomass estimates and standard errors, and updated 2015 catch.

Spawning biomass and stock trends

Applying the random effects model to trawl survey data from 1984-2015 results in a 2016 exploitable biomass of 57,175 t for shortraker rockfish, a 3% decrease from the previous year's biomass (58,797 t).

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Shortraker rockfish are Tier 5 species for specifications where $F_{ABC} = 0.75M = 0.0225$, and $F_{OFL} = 0.03$. Applying this definition to the exploitable biomass results in a 2016 ABC and OFL of 1,286 t and 1,715 t respectively.

Status determination

Information is insufficient to determine stock status relative to overfished criteria. Catch levels for this stock remain below levels where overfishing would be a concern.

Area apportionment

For apportionment of ABC/OFL, the random effects model was fit to area-specific biomass and proportions of biomass by area were calculated. The following table shows the recommended apportionment for 2016 and 2017. It was noted that the 2015 WGOA catch (47 t) exceeds this apportionment.

Western	Central	Eastern	Total
2.98%	23.40%	73.62%.	**100%**
38	301	947	1,286

12. Dusky rockfish

Status and catch specifications (t) of dusky rockfish and projections for 2016 and 2017. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2016 and 2017 are those recommended by the Plan Team. Catch data are current through November 7th, 2015.

Year	Age 4+ biomass	OFL	ABC	TAC	Catch
2014	69,371	6,708	5,486	5,486	3,061
2015	66,629	6,246	5,109	5,109	2,742
2016	60,072	5,733	4,686		
2017		5,253	4,284		

Changes in assessment methods and data

Dusky rockfish are assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. For this year's assessment, a new geostatistical generalized linear mixed model was used to compute trawl survey biomass estimates from survey catch data. Additional updates included using a length-stratified design to estimate growth, extending the ageing error matrix, setting the plus age group at 25, and using the recommended random effects model for apportionment. New data added to the model included survey age compositions for 2013, updated catch for 2014 and 2015, fishery age compositions from 2012, and fishery size compositions for 2013.

Spawning biomass and stock status trends

The 2016 projected spawning biomass estimate (25,238 t) is above $B_{40\%}$ (19,707 t) and projected to decrease to 23,245 t in 2017.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Dusky rockfish are in Tier 3. The Plan Team agreed with the authors' recommendation of maximum permissible ABC and OFL of 4,686 t and 5,733 t for 2016. This ABC is 8% lower than the 2015 ABC of 5,109 t but similar to the ABC of 4,711 t projected for 2016 in the 2015 assessment.

Status determination

Dusky rockfish are not being subjected to overfishing and is neither overfished nor approaching an overfished condition. Recent catches have been below TACs and below levels where overfishing would be a concern.

Area apportionment

Area apportionments of dusky rockfish ABC's for 2016 are based on the random effects model applied to GOA bottom trawl survey biomass in each area. Allocation for West Yakutat and SEO is equal to the upper 95% confidence interval of the ratio of biomass in West Yakutat area to SEO area.

Year	Western	Central	Eastern (7.8%)		Total
			WYAK	SEO	
	3.7%	88.5%	5.9%	1.9%	100%
2016	173	4,147	275	91	4,686
2017	159	3,791	251	83	4,284

13. Rougheye and blackspotted rockfish

Status and catch specifications (t) of rougheye and blackspotted rockfish and projections for 2016 and 2017. Biomass for each year corresponds to the projections given in the SAFE report issued in the preceding year. The OFL and ABC for 2016 and 2017 are those recommended by the Plan Team. Catch data are current as of October 1, 2015.

Year	Biomass	OFL	ABC	TAC	Catch
2014	42,810	1,497	1,244	1,244	738
2015	36,584	1,345	1,122	1,122	522
2016	41,864	1,596	1,328		
2017		1,592	1,325		

Changes from the previous assessment

A full assessment was compiled this year, which addressed several issues identified in previous analyses. Trawl survey age sample treatment was modified to be consistent with the length-stratified sampling design. The ageing error transition matrix was updated to model the ages at or near the plus age group which previously were consistently overestimated. The plus group was adjusted to reduce the aggregation of a large proportion of the observations and predictions into a single bin. Seven models were presented in the assessment, starting with the last full assessment model (M0), updating that model with the most recent data (M1), and adding the revised ageing error and length stratified growth (M2). The final two models (M3 and M4) explored differing treatment of the trawl survey selectivity and included sub-models (a and b) to explore the choice of age composition plus group. The authors and Plan Team recommend Model M4a for the 2016 assessment based on improved overall model fit to the data, parsimony, and the inclusion of the length-stratified estimator. The M4 model uses a Gamma function for trawl survey selectivity and a plus group at age 42.

New and updated data in the 2015 assessment included updated and new catch estimates (2014-2015), new fishery ages (2010), new fishery lengths (2013), a new trawl survey estimate (2015), new trawl survey ages (2013), and revised longline survey abundance estimates and length frequencies, new longline survey relative population number (RPN) for 2015, and new longline survey lengths for 2015.

Spawning biomass and stock status trends

Female spawning biomass (13,804 t) is above $B_{40\%}$ (8,226 t) and projected to remain stable. The 2013 trawl survey was at a historic low, but increased by 25% in 2015. The 2015 longline survey abundance index decreased by 6% from 2014, but was 10% above the long-term average.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The rougheye/blackspotted complex qualifies as a Tier 3a stock. For the 2016 fishery, the Plan Team accepts the authors' recommended maximum permissible ABC of 1,328 t ($F_{ABC} = F_{40\%} = 0.040$) and OFL ($F_{OFL} = F_{35\%} = 0.048$) of 1,592 t.

Status determination

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

Area apportionment

A random effects model for RE/BS rockfish was evaluated for 2016. The assessment model uses two survey indices but the current form for the random effects model does only uses one of the indices. The Plan Team agreed to continue with the authors' recommendation to use the historical apportionment method (4:6:9 weighted average of the proportion of biomass in each area from the three most recent bottom trawl surveys) until the random effects model can be more fully developed.

The 2015 apportionment values for rougheye and blackspotted rockfish ABCs are: Western area, 7.9%; Central area, 53.2%; and Eastern area, 38.9%:

Year	Western	Central	Eastern	Total
2016	105	707	516	1,328
2017	105	705	515	1,325

14. Demersal shelf rockfish

Status and catch specifications (t) of demersal shelf rockfish and projections for 2016 and 2017. Biomass for each year corresponds to the survey biomass estimates given in the SAFE report issued in the preceding year(s). The 2015 catch data are current as of November 7th, 2015.

Year	Biomass	OFL	ABC	TAC	Catch
2014[1]	13,274	438	274	274	105
2015[1]	10,933	361	225	225	108
2016[2]	10,005	364	231		
2017[2]		364	231		

[1]For 2014 and 2015, the DSR ABCs and OFLs were increased by 3% to determine the percentage of non-yelloweye DSR for the ABCs and OFLs.

[2] For 2016 and 2017, the non-yelloweye DSR ABCs and OFLs are calculated using Tier 6 methodology. Non-yelloweye Tier 6 ABCs and OFLs are added to the Tier 4 yelloweye ABCs and OFLs for total DSR values.

Changes from the previous assessment

Harvest specifications are set based on the most recent ROV and submersible density estimates of yelloweye rockfish in each management area using historical methods with one exception. Authors decided to remove Northern Southeast Outside (NSEO) data (too few yelloweye observed to calculate a density estimate) and used 2012 Central Southeast Outside (CSEO) density as a proxy. Catch information and average weights for yelloweye rockfish catch from the commercial fishery were updated for 2015. There was no directed fishery in Southern Southeast Outside (SSEO) in 2014 or 2015, and no samples were taken from the halibut fishery in this area, so average weight from 2013 was used. Yelloweye rockfish density was updated in the assessment for East Yakutat (EYKT) using the 2015 ROV-derived survey data. This year non-yelloweye DSR biomass was estimated using Tier 6 calculations based on recreational, commercial and subsistence catch data from 2010 to 2014. This period was the only range when all three catch data sets overlapped. The authors recommended the Tier 6 option for non-yelloweye DSR because it is consistent with other stock assessments that do not have reliable biomass estimates and is based on historical catch rather than an expansion of yelloweye rockfish biomass

Preliminary results from an age-structured model for yelloweye rockfish in southeast outside Alaska waters was presented as an appendix. See Plan Team minutes for further discussion of the age-structured model.

Spawning biomass and stock trends

Overall density estimates have declined in all management areas in recent years. CSEO exhibits the biggest downward trend. In SSEO trends increased through 2003, and then declined. The EYKT density estimates are more variable and relatively stable through the survey time series.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Under Tier 4 (Tier 4 for yelloweye, Tier 6 for non-yelloweye), $F_{ABC} \leq F_{40\%}$ and $F_{OFL} = F_{35\%}$. The overfishing level (OFL) was set using $F_{35\%} = 0.032$; which was 364 t for 2016 compared to 361 for 2015. The maximum ABC for 2016 is 280 t. The authors recommend an $F = M$ harvest rate lower than the maximum permissible and the Plan Team concurred. Due to updated average body weight (based on fishery data), updated biomass projections, and the new Tier 6 calculations for non-yelloweye DSR, the recommended ABC is 231 t for 2016, up slightly from that recommended for 2015. For subsistence use, 7 t was deducted from the ABC

for DSR caught resulting in 224 t. This was then divided among sport and commercial fisheries (84:16) according to a Board of Fish decision. This resulted in 188 t for commercial fisheries and 36 t allocated to sport fisheries.

Status determination

The DSR stock complex in the southeast outside district of the Gulf of Alaska is not being subjected to overfishing. Information is insufficient to determine stock status relative to overfished criteria as estimates of spawning biomass are unavailable.

Area apportionment

The ABC and OFL for DSR are for the SEO Subdistrict. DSR management is deferred to the State of Alaska and any further apportionment within the SEO Subdistrict is at the discretion of the State.

15. Thornyheads

Status and catch specifications (t) of thornyheads in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data for 2015 are current through November 7, 2015.

Year	Biomass	OFL	ABC	TAC	Catch
2014	81,816	2,454	1,841	1,841	1,130
2015	81,816	2,454	1,841	1,841	1,024
2016	87,155	2,615	1,961		
2017		2,615	1,961		

Changes from previous assessment

Thornyheads are assessed on a biennial schedule to coincide with the timing of survey data. This is the first full assessment for the Gulf of Alaska thornyhead stock complex since 2011. For this on-cycle year, new survey biomass from the 2015 bottom trawl survey was incorporated into the assessment.

Changes in the data presented in the assessment document include:1) total catch weight for GOA thornyheads with partial 2015 data; 2) length compositions from the 2012, 2013, 2014, and 2015 longline and trawl fisheries; 3) biomass and length composition information for GOA thornyheads from the 2015 GOA bottom trawl survey; and 4) relative population numbers and weights and size compositions for GOA thornyheads from the AFSC annual longline surveys are updated with 2012, 2013, and 2014 and 2015 data.

The random-effects method to average survey biomass was used to specify ABC and OFL values for the first time this year.

Spawning biomass and stock trends

Estimates of spawning biomass are unavailable for thornyheads. For shortspine thornyhead, GOA bottom trawl survey biomass was fit with the random effects model by region and depth, in order to compensate for missing regions and depth strata in the bottom trawl survey (as thornyheads are found to 1000 m). Thornyhead biomass in the GOA has shown an increasing trend since 2011. Following a steady decline since 2003, the 2015 biomass showed a large increase from 2013, to approximately 95,000 t. It should be noted that while the estimated trawl survey biomass of thornyhead has continued to increase, calculated RPNs and RPWs from the 2015 longline survey show a slight decrease.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Thornyhead rockfish are in Tier 5. The Plan Team concurred with the author's recommendation for OFL and ABC for 2016 and 2017. Gulf-wide catch of thornyheads was only 61% of the ABC. The 2016 (and 2017) ABC recommendation (F_{ABC} =0.0225) is 1,961 t and the OFL (F_{OFL} =0.03) is 2,615 t.

Status determination

The thornyhead complex is not being subjected to overfishing. Information is insufficient to determine stock status relative to overfished criteria as estimates of spawning biomass are unavailable. Catch levels for this stock remain below the TAC and below levels where overfishing would be a concern.

Area apportionment

Apportionment is based on random effects estimation of biomass by region, fit to 1984-2015 trawl survey biomass estimates. The thornyhead apportionment of ABC has continued to increase in the WGOA from 235 t in 2015 to 291 t in 2016 and also increased in the CGOA from 875 t in 2015 to 988 t in 2016 but has decreased in the EGOA from 731 t in 2015 to 682 t in 2016. Area apportionments of the 2016-2017 ABC for thornyhead rockfish are:

Western	Central	Eastern	Total
291	988	682	1,961

16. Other rockfish

Status and catch specifications (t) of other rockfish. In 2013, the seven species of DSR rockfish were included in the WGOA and CGOA areas. Biomass estimates are based on the three most recent trawl survey estimates. The OFL and ABC for 2016 and 2017 are those recommended by the Plan Team. Catch data are current through November 7th, 2015. Note that 4 t of northern rockfish has been added for management purposes to "other rockfish" in the EGOA.

Year	Survey biomass	OFL	ABC	TAC	Catch
2014	83,383	5,347	4,081	1,811	987
2015	83,383	5,347	4,080	1,811	1,094
2016	104,826	7,424	5,773		
2017		7,424	5,773		

Changes from the previous assessment

Other rockfish are assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. Methodology for calculating exploitable biomass has changed to the use of a random effects model applied to trawl survey biomass estimates. New data included in the assessment are 2015 Gulf of Alaska survey biomass estimates and standard errors, and updated total catch for from 2003 – 2015. For harvest specifications, previous assessments had excluded canary, China, copper, quillback, rosethorn, tiger, and yelloweye rockfish. While these species were previously excluded in harvest specifications, catch estimates had been included in the complex total. These seven species are managed as part of the "Other Rockfish" complex west of 140°W longitude (Western and Central GOA and the West Yakutat portion of the Eastern GOA) but are managed as Demersal Shelf Rockfish east of 140°W longitude. Tier 6 calculations are recommended for these seven species (west of 140°W) because reliable biomass estimates are unavailable.

Spawning biomass and stock trends

The estimated biomass of 104,826 t is based on the random effects model. The model indicates stability for this complex.

Tier determination/ Plan Team discussion and resulting ABC and OFL recommendations

Previously GOA other rockfish have been managed as a Tier 4/5 stock complex. The author recommended that this methodology continue with the addition of Tier 6 calculations for the seven species mentioned above. The Team agreed with the recommendation. The author's Tier 6 calculations were based on the maximum catch of 2013-2014. The Team noted that this method is temporarily acceptable. The

appropriateness of using maximum catch and whether years included in the calculation should be modified as the catch history is extended, should be evaluated in future assessments.

The Plan Team agreed with the authors' recommendation of an OFL of 7,424 t and a maximum permissible ABC of 5,773 t for 2016 and 2017 (including the 4 t from the northern rockfish assessment).

Status determination
The "other rockfish" complex is not being subjected to overfishing. Information is insufficient to determine stock status relative to overfished criteria as estimates of spawning biomass are unavailable. Catch levels for this stock remain below the TAC and below levels where overfishing would be a concern.

Area apportionment
Area apportionment is based on the sum of random effects model biomass (Tier 4/5 species) and catch history (Tier 6 species) by region. The Plan Team again recommends a single ABC for the combined WGOA and CGOA areas to address concerns about the ability to manage smaller ABCs in the WGOA. The recent overages in the WGOA prior to 2014 were not been viewed as a conservation concern because the catch in this region has consisted primarily of harlequin rockfish, which generally occur in untrawlable grounds. Thus, the biomass in this area is likely underestimated due to lack of sampling in untrawlable areas. The apportionments recommended for **2016 and 2017** are:

Other Rockfish	W/C GOA	WYAK	EYAK/SE	Total
ABC (t)	1,534	574	3,665*	5,773
OFL (t)				7,424

*Note for management purposes this includes 4 t of northern rockfish from the northern rockfish stock EGOA allocation.

17. Atka mackerel

Status and catch specifications (t) of Atka mackerel in recent years. Atka mackerel are managed under Tier 6 because reliable estimates of biomass are not available. The OFL and ABC for 2016 and 2017 are those recommended by the Plan Team. Catch data are current through November 7th, 2015.					
Year	**Biomass**	**OFL**	**ABC**	**TAC**	**Catch**
2014	-	6,200	4,700	2,000	1,042
2015	-	6,200	4,700	2,000	1,191
2016	-	6,200	4,700		
2017		6,200	4,700		

Changes from the previous assessment
Atka mackerel are assessed on a biennial schedule to coincide with the timing of survey data. The last full assessment was in 2011. New information includes updated 2013 and 2014 catches. Since the 2013 stock assessment, ages from the 2013 survey and 2013 fishery have become available and are comprised mostly of fish from the 2006, 2007, and 2011, year classes which are also prevalent in the Aleutian Islands. There are no changes to the methodology used to assess GOA Atka mackerel.

Spawning biomass and stock trends
Estimates of spawning biomass are not available for Gulf of Alaska Atka mackerel. The very patchy distribution of GOA Atka mackerel results in highly variable estimates of abundance. Therefore survey biomass estimates are not considered reliable indicators of absolute abundance or indices of trend.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Since 1996, the maximum permissible ABC has been 4,700 t under Tier 6 and the OFL has been 6,200 t. The Plan Team continues to recommend that GOA Atka mackerel be managed under Tier 6. The Plan Team recommends a 2015 ABC for GOA Atka mackerel equal to the maximum permissible value of 4,700 t. The 2015 OFL is 6,200 t under Tier 6.

Due to concerns over uncertainty with the ABC estimates using Tier 6, a low TAC is recommended to provide for anticipated incidental catch needs of other fisheries, principally for Pacific cod, rockfish and pollock fisheries.

Status determination

Information is insufficient to determine stock status relative to overfished criteria. Catches are below ABC and below levels where overfishing would be a concern.

18. Skates

Species	Year	Biomass	OFL	ABC	TAC	Catch
Big Skate	2014	50,155	5,016	3,762	3,762	1,673
	2015	43,398	4,340	3,255	3,255	1,410
	2016	50,857	5,086	3,814		
	2017		5,086	3,814		
Longnose Skate	2014	38,349	3,835	2,876	2,876	1,585
	2015	42,911	4,291	3,218	3,218	1,464
	2016	42,737	4,274	3,206		
	2017		4,274	3,206		
Other Skates	2014	26,518	2,652	1,989	1,989	1,941
	2015	29,797	2,980	2,235	2,235	1,476
	2016	25,580	2,558	1,919		
	2017		2,558	1,919		

Status and catch specifications (t) of skates 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 2016 and 2017 are those recommended by the Plan Team. Catch data are current through November 7th, 2015.

Changes from the previous assessment

Skates are assessed on a biennial schedule with full assessments presented in odd years to coincide with the timing of survey data. A full assessment was completed for 2015.

New inputs this year were the biomass estimates and length composition data from the 2015 GOA bottom trawl survey, updated groundfish fishery catch data, and fishery length composition data through 2015. The author continued the use of the random effects (RE) model that was introduced in the 2014 skate assessment for use in estimating survey biomass. In response to Plan Team and SSC requests, a separate RE model was run for each managed group, and for each regulatory area.

Spawning biomass and stock trends

The 2015 survey biomass estimates for big skates increased substantially, mainly due to an increase in the Central GOA estimate. This reversed a decline in Central GOA big skate biomass that began in 2003. The biomass for longnose skate and "other skates" decreased slightly relative to 2013, but in general the biomass for both groups has remained stable since 2000.

The application of the RE model to the survey data for each skate category continues to provide reasonable results for biomass estimates.

The catches of all skate species groups are substantially lower than in the years preceding 2014 (particularly 2009-2013). This decrease likely is due to prohibitions on retention of big skates in the CGOA (beginning in 2013), which discouraged "topping-off" behavior that resulted in high levels of catch, particularly for big skates in the CGOA.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Skates are managed in Tier 5. Applying *M*=0.1 and 0.75*M* to the estimated biomass from the random effects models for each stock component, gives stock specific OFLs and ABCs. The Team concurred with this approach as used in the 2014 assessment.

Status determination

Catch as currently estimated does not exceed any gulf-wide OFLs, and therefore, is not subject to overfishing. It is not possible to determine the status of stocks in Tier 5 with respect to overfished status.

Area apportionment

The Team concurred with the use of the random effects model for estimating proportions by area. Big and longnose skates have area-specific ABCs and gulf-wide OFLs; other skates have a gulf-wide ABC and OFL.

| Years | Species | ABC | | | | OFL |
		Western	Central	Eastern	Total	
2016 and 2017	Big skate	908	1,850	1,056	3,814	5,086
2016 and 2017	Longnose skate	61	2,513	632	3,206	4,274
2016 and 2017	other skates				1,919	2,558

19. Sculpins

Status and catch specifications (t) of GOA sculpins and projections for 2016 and 2017. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2016 and 2017 are those recommended by the Plan Team. Catch data for 2015 are current through November 7th, 2015.

Year	Biomass	OFL	ABC	TAC	Catch
2014	33,550	7,448	5,569	5,569	1,167
2015	33,550	7,448	5,569	5,569	941
2016	34,943	7,338	5,591		
2017		7,338	5,591		

Changes from the previous assessment

GOA sculpins are assessed on a biennial stock assessment schedule to coincide with the timing of the NMFS bottom trawl survey. A full assessment is presented in this SAFE Report with updated key assessment parameters and projections for 2016 and 2017. New information includes the 2015 trawl survey biomass estimates, and catch data updated through 2014 and partial data for 2015, by target fishery and area.

There were changes to the Tier 5 approach used previously. Biomass estimates were based on the random effects model applied to the time series NMFS bottom trawl surveys.

Spawning biomass and stock trends

The stock trends appear to be stable based on survey data.

Tier determination/Plan Team discussion and resulting ABC and OFL recommendations

The Plan Team concurred with the Tier 5 approach, including the biomass estimates based on the random effects model. Gulfwide OFL and ABC for the sculpin complex in 2016 and 2017 are 7,338 t and 5,591 t respectively.

Status determination

There is insufficient data to determine if the sculpin complex is in an overfished condition. Recent catches of sculpins have been well below the ABC first established for the sculpin complex in 2011 hence the sculpin complex is not currently being subjected to overfishing.

Area apportionment

GOA sculpins are managed gulf-wide.

20. Sharks

Status and catch specifications (t) of the GOA shark complex. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2016 and 2017 are those recommended by the Plan Team. Catch data for 2014 are current through November 7th, 2015.

Year	Biomass	OFL	ABC	TAC	Catch
2014	76,452	7,986	5,989	5,989	1,526
2015	76,452	7,986	5,989	5,989	1,306
2016	56,181	6,020	4,514		
2017		6,020	4,514		

Changes from the previous assessment

Sharks are assessed on a biennial stock assessment schedule to coincide with the timing of the NMFS bottom trawl survey. This year a full assessment was presented with 2015 bottom trawl survey information. Relative to the previous assessment total catch for GOA sharks from 2003 – 2015 has been updated along with NMFS bottom trawl, longline, and IPHC survey data. The ADF&G trawl and longline survey indices included for the first time and the random effects approach to survey averaging was used.

Assessment methodology

The random effects approach was used to estimate the biomass of spiny dogfish for the ABC/OFL calculations. A maximum sustainable F (F_{max}), based on demographic modelling methods, was presented as an alternative to $F_{OFL} = M$. The Team was supportive of continued evaluation of this approach, but recommended maintaining the status quo approach for the current specifications.

Spawning biomass and stock trends

Reliable total biomass estimates for the shark complex are unavailable, and little is known about spawning biomass or stock status trend.

Tier determination/Plan Team discussion and resulting ABC and OFL recommendations

For ABC/OFL estimates, a Tier 5 approach was used for the spiny dogfish component while the other components were treated as Tier 6 species. The Team concurred with the authors' recommendation to continue with this approach.

Status determination
Sharks are caught incidentally in other target fisheries. Catches of sharks from 1992 through 2015 have been well below the ABC first established for the shark complex in 2011. There is insufficient data to determine if the shark complex is in an overfished condition but the complex is not currently being subjected to overfishing.

Area apportionment
GOA sharks are managed Gulf-wide.

21. Squid

Status and catch specifications (t) of GOA squid. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year (no biomass estimates were made for 2014 and 2015). The OFL and ABC for 2016 and 2017 are those recommended by the Plan Team. Catch data for 2015 are current through November 7th, 2015.					
Year	**Biomass**	**OFL**	**ABC**	**TAC**	**Catch**
2014	-	1,530	1,148	1,148	93
2015	-	1,530	1,148	1,148	408
2016	6,889	2,978	2,234		
2017		2,978	2,234		

Changes from the previous assessment
This was the first full assessment since 2011, the year when squids were split out from the "other species" complex. In previous assessments, harvest recommendations were based on an historical catch approach setting OFL equal to maximum historical catch during 1997 – 2007. For this assessment, harvest recommendations for squids in the GOA and the Bering Sea/Aleutian Islands (BSAI) are considered in the context of the potential for squid bycatch to constrain pollock fisheries. For the 2016 and 2017 specifications, the author developed and recommended a new assessment approach. Specifically, the author recommended an alternative similar to a Tier 5 approach incorporating 2015 survey and catch data.

The author explored a range of biomass-based approaches incorporating parameter estimates for GOA squids. These included setting M=1.0, a conservative value as squids live at most 2 years. The methods also apply the Baranov catch equation to account for mortality during the year. The recommended approach uses the long-term survey average instead of the random effects model for the biomass estimate (6,889 t) because biomass in a given year is considered independent of surrounding years.

The author's recommended approach is different from the modified Tier 6 assessment method that was used for previous assessments. That method uses maximum historical catch during 1997-2007 as the basis for OFL and ABC calculations.

In October 2015, the Council initiated an analysis to determine whether it is appropriate to move squid to the Ecosystem Component from the Fishery Component.

Spawning biomass and stock trends
Reliable estimates of spawning biomass and stock trends are unavailable. Total squid catches for years in which data are available, from 1990 through 2015, have been well below the ABC first established for the squid complex in 2011. The exception is 2006, the year in which the highest historical catch was observed. There is no directed fishery for squid and historically the majority of squid catch has usually occurred as incidental catch in the pollock fishery. Most of the catch in recent years has occurred in NMFS Area 620.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Since reliable estimates of biomass do not exist, the squid complex is in Tier 6. The Plan Team concurred with the author's recommendation to use a new biomass-based approach, which results in an OFL of 2,978 t and an ABC of 2,234 t.

Total squid catches for years in which data are available, from 1990 through 2015, have been well below the ABC first established for the squid complex in 2011. The exception is 2006, the year in which the highest historical catch was observed. There is no directed fishery for squid and historically the majority of squid catch has usually occurred as incidental catch in the pollock fishery. Most of the catch in recent years has occurred in NMFS Area 620.

Status determination

Information is insufficient to determine stock status relative to overfished criteria. Catches are below ABC and below levels where overfishing would be a concern.

Area apportionment

GOA squid are managed Gulf-wide.

22. Octopus

Status and catch specifications (t) of GOA octopus. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2016 and 2017 are those recommended by the Plan Team. Catch data for 2015 are current through November 7th, 2015.					
Year	**Biomass**	**OFL**	**ABC**	**TAC**	**Catch**
2014	-	2,009	1,507	1,507	1,293
2015	-	2,009	1,507	1,507	909
2016	-	6,504	4,878		
2017	-	6,504	4,878		

Changes from the previous assessment

The GOA octopus stock complex consists of at least seven species of octopus. GOA octopus are assessed on a biennial stock assessment schedule to coincide with the timing of the NMFS bottom trawl survey. A full assessment was provided this year which included 2015 survey biomass and length frequency data. Catch data were updated to include 2014 and partial data reported for 2015. A time series of CPUE data from the Central GOA area 630 was presented. In addition to the status quo three-survey average used to estimate biomass, results from the random effects model were also presented. There are no proposed changes in assessment methodology.

Spawning biomass and stock trends

The estimated GOA survey biomass of all octopus species in 2015 was 12,990 t, 97% of which was identified as *E. dofleini*. This represented a 384% increase relative to the 2013 survey biomass estimate, and is the highest estimate in the survey time series. The increase in the number of octopus caught in the 2015 survey is consistent with higher incidental fishery catches observed in 2014 and 2015. Biomass estimates for this stock complex are generally unreliable, but survey data are used as a "minimum" estimate.

Octopus are taken as incidental catch mainly in pot fisheries although this species is used as bait. The highest octopus catch rates occur in Pacific cod pot fisheries in the WGOA and CGOA. There has been a sharp increase in this incidental catch of octopus over the last 2 years.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The status quo assessment method is a modified Tier 6 approach that includes a conservative natural mortality estimate (0.53) and a minimum biomass estimate. For 2012-2014, biomass was estimated using the average of the last three surveys. This year, results from the random effects model were also presented. The three-survey average biomass incorporating the 2015 survey estimate is 6,858 t. The random effects model biomass estimate for 2015 is 12,271 t, which is considerably higher than the three-survey average. The Plan Team recommends the random effects model for calculating a minimum biomass estimate of octopus. Using a Tier 5-like calculation of OFL, average minimum $B \times M$ (12,271 t $\times$ 0.53 = 6,504 t) and the ABC equal to 0.75 $\times$ OFL (4,878 t) is estimated.

Status determination

Information is insufficient to determine stock status relative to overfished criteria. However, catches are below ABC and below levels where overfishing would be a concern.

Additional Plan Team recommendations

The Plan Team continues to recommend that a stock structure template be completed and presented in September 2016. The Plan Team would also like to see preliminary analyses and results from the size-based stage-structured model for the September 2016 meeting.

Area apportionment

The GOA octopus complex is currently managed Gulf-wide.

Tables

Table 1. Gulf of Alaska groundfish 2016 - 2017 OFLs and ABCs, 2015 TACs, and 2015 catch (reported through November 7th, 2015).

Species	Area	2015				2016		2017	
		OFL	ABC	TAC	Catch	OFL	ABC	OFL	ABC
Pollock	W/C/WYAK	256,545	191,309	186,526	162,700	322,858	254,310	289,937	250,544
	W(61)*		31,634	31,634	28,730		56,494		55,657
	C(62)*		97,579	97,579	81,324		124,927		123,078
	C(63)*		52,594	52,594	52,396		57,183		56,336
	WYAK*		4,719	4,719	250		9,348		9,209
	EYAK/SEO	16,833	12,625	12,625		13,226	9,920	13,226	9,920
	Total	273,378	203,934	199,151	162,700	336,084	264,230	303,163	260,464
Pacific Cod	W		38,702	27,091	18,038		40,503		34,998
	C		61,320	45,990	33,372		49,312		42,610
	E		2,828	2,121	87		8,785		7,592
	Total	140,300	102,850	75,202	51,497	116,700	98,600	100,800	85,200
Sablefish	W		1,474	1,474	1,012		1,272		1,163
	C		4,658	4,658	4,570		4,023		3,678
	WYAK		1,708	1,708	1,802		1,475		1,348
	SEO		2,682	2,682	2,822		2,317		2,118
	Total	12,425	10,522	10,522	10,206	10,326	9,087	9,825	8,307
Shallow Water Flatfish	W		22,074	13,250	274		20,851		19,159
	C		19,297	19,297	2,959		19,242		17,680
	WYAK		2,209	2,209	1		3,177		2,919
	EYAK/SEO		625	625	1		1,094		1,006
	Total	54,207	44,205	35,381	3,235	54,520	44,364	50,220	40,764
Deep Water Flatfish	W		301	301	54		186		187
	C		3,689	3,689	183		3,496		3,516
	WYAK		5,474	5,474	2		2,997		3,015
	EYAK/SEO		3,870	3,870	3		2,548		2,563
	Total	15,993	13,334	13,334	242	11,102	9,226	11,168	9,281
Rex Sole	W		1,258	1,258	76		1,315		1,318
	C		5,816	5,816	1,793		4,445		4,453
	WYAK		772	772			766		767
	EYAK/SEO		1,304	1,304			967		969
	Total	11,597	9,150	9,150	1,869	9,791	7,493	9,810	7,507
Arrowtooth Flounder	W		30,752	14,500	557		28,183		28,659
	C		114,170	75,000	17,857		107,981		109,804
	WYAK		36,771	6,900	37		37,368		37,999
	EYAK/SEO		11,228	6,900	22		12,656		12,870
	Total	226,390	192,921	103,300	18,473	219,430	186,188	196,714	189,332
Flathead Sole	W		12,767	8,650	199		11,027		11,080
	C		24,876	15,400	1,707		20,211		20,307
	WYAK		3,535	3,535	1		2,930		2,944
	EYAK/SEO		171	171			852		856
	Total	50,792	41,349	27,756	1,907	42,840	35,020	43,060	35,187

*These area-apportioned ABCs account for the 2.5% reduction for the Prince William Sound
(continued on next page…)

Table 1 (continued) Gulf of Alaska groundfish 2016 and 2017 OFLs and ABCs, 2015 TACs, and 2015 catch (reported through November 7th, 2015).

Species	Area	2015				2016		2017	
		OFL	ABC	TAC	Catch	OFL	ABC	OFL	ABC
Pacific Ocean Perch	W		2,302	2,302	2,038		2,737		2,709
	C		15,873	15,873	14,196		17,033		16,860
	WYAK		2,014	2,014	1,980		2,847		2,818
	W/C/WYAK	23,406	20,189	20,189	18,214	26,313	22,617	26,045	22,387
	SEO	954	823	823		2,118	1,820	2,096	1,802
	Total	24,360	21,012	21,012	18,214	28,431	24,437	28,141	24,189
Northern Rockfish	W		1,226	1,226	978		457		430
	C		3,772	3,772	2,957		3,547		3,338
	E						4**		4**
	Total	5,961	4,998	4,998	3,935	4,783	4,004	4,501	3,768
Shortraker Rockfish	W		92	92	49		38		38
	C		397	397	254		301		301
	E		834	834	264		947		947
	Total	1,764	1,323	1,323	567	1,715	1,286	1,715	1,286
Dusky Rockfish	W		296	296	183		173		159
	C		3,336	3,336	2,551		4,147		3,791
	WYAK		1,288	1,288	1		275		251
	EYAK/SEO		189	189	7		91		83
	Total	6,246	5,109	5,109	2,742	5,733	4,686	5,253	4,284
Rougheye and Blackspotted Rockfish	W		115	115	29		105		105
	C		632	632	345		707		705
	E		375	375	155		516		515
	Total	1,345	1,122	1,122	529	1,596	1,328	1,592	1,325
Demersal shelf rockfish	GOA-wide	438	225	225	108	364	231	364	231
Thornyhead Rockfish	W		235	235	232		291		291
	C		875	875	581		988		988
	E		731	731	211		682		682
	Total	2,454	1,841	1,841	1,024	2,615	1,961	2,615	1,961
Other Rockfish	WC		1,031	1,031	1,041		1,534		1,534
	WYAK		580	580	34		574		574
	EYAK/SEO		2,469	200	19		3,665*		3,665
	Total	5,347	4,080	1,811	1,094	7,424	5,773	7,424	5,773
Atka mackerel	GOA-wide	6,200	4,700	2,000	1,191	6,200	4,700	6,200	4,700
Big Skate	W		731	731	182		908		908
	C		1,257	1,257	1,173		1,850		1,850
	E		1,267	1,267	55		1,056		1,056
	Total	4,340	3,255	3,255	1,410	5,086	3,814	5,086	3,814
Longnose Skate	W		152	152	98		61		61
	C		2,090	2,090	1,055		2,513		2,513
	E		976	976	311		632		632
	Total	4,291	3,218	3,218	1,464	4,274	3,206	4,274	3,206
Other Skates	GOA-wide	2,980	2,235	2,235	1,476	2,558	1,919	2,558	1,919
Sculpins	GOA-wide	7,448	5,569	5,569	941	7,338	5,591	7,338	5,591
Sharks	GOA-wide	7,986	5,989	5,989	1,306	6,020	4,514	6,020	4,514
Squids	GOA-wide	1,530	1,148	1,148	408	2,978	2,234	2,978	2,234
Octopuses	GOA-wide	2,009	1,507	1,507	909	6,504	4,878	6,504	4,878
Total		870,064	685,597	536,158	287,447	894,412	728,769	817,323	709,714

** Note that the 4 t of EGOA northern rockfish is excluded from that stock's total as it is managed as part of the EGOA "other rockfish" category.

Table 2.   Gulf of Alaska 2016 ABCs, biomass, and overfishing levels (t) for Western, Central, Eastern, Gulfwide, West Yakutat, and Southeast Outside regulatory areas.

| Species/Assemblage | Area | 2016 | | |
		ABC	Biomass	OFL
Pollock	W(61)	*56,494* [a]		
	C(62)	*124,927* [a]		
	C(63)	*57,183* [a]		
	WYAK	*9,348* [a]		
	Subtotal	*247,952* [a]	1,937,900	322,858
	EYAK/SEO	*9,920*	44,087	13,226
	Total	257,872 [a]	1,981,987	336,084
Pacific Cod	W	*40,503*		
	C	*49,312*		
	E	*8,785*		
	Total	98,600	518,800	116,700
Sablefish	W	1,272		
	C	4,023		
	WYAK	1,475		
	EY/SEO	2,317		
	Total	9,087	122,000	10,326
Shallow water Flatfish	W	20,851		
	C	19,242		
	WYAK	3,177		
	EYAK/SEO	1,094		
	Total	44,364	303,299	54,520
Deepwater Flatfish	W	186		
	C	3,495		
	WYAK	2,997		
	EYAK/SEO	2,548		
	Total	9,226	141,824	11,102
Rex sole	W	1,315		
	C	4,445		
	WYAK	766		
	EYAK/SEO	967		
	Total	7,493	67,941	9,791
Arrowtooth Flounder	W	28,183		
	C	107,981		
	WYAK	37,368		
	EYAK/SEO	12,656		
	Total	186,188	2,103,860	219,430
Flathead sole	W	11,027		
	C	20,211		
	WYAK	2,930		
	EYAK/SEO	852		
	Total	35,020	265,088	42,840

[a] The Prince William Sound GHL (2.5% of ABC; 6,358 t) is deducted from these area apportioned ABCs.

Table 2.   Continued… Gulf of Alaska 2016 ABCs, biomass, and overfishing levels (t) for Western, Central, Eastern, Gulfwide, West Yakutat, and Southeast Outside regulatory areas.

Species/Assemblage	Area	2016 ABC	Biomass	OFL
Pacific ocean perch	W	2,737		
	C	17,033		26,313
	WYAK	2,847		
	EY/SEO	1,820		2,118
	Total	24,437	457,768	28,431
Northern rockfish	W	457		
	C	3,547		
	E	[1]		
	Total	4,004	77,596	4,783
Shortraker	W	38		
	C	301		
	E	947		
	Total	1,286	57,175	1,715
Dusky rockfish	W	173		
	C	4,147		
	WYAK	275		
	EYAK/SEO	91		
	Total	4,686	60,072	5,733
Rougheye/blackspotted rockfish	W	105		
	C	707		
	E	516		
	Total	1,328	41,864	1,596
Demersal shelf rockfish	Total	231	10,005	364
Thornyhead rockfish	Western	291		
	Central	988		
	Eastern	682		
	Total	1,961	87,155	2,615
Other rockfish	W/C	1,534		
	WYAK	574		
	EY/SEO	3,665[1]		
	Total	5,773	104,826	7,424
Atka mackerel	Total	4,700		6,200
Big skates	W	908		
	C	1,850		
	E	1,056		
	Total	3,814	50,857	5,086
Longnose skates	W	61		
	C	2,513		
	E	632		
	Total	3,206	42,737	4,274
Other Skates	Total	1,919	25,580	2,558
Sculpins		5,591	34,943	7,338
Sharks		4,514	56,181	6,020
Squid		2,234	6,889	2,978
Octopus		4,878		6,504
Total		728,769	6,830,781	894,412

[1]For management purposes 4 t of EGOA northern rockfish were moved into "other rockfish" in the eastern GOA.

Table 3.　　　Summary of fishing mortality rates and overfishing levels for the Gulf of Alaska, 2015.

Species	Tier	F_{ABC}[1]	Strategy	F_{OFL}[2]	Strategy
Pollock (W/C/WYAK)	3a	0.23	F_{ABC}	0.29	$F_{35\%}$
(SEO)	5	0.225	$F=0.75M$	0.30	$F=M$
Pacific cod	3a	0.407	$F_{40\%}$	0.495	$F_{35\%}$
Sablefish	3b	0.078	$F_{40\% \text{ adjusted}}$	0.093	$F_{35\% \text{ adjusted}}$
Deepwater flatfish	3a, 6[3]	0.10	$F_{40\%}$, F_{ABC}[3]	0.12	$F_{35\%}$, F_{OFL}[4]
Rex sole	5	0.128	$F=0.75M$	0.17	$F=M$
Flathead sole	3a	0.32	$F_{40\%}$	0.40	$F_{35\%}$
Shallow water flatfish (excl. rocksoles)	5	0.15	$F=0.75M$	0.20	$F=M$
Northern rocksole	3a	0.248	$F_{40\%}$	0.299	$F_{35\%}$
Southern rocksole	3a	0.186	$F_{40\%}$	0.222	$F_{35\%}$
Arrowtooth	3a	0.171	$F_{40\%}$	0.204	$F_{35\%}$
Pacific ocean perch	3a	0.102	$F_{40\%}$	0.119	$F_{35\%}$
Rougheye and blackspotted rockfish	3a	0.04	$F_{40\%}$	0.048	$F_{35\%}$
Shortraker rockfish	5	0.0225	$F=0.75M$	0.03	$F=M$
Other rockfish	4, 5[5]	0.065, 0.0015-0.075	$F_{40\%}$, $F=0.75M$[5]	0.079, 0.02-0.10	$F_{35\%}$, $F=M$[6]
Northern rockfish	3a	0.062	$F_{40\%}$	0.074	$F_{35\%}$
Dusky rockfish[7]	3a	0.098	$F_{40\%}$	0.121	$F_{35\%}$
Demersal shelf rockfish	4, 6[8]	0.02, NA	$F=M$, F_{ABC}[8]	0.032, NA	$F_{35\%}$, F_{OFL}[9]
Thornyhead rockfish	5	0.0225	$F=0.75M$	0.03	$F=M$
Atka mackerel	6	NA	F_{ABC}[10]	NA	F_{OFL}[11]
Skates	5	0.075	$F=0.75M$	0.10	$F=M$
Sculpins	5	0.16	$F=0.75M$	0.21	$F=M$
Squid	6	NA	F_{ABC}[12]	NA	F_{OFL}[13]
Octopus	6	0.3975	$F_=0.75M$[14]	0.53	$F=M$[15]
Sharks	6[16]	0.073	$F=0.75M$, F_{ABC}[16]	0.097	$F=M$, F_{OFL}[17]

1/ 　　　Fishing mortality rate corresponding to acceptable biological catch.

2/ 　　　Maximum fishing mortality rate allowable under overfishing definition.

3/ 　　　$F_{40\%}$ for Dover sole (Tier 3a), ABC=0.75 x average catch (1978-1995) for other deepwater flatfish (Tier 6).

4/ 　　　$F_{35\%}$ for Dover sole (Tier 3a), average catch (1978-1995) for other deepwater flatfish (Tier 6).

5/ 　　　$F_{40\%}$ for sharpchin rockfish (Tier 4), $F=0.75M$ for other rockfish species (Tier 5). The other rockfish category (formerly the "other slope" rockfish category now includes widow and yellowtail rockfish.

6/ 　　　$F_{35\%}$ for sharpchin (Tier 4), $F=M$ for other species (Tier 5). The other rockfish category (formerly the "other slope" rockfish category now includes widow and yellowtail rockfish.

7/ 　　　Dusky rockfish were formerly in the "pelagic shelf" rockfish category which no longer exists. Widow and yellowtail rockfish which were in the former "pelagic shelf" category have been moved to the other rockfish category.

8/ 　　　$F_=M$ for yelloweye rockfish (Tier 4), ABC=0.75 x average catch (2010-2014) for other demersal shelf rockfish (Tier 6).

9/ 　　　$F_{35\%}$ for yelloweye rockfish (Tier 4), average catch (2010-2014) for other demersal shelf rockfish (Tier 6).

10/ 　　ABC for Atka mackerel is equal to 0.75 x average catch from 1978 to 1995. This maximum permissible ABC is intended for bycatch in other target fisheries and to minimize targeting.

11/ 　　OFL for Atka mackerel is equal to average catch from 1978 to 1995.

12/ 　　ABC for squid is equal to 0.75 x the maximum catch of squid from 1997-2007. This is a modified Tier 6 recommendation.

13/ 　　OFL for squid is equal to the maximum catch of squid from 1997-2007. This is a modified Tier 6 recommendation.

14/ 　　ABC for octopus is equal to $F=0.75M$ x the 2015 random effects model survey biomass estimate. This is a modified Tier 6 recommendation.

15/ 　　OFL for octopus is equal to $F=M$ x the 2015 random effects model survey biomass estimate. This is a modified Tier 6 recommendation.

16/ 　　$F_{ABC} = 0.073$ for spiny dogfish (Tier 6). While spiny dogfish are a Tier 6 species, a Tier 5 approach is used. They are not a Tier 5 because the trawl survey biomass is not considered reliable for the species. ABC for other sharks is equal to 0.75 x average catch from 1997-2007 (Tier 6). This time frame differs from the standard Tier 6 time frame of 1978-1995.

17/ 　　$F=M$ for spiny dogfish (Tier 6). While spiny dogfish are a Tier 6 species, a Tier 5 approach is used. They are not a Tier 5 because the trawl survey biomass is not considered reliable for the species. OFL for other sharks is equal to the average catch from 1997-2007 (which differs from the standard Tier 6 time frame of 1978-1995).

Table 4.   Maximum permissible fishing mortality rates and ABCs as defined in Amendment 56 to the GOA and BSAI Groundfish FMPs, and the Plan Team's 2016 recommended fishing mortality rates and ABCs, for those species whose recommendations were below the maximum.

Species	Tier	2016 Max F_{ABC}	Max ABC	F_{ABC}	2016 ABC
Pollock[1]	3a	0.25	278,385	0.23	254,310
Demersal shelf rockfish	4, 6	0.026	280	0.02	231225

1/ The Plan Team recommended 2016 W/C pollock ABC of 254,310 t listed here, has not been reduced as in past years' tables, to accommodate the Prince William Sound (PWS) GHL. The 2016 PWS GHL value is 2.5% of the W/C pollock ABC (0.025 x 254,310 = 6,358 t). This value is deducted from 254,310 t for apportionments which are listed in the pollock summary.

Table5.   Groundfish landings (metric tons) in the Gulf of Alaska,1956-2015.

Year	Pollock	Pacific cod	sablefish	Flatfish	Arrowtooth Flounder	Slope rockfish[a]
1956			1,391			
1957			2,759			
1958			797			
1959			1,101			
1960			2,142			
1961			897			16,000
1962			731			65,000
1963			2,809			136,300
1964	1,126	196	2,457	1,028		243,385
1965	2,749	599	3,458	4,727		348,598
1966	8,932	1,376	5,178	4,937		200,749
1967	6,276	2,225	6,143	4,552		120,010
1968	6,164	1,046	15,049	3,393		100,170
1969	17,553	1,335	19,376	2,630		72,439
1970	9,343	1,805	25,145	3,772		44,918
1971	9,458	523	25,630	2,370		77,777
1972	34,081	3,513	37,502	8,954		74,718
1973	36,836	5,963	28,693	20,013		52,973
1974	61,880	5,182	28,335	9,766		47,980
1975	59,512	6,745	26,095	5,532		44,131
1976	86,527	6,764	27,733	6,089		46,968
1977	112,089	2,267	17,140	16,722		23,453
1978	90,822	12,190	8,866	15,198		8,176
1979	98,508	14,904	10,350	13,928		9,921
1980	110,100	35,345	8,543	15,846		12,471
1981	139,168	36,131	9,917	14,864		12,184
1982	168,693	29,465	8,556	9,278		7,991
1983	215,567	36,540	9,002	12,662		7,405
1984	307,400	23,896	10,230	6,914		4,452
1985	284,823	14,428	12,479	3,078		1,087
1986	93,567	25,012	21,614	2,551		2,981
1987	69,536	32,939	26,325	9,925		4,981
1988	65,625	33,802	29,903	10,275		13,779
1989	78,220	43,293	29,842	11,111		19,002
1990	90,490	72,517	25,701	15,411		21,114
1991	107,500	76,997	19,580	20,068		13,994
1992	93,904	80,100	20,451	28,009		16,910
1993	108,591	55,994	22,671	37,853		14,240
1994	110,891	47,985	21,338	29,958		11,266
1995	73,248	69,053	18,631	32,273		15,023
1996	50,206	67,966	15,826	19,838	22,183	14,288
1997	89,892	68,474	14,129	17,179	16,319	15,304
1998	123,751	62,101	12,758	11,263 [i]	12,974	14,402
1999	95,637	68,613	13,918	8,821	16,209	18,057
2000	71,876	54,492	13,779	13,052	24,252	15,683
2001	70,485	41,614	12,127	11,817	19,964	16,479
2002	49,300 [j]	52,270	12,246	12,520	21,230	17,128
2003	49,300	52,500	14,345	10,750	23,320	18,678
2004	62,826	43,104	15,630	7,634	15,304	18,194
2005	80,086	35,205	13,997	9,890	19,770	17,306
2006	70,522	37,792	13,367	14,474	27,653	20,492
2007	51,842	39,473	12,265	15,077	25,364	18,718
2008	51,721	43,481	12,326	16,393	29,293	18,459
2009	42,389	39,397	10,910	17,360	24,937	18,621
2010	75,167	58,003	10,086	13,556	24,334	21,368
2011	79,789	62,475	11,148	10,043	30,890	19,612
2012	101,356	56,520	11,914	8,909	20,714	22,334
2013	93,733	51,792	11,945	12,283	21,620	19,367
2014	140,260	62,223	10,422	11,236	36,290	23,360
2015 [h]	162,700	51,497	10,206	7,253	18,473	23,245

a Catch defined as follows: (1) 1961-78, Pacific ocean perch (*S.alutus*) only;(2)1979-1987, the 5 species of the Pacific ocean perch complex; 1988-90, the 18 species of the slope rock assemblage;1991-1995, the 20 species of the slope rockfish assemblage.
b Catch from Southeast Outside District.
c Thornyheads were included in the other species category, and are foreign catches only.
d Other species category stabilized in 1981 to include sharks, skates, sculpins, eulachon, capelin (and other smelts in the family Osmeridae and octopus. Atka mackerel and squid were added in 1989. Catch of Atka Mackerel is reported separately for 1990-1992; thereafter Atka mackerel was assigned a separate target species.
e Atka mackerel was added to the Other Species category in1988 and separated out in 1994
f PSR includes light dusky, yellowtail, widow, dark, dusky, black, and blue rockfish; black and blue excluded in 1998, dark in 2008, widow and yellowtail in 2012 (note only dusky remains in PSR since 2012)
g Does not include at-sea discards.
h Catch data reported through November 8th,2014.
i Includes all species except arrowtooth.
j Does not include state fisheries
k Includes all managed skates species

Table5.   (cont'd) Groundfish landings (metric tons) in the Gulf of Alaska,1956-2015. See legend on previous page for conditions that apply.

Year	Pelagic Shelf rockfish	Demersal shelf rockfish[b]	Thornyheads[c]	Atka mackerel[e]	Skates[k]	Other species[d]	Total
1956							1,391
1957							2,759
1958							797
1959							1,101
1960							2,142
1961							16,897
1962							65,731
1963							139,109
1964							248,192
1965							360,131
1966							221,172
1967							139,206
1968							125,822
1969							113,333
1970							84,983
1971							115,758
1972							158,768
1973							144,478
1974							153,143
1975							142,015
1976							174,081
1977			0	19,455		4,642	195,768
1978			0	19,588		5,990	160,830
1979			0	10,949		4,115	162,675
1980			1,351	13,166		5,604	202,426
1981			1,340	18,727		7,145	239,476
1982		120	788	6,760		2,350	234,001
1983		176	730	12,260		2,646	296,988
1984		563	207	1,153		1,844	356,659
1985		489	81	1,848		2,343	320,656
1986		491	862	4		401	147,483
1987		778	1,965	1		253	146,703
1988	1,086	508	2,786	-		647	158,411
1989	1,739	431	3,055	-		1,560	188,253
1990	1,647	360	1,646	1,416		6,289	236,591
1991	2,342	323	2,018	3,258		1,577	247,657
1992	3,440	511	2,020	13,834		2,515	261,694
1993	3,193	558	1,369	5,146		6,867	256,482
1994	2,990 [f]	540	1,320	3,538		2,752	232,578
1995	2,891	219 [g]	1,113	701		3,433	216,585
1996	2,302	401	1,100	1,580		4,302	199,992
1997	2,629	406	1,240	331		5,409	231,312
1998	3,111	552	1,136	317		3,748	246,113
1999	4,826	297	1,282	262		3,858	231,780
2000	3,730	406	1,307	170		5,649	204,396
2001	3,008	301	1,339	76		4,801	182,011
2002	3,318	292	1,125	85		4,040	173,554
2003	2,975	229	1,159	578		6,339	180,173
2004	2,674	260	818	819	2,912	1,559	171,734
2005	2,235	187	719	799	2,710	2,294	185,211
2006	2,446	166	779	876	3,501	3,526	195,594
2007	3,318	250	701	1,453	3,498	2,928	174,887
2008	3,634	149	741	2,109	3,606	2,776	184,149
2009	3,057	138	666	2,222	7,020	2,870	169,604
2010	3,111	128	565	2,417	5,056	2,042	215,833
2011	2,531	82	612	1,615	4,437	2,362	225,596
2012	4,012	178	746	1,187	4,107	1,940	233,927
2013	3,978	218	1,153	1,277	6,160	6,766	230,292
2014	3,061	105	1,130	1,042	5,199	2646	296,974
2015 [h]	2,742	108	1,024	1,191	4,350	3564	286,353