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

with contributions by

T. A'mar, J. Armstrong, K. Aydin, S. Barbeaux, E. Conners, C. Conrath, M. Dalton, O. Davis, M. Dorn, K. Echave, C. Faunce, B. Fissel, D. Hanselman, J. Heifetz, P. Hulson, J. Ianelli, D. Jones, M. Jaenicke, A. Kingham, K. V. Kirk, S. Lowe, C. Lunsford, P. Lynch, C. McGilliard, D. McGowan, S. Meyer, J. Moss, R. Narita, D. Nichol, A. Olson, O. Ormseth, W. Palsson, M. Peterson, C. Rodgveller, J. Rumble, K. Shotwell, K. Spalinger, P. Spencer, I. Spies, J. Stahl, M. Stichert, S. Stienessen, T. TenBrink, C. Tribuzio, J. Turnock, T. Wilderbuer, B. Williams

November 2016

North Pacific Fishery Management Council
605 W 4th Avenue, Suite 306
Anchorage, AK 99501

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 14-18, 2016 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, Ben Williams, Janet Rumble, Mark Stichert, Mike Dalton, Patrick Lynch, Paul Spencer, Jim Armstrong, and Obren Davis.

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.

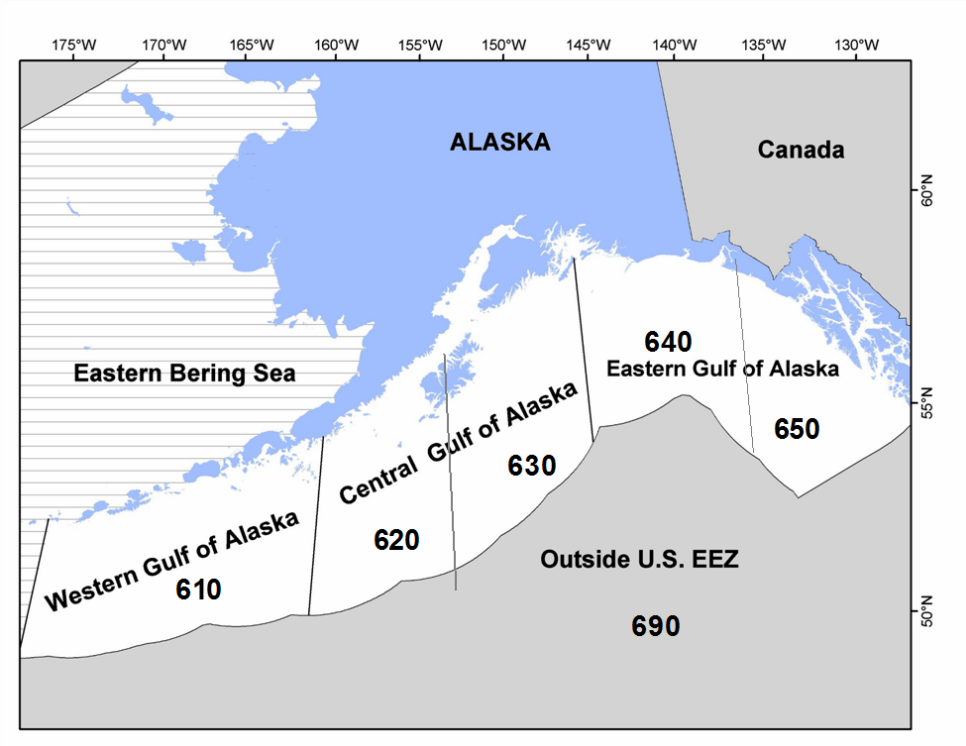

Figure 1. Gulf of Alaska statistical and reporting areas.

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, shallow water flatfish, 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, squids, sculpins, 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) Grenadiers – 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, 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 2018 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 2017 and 2018 PWS GHL (equal to 2.5% of the recommended 2017 and 2018 W/C/WY pollock ABCs) from the recommended 2017 and 2018 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 2017 and 2018 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% CI
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 more than 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 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 2016 or 2) above ½ of its MSY level in 2016 and above its MSY level in 2026 under this scenario, then the stock is not overfished.)

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

In 2017 and 2018, 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 2018 or 2) above 1/2 of its MSY level in 2018 and expected to be above its MSY level in 2028 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.

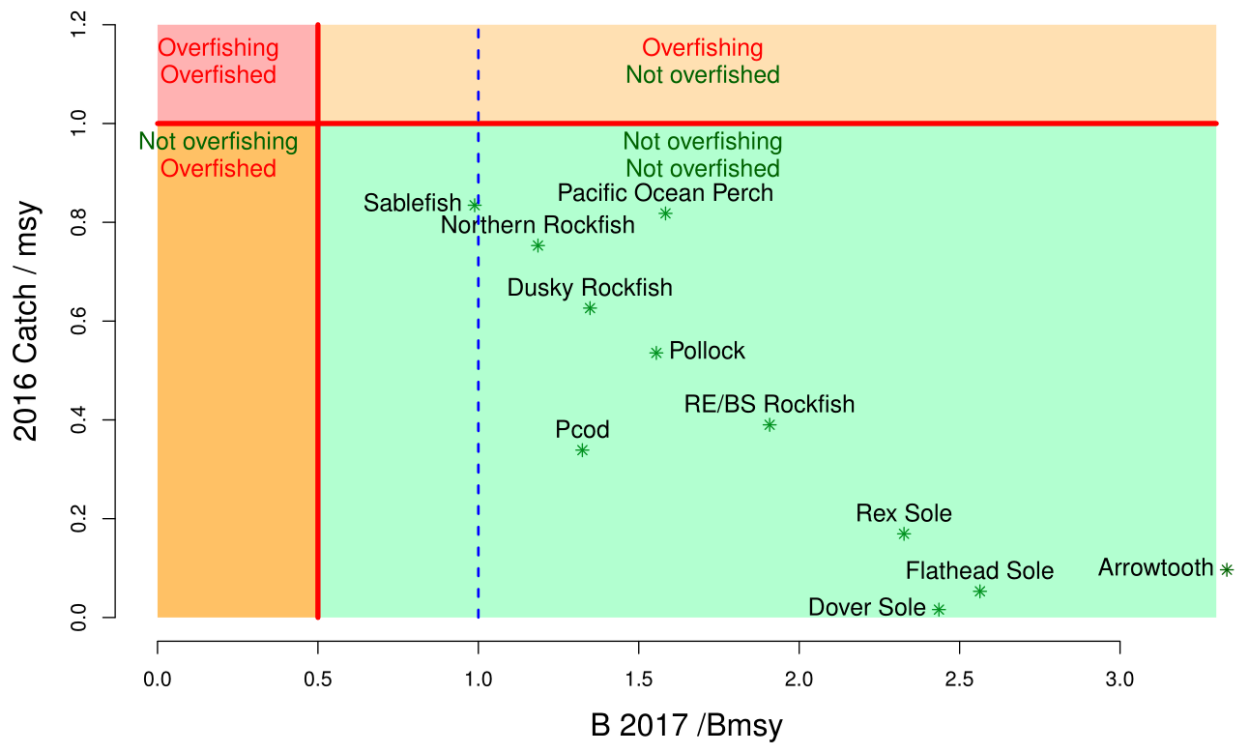

Figure 2. Summary of Gulf of Alaska stock status next year (spawning biomass relative to B_{msy}; horizontal axis) and current year catch relative to fishing at F_{msy} (vertical axis). Note that sablefish is for Alaska-wide values including the BSAI catches.

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 2016, and recommendations for ABCs and overfishing levels (OFLs) for 2017 and 2018. 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, 1956-2016.

The sums of the preliminary 2017 and 2018 ABCs for target species are 667,877 and 597,052 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 2017 and 2018 OFLs are 796,552 and 709,242 t, respectively. The Team notes that because

of halibut bycatch mortality considerations in the high-biomass flatfish fisheries, an overall OY for 2017 will be considerably under this upper limit. For perspective, the sum of the 2016 TACs was 590,809 t, and the sum of the ABCs was 727,684 t (and catch through November 5th, 2016 was just above 291,000 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 values 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 2015 and 2016 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 2017 and 2018 correspond to the Plan Team recommendations.
(4) The exploitable biomass for 2015 and 2016 that are reported in the following summaries were estimated by the assessments in *those* years. Comparisons of the projected 2017 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 2017 and 2018 were from modified assessments for selected species, rolled over (typically for Tiers 4-6) or based on updated projections. 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 and/or is incorporated in the assessment).

General recommendations

The Team recommends that authors ensure survey and fishery data are updated over the entire time series (biomass estimates, composition data, etc.)

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. Since 2016 is an off-year for the NMFS GOA groundfish trawl survey, only summaries for most of the GOA species were produced.

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 2017 and 2018 (Table 1). In the case of stocks managed under Tier 3 and for which modified assessments was produced, 2017 and 2018 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 3, 4 and 5 for which only a summary was produced, the latest survey data (2015) was reported and for Tier 5 species used for ABC and OFL calculations. Tier 6 stocks may have alternatives based on updated catch information.

The 2018 ABC and OFL values recommended in next year's SAFE report are likely to differ from this year's projections for 2018 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 2014-15

The ex-vessel value of all Alaska domestic fish and shellfish catch, which includes the amount paid to harvesters for fish caught, and the estimated value of pre-processed fish species that are caught almost exclusively by catcher/processors, decreased from $1,853 million in 2014 to $1,720 million in 2015. The first wholesale value of 2015 groundfish catch after primary processing was $2,262 million. The 2015 total groundfish catch decreased by 1%, and the total first-wholesale value decreased by 4%, relative to 2014.

The groundfish fisheries accounted for the largest share (52%) of the ex-vessel value of all commercial fisheries off Alaska, while the Pacific salmon (*Oncorhynchus spp*.) fishery was second with $413 million or 24% of the total Alaska ex-vessel value. The value of the shellfish fishery amounted to $293 million or 17% of the total for Alaska and exceeded the value of Pacific halibut (*Hippoglossus stenolepis*) with $111 million or 6% 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, economic performance indices, 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, an Amendment 91 fishery economic data report (EDR) and vessel master survey 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. Appendices contain species specific ex-vessel and first-wholesale data for flatfish and rockfish, data on fishmeal, global whitefish production from the FAO, fisheries export data from the Census Bureau, employment data from the Alaska Dept. of Labor, and alternative ex-vessel pricing and value based on CFEC fish tickets. Generally, the data presented in this report cover 2011 - 2015, but limited catch and ex-vessel value data are reported for earlier years to illustrate the rapid development of the domestic groundfish fishery in the 1980s and to provide a more complete historical perspective on catch. 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 2014-15 in the GOA

The following brief analysis summarizes the overall changes that occurred between 2014-15 in the quantity produced and revenue generated from GOA groundfish. According to data reported in the 2016 Economic SAFE report, the ex-vessel value of GOA groundfish decreased from $208 million in 2014 to $206 million in 2015 (Figure 3), and first-wholesale revenues from the processing and production of groundfish in the Gulf of Alaska (GOA) fell from $388 million in 2014 to $350 million in 2015, a decrease of 10% (Figure 4). At the same time, the total quantity of groundfish products from the GOA decreased from 131 thousand metric tons to 126 thousand metric tons, a difference of 5 thousand metric tons. These changes in the GOA

account for part of the change in first-wholesale revenues from Alaska groundfish fisheries overall which decreased by $83 million, a relative decrease of 4% in 2015 compared to 2014.

By species group, negative quantity effect for flatfish of $17 million was the largest change in first-wholesale revenues from the GOA for 2014-15, followed closely by negative price and quantity effects for cod that implied a negative net effect of $15 million (Figure 5). By product group, negative price and quantity effects were concentrated in the fillets category for a negative net effect of $28 million in the GOA first-wholesale revenue decomposition for 2014-15.

In summary, first-wholesale revenues from the GOA groundfish fisheries decreased by $37 million from 2014-15. The main drivers of this decrease were a negative quantity effect for flatfish, and negative price and quantity effects for cod. These negative effects were highest in the fillets product group. In comparison, first-wholesale revenues decreased by $46 million from 2014-15 in the BSAI due mainly to a negative quantity effect for flatfish, and negative price and quantity effects for pollock.

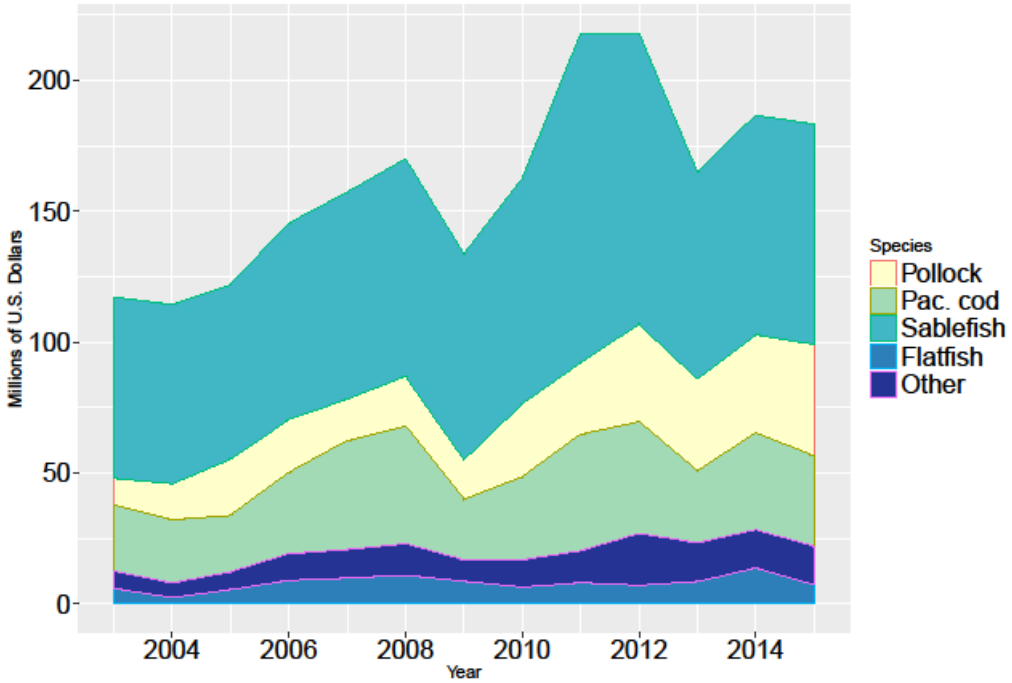

Figure 3. Real ex-vessel value of the groundfish catch in the domestic commercial fisheries in the GOA area by species, 2003-2015 (base year = 2015).

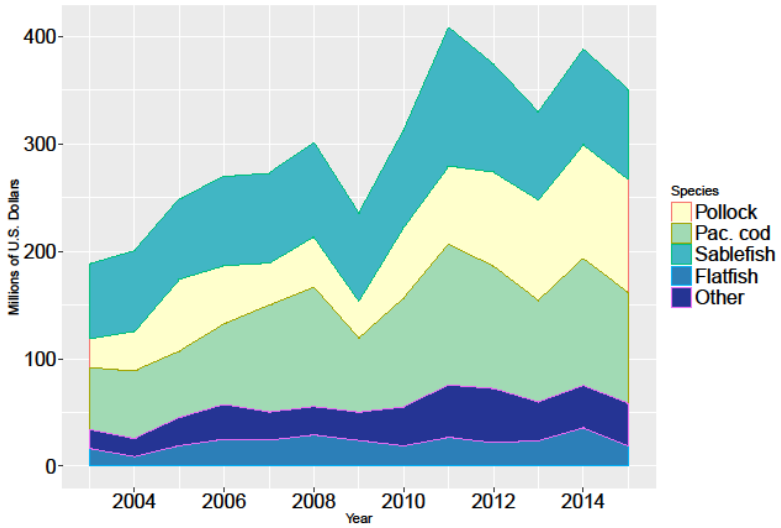

Figure 4. Real gross product value of the groundfish catch in the GOA area by species, 2003-2015 (base year = 2015).

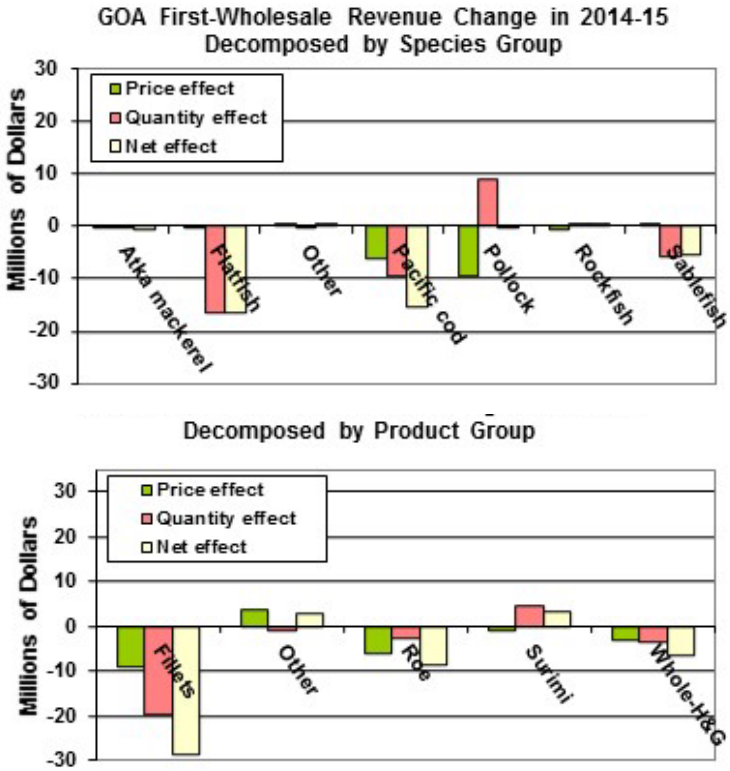

Figure 5. Decomposition of the change in first-wholesale revenues from 2014-15 in the GOA area. The first decomposition is by the species groups used in the Economic SAFE report, and the second decomposition is by product group. The price effect refers to the change in revenues due to the change in the 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 2016: Status of Alaska's Marine Ecosystems* chapter consists of four main components:

1) an executive summary with ecosystem report cards, and physical, environmental, ecosystem, fishing, and fisheries trends,
2) an ecosystem assessment, and
3) ecosystem 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 2016 Gulf of Alaska Report Cards. For 2016, two separate report cards were produced, one for the Western GOA and one for the Eastern GOA.

The **Western GOA** (which includes the CGOA and WGOA NMFS management areas) report card includes ten indicators summarized as follows:

1. The Gulf of Alaska in 2016 was characterized by warm conditions that were first seen in 2014, and have continued as reflected in the positive PDO pattern. Anomalously warm conditions are expected to continue through the winter.
2. Fresh water input as estimated at the GAK1 station has been variable over the long time series. The most recent data indicate an increasing trend.
3. Mesozooplankton biomass measured by the continuous plankton recorder has shown a largely biennial trend since 2009 with higher biomass during even-numbered years. However, biomass remained greater than average in 2015. Biomass trends can be influenced by ecosystem conditions and mean size of the community. This suggests that prey availability for planktivorous fish, seabirds, and mammals have been variable recently. The biennial patterns suggest a possible link with biennially varying planktivorous pink salmon abundance.
4. Copepod community size has been declining in recent years, suggesting that less lipid-rich prey were available to planktivores.
5. Survey biomass of motile epifauna has been above its long-term mean since 2001. The increase from 1987 to 2001 was driven by hermit crabs and brittle stars, which dominate the biomass. Since 2001 their biomass has been stable. Record catches of octopus influenced the increased estimate in 2015.
6. Trends in capelin as sampled by seabirds and groundfish have indicated that capelin were abundant from 2008 to 2013, but have declined in the past two years. This pattern coincides with the period of cold water temperatures in the Gulf of Alaska.
7. Fish apex predator survey biomass is currently below its 30-year mean, although the declining trend seen in recent years has leveled off. The trend is driven primarily by arrowtooth flounder, which, along with halibut, had been declining since 2005. Both increased slightly in 2015. It is unknown whether these increases were due to distributional shifts in the warm water. Pacific cod has declined from a peak survey biomass in 2009.
8. Black-legged kittiwakes had moderate reproductive success in 2016 at the Semedi Islands, in contrast to the complete failure in 2015 for kittiwakes as well as other seabird species. Their reproductive success is typically variable, presumably reflecting foraging conditions prior to the breeding season, during, or both (before and during).
9. Modeled estimates of western Gulf of Alaska Steller sea lion non-pups counts are above the long term mean and continuing to increase, suggesting conditions are favorable for sea lions in the western Gulf.
10. Homer is the sole town with a steadily increasing population trend. Kodiak experienced declines until 2006 and has recovered slightly since then.

The **Eastern GOA** report card includes eight active indicators summarized as follows:

1. The Gulf of Alaska in 2016 was characterized by warm conditions that were first seen in 2014, and have generally continued since. The strong El Nino of last winter has lessened, and near neutral conditions are expected for next winter.
2. The sub-arctic front was further north than usual, which is consistent with the northerly surface currents seen in the past three years.
3. Total zooplankton density in Icy Strait has been anomalously low in the past three years. Zooplankton density has declined since peak values in 2008 and 2009. This suggests that prey availability has been low for planktivores.
4. Also in Icy Strait, large copepod abundance has declined over the past five years and was particularly low in 2015. The prevalence of small copepods during 2014 fit predictions of warm conditions favoring small copepods, but small copepods also declined in 2015. This suggests that less lipid-rich prey were available to planktivores.
5. A decrease in estimated total mature herring biomass in southeastern Alaska has been observed since the peak in 2011, although the biomass has been above the long-term (1980-2015) median since 2002.
6. Growth rates of piscivorous rhinoceros auklet chicks were anomalously low in 2015, suggesting that the adult birds were not able to find sufficient prey to support successful chick growth. This is in contrast to 2012 and 2013, when chick growth rates were above the long-term average.
7. Modeled estimates of eastern Gulf of Alaska Steller sea lion non-pups counts are above the long term mean, although the rate of increase is slower than that for the western Gulf of Alaska.
8. Human populations in the Gulf of Alaska coastal towns of Yakutat and Sitka are near their 25-year mean. The population of Yakutat has gradually declined since 1997. Sitka has been increasing since 1997, with two substantial declines in 2007 and 2015.

Ecosystem authors expect that these broad-based indicators will be refined over time. Current indicators were reviewed with the Plan Team and alternative indicators were discussed.

There was one "hot topic" noted for the GOA this year:

Increasing salp abundance - Salps are phytoplankton grazers and can filter a large volume of water proportional to body size, and can exhibit a high degree of predation pressure on phytoplankton. This trend may be indicative of low productivity. Also, abundance for a pterapod species was found to be increasing.

Stock summaries

1. Walleye pollock

Status and catch specifications (t) of pollock and projections for 2017 and 2018. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2017 and 2018 are those recommended by the Plan Team. Catch data are current through November 5th, 2016. **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	2015	1,940,031	273,378	203,934	199,151	163,065
	2016	1,981,987	336,084	264,230	257,872	172,927
	2017	1,435,377	249,033	213,689		
	2018		195,430	167,416		
W/C/WYAK	2015	1,883,920	256,545	191,309	186,526	163,065
	2016	1,937,900	322,858	254,310	247,952	172,927
	2017	1,391,290	235,807	203,769		
	2018		182,204	157,496		
SEO	2015	56,111	16,833	12,625	12,625	0
	2016	44,087	13,226	9,920	9,920	0
	2017	44,087	13,226	9,920		
	2018		13,226	9,920		

Changes from the previous assessment

The age-structured assessment model used for GOA W/C/WYAK pollock assessment was modified in the 2016 assessment. The changes included the use of a random effects model for processing the input fishery weight-at-age, and applying a delta-generalized linear model (delta-GLM) to develop a standardized index of abundance from the Alaska Department of Fish & Game (ADFG) trawl survey. The 2016 assessment compared four models to the 2015 model with the new data (Model 15.1a):

Model 16.1 as 15.1a but using the random effects model for processing the input fishery weight-at-age,

Model 16.2 as 16.1, but applying the delta-GLM to the ADFG survey instead of area-swept biomass,

Model 16.3 as 16.2, but with revised Shelikof Strait acoustic survey estimates for net selectivity, and

Model 16.4 as 16.2, but with a spatial generalized linear mixed model (GLMM) for the NMFS bottom trawl survey instead of area-swept biomass.

Models 16.3 and 16.4 were exploratory at this stage and might be considered as options in future assessments. The Plan Team accepted the authors' recommended final model configuration (16.2) that used the random effects model for processing fishery weight-at-age and the delta-GLM for the ADFG abundance index standardization.

This year's pollock assessment features the following new data: 1) 2015 total catch and catch-at-age from the fishery, 2) 2016 biomass and age composition from the Shelikof Strait acoustic survey, 3) 2015 biomass and age composition from NMFS bottom trawl survey, 4) 2016 biomass and 2015 age composition from the ADFG crab/groundfish trawl survey, and 5) 2013 and 2015 age compositions from the summer acoustic survey.

Model 16.2 fits to fishery age composition data was reasonable. 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 were like previous assessments, and general trends in survey time series were fit reasonably well. It was 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 was unable to fit the extreme low value for the ADFG survey in 2015 and 2016, though otherwise the fit to this survey was quite good. The fit to the age-1 and age-2 Shelikof acoustic indices appeared adequate though variable. The addition of the 2016 data point to the age-2 acoustic indices resulted in a large outlier that degraded the fit to the entire time series.

Spawning biomass and stock trends

In 1998, the stock dropped below $B_{40\%}$ for the first time since the early 1980s and reached a minimum in 2003 at 25% of unfished stock size. Over the years 2009-2013, the stock increased from 32% to 60% of unfished, but declined to 33% by 2016. The spawning stock is projected to increase again in 2017 as the strong 2012 year class starts maturing. The model estimate of female spawning biomass in 2017 is 363,800 t, which is 54.5% of unfished spawning biomass (based on average post-1977 recruitment) and above the $B_{40\%}$ estimate of 267,000 t. The large and unexplained decline in pollock biomass in the 2015 ADFG survey continued in 2016, and thus remains a concern, especially since this time series has shown relatively little variability compared to other indices.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Because the model projection of female spawning biomass in 2017 is above $B_{40\%}$, the W/C/WYAK Gulf of Alaska pollock stock is in Tier 3a. The projected 2017 age-3+ biomass estimate is 1,391,290 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 2017 ABC for pollock in the Gulf of Alaska west of 140° W longitude (W/C/WYAK) is 203,769 t which is a decrease of 20% from the 2016 ABC. The OFL is 235,807 t for 2017. The 2017 Prince William Sound (PWS) GHL is 5,094 t (2.5% of the ABC).

For pollock in southeast Alaska (East Yakutat and Southeastern areas), the ABC for both 2017 and 2018 is 9,920 t and the OFL for both 2017 and 2018 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 a random effects model fit to the 1990-2015 bottom trawl survey biomass estimates in Southeast Alaska.

Status determination

The Gulf of Alaska pollock stock 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 survey, 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. Last year, the Plan Team recommended that summer acoustic survey data be averaged with the random effects model of bottom-trawl survey biomass to determine the summer allocation. Area apportionments, reduced by 2.5% of the ABC (5,094 t in 2017 and 3,937 t in 2018) 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 2017 and 2018 pollock ABCs for the Gulf of Alaska (t).						
Year	**610 Western**	**620 Central**	**630 Central**	**640 WYAK**	**650 SEO**	**Total**
2017	43,602	98,652	48,929	7,492	9,920	208,595
2018	33,701	76,249	37,818	5,791	9,920	163,479

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 2017 and 2018 are those recommended by the Plan Team. Catch data are current through November 5th, 2016.					
Year	**Age 0+ biomass**	**OFL**	**ABC**	**TAC**	**Catch**
2015	583,800	140,300	102,850	75,202	55,260
2016	518,800	116,700	98,600	71,925	39,544
2017	426,384	105,378	88,342		
2018		94,188	79,272		

Changes from the previous assessment

The fishery catch data was updated for 2015 and 2016 (2016 expected total year catch was projected). Fishery size composition data were updated for 2015, preliminary fishery size composition were included for 2016, and weight and age at length and age composition data for the 2015 bottom trawl survey were included. For the first time, AFSC longline survey relative population numbers (RPNs) and length composition data for 1990 – 2016 were included. A major difference in the new models examined was that all the data were annually aggregated rather than stratified by season.

The author evaluated several models and presented a subset of models that included the model configuration from 2015 with updated data (Model 15.3), models similar to those presented at the September Plan Team meeting with updated data and extension of modeled ages to 20 years, and five additional model configurations. Model tuning was also evaluated.

Model 16.08.25 was recommended by the author and Team concurred. This model's performance in both fit to available data and retrospective patterns was better than other models. Major features of this model included dome shaped selectivity for pot and trawl fishery length compositions and survey length and age compositions. Natural mortality and survey catchability (Q) was estimated within the model. The estimate of natural mortality was considerably higher than the fixed value used in Model 15.3 (0.47 vs 0.38). The higher *M* resulted in a higher proportion of the population observed by the surveys compared to last year's assessment.

Spawning biomass and stock trends

The $B_{40\%}$ estimate was 78,711 t, with projected 2017 spawning biomass of 91,198 t. Recruitment was above average for the 2005-2013 period and below average for 2014-2016. Spawning biomass is expected to increase in 2018 and then decline.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The higher *M* (0.47) implies higher productivity but lower overall abundance than in previous assessments, which results in a higher $F_{40\%}$. This stock is in Tier 3a because the 2017 spawning biomass is estimated to be greater than $B_{40\%}$. The $F_{35\%}$ and $F_{40\%}$ are 0.652 and 0.530, respectively. The maximum permissible ABC of 88,342 t is a 10.4% decrease from the 2016 ABC of 98,600 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
2017	36,291	44,180	7,871	88,342
2018	32,565	39,644	7,063	79,272

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 2017 and 2018 are those recommended by the Plan Team. Catch data are current through November 5th, 2016.

Year	Age 4+ biomass	OFL	ABC	TAC	Catch
2015	130,000	12,425	10,522	10,522	10,330
2016	122,000	10,326	9,087	9,087	9,281
2017	139,000	12,279	10,074		
2018		12,444	10,207		

Relative to last year's assessment, the following substantive changes in the current assessment were made.

Changes in the input data
New data included in the assessment model were relative abundance and length data from the 2016 longline survey, relative abundance and length data from the 2015 longline fishery, length data from the 2015 trawl fisheries, age data from the 2015 longline survey and 2015 fixed gear fishery, updated catch for 2015, and projected 2016 - 2018 catches. The following substantive changes were made to the data inputs:

1) New analytical variance calculations for the domestic longline survey abundance index
2) New area sizes for the domestic longline survey abundance index
3) Domestic longline survey estimates corrected for sperm whale depredation
4) Estimates of killer and sperm whale depredation in the fishery

Changes in the assessment methodology
The 2016 Center for Independent Experts (CIE) review panel had several recommendations to improve the reference model. Five alternative models address the data inputs described above. Two of these alternatives incorporated the new area sizes and variance estimates for the domestic longline survey. Three models incorporated corrections of the domestic longline survey and longline fishery for whale depredation.

The CIE panel expressed concern that last year's model provided "overly precise" estimates of management quantities. This concern was addressed in the authors' preferred model (Model 16.5) by reweighting the abundance indices along with estimating natural mortality internally (with a prior distribution).

For the first time, whale depredation factors have been accounted for within the survey index and historical fishery catch. The amount of anticipated whale depredation due to fishing was also deducted from the recommended maximum permissible ABC. The Team concurred with the authors' recommended model because of the retrospective performance and improved model fits. The treatment of whale depredation effects was considered an improvement.

Spawning biomass and stock trends

Projected 2017 spawning biomass is 36% of unfished spawning biomass. The longline survey abundance index increased 34% from 2015 to 2016 following a 21% decrease from 2014 to 2015 which was the lowest point of the time series. The fishery abundance index decreased 12% from 2014 to 2015 and is the time series low (the 2016 data are not available yet). Spawning biomass is projected to decrease slightly from 2017 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 were calculated using recruitments from 1977-2013. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from this assessment are 105,836 t (combined across the EBS, AI, and GOA), 0.094, and 0.113, respectively. Projected female spawning biomass (combined areas) for 2017 is 91,553 t (87% of $B_{40\%}$), placing sablefish in Tier 3b.

The maximum permissible value of F_{ABC} under Tier 3b is 0.081 which results in a 2017 ABC of 10,408 t. Deducting the expected amount of whale depredation, the recommended 2017 ABC is 10,074 t for the GOA. The OFL fishing mortality rate is 0.097 which results in a 2017 OFL of 12,279 t.

Status determination

Model projections indicate that this stock is not subject to overfishing, overfished, nor approaching an overfished condition.

Area apportionment

Apportionments have been held constant since the 2013 fishery and the Teams concurred:

	2016			2017		2018	
Region	**OFL**	**ABC**	**TAC**	**OFL**	**ABC**	**OFL**	**ABC**
W	--	1,272	1,272	--	1,349	--	1,367
C	--	4,023	4,023	--	4,514	--	4,574
**WYAK	--	1,475	1,475	--	1,605	--	1,626
SEO	--	2,316	2,316	--	2,606	--	2,640
GOA	**10,326**	**9,087**	**9,087**	**12,279**	**10,074**	**12,444**	**10,207**
BS	1,304	1,151	1,151	1,551	1,274	1,572	1,291
AI	1,766	1,557	1,557	2,101	1,735	2,129	1,758
Total	13,397	11,795	11,795	13,397	13,083	16,145	13,256

* Catch through November 5th 2016.

** 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 2017 and 2018. 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 5th, 2016.

Year	Biomass	OFL	ABC	TAC	Catch
2015	287,534	54,207	44,205	35,381	3,232
2016	303,299	54,520	44,364	36,763	3,591
2017	299,858	54,583	44,514		
2018		54,893	44,771		

Changes from the previous assessment

An executive summary for shallow water flatfish was presented which included updated 2015 catch and the partial 2016 catch as well as 2016 catch projections for northern and southern rock sole. Projected catch to the end of 2016 is calculated as the average fraction of catch to October 13 from the last 10 years (83.4%). The projected 2017 catch is set equal to the projected 2016 catch. This is a change from previous assessments which assumed maximum permissible ABC as the catch for the upcoming year.

Last year's projected 2017 biomass, OFL and ABC estimates for the shallow-water complex from the 2015 assessment used catch assumptions that were considerably higher than current estimates. This resulted in lower biomass projections than the current update. Otherwise there were no changes to the assessment methodology. The random effects model was used to estimate 2015 biomass for the Tier 5 calculations.

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. Biomass, OFL and ABC values for 2017 and 2018 for northern and southern rock sole are estimated using projections from the 2015 assessment model with catches updated for 2015 and 2016.

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 44,514 t and OFL of 54,583 t for 2017.

Status determination

The northern and southern rock sole component of the complex represents 78% of catch in 2016. Most recently, the catch has been less than 15% of the ABC. Northern and southern rock 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 the rest of the shallow water flatfish stock complex. Catch levels for this complex remain well below the TAC and below levels where overfishing would be a concern. The Team recommends that the complex's status is not overfished.

Area apportionment

The recommended apportionment for the 2017 ABC are estimated using the random effects model estimates of biomass for the shallow water flatfish complex by management areas.

Year	Western	Central	Yakutat	Southeast	Total
	47%	44%	7%	2%	
2017	20,921	19,306	3,188	1,099	44,514
2018	21,042	19,418	3,206	1,105	44,771

5. Deepwater flatfish complex (Dover sole and others)

Status and catch specifications (t) of deepwater flatfish (Dover sole and others) and projections for 2017 and 2018. 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 5, 2016.

Year	Biomass	OFL	ABC	TAC	Catch
2015	182,160	15,993	13,334	13,344	242
2016	141,824	11,102	9,226	9,226	170
2017	141,824	11,182	9,292		
2018		11,290	9,382		

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. This year is an off-year thus an executive summary of the assessment was presented and there were no changes in assessment methodology. New information available to update the Dover sole projection model consisted of updated 2015 catch and catch estimates for 2016 and 2017.

A different method for apportionment, discussed below, was used and endorsed by the Team.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Dover sole is a Tier 3 stock which is assessed using an age-structured model. A single species projection model was run using parameter values from the accepted 2015 Dover sole assessment model. Both Greenland turbot and deepsea sole are in Tier 6. The 2017 Dover sole ABC is 9,109 t. The Tier 3a calculations for Dover sole result in 2017 OFL of 10,938 t. The 2017 Tier 6 calculation of ABC for the other species in the complex is 183 t and OFL is 244 t. The GOA Plan Team agrees with the authors' recommendation to use the combined species' ABCs and OFLs for the deepwater flatfish complex for 2017. This equates to a 2017 maximum permissible ABC of 9,292 t and OFL of 11,182 t for the deepwater flatfish complex.

Status determination

Based on the results of the updated assessment, 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. Since Dover sole comprises approximately 98% of the deepwater flatfish complex the species is considered the main component for determining the status of this stock complex. Catch levels for this complex remain well below the TAC and below levels where overfishing would be a concern.

Area apportionment

Apportionment for the deepwater flatfish complex was done using the random effects model to fill in depth and area gaps in the survey biomass by area for Dover sole. The resulting proportion of predicted survey biomass in each area formed the basis for apportionment of the Dover sole portion of the deepwater complex. The Greenland turbot and deepsea sole portion was based on the proportion of survey biomass for each species in each area, averaged over the years 2005-2015. The ABC by area for the deepwater flatfish complex is then the sum of the species-specific portions of the ABC.

Year	Western	Central	WYAK	SEO	Total
	2.8%	37.2%	32.5%	27.6%	100.0%
2017	256	3,454	3,017	2,565	9,292
2018	257	3,488	3,047	2,590	9,382

6. Rex Sole

Status and catch specifications (t) of rex sole and projections for 2017 and 2018. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 5th, 2016.					
Year	Biomass	OFL	ABC	TAC	Catch
2015	82,972	11,957	9,150	9,150	1,957
2016	67,941	9,791	7,493	7,493	1,662
2017	75,359	10,860	8,311		
2018		11,004	8,421		

Changes from the previous assessment

The rex sole stock is assessed on a biennial schedule to coincide with the timing of survey data. This year is an off-year thus an executive summary of the assessment was presented. The projection model was run using updated 2015 catch and new/estimated catches for 2016-2017.

Spawning biomass and stock trends

The model estimate of 2017 female spawning biomass is 47,008 t, which is a 2% increase from 2016, and well above $B_{40\%}$ (22,738 t). The total biomass estimate (age 3+) increased from 68,074 t in 2016 to 75,359 t in 2017 with a slightly higher projected increase expected in 2018.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Since 2005, the Team has adopted a Tier 5 approach (using model estimated adult biomass) for rex sole ABC recommendations due to unreliable estimates of $F_{40\%}$ and $F_{35\%}$. ABCs and OFLs are calculated using the catch equation applied to beginning year biomass values estimated by the age structured model. Using $F_{ABC} = 0.75M = 0.128$ results in a 2017 ABC of 8,311 t. The 2017 OFL using $F_{OFL} = M = 0.17$ is 10,860 t. The Team concurs with the author's recommended maximum permissible ABCs for 2017 and 2018.

Status determination

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

Area apportionment

Area apportionments of rex sole ABC's for 2017 and 2018 are based on the random effects model applied to GOA bottom trawl survey biomass in each area.

Year	Western	Central	WYAK	SEO	Total
	17.55%	59.32%	10.22%	12.90%	
2017	1,459	4,930	850	1,072	8,311
2018	1,478	4,995	861	1,087	8,421

7. Arrowtooth flounder

Status and catch specifications (t) of arrowtooth flounder and projections for 2017 and 2018. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data current through November 5th, 2016.					
Year	**Biomass**	**OFL**	**ABC**	**TAC**	**Catch**
2015	1,957,970[1]	226,390	192,921	103,300	19,054
2016	2,103,860[2]	219,430	186,188	103,300	18,993
2017	2,103,090[2]	219,327	186,093		
2018		196,635	170,510		

[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

There were no changes in assessment methodology since this was an off-cycle year. Parameter values from the previous year's assessment model, projected catch for 2016, and updated 2015 catch were used to make projections for ABC and OFL estimates.

Spawning biomass and stock trends

Arrowtooth flounder biomass estimates are very similar to those estimated in the last full assessment in 2015. The projection model estimate of total (age 1+) biomass shows a slight decrease to 2,103,090 t in 2017. Female spawning biomass in 2017 was estimated at 1,174,400 t, which is above $B_{40\%}$, and is essentially equivalent (0.5% decrease) to the 2016 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.

Status determination

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

Area apportionment

The recommended area apportionment from the random effects model was used by the Team to provide apportionments for the 2017 and 2018 ABCs:

	Western	Central	WYAK	SEO	Total
Year	15.1%	58.0%	20.1%	6.8%	100%
2017	28,100	107,934	37,405	12,654	186,093
2018	25,747	98,895	34,273	11,595	170,510

8. Flathead sole

Status and catch specifications (t) of flathead sole and projections for 2017 and 2018. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 5th, 2016.

Year	Biomass age 3+	OFL	ABC	TAC	Catch
2015	254,602	50,972	41,349	27,756	2,001
2016	265,088	42,840	35,020	27,832	2,283
2017	269,638	43,128	35,243		
2018		43,872	35,829		

Changes from the previous assessment

The flathead sole stock is assessed on a biennial schedule to coincide with the timing of survey data. This year is an off-year thus an executive summary of the assessment was presented. The projection model was run using updated 2015 catch and new estimated total year catches for 2016-2017.

Spawning biomass and stock trends

The 2017 spawning biomass estimate (82,819 t) is above $B_{40\%}$ (36,866 t) and projected to be stable through 2018. Total biomass (3+) for 2017 is 269,638 t and is projected to slightly increase in 2018.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Flathead sole are determined to be in Tier 3a. For 2017 the Plan Team concurred with the authors' recommendation to use the maximum permissible ABC of 35,243 t from the updated projection. The F_{OFL} is set at $F_{35\%}$ (0.40) which corresponds to an OFL of 43,128 t.

Status determination

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

Area apportionment

Area apportionments of flathead sole ABCs for 2017 and 2018 are based on the random effects model applied to GOA bottom trawl survey biomass in each area.

Year	Western	Central	WYAK	SEO	Total
	31.49%	57.71%	8.37%	2.43%	100.00%
2017	11,098	20,339	2,949	857	35,243
2018	11,282	20,677	2,998	872	35,829

9. Pacific ocean perch

Status and catch specifications (t) of Pacific ocean perch and projections for 2017 and 2018. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2017 and 2018 are those recommended by the Plan Team. Catch data are current as of November 5th, 2016.

Year	Biomass	OFL	ABC	TAC	Catch
2015	416,140	24,360	21,012	21,012	18,733
2016	457,768	28,431	24,437	24,437	23,020
2017	445,672	27,826	23,918		
2018		27,284	23,454		

Changes from the previous assessment

The Pacific ocean perch (POP) stock is assessed on a biennial schedule to coincide with the timing of survey data. During on-cycle (odd) years, a full assessment model with updated assessment and projection model results are presented. New data added to the projection model included updated 2015 catch and new projected total year catches for 2016-2018.

Spawning biomass and stock trends

The 2017 spawning biomass estimate (156,563 t) is above $B_{40\%}$ (114,131 t). The projected 2018 spawning stock biomass estimate is 156,444 t.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The GOA Pacific ocean perch stock was determined to be in Tier 3a. The Team accepted the author recommended model resulting in an estimated maximum permissible ABC of 23,918 t (with $F_{ABC} = F_{40\%}$ of 0.102). The F_{OFL} is specified to be equal to the $F_{35\%}$ estimate (0.119) and results in an OFL of 27,826 t.

Status determination

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

Area apportionment

The apportionment of ABCs was developed in the 2015 full assessment based on the random effects model applied to the subarea biomass indices from the GOA trawl survey. The apportionments are 11.2% for the Western area, 69.7% for the Central area, and 19.1% for the Eastern area. The recommended 2017 ABC's are 2,679 t for the Western area, 16,671 t for the Central area, and 4,568 t for the Eastern area.

Amendment 41 prohibited trawling in the Eastern area east of 140º W longitude. Since POP are caught exclusively with trawl gear, there is concern that the entire Eastern area TAC could be taken in the area that remains open to trawling (between 140º and 147º W longitude). Thus, the Team recommends that a separate ABC continue to be set for POP in WYAK using the weighted average of the upper 95% confidence interval for W. Yakutat. This results in the proportion of biomass in the W. Yakutat area (between 140° W and 147° W) being 0.61. The 2017 ABCs for the W. Yakutat and eastern area (East Yakutat/Southeast Outside area) are 2,786 t and 1,782 t, respectively.

POP are determined to be in Tier 3a ($F_{OFL} = F_{35\%}$=0.139) and OFL is equal to 27,826 t. In 2012, area OFLs were combined for the Western, Central, and West Yakutat (W/C/WYAK) areas, while the East Yakutat/Southeast (SEO) OFL was separated due to stock structure concerns. The 2012 OFL apportionment method is recommended for 2017 resulting in overfishing levels for W/C/WYAK area of 25,753 t (92.5%) and 2,073 t (7.5%) in the SEO area.

Area apportionment of 2017-2018 ABC and OFL for POP in the Gulf of Alaska:

Year	Quantity	Western	Central	WYAK	SEO	Total
2017	ABC	2,679	16,671	2,786	1,782	23,918
2018	ABC	2,627	16,347	2,733	1,747	23,454
	Quantity	**Western/Central/WYAK**			**SEO**	**Total**
2017	OFL	25,753			2,073	27,826
2018	OFL	25,252			2,032	27,284

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 2017 and 2018 are those recommended by the Plan Team. Catch data are current through November 5th, 2016. Note that for management purposes, the northern rockfish from the EGOA ABC is combined with other rockfish. The ABC for 2017 and 2018 listed below deducts 4 t.

Year	Age 2+ biomass	OFL	ABC	TAC	Catch
2015	98,409	5,961	4,998	4,998	3,944
2016	77,596	4,783	4,004	4,004	3,389
2017	75,028	4,522	3,790		
2018		4,175	3,512		

Changes from the previous assessment

Rockfish are assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. For Gulf of Alaska rockfish in alternate (even) years an executive summary is provided to recommend harvest levels for the next two years. New data added to the projection model included updated 2015 catch and projected total year catches for 2016-2018.

Spawning biomass and stock trends

The 2017 spawning biomass estimate (29,198 t) is above $B_{40\%}$ (27,983 t) and projected to decrease to 27,344 t in 2018. Total biomass (2+) for 2017 is 75,028 t and is projected to decrease to 73,248 in 2018.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Northern rockfish are estimated to be in Tier 3a in 2017 and 3b in 2018. The Plan Team agreed with the authors' recommendation to use the maximum permissible 2017 ABC and OFL values of 3,790 t and 4,522 t, respectively.

Status determination

This 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 2017 and 2018 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 2017-2018:

Year	Western	Central	Eastern	Total
2017	432	3,354	4	3,790
2018	400	3,108	4	3,512

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 2017 and 2018 are those recommended by the Plan Team. Catch data are current as of November 5th, 2016.

Year	Biomass	OFL	ABC	TAC	Catch
2015	58,797	1,764	1,323	1,323	578
2016	57,175	1,715	1,286	1,286	746
2017	57,175	1,715	1,286		
2018		1,715	1,286		

Changes from the previous assessment

Rockfish are assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. For Gulf of Alaska rockfish in alternate (even) years an executive summary is provided to recommend harvest levels for the next two years. The authors provided results from application of the stock-structure template to shortraker rockfish and is attached as an appendix to this year's assessment. See minutes for Team recommendations and comments.

Spawning biomass and stock trends

The trend of survey biomass remains stable.

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 average survey biomass (based on random effects model) results in a 2017 ABC and OFL of 1,286 t and 1,715 t respectively.

Status determination

The stock was not being subjected to overfishing last year.

Area apportionment

The following table shows the recommended apportionment for 2017. The apportionment percentages are the same as in the 2015 assessment (for the 2016 fishery). Please refer to the last full stock assessment report for information regarding the apportionment rationale for the shortraker rockfish stock.

Year	Western	Central	Eastern	Total
	2.98%	23.40%	73.62%.	
2017 and 2018	38	301	947	1,286

Catches in the Western GOA have exceeded this apportionment in 2015 (47 t) and 2016 (52 t as of Nov 5th 2016) and in the Central GOA in 2016 (395 t as of Nov 5th, 2016). An initial look at 2016 catch by region and fishery show that the pollock fishery in the Central GOA caught nearly 147 t of shortraker rockfish, whereas the average shortraker rockfish catch in the pollock fishery in this region during years 2009 – 2015 was under 2 t.

12. Dusky rockfish

Status and catch specifications (t) of dusky rockfish and projections for 2017 and 2018. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2017 and 2018 are those recommended by the Plan Team. Catch data are current through November 5th, 2016.

Year	Age 4+ biomass	OFL	ABC	TAC	Catch
2015	66,629	6,246	5,109	5,109	2,781
2016	60,072	5,733	4,686	4,686	3,290
2017	57,307	5,233	4,278		
2018		4,837	3,954		

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. This off-year assessment consists of updating the catch data and running the projection model from the 2015 assessment. There were no changes in the assessment methods. New data added to the projection model included updated 2015 catch and new projected catches for 2016-2018.

Spawning biomass and stock status trends

The 2017 projected spawning biomass estimate (23,178 t) is above $B_{40\%}$ (19,707 t) and projected to decrease to 21,554 t in 2018.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The dusky rockfish stock is in Tier 3. The Plan Team agreed with the authors' recommendation of maximum permissible ABC of 4,278 t for 2017. This ABC is 9% lower than the 2016 ABC of 4,686 t.

Status determination

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

Area apportionment

Area apportionment percentages for 2017 are the same as used in the last full assessment.

			Eastern (7.8%)		
	Western	**Central**	**WYAK**	**SEO**	**Total**
Year	3.7%	88.5%	5.9%	1.9%	100%
2017	158	3,786	251	83	4,278
2018	146	3,499	232	77	3,954

13. Rougheye and blackspotted rockfish

Status and catch specifications (t) of rougheye and blackspotted rockfish and projections for 2017and 2018. Biomass for each year corresponds to the projections given in the SAFE report issued in the preceding year. The OFL and ABC for 2017 and 2018 are those recommended by the Plan Team. Total biomass estimates are age-3+ from the age-structured model; catch data are current as of November 5th, 2016.

Year	Biomass	OFL	ABC	TAC	Catch
2015	36,584	1,345	1,122	1,122	550
2016	41,864	1,596	1,328	1,328	621
2017	41,650	1,594	1,327		
2018		1,583	1,318		

Changes from the previous assessment

Rockfish are assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. For Gulf of Alaska rougheye and blackspotted rockfish in alternate (even) years, an executive summary is provided to recommend harvest levels for the next two years. New data added to the projection model included updated 2015 catch and new projected total year catches for 2016-2018.

Spawning biomass and stock status trends

Female spawning biomass (13,754 t) is above $B_{40\%}$ (8,226 t) and projected to remain stable.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The rougheye/blackspotted complex qualifies as a Tier 3a stock. For the 2017 fishery, the Plan Team accepts the authors' recommended maximum permissible ABC of 1,327 t ($F_{ABC} = F_{40\%} = 0.04$) and OFL ($F_{OFL}=F_{35\%} = 0.048$) of 1,594 t.

Status determination

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

Area apportionment

Apportionment of the 2017 and 2018 ABC is based on the same method used last year (3 survey weighted average) resulting in the following percentage apportionments by area: Western 7.9%, Central 53.2% and Eastern 38.9%.

Year	Western	Central	Eastern	Total
2017	105	706	516	1,327
2018	104	702	512	1,318

14. Demersal shelf rockfish

Status and catch specifications (t) of demersal shelf rockfish and projections for 2017 and 2018. Biomass for each year corresponds to the survey biomass estimates given in the SAFE report issued in the preceding year(s). The 2016 catch data are current as of November 5th, 2016.

Year	Biomass	OFL	ABC	TAC	Catch
2015[1]	10,933	361	225	225	108
2016[2]	10,559	364	218	211	115
2017[2]	10,347	357	227		
2018[2]		357	227		

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

[2] For 2016, 2017, and 2018 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

Catch information and average weights for yelloweye rockfish catch from the commercial fishery were updated for 2016.

Results from the statistical age-structured model for yelloweye rockfish in southeast outside Alaska waters was presented as an appendix. The Plan Team was encouraged by the development and expects to review preliminary model results in September 2017. 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 exhibited 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 for yelloweye the overfishing level (OFL) was set using $F_{35\%}$=0.032; which equates to 357 t for 2017 compared to 364 t for 2016. The maximum permissible ABC for 2017 is 289 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 Tier 6 calculations for non-yelloweye DSR, the recommended ABC is 227 t for 2017, down slightly from that recommended for 2016.

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 2016 are current through November 5th, 2016.

Year	Biomass	OFL	ABC	TAC	Catch
2015	81,816	2,454	1,841	1,841	1,034
2016	87,155	2,615	1,961	1,961	1,092
2017	87,155	2,615	1,961	1,961	
2018		2,615	1,961		

Changes from previous assessment

Thornyheads are assessed on a biennial schedule to coincide with the timing of survey data. In this off-cycle year, estimates from 2015 are rolled over for the next two years. There were no changes made to assessment inputs or assessment methodology. An executive summary was presented. New catch information includes updated 2015 and estimated 2016 catch.

The author provided an appendix which summarizes thornyhead tagging studies in Alaska.

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 ABCs by region for 2017 and 2018 are as follows:

Western	Central	Eastern	Total
291	988	682	1,961

16. Other rockfish

Status and catch specifications (t) of other rockfish. Biomass estimates for 2016 and 2017 are based on the random effects model for Tier 4 and 5 species. The OFL and ABC for 2017 and 2018 are those recommended by the Plan Team. Catch data are current through November 5th, 2016. 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
2015	83,383	5,347	4,080	1,811	1,110
2016	104,826	7,424	5,773	2,308	1,380
2017	104,826	7,424	5,773		
2018		7,424	5,773		

Changes from the previous assessment

There were no changes in assessment inputs or methodology since this was an off-cycle year.

Spawning biomass and stock trends

The estimated biomass of 104,826 t is based on the random effects model applied to survey biomass for the Tier 4 and 5 species in the complex. Surveys indicate stability for this complex.

Tier determination/ Plan Team discussion and resulting ABCs and OFLs

GOA other rockfish are managed as a Tier 4/5/6 stock complex. 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 2017 and 2018 (including the 4 t from the northern rockfish category).

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. As in previous recent assessment, a single ABC for the combined WGOA and CGOA areas is used to address concerns about the ability to manage smaller ABCs in the WGOA. The apportionments recommended for **2017 and 2018** were:

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

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 2017 and 2018 are those recommended by the Plan Team. Catch data are current through November 5th, 2016.

Year	Biomass	OFL	ABC	TAC	Catch
2015	-	6,200	4,700	2,000	1,228
2016	-	6,200	4,700	2,000	993
2017	-	6,200	4,700		
2018	-	6,200	4,700		

Changes from the previous assessment

New information includes updated 2014 and 2015 catches. Since the 2015 stock assessment, ages from the 2014 and 2015 GOA fisheries have become available. In addition, new survey age information is available from the 2015 summer bottom trawl survey, and these data are comprised of fish from the Western and Central Gulf of Alaska.

Spawning biomass and stock trends

Estimates of spawning biomass are unavailable 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 considered unreliable 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 2017 ABC for GOA Atka mackerel equal to the maximum permissible value of 4,700 t. The 2017 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

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 2017 and 2018 are those recommended by the Plan Team. Catch data are current through November 5th, 2016.

Species	Year	Biomass	OFL	ABC	TAC	Catch
Big Skate	2015	43,398	4,340	3,255	3,255	1,515
	2016	50,857	5,086	3,814	3,814	1,380
	2017	50,857	5,086	3,814		
	2018		5,086	3,814		
Longnose Skate	2015	42,911	4,291	3,218	3,218	1,671
	2016	42,737	4,274	3,206	3,206	1,310
	2017	42,737	4,274	3,206		
	2018		4,274	3,206		
Other Skates	2015	29,797	2,980	2,235	2,235	1,782
	2016	25,580	2,558	1,919	1,919	1,568
	2017	25,580	2,558	1,919		
	2018		2,558	1,919		

Changes from the previous assessment

Skates are normally assessed on a biennial schedule, with full assessments presented in odd years to coincide with the timing of survey data. The 2016 assessment is an executive summary prepared with updated catch data.

Spawning biomass and stock trends

The survey biomass trend was mixed between the stocks covered. Big skate biomass increased, other skates decreased, and longnose skates were stable.

Tier determination/Plan Team discussion and resulting ABCs and OFLs
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.

		ABC				
Years	Species	Western	Central	Eastern	Total	OFL
2017 and 2018	Big skate	908	1,850	1,056	3,814	5,086
2017 and 2018	Longnose skate	61	2,513	632	3,206	4,274
2017 and 2018	other skates				1,919	2,558

19. Sculpins

Status and catch specifications (t) of GOA sculpins and projections for 2017 and 2018. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2017 and 2018 are those recommended by the Plan Team. Catch data for 2016 are current through November 5th, 2016.

Year	Biomass	OFL	ABC	TAC	Catch
2015	33,550	7,448	5,569	5,569	1,015
2016	34,943	7,338	5,591	5,591	1,283
2017	34,943	7,338	5,591		
2018		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. There were no changes to the Tier 5 approach used in 2015. New information includes updated 2015 and 2016 catch data.

Spawning biomass and stock trends

The stock complex trends overall appear to be stable based on survey data. However, the author noted that some stocks (e.g., bigmouth sculpin) had survey biomass estimates that indicated declines.

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

The Team concurred with the Tier 5 approach, including the biomass estimates based on the random effects model.

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. 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 2017 and 2018 are those recommended by the Plan Team. Catch data are current through November 5th, 2016.

Year	Biomass	OFL	ABC	TAC	Catch
2015	76,452	7,986	5,989	5,989	1,414
2016	56,181	6,020	4,514	4,514	1,841
2017	56,181	6,020	4,514		
2018		6,020	4,514		

Changes from the previous assessment

The GOA shark complex (spiny dogfish, Pacific sleeper shark, salmon shark, and other/unidentified sharks) are assessed on a biennial stock assessment schedule to coincide with the timing of the NMFS bottom trawl survey. In this off-cycle year, estimates from the 2015 full assessment are rolled over for the next two years. New information includes updated 2015 and estimated 2016 catch.

Assessment methodology

There were no changes to assessment methodology.

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 (termed a modified Tier 6 or Tier 6*) 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 2016 have been well below the ABC first established for the shark complex in 2011. There are 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. The OFL and ABC for 2017 and 2018 are those recommended by the Plan Team. Catch data are current through November 5th, 2016.

Year	OFL	ABC	TAC	Catch
2015	1,530	1,148	1,148	411
2016	1,530	1,148	1,148	241
2017	1,516*	1,137		
2018	1,516*	1,137		

*Maximum historical catch was updated and the OFL reflects that change.

Changes from the previous assessment

Total catch and retention rates were updated through October 2016. An executive summary was presented in the 2016 SAFE report.

Spawning biomass and stock trends

Reliable estimates of spawning biomass and stock trends are unavailable. Squid catch in 2015 and 2016 was like recent years except 2012, when it was anomalously low. Squid catch patterns were also like earlier years. Squid retention rates are variable but indicate that many captured squids were retained.

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 set the OFL equal to the maximum historical catch between 1997 and 2007 (1,516 t) and the ABC equal to 0.75 x OFL (1,137 t).

Status determination and area apportionment

As a Tier 6 stock, there is insufficient data to determine if the squid complex is in an overfished condition or being subject to overfishing and therefore the status is unknown. This complex is 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 2017 and 2018 are those recommended by the Plan Team. 2016 catches current through November 5th, 2016.

Year	Biomass	OFL	ABC	TAC	Catch
2015	12,271	2,009	1,507	1,507	968
2016	12,271	6,504	4,878	4,878	323
2017	12,271	6,504	4,878		
2018	-	6,504	4,878		

Changes from the previous assessment

There have been no changes in the assessment methods. This is a Tier 6 assessment with an alternative method approved by the Plan Team and SSC. A minimum biomass estimate based on trawl survey data and a conservative rate of natural mortality were used to set OFL and ABC, as in previous years.

Spawning biomass and stock trends

The most recent data from the 2015 GOA trawl survey and suggested an increase in octopus biomass.

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 the minimum biomass estimate. Using a Tier 5-like calculation of OFL, average minimum B×M (12,271 t × 0.53 = 6,504 t) and the ABC equal to 0.75 × OFL (4,878 t) was estimated.

Status determination and area apportionment

Biomass estimates for octopuses are unreliable so determination of spawning biomass or stock status is unavailable. The stock is not being subjected to overfishing. This stock is managed Gulf-wide.

Tables

Table 1. Gulf of Alaska groundfish 2017 - 2018 OFLs and ABCs, 2016 TACs, and 2016 catch (reported through November 5th, 2016).

		2016				2017		2018	
Species	**Area**	**OFL**	**ABC**	**TAC**	**Catch**	**OFL**	**ABC**	**OFL**	**ABC**
Pollock	State GHL		6,358	-	-	-	5,094	-	3,937
	W(61)		56,494	56,494	61,222		43,602		33,701
	C(62)		124,927	124,927	46,968		98,652		76,249
	C(63)		57,183	57,183	64,605		48,929		37,818
	WYAK		9,348	9,348	132		7,492		5,791
	Subtotal	322,858	254,310	247,952	172,927	235,807	203,769	182,204	157,496
	EYAK/SEO	13,226	9,920	9,920	-	13,226	9,920	13,226	9,920
	Total	336,084	264,230	257,872	172,927	249,033	213,689	195,430	167,416
Pacific Cod	W		40,503	28,352	17,539		36,291		32,565
	C		49,312	36,984	21,939		44,180		39,644
	E		8,785	6,589	66		7,871		7,063
	Total	116,700	98,600	71,925	39,544	105,378	88,342	94,188	79,272
Sablefish	W		1,272	1,272	1,037		1,349		1,367
	C		4,023	4,023	4,147		4,515		4,574
	WYAK		1,475	1,475	1,640		1,605		1,626
	SEO		2,317	2,317	2,457		2,605		2,640
	Total	10,326	9,087	9,087	9,281	12,279	10,074	12,444	10,207
Shallow Water Flatfish	W		20,851	13,250	145		20,921		21,042
	C		19,242	19,242	3,445		19,306		19,418
	WYAK		3,177	3,177	-		3,188		3,206
	EYAK/SEO		1,094	1,094	1		1,099		1,105
	Total	54,520	44,364	36,763	3,591	54,583	44,514	54,893	44,771
Deep Water Flatfish	W		186	186	4		256		257
	C		3,495	3,495	161		3,454		3,488
	WYAK		2,997	2,997	9		3,017		3,047
	EYAK/SEO		2,548	2,548	5		2,565		2,590
	Total	11,102	9,226	9,226	179	11,182	9,292	11,290	9,382
Rex Sole	W		1,315	1,315	169		1,459		1,478
	C		4,445	4,445	1,492		4,930		4,995
	WYAK		766	766	1		850		861
	EYAK/SEO		967	967	-		1,072		1,087
	Total	9,791	7,493	7,493	1,662	10,860	8,311	11,004	8,421
Arrowtooth Flounder	W		28,183	14,500	985		28,100		25,747
	C		107,981	75,000	17,970		107,934		98,895
	WYAK		37,368	6,900	25		37,405		34,273
	EYAK/SEO		12,656	6,900	13		12,654		11,595
	Total	219,430	186,188	103,300	18,993	219,327	186,093	196,635	170,510
Flathead Sole	W		11,027	8,650	214		11,098		11,282
	C		20,211	15,400	2,069		20,339		20,677
	WYAK		2,930	2,930	-		2,949		2,998
	EYAK/SEO		852	852	-		857		872
	Total	42,840	35,020	27,832	2,283	43,128	35,243	43,872	35,829

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Table 1. (continued) Gulf of Alaska groundfish 2017 - 2018 OFLs and ABCs, 2016 TACs, and 2016 catch (reported through November 5th, 2016).

		2016				2017		2018	
Species	**Area**	**OFL**	**ABC**	**TAC**	**Catch**	**OFL**	**ABC**	**OFL**	**ABC**
Pacific Ocean Perch	W		2,737	2,737	2,627		2,679		2,627
	C		17,033	17,033	17,566		16,671		16,347
	WYAK		2,847	2,847	2,827		2,786		2,733
	W/C/WYAK	26,313	22,617	22,617	23,020	25,753	22,136	25,252	21,707
	SEO	2,118	1,820	1,820	-	2,073	1,782	2,032	1,747
	Total	28,431	24,437	24,437	23,020	27,826	23,918	27,284	23,454
Northern Rockfish	W		457	457	115		432		400
	C		3,547	3,547	3,274		3,354		3,108
	E		4	-	-		4		4
	Total	4,783	4,004	4,004	3,389	4,522	3,790	4,175	3,512
Shortraker Rockfish	W		38	38	52		38		38
	C		301	301	395		301		301
	E		947	947	299		947		947
	Total	1,715	1,286	1,286	746	1,715	1,286	1,715	1,286
Dusky Rockfish	W		173	173	91		158		146
	C		4,147	4,147	3,184		3,786		3,499
	WYAK		275	275	7		251		232
	EYAK/SEO		91	91	8		83		77
	Total	5,733	4,686	4,686	3,290	5,233	4,278	4,837	3,954
Rougheye and Blackspotted Rockfish	W		105	105	40		105		104
	C		707	707	467		706		702
	E		516	516	114		516		512
	Total	1,596	1,328	1,328	621	1,594	1,327	1,583	1,318
Demersal shelf rockfish	GOA-wide	364	231	231	115	357	227	357	227
Thornyhead Rockfish	W		291	291	207		291		291
	C		988	988	663		988		988
	E		682	682	222		682		682
	Total	2,615	1,961	1,961	1,092	2,615	1,961	2,615	1,961
Other Rockfish	WC		1,534	1,534	1,294		1,534		1,534
	WYAK		574	574	48		574		574
	EYAK/SEO		3,665	200	38		3,665		3,665
	Total	7,424	5,773	2,308	1,380	7,424	5,773	7,424	5,773
Atka mackerel	GOA-wide	6,200	4,700	2,000	993	6,200	4,700	6,200	4,700
Big Skate	W		908	908	134		908		908
	C		1,850	1,850	1,874		1,850		1,850
	E		1,056	1,056	44		1,056		1,056
	Total	5,086	3,814	3,814	1,380	5,086	3,814	5,086	3,814
Longnose Skate	W		61	61	131		61		61
	C		2,513	2,513	843		2,513		2,513
	E		632	632	336		632		632
	Total	4,274	3,206	3,206	1,310	4,274	3,206	4,274	3,206
Other Skates	GOA-wide	2,558	1,919	1,919	1,568	2,558	1,919	2,558	1,919
Sculpins	GOA-wide	7,338	5,591	5,591	1,293	7,338	5,591	7,338	5,591
Sharks	GOA-wide	6,020	4,514	4,514	1,841	6,020	4,514	6,020	4,514
Squids	GOA-wide	1,530	1,148	1,148	241	1,516	1,137	1,516	1,137
Octopuses	GOA-wide	6,504	4,878	4,878	323	6,504	4,878	6,504	4,878
Total		892,964	727,684	590,809	291,062	796,552	667,877	709,242	597,052

*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 2017 ABCs, biomass, and overfishing levels (t) for Western, Central, Eastern, Gulfwide, West Yakutat, and Southeast Outside regulatory areas.

		2017		
Species/Assemblage	**Area**	**ABC**	**Biomass**	**OFL**
Pollock	W(61)	43,602 [a]		
	C(62)	98,652 [a]		
	C(63)	48,929 [a]		
	WYAK	7,492 [a]		
	Subtotal	203,769 [a]	1,435,377	235,807
	EYAK/SEO	9,920	44,087	13,226
	Total	213,689 [a]	1,479,464	249,033
Pacific Cod	W	36,291		
	C	44,180		
	E	7,871		
	Total	88,342	426,384	105,378
Sablefish	W	1,349		
	C	4,515		
	WYAK	1,605		
	EY/SEO	2,605		
	Total	10,074	139,000	12,279
Shallow water Flatfish	W	20,921		
	C	19,306		
	WYAK	3,188		
	EYAK/SEO	1,099		
	Total	44,514	299,858	54,583
Deepwater Flatfish	W	256		
	C	3,454		
	WYAK	3,017		
	EYAK/SEO	2,565		
	Total	9,292	141,824	11,182
Rex sole	W	1,459		
	C	4,930		
	WYAK	850		
	EYAK/SEO	1,072		
	Total	8,311	75,359	10,860
Arrowtooth Flounder	W	28,100		
	C	107,934		
	WYAK	37,405		
	EYAK/SEO	12,654		
	Total	186,093	2,103,090	219,327
Flathead sole	W	11,098		
	C	20,339		
	WYAK	2,949		
	EYAK/SEO	857		
	Total	35,243	269,638	43,128

[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 2017 ABCs, biomass, and overfishing levels (t) for Western, Central, Eastern, Gulfwide, West Yakutat, and Southeast Outside regulatory areas.

	2017			
Species/Assemblage	**Area**	**ABC**	**Biomass**	**OFL**
Pacific ocean perch	W	2,679		25,753
	C	16,671		26,313
	WYAK	2,786		
	EY/SEO	1,782		2,073
	Total	23,918	445,672	27,826
Northern rockfish	W	432		
	C	3,354		
	E	[1]		
	Total	3,786	75,028	4,522
Shortraker	W	38		
	C	301		
	E	947		
	Total	1,286	57,175	1,715
Dusky rockfish	W	158		
	C	3,786		
	WYAK	251		
	EYAK/SEO	83		
	Total	4,278	57,307	5,233
Rougheye/blackspotted rockfish	W	105		
	C	706		
	E	516		
	Total	1,327	41,650	1,594
Demersal shelf rockfish	Total	227	10,347	357
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		1,137		1,516
Octopus		4,878	12,271	6,504
Total		667,877	6,036,346	796,552

[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, 2017.

Species	Tier	F_{ABC}[1]	Strategy	F_{OFL}[2]	Strategy
Pollock (W/C/WYAK)	3a	0.25	$F_{40\%}$	0.30	$F_{35\%}$
(SEO)	5	0.225	F=0.75M	0.30	F=M
Pacific cod	3a	0.53	$F_{40\%}$	0.652	$F_{35\%}$
Sablefish	3b	0.078	F_{ABC}	0.089	$F_{35\%\ adjusted}$
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, 6[5]	0.065, 0.0015-0.075	$F_{40\%}$, F=0.75M, F_{ABC}[6]	0.079, 0.02-0.10	$F_{35\%}$, F=M, F_{OFL}[7]
Northern rockfish	3a	0.062	$F_{40\%}$	0.074	$F_{35\%}$
Dusky rockfish	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/ Sharpchin rockfish are in Tier 4, 16 species are in Tier 5, 7 species are in Tier 6 (these 7 are managed as DSR in the East Yakutat/Southeast region of the Eastern GOA.
6/ $F_{40\%}$ for sharpchin rockfish (Tier 4), F=0.75M for 16 species of the other rockfish category (Tier 5), ABC for 7 species of the other rockfish category is equal to 0.75 x maximum catch over 2013-2014. This is a modified Tier 6 recommendation.
7/ $F_{35\%}$ for sharpchin (Tier 4), F=M for 16 species of the other rockfish category (Tier 5), OFL for 7 species of the other rockfish category is equal to the maximum catch over 2013-2014. This is a modified Tier 6 recommendation.
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 2017 recommended fishing mortality rates and ABCs, for those species whose recommendations were below the maximum.

			2017		
Species[1]	Tier	*Max* F_{ABC}	*Max* ABC	F_{ABC}	ABC
Sablefish	3b	0.081	10,408	0.078	10,074
Demersal shelf rockfish	4, 6	0.026	289	0.02	227

1/ In the past, the recommended W/C pollock ABC was based on a model projection using a more conservative harvest rate than the maximum permissible. This year, the alternative calculation gives the same ABC as the maximum permissible ABC.

Table 5. Groundfish landings (metric tons) in the Gulf of Alaska,1956-2016.

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	163,065	55,260	10,313	7,572	19,054	24,915
2016 [h]	172,927	39,544	9,281	7,715	18,993	29,156

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.

Table 5. (cont'd) Groundfish landings (t) in the Gulf of Alaska,1956-2016. 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	2,646	296,974
2015	2,781	108	1,034	1,228	4,968	3,808	294,106
2016 [h]	3,290	115	1,092	993	4,258	3,698	291,062