Discussion Paper:
Sablefish Discard Allowance

September 19, 2018[1]

Contents

1 Background / Introduction

According to the latest Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) Groundfish Stock Assessment and Fishery Evaluations (SAFEs; Hanselman et al., 2017) the 2014 year class of sablefish is the largest year class in the history of recruitment estimates, two and a half times larger than the most recent very large year class in 1977. The maximum acceptable biological catch (ABC) for the 2018 fishing year increased 89% compared to 2017, but in setting ABC for 2018, the Council chose a more conservative 14% increase. This was done with two major considerations in mind that are expressed in the 2017 SAFE: (1) scientific uncertainty in the magnitude of the 2014-year class along with diminishing production from the existing spawning stock, and (2) scientific and management uncertainty regarding the impacts of whale depredation on estimates of sablefish abundance and fishery removals.

Public testimony at the April 2018 Council meeting indicated that the directed fishery encountered large numbers of unmarketable small sablefish in 2017, but regulations require that all sablefish encountered in the IFQ fishery must be retained. Discussion at the April meeting reflected Council and industry interest

[1] Prepared by: Jim Armstrong and Sam Cunningham, Council staff with input from Megan Mackey (NMFS), Mary Furuness (NMFS), Joe Krieger (NMFS), Mary Furuness (NMFS), Lisa Thompson (NMFS), Cara Rodgeveller (NMFS), Dana Hanselman (NMFS), Chris Lunsford (NMFS), and Alicia Miller (NMFS). Data from Mike Fey (AKFIN)

in management flexibility that could effectively reduce fishing mortality on the 2014 year class in the near term while these fish are small and have low economic value in order to improve the year class's future contribution to the spawning stock and fishery. The Council initiated this discussion paper to consider modifying the retention requirement in the IFQ longline and pot fisheries in the GOA and BSAI. If the Council chooses to pursue further action on this issue, it should define the scope of the potentially affected entities by explicitly stating whether analysts should consider changes to retention regulations for both catcher vessels and catcher-processors.

The Council's April 2018 motion[2] reads as follows:

> Initiate a discussion paper to consider modifying the requirement to retain small sized sablefish in the Alaska Individual Fishing Quota (IFQ) longline and pot fisheries (GOA and BSAI).
>
> - The discussion paper should include a description of available data to inform development of a *discard mortality rate* for sablefish in the Alaska longline and pot fisheries, with the intent of informing potential changes in retention regulations to allow for the release of smaller sablefish.
> - The paper should include a discussion about the potential *trade-offs* of a minimum size requirement regulation for sablefish versus allowing careful release of small juvenile sablefish.
> - The paper should include an economic section describing the *value of sablefish* of different sizes.
> - The paper should also include a discussion about the effects on *observer sampling* of modifying the sablefish retention requirement.

Organization of the Document

To provide a complete narrative of the issues involved, this discussion paper is organized into biological, economic, and management sections with summary points provided at the end. The issues raised in the Council's motion (*italicized* in the text above) are addressed within this structure in the following document sections: Discard mortality rate (2.4), Trade-offs (2.3 and 3.2), Value of sablefish by size (3.1), and Observer sampling (4.2).

2 Biological Considerations

2.1 Contribution of the 2014 Year Class to Sablefish Biomass

Despite a consistent, conservative management approach, the long-term biomass trend for sablefish has included several prolonged periods of decline during its management history. In a sense, the stock can be said to have been "waiting" for a large year class to provide a change in that trend. Recruitment or year class size for the North Pacific sablefish population is highly variable but very large year classes are quite rare (Figure 1). Ignoring the outlier years (e.g., 1977 and 2014) recruitment generally varies between 1 and 20 million fish (~80% of year classes), averaging around 14 million fish. According to the 2017 SAFE, the 2014 year class was estimated to have been greater than 200 million fish (Figure 1).

Sablefish are a long-lived species and fish over 40 years old are commonly found in commercial samples (Alaska record is 94 years, and Canada record is 55 years). Natural mortality (M) is, of course, low for long-lived species (M is estimated to be 0.097 for sablefish) and harvest specifications set by the Council have achieved low fishing mortality (F). Sablefish are a tier 3 stock under the Council's catch limit control rule system and harvest limits are set to achieve increasingly conservative values of F if stock

[2] http://npfmc.legistar.com/gateway.aspx?M=F&ID=d5415301-65cd-4f32-9d30-30103b00663e.pdf

biomass decreases below the $B_{40\%}$ reference point (98,332 mt). According to the most recent stock assessment, sablefish spawning biomass (88,928 mt) is below $B_{40\%}$ but above $B_{35\%}$ (86,040 mt). The benefit of having an unusually large year class in the population is that it affords the Council the opportunity to choose harvest levels that can achieve both near term yield goals while also building, rather than just maintaining, the spawning stock. The Council's specified ABC for 2018 is consistent with increasing the size of the spawning stock. The degree to which future ABC levels would grow the spawning stock can be explored by incorporating harvest scenarios into population projections. Projections from the 2017 SAFE indicate a steep increase in spawning biomass over the next several years (Figure 2) due to increased abundance from the 2014 year class. As with all projections, there is substantial uncertainty associated with harvest and biomass predictions, however, it appears quite likely that the spawning stock will grow well above the biomass target ($B_{40\%}$) over the next several years (Figure 2).

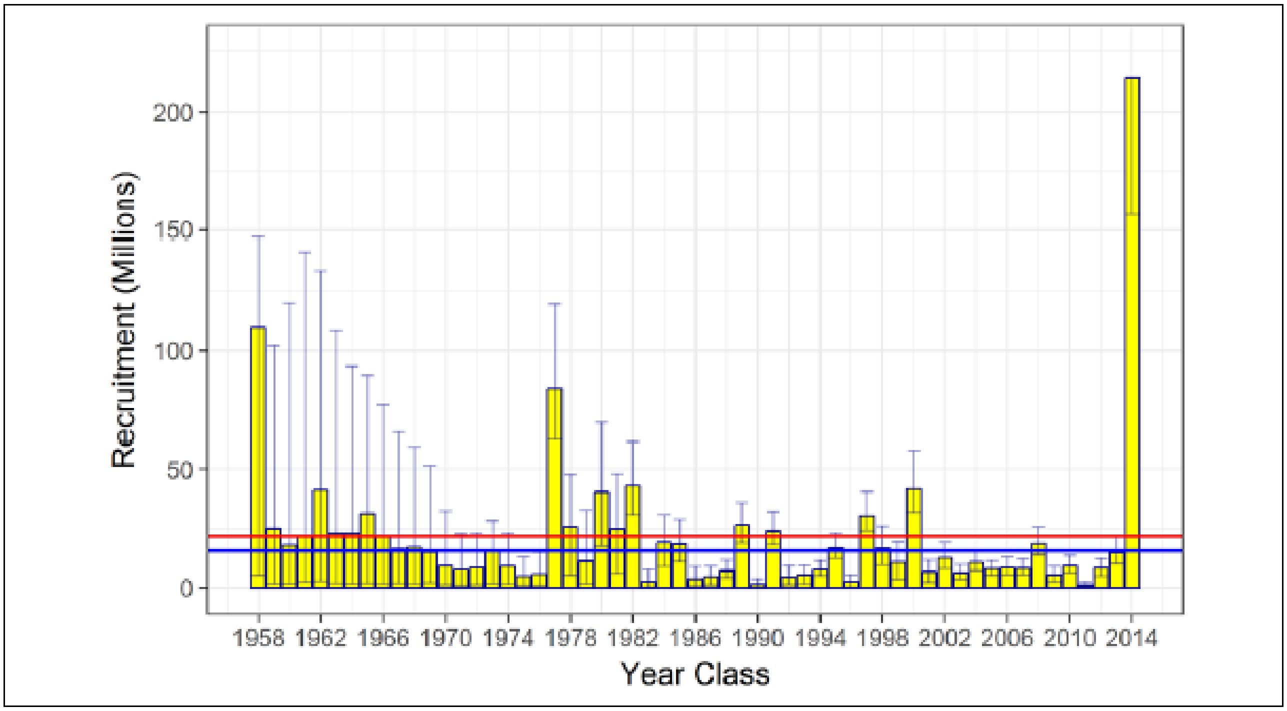


Figure 1 Estimates of the number of age-2 sablefish (millions) with 95% credible intervals by year class. Red line is overall mean, blue line is recruitments from year classes between 1977 and 2013. From Hanselman et al. (2017).

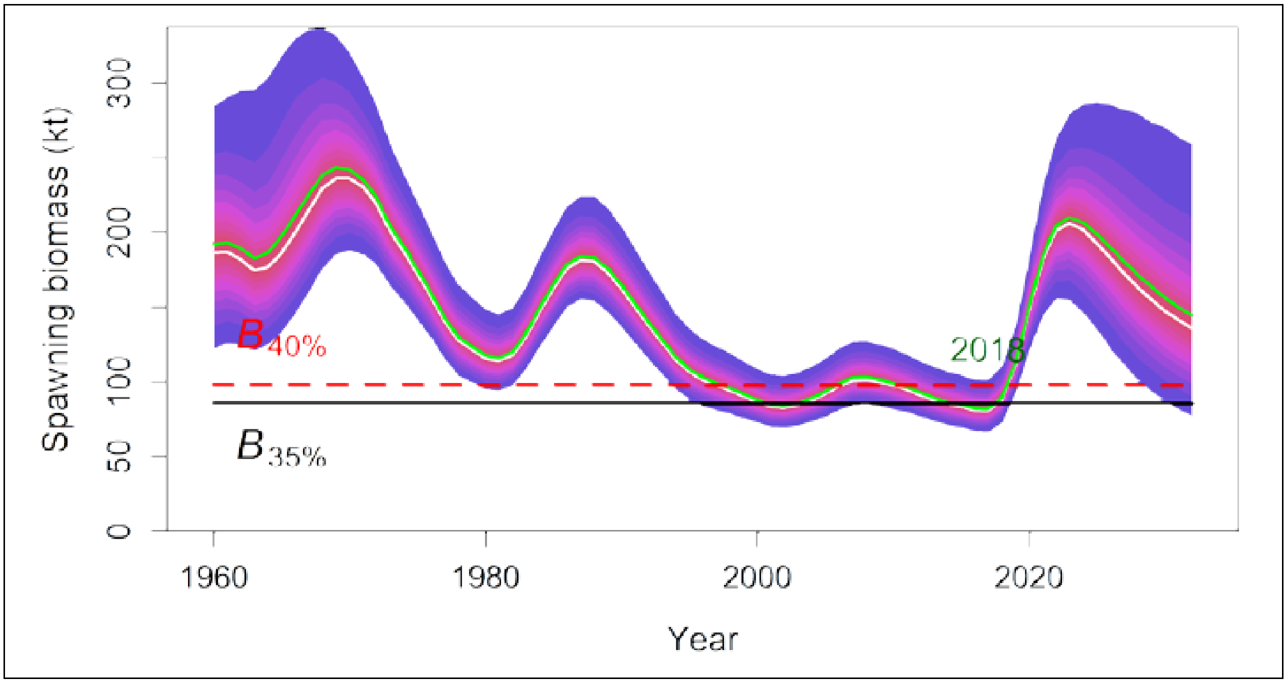


Figure 2 Estimates of female spawning biomass (thousands t) and their uncertainty. White line is the median and green line is the mean, shaded fills are 5% increments of the posterior probability distribution of spawning biomass based on Monte Carlo Markov Chain simulations. Width of shaded area is the 95% credibility interval. From Hanselman et al. (2017).

2.2 Growth of the 2014 Year Class

A major concern for the fishery is the rate of sablefish growth, with the issue being that small fish from a single year class could enter the fishery and swamp the catch for several years to come. Thus, the question becomes one of *when* the 2014 year class will grow out of the lower value market categories (see Section 3 below) and begin to contribute to the larger and more valuable size categories. Although slower growth due to increased resource competition is a hypothetical outcome from the occurrence of a large year class, there has been no evidence thus far that this is occurring (pers comm Hanselman). Therefore, the growth of the 2014 year class is expected to occur at “normal” rates (e.g., **Figure 3**).

Based on size and age data from the directed fishery and fishery-independent surveys, sablefish from the 2014 year class are approximately 55-65 cm (22-26 in) in 2018. Fish this size comprise the lower range of lengths captured by the directed fishery in more typical years (60-80 cm; e.g., 2004-2015 in **Figure 4**). Fish growth can vary greatly among individual fish in a population (**Figure 3**), and faster growing sablefish from the 2014 year class were already being detected in directed fishery catches in 2016 (bottom panel in Figure 4). Small sablefish are more likely to get caught in the non-directed trawl fisheries, and length compositions of trawl-caught sablefish (Figure 5) in 2016 reflect sizes consistent with the presence of a strong 2014 year class. Assuming growth rates continue to be consistent with those that have previously been observed, for 2019 the 2014 year class should mostly comprise fish that are 60-70 cm (24-28 in) which is more typical of the retained IFQ catch.

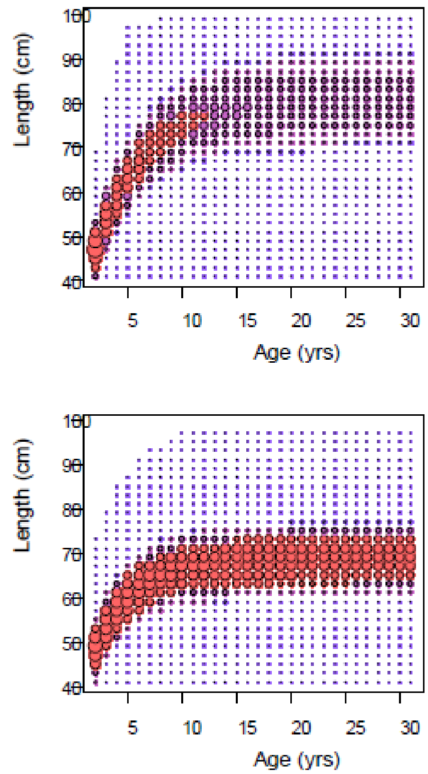


Figure 3 Age-length conversion matrices for sablefish. Top panel is females, bottom panel is males, based on data from 1996-2017. From Hanselman et al. (2017).

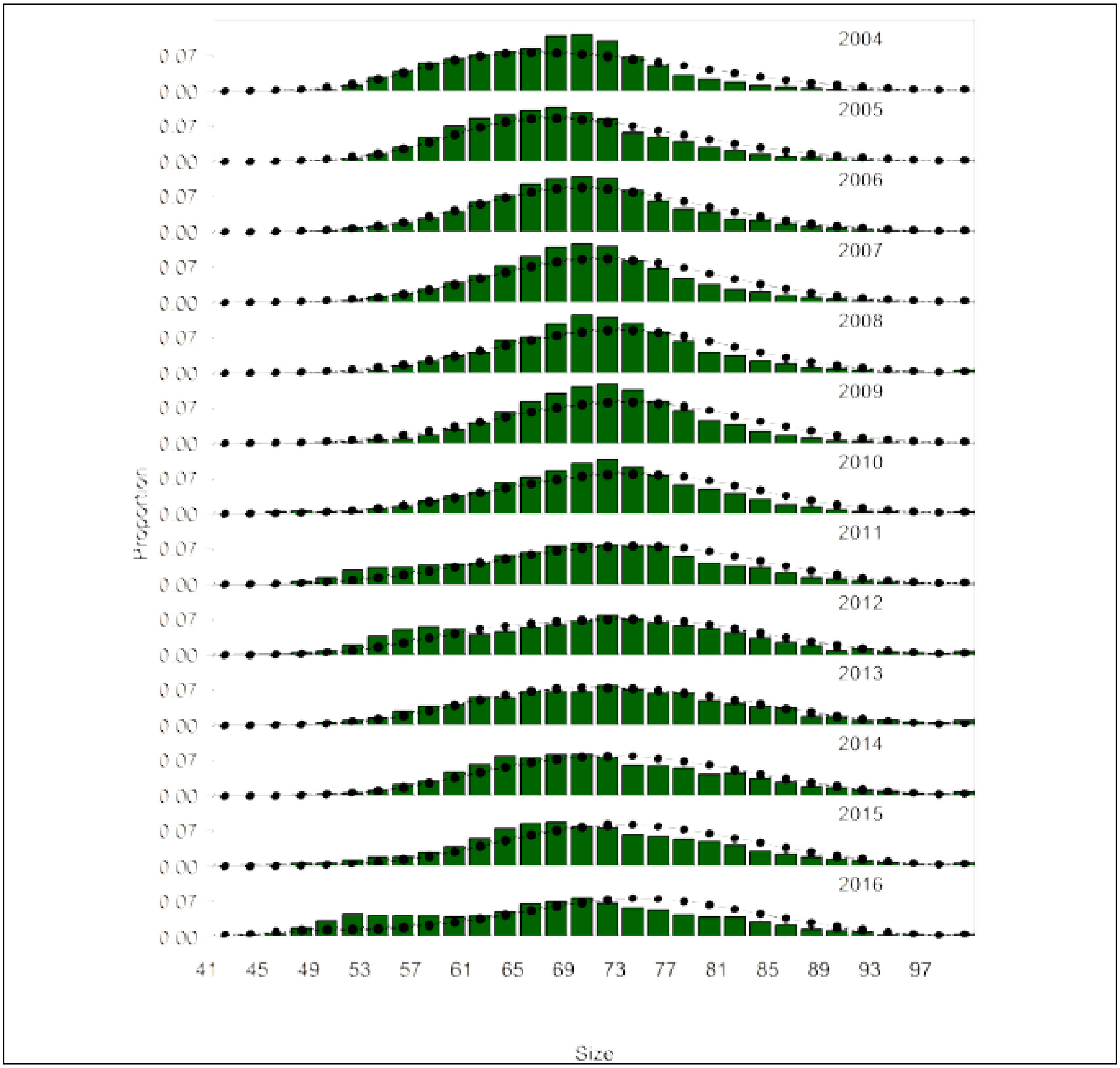


Figure 4 Length frequencies of female sablefish in fixed gear (longline and pot) fisheries off Alaska. Bars are observed frequencies and lines are predicted frequencies. From Hanselman et al. (2017).

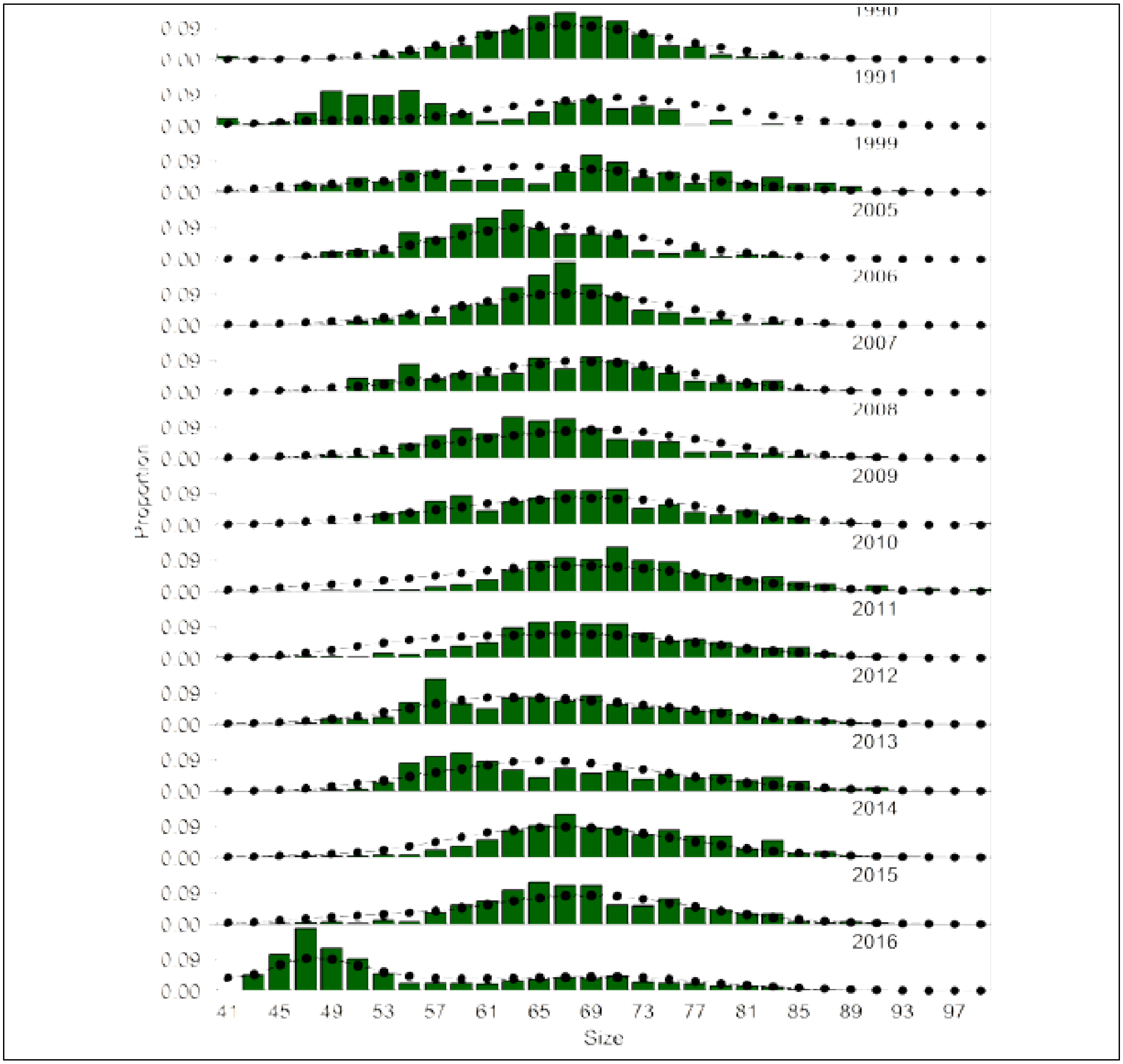


Figure 5 Domestic trawl gear fishery length (cm) compositions for females. Bars are observed frequencies and lines are predicted frequencies. From Hanselman et al. (2017).

Age-4 sablefish that are being caught in 2018 are predominantly 56 to 62 cm or 4 to 5 lbs. (Figure 6). These fish are expected to be around 6 lbs. in 2020, which is the earliest that any management measures resulting from this considered action to require or allow for discarding would go into effect. Six pound fish are in the middle of the distribution of market categories for the IFQ fishery (Section 3).

During the 2017 longline survey, 3 year old sablefish (individuals from the 2014 year class) made up 30.5% of the total collection of sablefish. For comparison, the collective catch of age-4 through age-8 individuals from that same survey accounted for 38.4% of total collections. To the extent that longline survey catches translate to the fishery, individuals from the 2014 year class will have contributed significantly to the commercial catch in 2017 which would match concern expressed through public testimony from the April 2018 Council meeting.

While sablefish from the 2014 year class have already entered the fishery and would not be affected by any changes in current regulation, a review of the effects and implications of a revision may still be warranted in case of future large year class events. One such event in the BSAI and GOA may already be underway. Catches of age-1 sablefish in the 2017 trawl survey (Figure 7) suggest that the 2016 year class may also be uncharacteristically large and could leave an ecological footprint on the fishery similar to that being observed from the 2014 year class. At age-3, sablefish from the 2016 year class would first appear in the fishery in 2019, at which time regulations requiring or allowing release of small sablefish could be applicable to that year class.

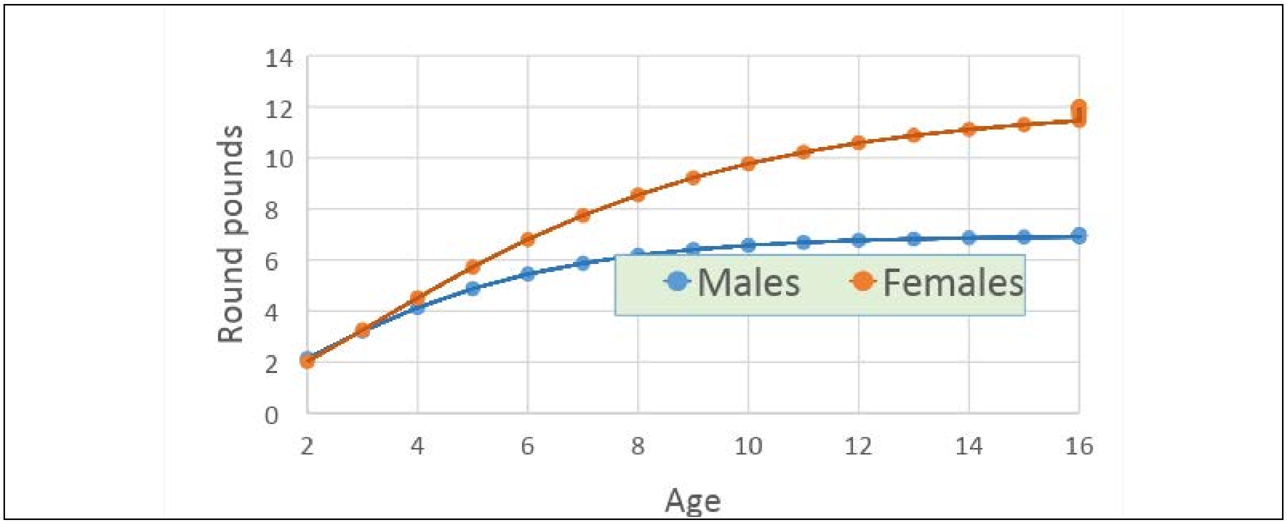


Figure 6 Weight at age for male and female sablefish in Alaska. From Hanselman et al. (2017).

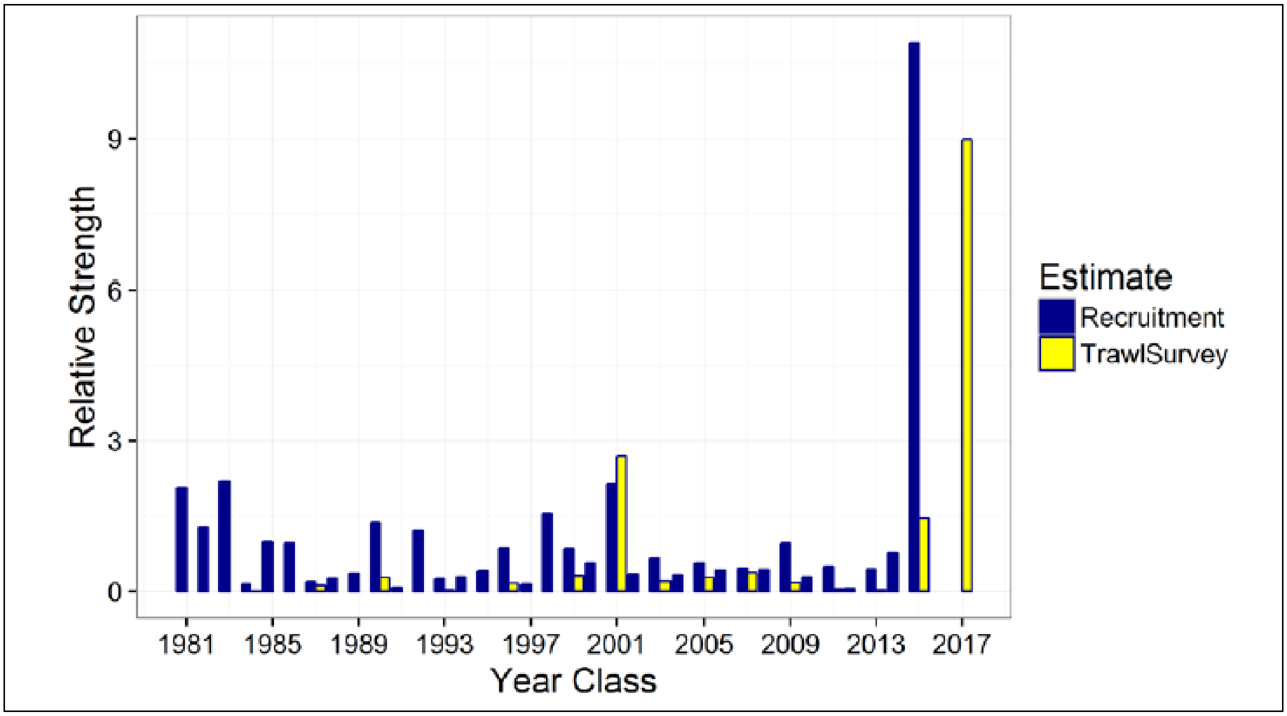


Figure 7 Strength of presence of one-year-old (Length < 32 cm) sablefish in the Gulf of Alaska trawl survey compared to the respective year classes of recruitment estimated by the stock assessment. Strength is relative to the mean abundance or recruitment (i.e., a strength of 7.5 is 7.5x average). From Hanselman et al. (2017).

2.3 Biological Implications of Size Limits and Discarding

Yield per recruit (YPR) analysis is generally conducted to estimate yield and biomass from year classes subjected to fishing mortality under a range of hypothetical sizes at entry to the fishery. In other words, if the onset of fishing mortality is delayed to older age fish through the implementation of a size limit or an allowance for discarding, the hypothetical effect of the size limit on yield and biomass can be explored. Lowe et al. (1991) present analyses of minimum size on the YPR of sablefish using 4 cm (1.6 in) increments from 37 to 61 cm (14.5-24 in). In the analyses, two discard mortality rate (DMR) scenarios are evaluated: 0% DMR for all gear types, and 35% DMR for longline gear and 100% DMR for trawl gear. When the DMR is 0%, yield increased with increasing size limits, but at the larger DMR values the larger size limits produced lower yields. Additionally, population biomass was greatest when minimum size was large, particularly under larger DMRs. However, even with the high DMR, the increases in biomass were negligible when there were low levels of fishing mortality (F<0.10).

Stachura et al. (2012) suggest that sablefish DMR may be quite low (<12%) for longline gear, however, as stated above, overall mortality is also low. In this case, the findings of Lowe et al. (1991) suggest that *a minimum size would not likely be effective at increasing yield.*

Lowe et al. also incorporated monetary value into their analyses. With a 0% DMR the monetary value of the fishery was greater at larger minimum size, particularly at higher F rates (0.10-0.20). This trend reversed and the value to the fishery was lower when there were minimum size limits. However, the economic analysis included the assumption that the price/lb. was constant relative to fish size, which is not usually the case. Lowe et al. (1991) concluded that increases to YPR by implementing minimum size limits is only significant at high F rates. When F is high and DMR is insignificant, implementing size limits can lead to overfishing risks because there could be a more pronounced decrease in spawning biomass when there is poor recruitment than if there were no size limits.

2.3.1 Minimum Size Regulations for Sablefish

Minimum size limits are in place for sablefish fisheries in British Columbia, Canada and the U.S. West Coast Region. No size limit currently exists for State of Alaska jurisdictional sablefish fisheries.

Canada[3]

The history of the size limit regulations in Canada are described in McFarlane and Beamish (1983, p.20):

"*The increase in trawl landings in the "Vancouver" area may be partly attributed to a reduction in the minimum size limit. In 1945, a minimum size limit of 5 lb. (2.3 kg) dressed, head-on (approximately 63 cm FL) was imposed for economic reasons and in 1948 it was amended to 4.5 lb. (2.0 kg) dressed, head-off (Ketchen and Forrester, 1954). In 1965 the minimum size was reduced to 2.5 lb. (1.1 kg) dressed, head-off (approximately 54 cm FL). This regulation remained in effect until November 1970 when a large number of undersized sablefish were landed by special permit to test a specialty market for small sablefish. In July 1972 the minimum size regulation was waived for three months, on an experimental basis, and there was a corresponding sharp increase in trawl landings of sablefish. A downward shift in the sizes of fish landed was evident, as fish that would normally have been discarded were kept (unpub. data). In October 1972 the size limit was reinstated and has remained in effect since that time. In 1977 it was redefined as the equivalent size of 4 lb. (1.8 kg) round weight (approximately 55 cm FL).*"

U.S. West Coast Region

The West Coast Region currently has a 22 inch (56 cm) minimum size limit for non-trawl gear and trip limits for trawl gear retention of small fish.

From the Federal Register, 50 CFR Part 660, August 6, 2002:

"In an effort to reduce fishing effort on the continental shelf where bocaccio [rockfish] are found and move vessels into deeper waters off the slope, the Pacific Council recommended reinstating the minimum 22 inch (56 cm) size requirement for sablefish taken with non-trawl gear and a reduced trip limit for sablefish under the 22 inch (56 cm) requirement taken with trawl gear. Larger sablefish tend to be found at greater depths, thus, prohibiting retention of small sablefish in the non-trawl fisheries and reducing the trip limit in the limited entry trawl fishery is expected to force vessels into deeper water when targeting sablefish. In the trawl fishery south of 40º10' N. lat., the currently scheduled cumulative sablefish limit of 3,000 lb (1,361 kg) per 2 months will remain in effect, with a per trip restriction of no more than 500 lb (227 kg) of sablefish smaller than 22 inches (56 cm). To encourage the non-trawl fisheries to also operate in deeper waters, currently scheduled limits will apply, but retention of sablefish smaller than 22 inches (56 cm) will be prohibited."

Stewart (2011): History of management measures on the U.S. West Coast

1955 First minimum size limit (26-inches, OR and WA only, later removed).
1982 First trip limits imposed on the trawl fishery.
1983 22-inch minimum size limit north of Point Conception, CA (allowance for some smaller fish).

[3] "*No person shall catch and retain a sablefish that is less than 55 cm in length, measured from the tip of the nose to the fork of the tail or where the head has been removed, 39 cm in length measured from the origin of the first dorsal fin to the fork of the tail.*"

2.4 Discard Mortality Rates

2.4.1 Information needed for DMR estimate

As indicated above, the previous exploration of size limit scenarios is dependent on assumptions about discard mortality rates. Additionally, the Council explicitly requested that this discussion paper address DMRs. For management purposes, DMRs are estimated in order to account for total removals (landings + discard mortalities). DMRs vary greatly because they are affected by multiple factors from time of fish capture to time of release. Robust DMR estimates for sablefish would likely need to account for fish size, time on deck, and release condition and water temperature (Davis et al. 2001), which can be challenging to collect during fishing operations.

According to the 2011 sablefish stock assessment for the West Coast (Stewart et al. 2011),“Release mortality rates for the U.S. West Coast sablefish fishery, which has a minimum size limit of 56 cm (22 inches) fork length, are calculated as a function of sea surface temperature based on relationships derived in Davis et al. (2001) (Schirripa and Colbert 2005, Schirripa 2007). Instead, at sea release mortality rates (per year because they are additive to natural and fishing mortality rates) to 0.15/yr for trap gear, 0.30/yr for longline hook gear, and 0.80/yr for trawl. These equate to total annual mortality rates of 14%, 26%, and 55%, respectively.”

For Alaska, scientific field experiments would be needed to quantify DMRs in the context of these factors and would require numerous replicates over a realistic range of fishing conditions. Delayed mortality would need to be accounted for through long-term observation and/or tag-recapture studies. Laboratory studies could be used to simulate capture in fisheries, but it is notoriously difficult to simulate the range of handling practices in the actual fishery. Additionally, DMR estimates would probably not be static but would instead vary within and across fishing seasons.

If specific DMRs related to injury and handling were developed, annual data from the fishery would be needed to quantify the range of injuries and release conditions as well as fishing practices. For example, in order to estimate DMRs for halibut in Alaska, observers routinely measure halibut viability (condition) as part of their normal duties. Application of gear-specific DMRs for sablefish would likely require use of proxy values in the near term since gear-specific DMRs do not exist for sablefish in Alaska and would be challenging to obtain.

2.4.2 Assessment vs. Catch Accounting System use of DMRs

Applying a DMR can be achieved at the total catch/removals estimation stage (within NMFS Catch Accounting System, “CAS”) or within the stock assessment process. In Alaska, the CAS is where catch mortality estimates (retained and discarded) are generated for groundfish species. CAS estimates are used by in-season management to effectively open and close fisheries; analyses that would affect total catch should be applied during in-season management.

In accounting for total removals, stock assessment authors apply DMRs to the total discard estimates provided by CAS. Authors have the latitude to accept the discard mortalities estimated by CAS or independently estimate dead discards. Whichever choice the assessment authors make, the incorporation of DMRs into the stock assessment allows total fishing mortality to be partitioned in the assessment model that derives population estimates and recommended quotas.

2.4.3 Sablefish DMRs under Other Agencies

Other sablefish fisheries along the Pacific coast are managed by the Pacific Fishery Management Council (PFMC), the Department of Fisheries and Oceans Canada (DFO), and the Alaska Department of Fish and

Game (ADF&G). These entities use different DMRs based on gear or geographic area. Listed below are the various rates, rationales, and application.

Pacific Fishery Management Council

Rate: Trawl=50%; hook-and-line = 20% offshore, 7% nearshore (Somers et al. 2014).

Rationale: Trawl and offshore fixed gear rates are historically used numbers on the West Coast. The nearshore fixed gear rate is based on a study of lingcod (Albin and Karpov 1996) that is applied to all species without a swim-bladder in that fishery.

Application: Rate is applied by the stock assessment authors.

DFO – Pacific Region

Rate: Hook-and-Line = 15%, Trap (Pot) = 9%, Trawl: 10% mortality for first 2 hours fished, and 10% per additional hour (DFO 2007).

Rationale: No rationale given for fixed gears. The trawl rate is intended to be an incentive to reduce tow time and avoid bycatch.

Application: Rate is applied during total catch accounting.

Alaska Department of Fish and Game

Rate: Hook-and-Line (sablefish fishery) = 16% (Sullivan and Williams 2018); Hook-and-Line (Pacific halibut fishery) = 25% (Dressel 2009).

Rationale: For 2018, ADF&G is using a new method to estimate the probability of a fish being discarded based on price/lb., weight, sex, and age (Sullivan and Williams 2018). This information is being incorporated into the assessment model and will be reflected in the ABC in the next stock assessment. The DMR being used by ADF&G is 16%. This value was chosen both because it is the DMR used for the Pacific halibut fishery (Gilroy and Stewart 2013) and because it is similar to the estimate for sablefish from Stachura et al. (2012) of 11.7%. The Stachura (2012) estimate was based on the mortality rate of sablefish that were released carefully on a survey platform and so it was assumed that the DMR should be higher than that estimate.

Application: For the Northern Southeast Inside area (NSEI) (Chatham Strait) the 16% rate is applied within the assessment model for the sablefish fishery; the total discards calculated from the 25% DMR is decremented prior to setting the quota (in NSEI).

3 Economic Considerations

The preceding section of this paper identifies that sablefish in the length range corresponding to the 2014 year class have been encountered in the IFQ fishery since as early as 2016. This section addresses the Council's request for information on the differential value of sablefish across size categories and identifies recent trends in the predominance of small sablefish by area. The impetus for this request was to gauge whether a sudden and/or persistent influx of small sablefish into the fishery would negatively affect the value of the fishery. The first subsection identifies size and value trends across management areas and recent years. The second subsection scopes potential trade-offs to consider when weighing the option for a mandatory minimum retention size versus an option to carefully release sablefish at the fisherman's discretion.

As a premium high-priced whitefish, sablefish are an important source of harvesters' revenue. Annual harvest is at or near the TAC in the GOA management areas but is not fully harvested in the BSAI. The U.S. accounts for roughly 90% of global sablefish catch and Alaska accounts for roughly 75%-80% of the U.S. catch. Canada catches roughly 10% of the global supply and a small amount is also caught by Russia. Historically, most of the sablefish harvest has been exported to Asian markets in frozen head-and-gut form. More recently a domestic market has emerged, though a processor noted to staff that domestic buyers have low demand for smaller size fish. Given that Alaska is the primary global producer of sablefish, significant supply reductions in Alaska during the recent past increased wholesale and export prices. In other words, Alaska's dominant position in the sablefish market means that biological events and management decisions that occur in the region will directly affect the economic performance of the fishery. The GOA typically accounts for upwards of 90% of annual Alaska catch (Figure 8). Most IFQ sablefish are caught using hook-and-line gear, though use of pot gear has occurred on a small scale in the BSAI and became legal for the GOA in 2017. Increasing whale depredation on hook-and-line gear is likely to result in more use of pot gear in the future. The data presented in this section aggregate both longline and pot gear harvest of IFQ sablefish; Table 2 in Section 3.1 breaks out 2017 and 2018 (to-date) pot gear harvest in the GOA.

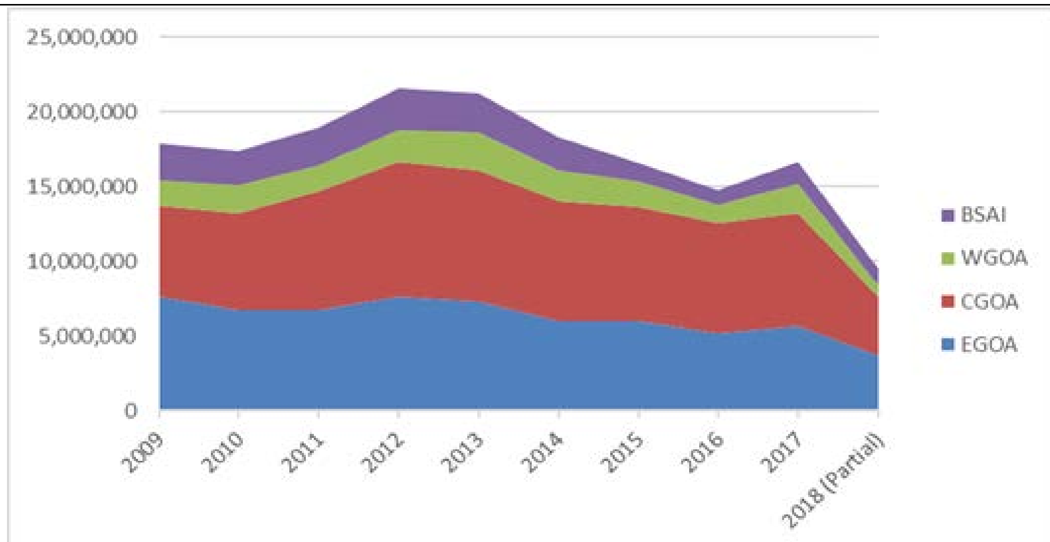
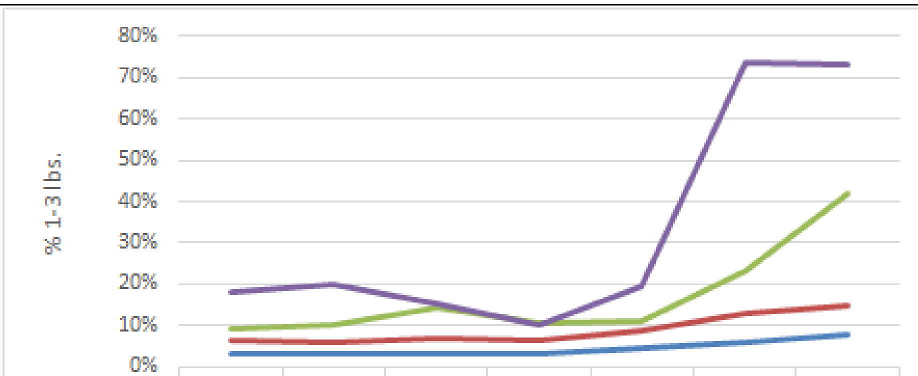


Figure 8 IFQ sablefish landings (lbs.) by area from 2009 through 2018 (partial year). Source: ADFG Fish Ticket data provided by AKFIN.

The tables and figures in this section and in the Appendix report delivered weight by market category in each area as well as ex-vessel value (annual and per pound) over the 2012 through August 2018 period. For catch and value by market category, the analysts rely on ADF&G Fish Tickets, provided by AKFIN, that report sablefish size in standardized weight categories. These categories break out 1-2 lb. fish, 2-3 lbs., 3-4 lbs., 4-5 lbs., 5-7 lbs., and >7 lbs. ("7-ups"). Fish Tickets that included standardized weight-based market categories comprised roughly 85% of IFQ sablefish landings over the 2012 through August 2018 period. Roughly 13% of IFQ sablefish landings were not designated with a market category; the analysts assume that these landings are evenly distributed across market categories. The roughly 2% of landings that are attributed to minor market categories are ignored. In total, the summary tables presented below as well as the exhaustive tables in the Appendix characterize the distribution of harvest for roughly 98% of total harvest during the analyzed period.

Figure 9 shows each area's trend in the annual percentage of total IFQ sablefish catch that is identified in the smallest two market categories (1-3 lbs.). Catch of small sablefish as a proportion of total IFQ landings is increasing in all areas, but the trend has emerged most dramatically in the Western GOA and the BSAI during the past two years. Note that the marked percent increase in small fish deliveries is, for the moment, occurring in the two areas that have historically accounted for only a small proportion of statewide IFQ catch (Figure 8). The analysts are not in a position to say whether spatial differences in market categories are explained by stable spatial differences in the size distribution of sablefish. Nevertheless, the Council might consider whether the effects of requiring or allowing the discard of small sablefish would vary by area. Evaluating alternative management measures on an area basis might address a problem where it is occurring without causing unintended effects – if any are identified – in other areas. That said, sablefish are managed as a statewide stock and the analysts do not propose that the effect of a future atypical year class would be contained to the same, or any, one or two specific areas. Given the fact that any regulations implemented as a result of this action would not come in time to address the 2014 year class, the Council might not wish to craft its policy based on the spatial nature of this unique recruitment event. The Council might also consider whether creating a patchwork of area-based discard regulations would unduly complicate the prosecution, management, and enforcement of the fishery.



	2012	2013	2014	2015	2016	2017	2018
EGOA	3%	3%	3%	3%	5%	6%	8%
CGOA	7%	6%	7%	6%	9%	13%	15%
WGOA	9%	10%	14%	10%	11%	23%	42%
BSAI	18%	20%	15%	10%	19%	74%	73%

Figure 9 Proportion of sablefish landings in the 1 lb. to 3 lbs. market categories by harvest area from 2012 through 2018 (partial year). Source: ADFG Fish Ticket data provided by AKFIN.

3.1 Value of sablefish by size

Fish Ticket data on IFQ sablefish landings show a clear delineation in ex-vessel value between market categories as defined by fish size in weight. Figure 10 collapses the six previously identified market categories into three for ease of presentation and plots annual average price per pound by area. Figure 10 shows market category by color (1-3 lbs. in red, 3-5 lbs. in blue, and 5+ lbs. in green) and shows area-based trends by line style (EGOA = solid, CGOA = dots, WGOA = long dash, BSAI = short dash). Ex-vessel value by area is difficult to distinguish in the figure because the area effect is small. (The reader may refer to the tables in the Appendix for area-specific data points.) The important distinctions illustrated in the figure are price effects based on market category and year. Furthermore, the year-effect is apparent across all market categories, as apparent in the fact that 2017 was a high-water mark across all size categories and thus far 2018 is a low value year across all categories.

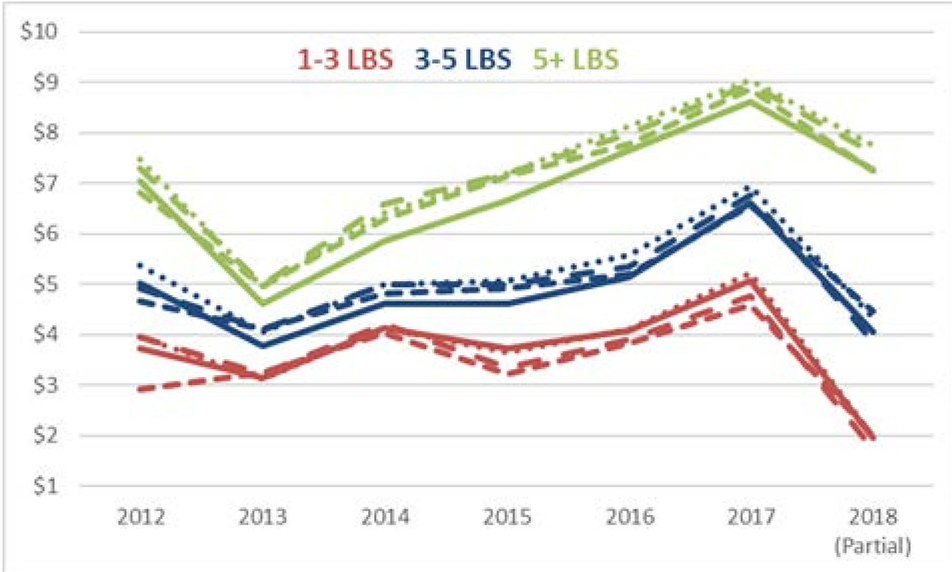


Figure 10 IFQ sablefish ex-vessel value/lb. by market category and by area from 2012 through 2018 (partial year). Source: ADFG Fish Ticket data provided by AKFIN.

Table 1 provides a snapshot of 2018 ex-vessel values on a statewide level, through the month of August. A financial lender's market snapshot, published June 30, 2018, corroborates the low-value signal apparent in Fish Ticket data. That report notes that a combination of smaller sized fish and frozen inventory holdovers from the 2017 season have pushed 2018 dock prices down year-on-year by an average of roughly $2.00/lb. across all size categories.[4] Fish Ticket data for 2018 represent a $0.80/lb. decrease relative to the average price for 2012 through 2017 when aggregated across all market categories. The 2018 price per pound was lower for fish smaller than 5 lbs. (range of -$2.34/lb. for 1-2 lb. fish to -0.86/lb. for 4-5 lb. fish). Sablefish larger than 5 lbs. are currently higher in value that the period average (+$0.73/lb. for 5-7 lb. fish and +$0.28/lb. for 7+ lb. fish) but are still markedly lower than 2017 price levels. The year-on-year comparison between 2017 and 2018 (YTD) likely reflects market forces that are not associated with size – e.g. holdover inventories and/or market demand.

Table 1 2018 (partial year) fixed-gear sablefish ex-vessel value/lb. by market category. ADFG Fish Ticket data (through August) and Northwest Farm Credit Services market snapshot (through June).

	1-2 lbs.	2-3 lbs.	3-4 lbs.	4-5 lbs.	5-7 lbs.	7+ lbs.
Fish Tickets	$1.42	$2.53	$3.72	$4.66	$7.21	$7.75
NWFCS			$3.50	$4.75	$7.50	$8.05

This document includes an Appendix with complete tables showing sablefish IFQ landings (lbs.), gross ex-vessel revenues ($nominal), and the calculated ex-vessel value per pound ($nominal) by FMP subarea and by market category from 2012 through August 2018. The tables compare harvest and gross ex-vessel revenue in 2017 and 2018 (YTD) against the period average for 2012 through 2016. The value data are calculated as the product of "sold whole weight" and "price detail". This methodology captures both advanced ex-vessel prices and paid bonuses. The story told in the Appendix tables is simply summarized. The Central and Eastern GOA account for the majority of sablefish IFQ landings (~77% from 2012 through August 2018) and the majority of gross revenue. The relative weighting of catch across areas has remained similar during higher and lower total harvest years (Figure 8), and the annual variation in price per pound for sablefish by market category is driven more so by year-effects than by catch area (Figure

[4] https://www.northwestfcs.com/-/media/Files/Industry-Insights/Market-Snapshots-2018/Fisheries-Market-Snapshot-06-30-18-Final.ashx?la=en

10). As a result, the recent emergence of small fish has had a greater marginal impact on gross revenues in the areas that are realizing a greater proportion of small fish in their catch – namely the BSAI and the WGOA. Catcher vessels in all areas are experiencing lower ex-vessel values across size categories as a result of broader market factors. Distinctions between areas in terms of gross revenue are the product of TAC levels, the proportion of small fish in the catch, and catchability (including whale depredation). Distinctions in net revenues are likely driven by long-established factors such as operating costs, the cost of quota shares, as well as area-specific catchability (again, including whale depredation).

As noted earlier, the use of pot gear for IFQ sablefish in the GOA was allowed beginning in 2017. Appendix Table 4 breaks out 2017 and 2018 pot gear catch, gross revenue, and calculated price per pound for comparison against total fixed gear catch across all GOA areas (Appendix Table 4). Over a short time series, those tables indicate a small premium for pot-caught sablefish on a per-pound basis on the order $0.15 to $0.25 per pound. However, Table 2 indicates that the first two years of pot gear use in the GOA is yielding smaller fish on average. The "All Fixed-Gear" panel includes both pot and hook-and-line and shows that catch is distributed around a median in the larger market categories as compared to the distribution that includes only the pot gear fishery. The reader should consider that the GOA pot gear fishery is relatively new and fishermen are in the process of tuning their gear to their desired market as best they can.

Table 2. Proportion GOA sablefish IFQ delivered weight by gear. Source: ADFG Fish Ticket data provided by AKFIN.

	All Fixed-Gear		Pot	
Market Category	2017	2018 (Partial)	2017	2018 (Partial)
1 - 2 Lbs	3%	3%	10%	8%
2 - 3 Lbs	9%	11%	26%	28%
3 - 4 Lbs	21%	25%	24%	30%
4 - 5 Lbs	20%	21%	17%	17%
5 - 7 Lbs	26%	23%	17%	13%
7 UP	21%	17%	6%	4%

Finally, Figure 11 and Figure 12 illustrate the distribution of landed weight across the six market categories for the GOA and the BSAI, respectively. Each figure compares 2017 and 2018 to the average over the 2012 through 2016 period. The presence of small sablefish landings in the data below indicate that vessels are not perfectly able to select for large fish, which are more valuable per pound. Hook-and-line vessels, which account for the majority of sablefish IFQ landings, use hook sizing and fishing area selection to target larger fish, but small sablefish have always comprised a portion of total catch.

The GOA sablefish IFQ harvest represents 90.2% of total statewide IFQ sablefish harvest during the studied period. Within GOA, CGOA (50%) and EGOA (39%) dominate. In the GOA, fish that are between 3 and 7 lbs. contribute to approximately 74% of the total harvest in typical years (here defined as 2012-2016) and 70% of ex-vessel revenue (Figure 11). The largest landings and revenue category for GOA as a whole is the 5-7 lbs. grouping. Due to the increasing value of sablefish at larger market sizes, the "7 up" market size comprises 21% of the landings but 25% of the revenue. Following the typical growth rates described in Section 2 of this paper, fish from the 2014 year class would be approximately 3 lbs. in 2017 and 4 lbs. in 2018, so the 2-3 lb. and 3-4 lb. market categories would be expected to increase in 2017 and 2018, respectively. The data provided in the Appendix shows that the shift toward smaller market categories becomes more pronounced when moving from east to west in the GOA. For example, EGOA landings of 2-3 lb. sablefish comprised 3.3% of landings in 2012-2016 but increased to 5.8% in 2017 and 7.3% in 2018 (Appendix Table 6). In the CGOA, landings of 2-3 lb. sablefish comprised 6.0% of landings in 2012-2016 but increased to 9.4% in 2017 and 11.6% in 2018 (Appendix Table 7). In the WGOA, landings of 2-3 lb. sablefish comprised 9.3% of landings in 2012-2016 but increased to 12.4% in 2017 and 19.3% in 2018 (Appendix Table 8).

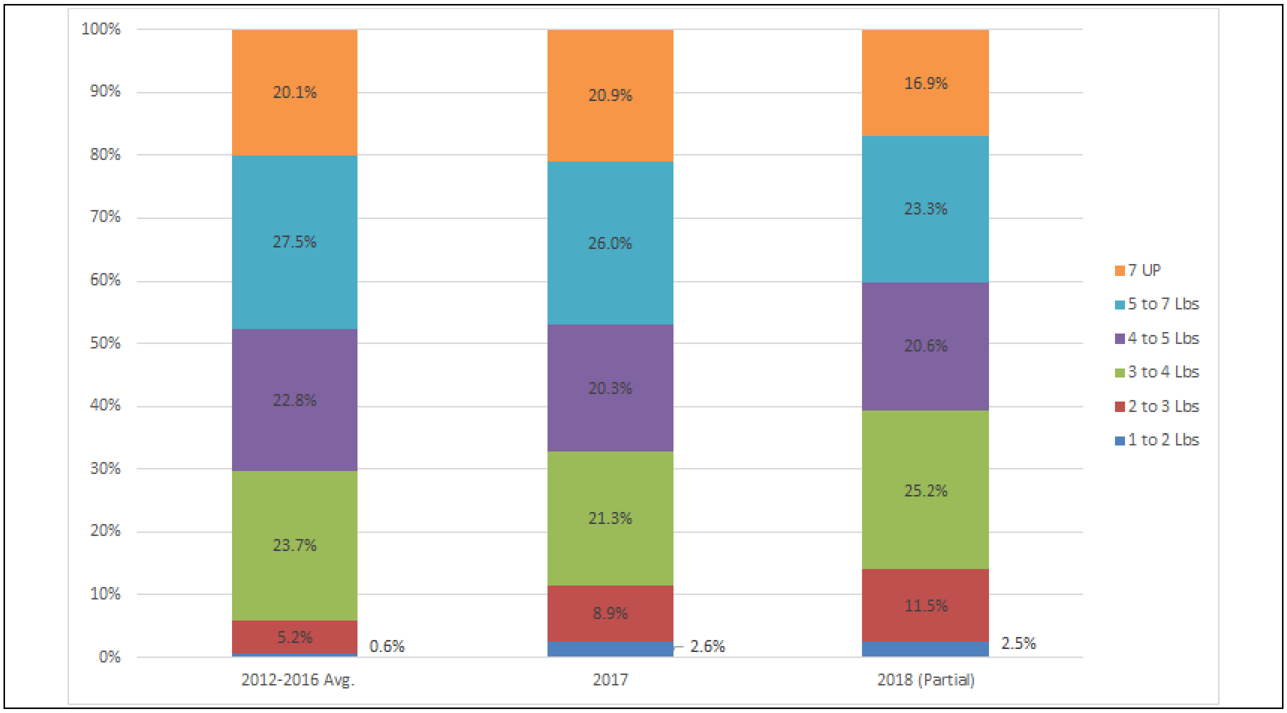


Figure 11 Landed sablefish weight by market category, 2012-2016 (Avg.) versus 2017 and 2018 for all Gulf of Alaska management areas. Source: ADFG Fish Ticket data provided by AKFIN.

BSAI sablefish harvest represented 9.8% of overall harvest off Alaska during the analyzed period. Sablefish were more evenly distributed among market categories in the (typical) 2012-2016 data than in the GOA, and larger size classes (5 lbs. and above) comprised the largest landings and revenue categories (Figure 12). The “7 up” category represented 24% of landings and 32% of revenue. The data show that from 2012 through 2016 there was a general decline in sablefish landings and revenue from the BSAI. This document does not explore the reasons for that decline, though whale depredation has often been cited in public testimony to the Council. The temporal shift toward smaller market categories (1-2 lbs, and 2-3 lbs) are much more apparent for the BSAI than for the GOA in 2017 and 2018 and appear as an extension of the east-west pattern in sizes observed across GOA areas.

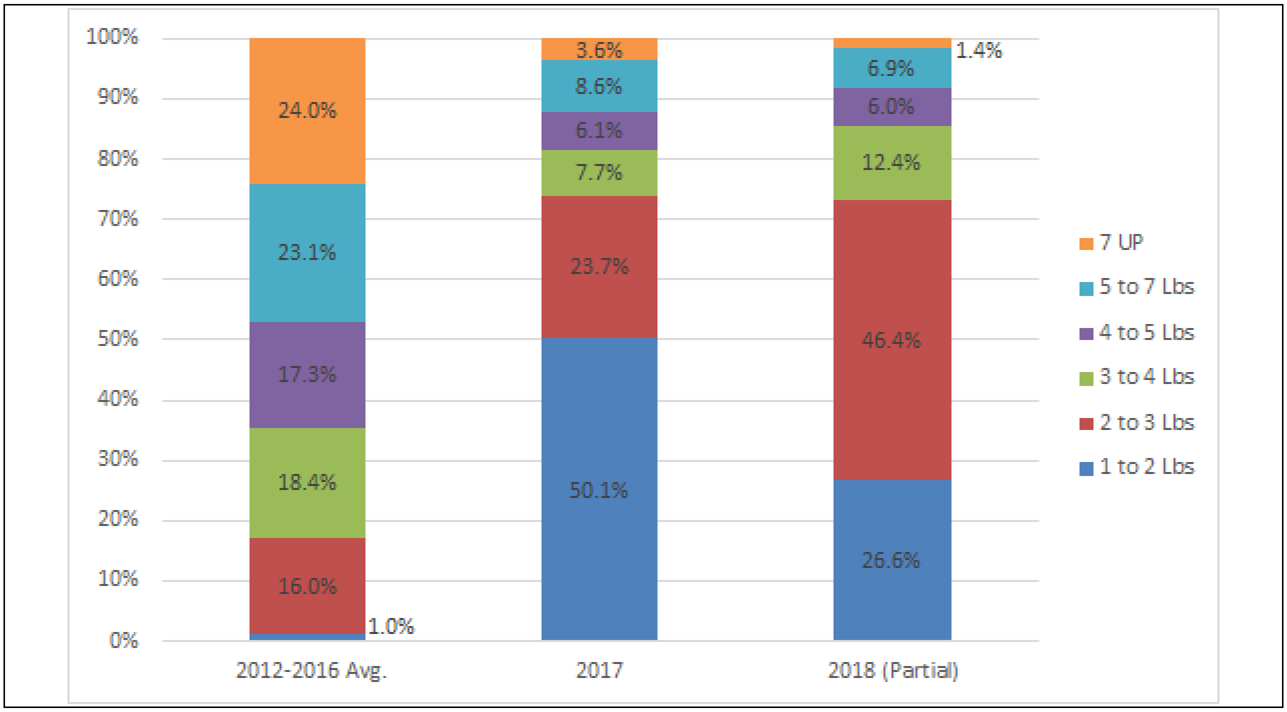


Figure 12 Landed sablefish weight by market category, 2012-2016 (Avg.) versus 2017 and 2018 for the Bering Sea and Aleutian Islands management areas. Source: ADFG Fish Ticket data provided by AKFIN.

3.2 Operational and Economic Trade-offs Between Minimum Size and Release Option

As the Council scopes potential alternatives for action, it will want to consider the contrast between a *requirement* to discard small sablefish and an *option* for discretionary release in terms of both practical and economic impacts. Section 2 of this document provides the biological basis for the conjecture that if the Council considers further action on small sablefish discards, it will be driven by the operational and economic challenges posed by the current situation – i.e., a large year class that is recruiting into the fishery at small sizes. In short, Section 2 stated that because *both* the overall fishing mortality (F) and the presumed fixed-gear discard mortality rates are low there is no compelling biological rationale for establishing a minimum size limit for sablefish retention. The F rate and the DMR (albeit unknown) factor into the yield-per-recruit analysis such that a minimum size threshold that maximizes biological yield is not clearly identifiable. In light of that analysis, the following discussion identifies operational and economic trade-offs that the Council might be making if it opts for a minimum size limit rather than optional careful release.

The defining difference between a size requirement and optional release is flexibility. It is difficult to imagine a scenario in which the optional release alternative does not provide fishermen with greater ability to respond to variations in the environment and in their individual markets. In determining the right policy for the fishery as a whole – and one that should be robust to future emergent events – the Council will need to weigh whether there is an amount of choice that is too great. One might define “too much choice” as a policy that could unintentionally harm the fishery resource or indirectly diminish socioeconomic outcomes. The earlier section of this paper, referenced above, suggests that discarding sablefish at the current F-rate is unlikely to harm the resource, so it follows that “too much choice” cannot be equated to “anything that results in more discards.” As a result, it makes sense for the Council to provide operational flexibility where possible while maintaining a precautionary approach in a rapidly changing marine environment. The Council should consider the term “precautionary” in two ways: (1) the traditional sense of buffering management strategies for biological sustainability, and (2) exercising caution before establishing a static size limit in regulation when there is no clear signal as to the economically optimal retention standard for a diverse array of participants.

Upon first consideration, discarding small sablefish seems beneficial to harvesters as less valuable fish can be replaced in the fish-hold by larger fish. In an area where the TAC is fully harvested, allowing small sablefish to be discarded could increase the total economic value of the fishery (depending on how the mortality of discarded sablefish accrues to vessels' annual IFQ, if at all). If discarding is found not to harm the resource and/or if sablefish DMRs turn out to be low, then QS holders and crew with a vested interest in the stock's health might be contributing to their own future opportunity. However, individual participants might place different values on the ability to discard small fish and thus would experience a regulated minimum size limit differently. Catching and discarding small fish entails an operational cost in terms of time, labor, and bait. While small sablefish are less valuable, they probably generate a net positive return on the margin. The analysts use the word "probably" because each individual operator is facing a unique cost-profile in terms of where they fish (time/distance traveled), whale depredation in their fishing area, debt service obligations (particularly for non-initial QS recipients), and the amount of IFQ they possess. To the latter point, a QS holder with a larger annual IFQ allocation might be able to make a profit with 14% or even 70% small (1-3 lbs.) fish (see Figure 11 and Figure 12) because they can catch a sufficient number of larger, higher-value fish. By contrast, a smaller scale operation whose opportunity to generate gross revenue (IFQ pounds) is consumed largely by low-value fish could see his or her margins erode. Framing a discard regulation as a choice allows participants to optimize the value of their labor within their unique constraints and in the context of changing environmental and market conditions.

Requiring discards could result in vessels taking longer trips. Longer trips increase operating costs and could also require additional work dressing fish to preserve quality. If trip length is bounded by the processor's quality standards, a vessel might haul more sets or expend more on bait. When small fish predominate in an area, mandatory discarding might affect vessels in the same way that depredating whales do – reducing the productivity of labor, potentially to the point that crew retention becomes a challenge. Vessels that hand-bait might be less able to continue turning over gear to meet their production goals compared to those that auto-bait.

Vessels with relatively low hold-capacity might value the ability to discard a small fish more than a vessel that is not as limited by capacity within the bounds of their planned trip length. Vessels that are not constrained by capacity might prefer never to discard sablefish and thus would experience a minimum size limit as a loss (i.e., forgone revenue plus time and bait).

Shore-based processors noted to staff – citing the IFQ Program 20-Year Review – that sablefish became less profitable after implementation of the program as harvesters with individual quota were able to extract a greater portion of economic rents from their catch. Because the per-unit wholesale value of H&G sablefish is strongly influenced by fish size, processors have no vested interest in receiving a higher proportion of small fish. Small fish require plants to process more volume to fulfill their contracts, reducing the productivity of their labor. Processors would benefit if a minimum size limit could reduce or eliminate the delivery of fish that provide little or negative economic return. It is not possible for the analysts to state whether small sablefish merely generate less return for processors or if they could actually generate a negative return. The threshold at which a negative return occurs – if any – is likely to vary across plants. Nevertheless, it is possible that plants are buying small sablefish at or near cost in order to secure the larger fish where they can make a profit. Moreover, plants do not purchase partial offloads so it is at least theoretically possible that the presence of small sablefish in a delivery represents an unavoidable loss depending on wholesale markets and operating costs. If requiring or allowing for discards of small sablefish causes vessels to take longer trips, processors might also have to evaluate how they regulate flesh quality. Vessels on longer trips might dress sablefish for the first days of the trip to preserve quality and deliver their latest catch in the round. Asking vessels to dress fish increases their labor and could also reduce the recovered weight for which they are paid.

Choosing the less flexible option could also have implications in terms of management cost and efficiency. Section 4.3 in this document outlines the impact that a size standard would have on fishery enforcement both shoreside and at-sea. Section 4.2.2 states that setting a size standard in regulation would create new monitoring duties for fishery observers and would require changes to the database infrastructure that incorporates observer data into estimation of catch and total removals. That section also notes that allowing discards – which is on the table under both options – could introduce bias into catch estimation, as has been a challenge with estimating release of sub-legal size Pacific halibut. The potential bias stems from the fact that many discarded fish would be smaller than the average discard size that is applied to estimate total catch, resulting in an overestimate. If the logic follows that more discards result in greater potential for biased estimates, then the Council will want to explore whether one approach is likely to result in more discards in the aggregate. This is a difficult question to answer because each vessel operator's incentive to discard fish, given the option, will vary according to the multiple factors listed above (including, but not limited to, hold size, distance from fishing grounds to offload site, quality of fishing, and presence of depredating whales). In short, operators who have the option to discard or retain sablefish might only choose to discard a lower-value fish if they have no expectation of replacing that fish with one of greater value, so the release option could result in more *or* fewer discards compared to a size limit. An operator's decision to discard might also be influenced by how the Catch Accounting System estimates discarded weight and applies it to a vessel's available IFQ. To that point, if regulatory discards (adjusted by a DMR) are counted against a vessel's IFQ then discarding represents a quantifiable loss.

If the Council were to recommend a minimum size limit it should be prepared to consider whether stakeholders fishing in different FMP subareas might request different limits based on economic considerations. For example, operators who focus in the BSAI where small sablefish have become dominant might want a lower minimum size. Figure 12 shows that in 2018 roughly 75% of BSAI sablefish deliveries were 3 lbs. or less, while roughly 27% were 2 lbs. or less. Setting the minimum size where 2-3 lb. fish must be discarded would have a much greater cost impact on BSAI operators compared to the GOA where 2-3 lb. fish accounted for 11.5% of catch and 1-2 lb. fish accounted for 2.5% (Figure 11).

For scoping purposes, the Council might consider whether an optional release policy should be paired with a maximum fish size (length) beyond which discarding is not allowed. Discarding the largest of what are generally considered to be "small sablefish" (~3 lbs.) could be viewed as high-grading. In practice, though, probably only the most capacity-limited vessel that is fishing in particularly good conditions would consider such discards. The net benefit of discarding those fish and replacing them with larger fish might be small as the additional effort increases costs. As opposed to a regulated minimum size, a release option allows individual operators and their processing markets to make appropriate decisions at the edge-cases where discarding a lower-value fish might actually reduce the trip's profitability. In addition, enforcing a maximum discard size would increase the cost of managing the fishery.

4 Management Considerations

Release of sablefish by the IFQ target fisheries is currently prohibited by regulation. The regulations that would need to be amended include 50 CFR 679.7(f)(11) and 50 CFR 679.7(d)(4)(H)(ii) regarding the discard of sablefish caught with fixed gear. Additionally, in both the BSAI and GOA Groundfish FMPs, the fourth provision under General Provisions section 3.7.1.7, prohibiting discarding of sablefish, would need to change.

4.1 IFQ Program

The sablefish IFQ longline and pot fisheries in the GOA and BSAI require full retention of sablefish caught, and 100% mortality is assumed. The origin for this retention requirement can be found in the IFQ proposed rule, which notes the requirement was intended to prohibit fishermen from discarding bycatch of IFQ halibut or sablefish from any catcher vessel in favor of other more valuable species (57 FR 57130).

When the IFQ sablefish sector lands fish, it accrues against their quota. There is no set aside for non-sablefish IFQ incidental catch or discards for the fixed gear allocation of the TAC, and past incidental catch and discards have been absorbed by the trawl allocation of the TAC. The 2016 Twenty-Year Review of the Pacific Halibut and Sablefish IFQ Program (Twenty-Year Review) provides some background on why a set-aside for incidental catch by non-IFQ fixed gear sablefish fishing was not included in the IFQ program.

> Incidental catch of sablefish refers to sablefish that are caught while targeting other species. In a Supplemental Environmental Impact Statement for the development of the IFQ Program (NPFMC, 1992), the Council acknowledged that if the total fixed gear allocation were allocated as IFQs, the incidental catch in other fisheries could result in annually exceeding the fixed-gear TAC. The Council acknowledged that the simplest solution would be to set aside a percentage of the TAC to support incidental catch of sablefish and allocate the remainder as IFQ. However, at that time, an estimated bycatch mortality rate had not been established for sablefish as it had been for halibut. The Council acknowledged that to determine this rate would require continued monitoring of incidental catch through expanded observer coverage. Therefore, no set-aside was established for incidental catch of sablefish when the IFQ Program was implemented. At implementation of the IFQ Program, the Council believed that there would be enough unused sablefish TAC in the trawl fisheries to absorb incidental catches without exceeding the overall sablefish TAC. Consequently, the fixed gear sablefish TACs are fully allocated to the IFQ Program, and none of the TAC is set aside for sablefish caught incidentally in other fixed gear fisheries (i.e., in the Pacific cod and halibut IFQ fisheries).

As the Twenty-Year Review notes, overages in the fixed gear allocation of the TAC were intended to be absorbed by the trawl gear allocation of the TAC. However, if the trawl sector catches their full allocation, there is no buffer to account for the discards in the fixed gear allocation. Overall both gear allocations in recent years are increasingly approaching closer to achieving the full TAC and there is less accommodation for fixed gear discards. Depending on how it is addressed, allowing for discards of small sablefish could add to the potential of exceeding the overall ABC. Table 3 shows the 2014 to 2018 total catch (retained and discards) of sablefish for all sectors in the BSAI and GOA, annual TAC/ABC, and catch remaining. Total catch is approaching the TAC/ABC as all sectors are achieving their allocations of the TAC leaving less as a buffer for the discards by non-sablefish IFQ vessels.

Table 3 Total sablefish catch versus remaining TAC/ABC. Source: NMFS CAS.

Area	Catch in Tons	2014	2015	2016	2017	2018 (Jan. – Aug.)
Alaska-wide	Total Catch	11,610	11,012	10,290	12,333	9,082
	TAC/ABC	13,722	13,657	11,795	13,083	14,957
	Catch Remaining	2,112	2,645	1,505	750	5,875

The IFQ program only applies landing data to the IFQ accounts. Estimates of at-sea discards are calculated after the landings data and observer/EM data enter the catch accounting system. There are only two ways to get estimates of discards: (1) industry-reported at-sea discard, and (2) establishing an at-sea discard rate based on observer/EM data. However, for the IFQ program these discard estimates do not currently exist because discards are prohibited. If discards were allowed in the IFQ program, then using estimates of at-sea discards from observer/EM data would be preferred to industry reported discards. Discard rates from vessels with observers/EM would be applied to vessels without observers/EM. The estimate of at-sea discards is not known at the time of landing to inform the IFQ holder of their remaining sablefish IFQ balance.

4.2 Observer Program

As part of the motion that initiated this discussion paper, the Council requested that the effects of modifying sablefish retention requirements on observer sampling be discussed.

4.2.1 Current Observer Sampling protocols

Observer training includes instruction in random sampling methods that observers use to determine how to best sample a haul; observers establish a sampling frame, define sampling units, and randomly select a set of sampling units for data collection for each haul sampled. While this general process is the same regardless of the vessel type or the gear being fished, the specific methods used to define sampling units and sample frames vary greatly.

The observer program uses a fully randomized hierarchical (nested) sampling design to monitor and collect fishery dependent data from the Federally managed commercial fisheries in Alaska. This hierarchy starts with the deployment of observers into several sampling strata as defined in the Annual Deployment Plan (citation). Once an observer is deployed to a vessel, they randomly select hauls to be sampled, select a random portion of the catch to collect species composition data, and randomly select individual fish from which they collect biological data and specimens (lengths, condition assessments, etc.). While this hierarchy describes an observer's basic sampling duties, there are numerous additional duties and data collection tasks carried out by observers (see Observer Manual citation). Estimation of at-sea discards is based on observer-collected species composition data.

On vessels fishing longline gear, sampling is conducted as the gear is being retrieved and individual catch items come over the side of the vessel at the roller. The observer divides the longline gear into equal sized sample units, selects one third (on average) of the units using a systematic random sample design, and identifies and enumerates (tallies) all the catch items on those sections of gear. Discarded catch items are documented at the roller where catch is either brought onboard or removed from the hook. During this tally sampling period, the observer is fully tasked with ensuring the accuracy of the counts, identifications and disposition of the catch and is generally not able to collect any additional data. Data from this sampling effort is used to estimate the number of each species retained and discarded. Additionally, the percent of the catch discarded at the roller is based on the observer counts of discarded and retained fish collected while tallying the catch.

Observers are routinely able to track the disposition of catch (retained or discarded at the roller) for two or three species. Since the rate of retained catch dropping off the gear is generally quite low, observers are able to collect these data with a high level of confidence. A significant increase in non-retention would increase the amount of data being collected and could impact the observer's ability to maintain an accurate account of species numbers, identification, and disposition.

To collect biological and weight per fish data, a second sample is collected, generally from just before or after the primary (tally) sample. The observer works closely with the rollerman to retain sufficient numbers of each species such that the collection of weight data adequately represents the species mean-weight-per-fish. This includes both the predominant species as well as the bycatch. Observers typically collect 15 individuals from each bycaught species and 60 of the predominant species. These weights are used to determine an average weight of each species or species group. Additional data collected from this second sample includes lengths measurements and biological specimens (e.g. otoliths). Note that this second sample is processed between the primary tally samples.

The estimated species-specific weight of catch for a set (haul) is the estimated number of fish for the set computed from the tally sample data multiplied by the mean weight per fish computed from the secondary sample data. The species-specific estimate of discard weight is computed by multiplying the estimated weight for a species and the species-specific percent discarded (computed from the disposition data collected during the primary (tally) sample).

In addition to the two data collections described above, observers also use the time between tally samples to collect additional data about the set, such as the number of hooks per segment of longline gear, total number of gear segments fished, halibut condition data, hook spacing data, etc.

4.2.2 Implications of size-selective discarding

<u>Data quality and potential bias of discard estimates</u>

In the directed Pacific halibut fishery, the minimum size limit (32 cm) results in discard of smaller fish. There have been long-standing concerns over the bias introduced to the halibut discard (wastage) estimates as a result of this size-selective discarding (e.g., Leaman and Stewart 2016). Since the percent discard is based on numbers of fish discarded (percent number of halibut discard) and discarded fish are typically smaller, when the percent discard is applied to the total weight of catch, the resulting discard estimates are biased high (over-estimating total discards). Analytic solutions based on the mean weight of fish over and under 32 cm are being evaluated; however, because of the diversity of data collection needs and database/technical constraints, changes to sampling methods to mitigate this bias are not possible at this time.

The same bias that currently exists for halibut discard estimates would be present in estimates of sablefish discard if a minimum size limit were instituted. In this case, development of an analytic solution might be possible, similar to those being considered for halibut discard estimates. If the minimum size of retained sablefish were not uniform throughout the fishery, this analytic solution might not be available.

Collection of data representing each disposition category (retained, discarded) would need to be collected as a regular part of observer sampling. This is currently beyond the scope of both the sample design used to collect the data and the structure of the database that houses the information.

In addition to the potential limitations on determining total catch weight for a single species with different dispositions, discarding catch based on size could have a negative impact on the collection of biological specimens. Although observers are generally successful at coordinating the retention of fish to facilitate the collection of biological specimens, requiring a crewmember to change their standard work practices can have mixed, and potentially unpredictable, results. One result could be a bias towards collecting data from fish in a particular size category, further exacerbating any biases already present.

<u>Data collection methods and observer protocols</u>

There will be few changes to observer sampling methods needed under the current data transmission and database constraints. Potential changes to accommodate size-based sampling may include reduced data collections in other areas. Sampling methods and data collection changes will require:

- Updates to the Observer Sampling Manual Updates

- Updates to data transmission applications and software
- Updates to NORPAC database

Biological data collections could be size-biased, and appropriate data-weighting methods would need to be developed or sampling methods would need to be changed. If the AFSC Observer Program is not able to address biases in a change to training (see above), the stock assessment team would need to include the implications to their data by using size biased biological collections.

Vessels with Electronic Monitoring (EM) systems

Current sampling protocols on the vessels that opt to use EM systems to collect catch information would not need to be changed. Length data will not be collected, hence analytic solutions to potential biases in estimates of discard weight will not be possible using vessel-specific data. Estimation of the percent retained and mean weight per fish for sablefish will be based on observed vessels. Discard estimates will potentially be biased depending on the degree of size-sorting.

Note that for vessels with EM data collections, discard estimates will be delayed, potentially up to four weeks. As more vessels opt into the EM pool, biological collections (sex lengths and otoliths) that are currently being collected by observers will decrease. This includes weight and percent retained data. Since these are necessary for sablefish stock assessments, the observer program would need to implement a dockside sampling program to obtain these data. This data collection would suffer from the same biases described above given at-sea size-selective discard of small sablefish.

4.3 Enforcement Implications

Changes in regulations that would allow or require size-based release of sablefish would present changes to enforcement scenarios for the IFQ fishery. Currently, enforcement officials primarily address the prohibition on release of sablefish as well as the cap on retention determined by the IFQ.

Release option: From an enforcement perspective, implementation of an allowance for discretionary release of sablefish by vessel operators would only require that the careful release requirements that are in place for prohibited species are employed. Specifically, these require that all prohibited species are returned to the sea immediately, with a minimum of injury (50 CFR 679.21(a)(2)(ii)).

Minimum size: Implementation of a minimum size (length) for sablefish would require enforcement of the careful release of fish as well as evaluation of minimum size compliance. For interception of deliveries by CVs to onshore processors, this would entail additional enforcement duties, but sampling the catch to assess compliance would be straight-forward. For on the water enforcement, officers would have to access the catch for lengths and also monitor discarding behavior by vessel crew such that discarded fish can be measured for length. A potential concern related to enforcement of, and compliance with, a minimum size requirement is the incentive to discard fish that are above the minimum size (high-grading) due to their greater value. This is different from the incentive to retain fish that are below minimum size in order to achieve catch targets. As above, any fish that are released would have to be released in a manner that is consistent with careful release requirement.

5 Summary Points

Biological Considerations

1. The large 2014 year class was approximately 2.5 times larger than the second largest year class recorded in the existing SAFE time series (1979); this year class is expected to contribute greatly to spawning biomass over the next decade.

2. Sablefish enter the fishery at ~ 3 to 4 years of age. As such, 2014 individuals have already recruited into the fishery. However, there is strong evidence that the 2016 year class is also large, in which case consideration of regulating minimum retention size could be relevant.
3. No clear biological benefits are associated with discarding options but new YPR analyses would be needed in order to fine tune with likely DMRs, identify an appropriate minimum size, and incorporate variable monetary value by size.
4. Presently, no DMRs are available for sablefish since all collected individuals are retained by the fishery. As such, basic studies are needed for establishing a species-specific DMR. In the short term, however, proxy DMRs from other sablefish fisheries that do not retain all individuals or from Alaskan fisheries using similar gears (such as halibut) could be put in place until basic studies are complete.
5. Research to provide robust DMR estimates would not affect discarding of 2014 or 2016 year classes.
6. Other jurisdictions have minimum sizes and they are similar to the lower end of harvested sizes in Alaska (~22 in or 56 cm).

<u>Management and Economic Considerations</u>

1. Operational flexibility for fishermen is greater for a careful release option than for a minimum size limit.
2. It is not obvious whether more discards would occur – all else equal – under an optional release policy or a minimum size limit.
3. Enforcement of careful release would be simpler than enforcement of a minimum size limit.
4. Viability sampling protocols would need to be established for observers. The dedication of observer time to new onboard assignments would reduce time available for other duties.
5. Minimizing bias in biological samples from observers would require protocols for sampling sablefish discards.
6. The Council should consider whether and how discarded sablefish accrue to an operator’s annual IFQ.
7. As the IFQ Program Twenty-Year Review notes, overages in the fixed gear allocation of the TAC were intended to be absorbed by the trawl gear allocation of the TAC. As the overall TAC has been approached by both gear allocations in recent years there is less accommodation available for fixed gear discards. Allowing for discards of small sablefish could increase to the probability of approaching the overall TAC or exceeding the ABC.
8. Annual variation in sablefish value/lb. move in the same direction across market categories (fish size) and across FMP subareas. If the value/lb. of small fish goes up (or down) year-on-year then the value/lb. also went up (or down) for large fish. If the value/lb. goes up (or down) in the EGOA then it also went up (or down) in the CGOA/WGOA/BSAI. In other words, price trends appear driven by external factors like demand and holdover inventory; they are not different across areas in a given year.
9. Small sablefish are recruiting into the fishery in all FMP subareas, but the relative economic impact is greatest where small fish now make up a high percentage of catch (BSAI and WGOA).
10. Individual vessel operators will evaluate the benefit of discarding a small fish differently based on their unique situation. Small sablefish cost money to catch and are not worthless, so discarding a saleable fish with no expectation of replacing it with a larger fish is experienced as a loss. Vessels vary in terms of their hold capacity, their planned trip length, the presence of whales in the area, and catch rates of larger fish in the area, among other factors. A uniform minimum size limit does not allow operators to determine whether discarding a small sablefish is a net benefit in their particular situation.

6 References

Albin, D. and K. A. Karpov. 1996. Mortality of lingcod, *Ophiodon elongatus*, related to capture by hook and line. Marine Fisheries Review 60(3):29-34.

Davis, M. W., B. L. Olla, and C. B. Schreck. 2001. Stress induced by hooking, net towing, elevated sea water temperature and air in sablefish: lack of concordance between mortality and physiological measures of stress. Journal of Fish Biology 58:1-15.

DFO (Department of Fisheries and Oceans). 2007. Pacific region integrated fisheries management plan, groundfish, March 10/2007 to March 31/2008. Department of Fisheries and Oceans, Pacific Region, Vancouver, British Columbia, Canada. Available at http://www.dfo-mpo.gc.ca/Library/329390.pdf.

Gilroy, H.L., and I.J. Stewart. 2013. Incidental mortality of halibut in the commercial halibut fishery (Wastage). In: International Pacific Halibut Commission Report of Assessment and Research Activities 2012, pp. 53-60.

Hanselman, D.H., C. Lunsford, C. Rodgveller, and K.H. Fenske. 2017. Assessment of the sablefish stock in Alaska. In Stock assessment and fishery evaluation report for the groundfish resources of the GOA and BS/AI. North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306 Anchorage, AK 99501.

NPFMC and NMFS. 2016. Twenty-Year Review of the Pacific Halibut and Sablefish Individual Fishing Quota Management Program. December 2017. Available at https://www.afsc.noaa.gov/REFM/Docs/2017/GOAsablefish.pdf

Leaman, B.M., and Stewart, I.J. 2016. 2.12 Research basis for estimated Discard Mortality Rates used for Pacific halibut in longline and trawl fisheries. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2016:133-172.

Lowe, S. A., J. T. Fujioka, and J. M. Terry. 1991. Bioeconomic analysis of a minimum size limit for Gulf of Alaska sablefish using a yield per recruit model. Fisheries Research 11:307-320.

Stachura, M. M., C. R. Lunsford, C. J. Rodgveller, and J. Heifetz. 2012. Estimation of discard mortality of sablefish (*Anoplopoma fimbria*) in Alaska longline fisheries. Fishery Bulletin 110:271-279.

Somers, K.A., M. Bellman, J. Jannot, N. Riley, and J. McVeigh. 2014. Estimated discard and catch of groundfish species in the 2013 U.S. west coast fisheries. NOAA Fisheries, NWFSC Observer Program, 2725 Montlake Blvd E., Seattle, WA 98112.

Sullivan, J., and B. Williams. 2018. Subject: NSEI sablefish assessment for 2018 ABC. State of Alaska Memorandum.

7 List of Preparers and Persons Consulted

Jim Armstrong	NPFMC Staff
Sam Cunningham	NPFMC Staff
Megan Mackey	NMFS AKRO
Joseph Krieger	NMFS AKRO
Mary Furuness	NMFS AKRO
Lisa Thompson	NMFS AFSC
Mike Fey	PSMFC AKFIN
Cara Rodgveller	NMFS AFSC
Dana Hanselman	NMFS AFSC
Chris Lunsford	NMFS AFSC
Alicia Miller	NMFS AKRO

Others Consulted

Nicole Kimball	Pacific Seafood Processors Assn.
Jim Hubbard	Kruzof Fisheries
Stephen Rhoads	F/V Marilyn J

8 Appendix

Table 4 Gulf of Alaska (all subareas) fixed-gear (hook-and-line & pot) sablefish landings, ex-vessel revenue, and prices by market category, 2012 - 2018. Source: ADFG Fish Ticket data provided by AKFIN.

Sold weight (1,000 lbs.)								% Total		
Market Category	2012	2013	2014	2015	2016	2017	2018 (Partial)	2012-16 Avg.	2017	2018 (Partial)
1 - 2 Lbs	116	74	58	59	156	334	203	1%	3%	3%
2 - 3 Lbs	795	830	796	639	695	1,140	925	5%	9%	11%
3 - 4 Lbs	3,867	3,700	3,529	3,167	2,707	2,738	2,027	24%	21%	25%
4 - 5 Lbs	3,628	3,725	3,235	3,117	2,620	2,611	1,656	23%	20%	21%
5 - 7 Lbs	4,756	4,639	3,605	3,508	3,184	3,346	1,872	28%	26%	23%
7 UP	3,668	3,560	2,626	2,342	2,179	2,691	1,363	20%	21%	17%
Total	**16,830**	**16,528**	**13,848**	**12,832**	**11,540**	**12,860**	**8,045**	**100%**	**100%**	**100%**

Ex-Vessel Value ($1,000)								% Total		
Market Category	2012	2013	2014	2015	2016	2017	2018 (Partial)	2012-16 Avg.	2017	2018 (Partial)
1 - 2 Lbs	451	221	242	210	605	1,627	260	0%	2%	1%
2 - 3 Lbs	3,181	2,728	3,296	2,307	2,982	6,032	2,366	4%	6%	6%
3 - 4 Lbs	17,914	14,025	16,488	14,330	13,641	17,351	7,529	19%	18%	18%
4 - 5 Lbs	20,855	15,387	16,314	16,325	15,075	18,955	7,711	21%	20%	18%
5 - 7 Lbs	31,737	21,094	20,563	22,751	22,758	27,776	13,514	30%	29%	32%
7 UP	28,649	17,943	17,297	17,259	18,847	25,174	10,556	25%	26%	25%
Total	**102,787**	**71,398**	**74,201**	**73,182**	**73,908**	**96,915**	**41,936**	**100%**	**100%**	**100%**

Price/LB.							
Market Category	2012	2013	2014	2015	2016	2017	2018 (Partial)
1 - 2 Lbs	3.89	3.00	4.19	3.55	3.89	4.88	1.28
2 - 3 Lbs	4.00	3.28	4.14	3.61	4.29	5.29	2.56
3 - 4 Lbs	4.63	3.79	4.67	4.52	5.04	6.34	3.71
4 - 5 Lbs	5.75	4.13	5.04	5.24	5.75	7.26	4.66
5 - 7 Lbs	6.67	4.55	5.70	6.49	7.15	8.30	7.22
7 UP	7.81	5.04	6.59	7.37	8.65	9.36	7.75

Table 5 Gulf of Alaska (all areas) Pot gear sablefish landings, ex-vessel revenue, and prices in the Gulf of Alaska (all areas) for 2017 and 2018 by market category. Source: ADFG Fish Ticket data provided by AKFIN

	Sold Weight (1,000 lbs.)		Ex-Vessel Value ($1,000)		Price/LB. ($)	
Market Category	2017	2018 (Partial)	2017	2018 (Partial)	2017	2018 (Partial)
1 - 2 Lbs	10%	8%	7%	3%	4.84	1.44
2 - 3 Lbs	26%	28%	21%	17%	5.35	2.49
3 - 4 Lbs	24%	30%	23%	28%	6.50	3.86
4 - 5 Lbs	17%	17%	19%	20%	7.43	4.81
5 - 7 Lbs	17%	13%	21%	24%	8.44	7.49
7 UP	6%	4%	9%	8%	9.50	8.18
Total	**1,318**	**997**	**8,849**	**4,090**	**6.71**	**4.10**

Table 6 Eastern Gulf of Alaska (Areas 640 and 650) fixed-gear sablefish landings, ex-vessel revenue, and prices by market category, 2012 - 2018. Source: ADFG Fish Ticket data provided by AKFIN.

Sold weight (1,000 lbs.)								% Total		
Market Category	2012	2013	2014	2015	2016	2017	2018 (Partial)	2012-16 Avg.	2017	2018 (Partial)
1 - 2 Lbs	9	7	3	4	11	15	16	0%	0%	0%
2 - 3 Lbs	208	224	179	160	204	312	255	3%	6%	7%
3 - 4 Lbs	1,366	1,400	1,212	1,116	1,000	1,023	794	20%	19%	23%
4 - 5 Lbs	1,494	1,521	1,328	1,281	1,086	1,140	755	23%	21%	21%
5 - 7 Lbs	2,075	1,946	1,565	1,543	1,292	1,415	898	28%	26%	26%
7 UP	1,974	1,829	1,449	1,228	1,050	1,437	796	25%	27%	23%
Total	**7,127**	**6,927**	**5,737**	**5,332**	**4,643**	**5,341**	**3,513**	**100%**	**100%**	**100%**

Ex-Vessel Value ($1,000)								% Total		
Market Category	2012	2013	2014	2015	2016	2017	2018 (Partial)	2012-16 Avg.	2017	2018 (Partial)
1 - 2 Lbs	33	20	13	14	43	74	21	0%	0%	0%
2 - 3 Lbs	827	733	742	582	898	1,662	669	2%	4%	3%
3 - 4 Lbs	6,191	5,014	5,392	4,748	4,784	6,309	2,820	16%	16%	15%
4 - 5 Lbs	8,246	6,051	6,369	6,337	5,987	8,051	3,444	20%	20%	18%
5 - 7 Lbs	13,391	8,519	8,471	9,609	8,970	11,430	6,292	30%	28%	33%
7 UP	15,069	8,890	9,087	8,685	8,785	13,148	6,004	31%	32%	31%
Total	**43,757**	**29,227**	**30,074**	**29,976**	**29,466**	**40,674**	**19,249**	**100%**	**100%**	**100%**

Price/LB.							
Market Category	2012	2013	2014	2015	2016	2017	2018 (Partial)
1 - 2 Lbs	3.50	3.00	4.11	3.82	3.76	4.82	1.31
2 - 3 Lbs	3.97	3.27	4.14	3.62	4.39	5.33	2.62
3 - 4 Lbs	4.53	3.58	4.45	4.25	4.78	6.17	3.55
4 - 5 Lbs	5.52	3.98	4.80	4.95	5.51	7.06	4.56
5 - 7 Lbs	6.45	4.38	5.41	6.23	6.94	8.08	7.01
7 UP	7.63	4.86	6.27	7.07	8.37	9.15	7.54

Table 7 Central Gulf of Alaska (Areas 620 and 630) fixed-gear (hook-and-line & pot) sablefish landings, ex-vessel revenue, and prices by market category, 2012 - 2018. Source: ADFG Fish Ticket data provided by AKFIN.

Sold weight (1,000 lbs.)								% Total		
Market Category	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018 (Partial)**	**2012-16 Avg.**	**2017**	**2018 (Partial)**
1 - 2 Lbs	61	44	31	40	113	219	128	1%	4%	3%
2 - 3 Lbs	444	413	396	342	396	555	445	6%	9%	12%
3 - 4 Lbs	2,119	1,899	1,907	1,752	1,519	1,454	1,074	28%	25%	28%
4 - 5 Lbs	1,707	1,784	1,570	1,522	1,314	1,215	814	24%	20%	21%
5 - 7 Lbs	2,057	2,047	1,608	1,534	1,538	1,498	877	26%	25%	23%
7 UP	1,274	1,245	886	835	892	989	516	15%	17%	13%
Total	**7,662**	**7,431**	**6,397**	**6,027**	**5,772**	**5,931**	**3,854**	**100%**	**100%**	**100%**

Ex-Vessel Value ($1,000)								% Total		
Market Category	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018 (Partial)**	**2012-16 Avg.**	**2017**	**2018 (Partial)**
1 - 2 Lbs	235	131	128	148	443	1,130	165	1%	3%	1%
2 - 3 Lbs	1,801	1,325	1,625	1,242	1,707	2,943	1,201	4%	7%	6%
3 - 4 Lbs	10,092	7,413	9,123	8,197	7,926	9,400	4,193	23%	21%	21%
4 - 5 Lbs	10,238	7,550	8,188	8,310	7,823	9,040	3,877	23%	20%	19%
5 - 7 Lbs	14,205	9,525	9,487	10,267	11,248	12,694	6,541	29%	28%	33%
7 UP	10,255	6,493	6,136	6,422	7,978	9,513	4,137	20%	21%	21%
Total	**46,826**	**32,438**	**34,687**	**34,587**	**37,124**	**44,721**	**20,114**	**100%**	**100%**	**100%**

Price/LB.							
Market Category	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018 (Partial)**
1 - 2 Lbs	3.84	3.01	4.16	3.67	3.93	5.15	1.29
2 - 3 Lbs	4.05	3.21	4.11	3.63	4.31	5.30	2.70
3 - 4 Lbs	4.76	3.90	4.78	4.68	5.22	6.46	3.90
4 - 5 Lbs	6.00	4.23	5.22	5.46	5.95	7.44	4.76
5 - 7 Lbs	6.90	4.65	5.90	6.69	7.31	8.47	7.46
7 UP	8.05	5.22	6.92	7.69	8.94	9.62	8.02

Table 8 Western Gulf of Alaska (Area 610) fixed-gear (hook-and-line & pot) sablefish landings, ex-vessel revenue, and prices by market category, 2012 - 2018. Source: ADFG Fish Ticket data provided by AKFIN

Sold weight (1,000 lbs.)								% Total		
Market Category	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018 (Partial)**	**2012-16 Avg.**	**2017**	**2018 (Partial)**
1 - 2 Lbs	45	23	24	15	32	99	59	2%	6%	9%
2 - 3 Lbs	143	193	221	137	94	273	224	9%	17%	33%
3 - 4 Lbs	382	401	411	299	187	261	159	20%	16%	23%
4 - 5 Lbs	428	420	337	313	220	257	87	20%	16%	13%
5 - 7 Lbs	623	647	432	410	354	433	97	29%	27%	14%
7 UP	420	486	290	279	238	265	51	20%	17%	8%
Total	**2,041**	**2,171**	**1,714**	**1,453**	**1,124**	**1,587**	**678**	**100%**	**100%**	**100%**

Ex-Vessel Value ($1,000)								% Total		
Market Category	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018 (Partial)**	**2012-16 Avg.**	**2017**	**2018 (Partial)**
1 - 2 Lbs	183	70	101	48	120	423	74	1%	4%	3%
2 - 3 Lbs	553	670	930	484	377	1,427	496	6%	12%	19%
3 - 4 Lbs	1,631	1,597	1,973	1,384	930	1,642	517	16%	14%	20%
4 - 5 Lbs	2,371	1,786	1,758	1,678	1,265	1,864	390	19%	16%	15%
5 - 7 Lbs	4,142	3,050	2,604	2,731	2,540	3,652	681	32%	32%	26%
7 UP	3,324	2,560	2,074	2,151	2,084	2,512	415	26%	22%	16%
Total	**12,204**	**9,732**	**9,440**	**8,476**	**7,317**	**11,521**	**2,573**	**100%**	**100%**	**100%**

Price/LB.							
Market Category	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018 (Partial)**
1 - 2 Lbs	4.03	2.97	4.23	3.16	3.79	4.28	1.26
2 - 3 Lbs	3.87	3.46	4.22	3.54	4.01	5.23	2.21
3 - 4 Lbs	4.27	3.98	4.80	4.63	4.96	6.28	3.25
4 - 5 Lbs	5.54	4.25	5.21	5.35	5.75	7.26	4.47
5 - 7 Lbs	6.65	4.72	6.04	6.67	7.18	8.44	7.02
7 UP	7.92	5.27	7.16	7.70	8.77	9.49	8.16

Table 9 Bering Sea and Aleutian Islands fixed-gear (hook-and-line & pot) sablefish landings, ex-vessel revenue, and prices by market category, 2012 - 2018. Source: ADFG Fish Ticket data provided by AKFIN.

Sold weight (1,000 lbs.)								% Total		
Market Category	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018 (Partial)**	**2012-16 Avg.**	**2017**	**2018 (Partial)**
1 - 2 Lbs	34	13	12	4	10	557	162	1%	50%	27%
2 - 3 Lbs	342	363	243	89	113	263	281	16%	24%	46%
3 - 4 Lbs	313	406	343	162	100	85	75	18%	8%	12%
4 - 5 Lbs	304	322	315	195	110	68	36	17%	6%	6%
5 - 7 Lbs	456	437	369	249	150	96	42	23%	9%	7%
7 UP	629	339	390	220	149	41	9	24%	4%	1%
Total	**2,080**	**1,881**	**1,674**	**922**	**634**	**1,113**	**606**	**100%**	**100%**	**100%**

Ex-Vessel Value ($1,000)								% Total		
Market Category	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018 (Partial)**	**2012-16 Avg.**	**2017**	**2018 (Partial)**
1 - 2 Lbs	94	38	48	13	38	2,275	256	1%	39%	15%
2 - 3 Lbs	1,052	1,317	977	311	442	1,337	681	11%	23%	39%
3 - 4 Lbs	1,286	1,604	1,554	733	480	517	291	15%	9%	17%
4 - 5 Lbs	1,586	1,375	1,610	1,036	614	483	183	16%	8%	10%
5 - 7 Lbs	2,903	2,043	2,161	1,634	1,039	799	279	26%	14%	16%
7 UP	4,561	1,775	2,608	1,696	1,286	381	67	31%	7%	4%
Total	**11,481**	**8,152**	**8,958**	**5,423**	**3,899**	**5,791**	**1,757**	**100%**	**100%**	**100%**

Price/LB.							
Market Category	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018 (Partial)**
1 - 2 Lbs	2.78	2.88	4.04	2.94	3.74	4.08	1.59
2 - 3 Lbs	3.08	3.63	4.02	3.49	3.91	5.08	2.42
3 - 4 Lbs	4.11	3.96	4.53	4.54	4.79	6.07	3.88
4 - 5 Lbs	5.21	4.27	5.11	5.30	5.60	7.05	5.03
5 - 7 Lbs	6.36	4.68	5.86	6.56	6.94	8.31	6.71
7 UP	7.25	5.24	6.69	7.72	8.62	9.40	7.76