

Estimate of discard weight and mortality associated with potential sablefish release allowance for the IFQ Fixed-Gear fishery

Draft Report for IFQ Council

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Background

Item 4 under Section 3.7.1.7 (General Provisions) of both the GOA and BSAI Management Plans states that “Discarding of sablefish is prohibited by persons holding sablefish IFQs and those fishing under the CDQ program”.

Potentially related to warming ocean conditions in the Gulf of Alaska, recent unprecedented strong year classes of sablefish (*Anoplopoma fimbria*) during 2014, 2016 and potentially 2017) have led to significant catches of small sablefish in the IFQ fixed-gear fisheries. Small sablefish have low commercial value, so their enforced retention is significantly impacting returns from fish sales in the fixed gear fleet.

Available data suggest that survival rates for carefully released sablefish are high. Operational flexibility to carefully release sablefish may increase the value of the commercial harvest and allow small fish to contribute to the overall biomass.

Objectives

- 1) Conduct preliminary analyses to estimate the likely fleet-wide discards (weight/number) from the trap fishery that would result from voluntary release of small Sablefish;
- 2) Estimate likely number/weight of fish that would die as a result of the release;
- 3) Relate this number back to the ABC and quota amounts; and,
- 4) Provide a preliminary estimate of cost/benefit to industry from the release allowance.

Methods

Data Inputs

The consequences of discarding small Sablefish were evaluated based largely on available information from the Alaskan pot fishery (Goethel et al. 2020). No new data was collected as part of this project.

Length frequency

Many thanks to Dana Hanselman and Daniel Goethel from NOAA Southeast Fisheries Science Center, Sustainable Fisheries Division for providing the time series of length frequency data collected by observers working on Fixed Gear vessels in the GOA and BSAI fisheries. Representative length-frequency data (numbers of males and females by 1 cm length classes). Separate male and female length frequencies were available from 1998 to 2020. Data pooled across the entire period was used to provide an “average” male and female length frequency for both GOA and BSAI. Data from only 2020 was used to represent the “recent” length frequency distribution with the high numbers of small sablefish. Only data between 40 – 100 cm fork length was used. Due to the relatively low sample numbers in the 2020 observer length frequencies, a 3-cm running average was used to smooth the 1-cm length frequency bins. This was done so that some of the larger 1-cm frequency changes observed did not unduly influence the results of applying the weight-converted length-based retention curve.

Length-weight relationship

Lengths were converted to weight for each size class based on the relationship between fork length (cm) and whole weight (kg) obtained from Table 3.12 in Goethel et al. (2020), (Table 2). This was modelled using the standard $w = a \times L^b$ relationship, where $a = 5.89 \times 10^{-6}$ and $b = 3.12955$.

\$ Value weight relationship

Fix Fleet TAC weight was converted to “Eastern Dressed Weight” (EDW) using the recovery multiplier of 0.63 (Bob Alverson pers com). The market value of different sized fish was determined using an average of the 2020 price information provided by one of the major sablefish processors as below. A relationship for these Eastern Dressed values was estimated as shown in Figure 1. The value of fish below 2lb dressed weight was set at \$0.40. The value of fish above this weight was estimated using the linear equation, $\$value = 0.872 \times EDW - 0.974$.

Table 1. Average 2020 market value of Eastern Dressed sablefish (Bob Alverson pers. Comm.)

Eastern dressed weight of individual fish (lb)	Market value (\$US)
<2	\$0.40/lb
2/3	\$1.40/lb
3/4	\$2.10/lb
4/5	\$2.70/lb
5/7	\$3.80/lb
>7	\$6.00/lb

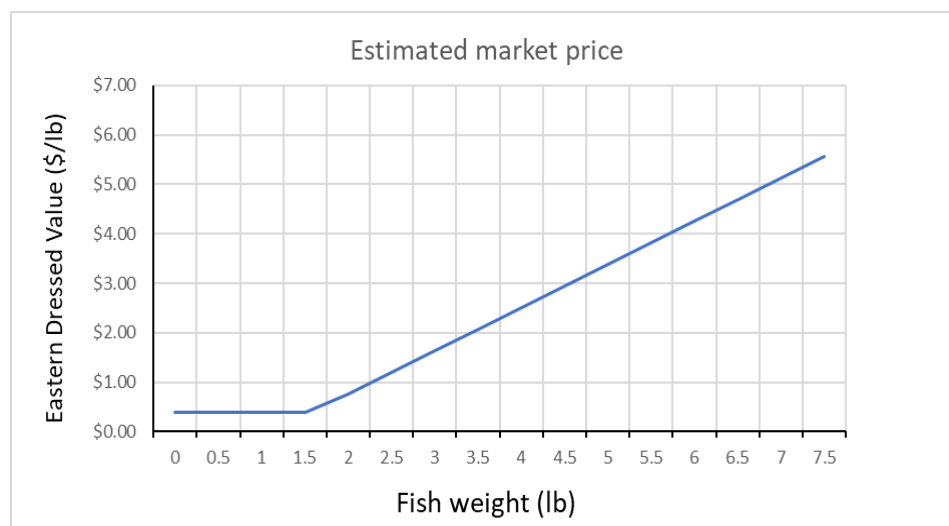


Figure 1. Conversion from Eastern Dressed fish weight (lbs) to \$US value of fish.

Based on the above information, the length frequency of the male and female catch was able to be converted first to whole weight, then to Eastern Dressed weight and then to a dollar value.

Table 2. Goethel et al. (2020) Table 3.12. Sablefish fork length (mm), weight (kg), and proportion mature by age and sex (weight-at-age modelled from 1996-2004 age-length data from the AFSC Longline survey).

Age	Length		Weight		Maturity	
	Male	Female	Male	Female	Male	Female
2	48.1	46.8	1.0	0.9	0.06	0.01
3	53.1	53.4	1.5	1.5	0.17	0.02
4	56.8	58.8	1.9	2.1	0.34	0.08
5	59.5	63.0	2.2	2.6	0.54	0.20
6	61.6	66.4	2.5	3.1	0.70	0.39
7	63.2	69.2	2.7	3.5	0.81	0.60
8	64.3	71.4	2.8	3.9	0.88	0.77
9	65.2	73.1	2.9	4.2	0.92	0.87
10	65.8	74.5	3.0	4.4	0.94	0.92
11	66.3	75.7	3.0	4.6	0.95	0.95
12	66.7	76.6	3.1	4.8	0.96	0.97
13	67.0	77.3	3.1	4.9	0.97	0.98
14	67.2	77.9	3.1	5.1	0.98	0.99
15	67.3	78.3	3.1	5.1	0.98	0.99
16	67.4	78.7	3.1	5.2	0.98	0.99
17	67.5	79.0	3.1	5.3	0.98	0.99
18	67.6	79.3	3.2	5.3	0.99	1.00
19	67.6	79.4	3.2	5.3	0.99	1.00
20	67.7	79.6	3.2	5.4	0.99	1.00
21	67.7	79.7	3.2	5.4	0.99	1.00
22	67.7	79.8	3.2	5.4	0.99	1.00
23	67.7	79.9	3.2	5.4	0.99	1.00
24	67.7	80.0	3.2	5.4	0.99	1.00
25	67.7	80.0	3.2	5.4	0.99	1.00
26	67.8	80.1	3.2	5.4	1.00	1.00
27	67.8	80.1	3.2	5.4	1.00	1.00
28	67.8	80.1	3.2	5.4	1.00	1.00
29	67.8	80.1	3.2	5.5	1.00	1.00
30	67.8	80.2	3.2	5.5	1.00	1.00
31+	67.8	80.2	3.2	5.5	1.00	1.00

Discard calculations

Based on the market value of different sized fish, industry indicated that they thought retention of fish of about 3 – 3 ½ lb (whole weight) would be appropriate. This represents fish of about 52 – 55 cm fork length.

To model this, a logistic retention curve was applied to the weight-frequency of the catch in the form of $P_{Ret} = 1 + \text{Exp}(S \times (W_{50} - W))$, where:

- P_{Ret} is the proportion retained;
- S is a steepness parameter;
- W_{50} is the weight at 50% retention; and,
- W is the whole weight of the fish.

In this manner, different retention curves could be applied to the resultant weight-frequency of the catch to determine retained and discarded numbers and weights. A high steepness parameter was used to imitate effectively knife-edge retention at the W_{50} weight. This suggests that the crew would be very good at determining the weight of individual fish and discarding accordingly.

Discard mortality

Factors affecting discard mortality can vary with depth, fish size and other environmental factors (Stachura et al. 2012). Stachura et al. (2012) estimated discard mortality of sablefish in the Alaska longline fishery and estimated the overall mortality as 11.71% but pointed out that “This estimate

may be lower than what actually occurs in commercial fisheries because fish are likely not handled as carefully as those in our study”. It is important to note, however, that this estimated related largely to “hooking injuries”, and may be higher than that associated with trap fisheries. Nevertheless, this value was used as the default for fixed gear in this analysis, but estimates between 10% and 25% were explored, as used in respectively in the federal Pacific Coast sablefish stock assessment and the southeast Alaska sablefish stock assessment conducted by the Alaska Department of Fish and Game for state waters – cited in Stachura et al. (2012).

TACs and Biomass scenarios

TACs mentioned in this report for BSAI and GOA only apply to the IFQ fixed gear fleets and are only provided as examples at levels similar to recent years. Two TAC scenarios are provided:

- 1) Discard mortality weights do not get deducted from the TAC; and,
- 2) Discard mortality weights do get deducted from the TAC.

In estimating the discard weight as a percentage of the total biomass, a figure of 650Kt was used for the total biomass. This is about the average of the estimated 2019 and 2020 total biomass (2+ fish) provided in Goethel et al (2020) Table 3.14.

Because only general figures for TAC and biomass are used in the calculations here, it is more useful to consider the results presented as relative comparisons rather than absolute values.

Relative impacts of different retention weights

Relative impacts of different retention weights on the fix gear fleet based on 2020 length frequency distribution were compared to no retention. Information of the costs of fishing of the fixed gear fleet were not able to be considered in this brief project. A simple assumption that the variable costs of fishing effort were directly proportional to the total amount of fish that are caught (retained and discarded) was used as a crude penalty function to explore optimal retention weights that take into account the cost of fishing. ***This aspect of the project can only be considered as draft exploratory work at this stage.***

Assumptions

The following assumptions were used in preparing these analyses.

1. Pots are used by 100% of the fixed-gear IFQ vessels
2. Same biological parameters between gully and slope habitats.
3. Single, homogenous population of Alaskan sablefish across all sablefish management areas
4. Male and female length frequency distributions and proportions collected by the observers separately for GOA and BSAI are representative of each of the different fisheries.
5. In applying the 11.7% mortality estimate, it is assumed that traps have the same mortality level as longlines.
6. A total biomass of 650Kt for both GOA and GSAI.

Results

It is important to note that in presenting these results, only a very simple deterministic approach has been applied to the length frequency of catches of sablefish to determine discard levels, mortality and the value of the catch at different levels of retention. As such, it does not address issues regarding the potential impact that discarding may have on future spawning biomass levels. This would need to be done through incorporation of discards as a scenario in the stock assessment model.

Gulf of Alaska

A fixed gear TAC of 18,000 t was assumed for the GOA (90% of a 20,000 t TAC, Alverson pers com) as an example.

A comparison of the length frequency of the fixed gear GOA catch in 2020 against the “average” length frequency across all years (1988-2020) is shown in Figure 2. On average, the modal length of fish ranges 64 – 70 cm fork length, equating to an estimated fishery value of about \$88.5 M. Due to the recent high numbers of small fish in the fishery the modal length-frequency has dropped to between 54 – 60 cm fork length, and because of their lower value per pound, the current value of the catch of the fixed gear fleet is reduced by about 26% compared to the average (Table 3). Figure 3 to Figure 6 show examples of 3 lb and 3 ½ lb retention with scenarios where discard mortality weights are not, and are deducted of the TAC. Table 4 and Figure 7 explore the impacts of different retention weights on the GOA fishery when the discard mortality weight is deducted from the fixed gear TAC.

Table 5 explores the impacts of different retention weights on the BSAI fishery when the discard mortality weight is deducted from the fixed gear TAC, and a 30% mortality rate of discards is assumed.

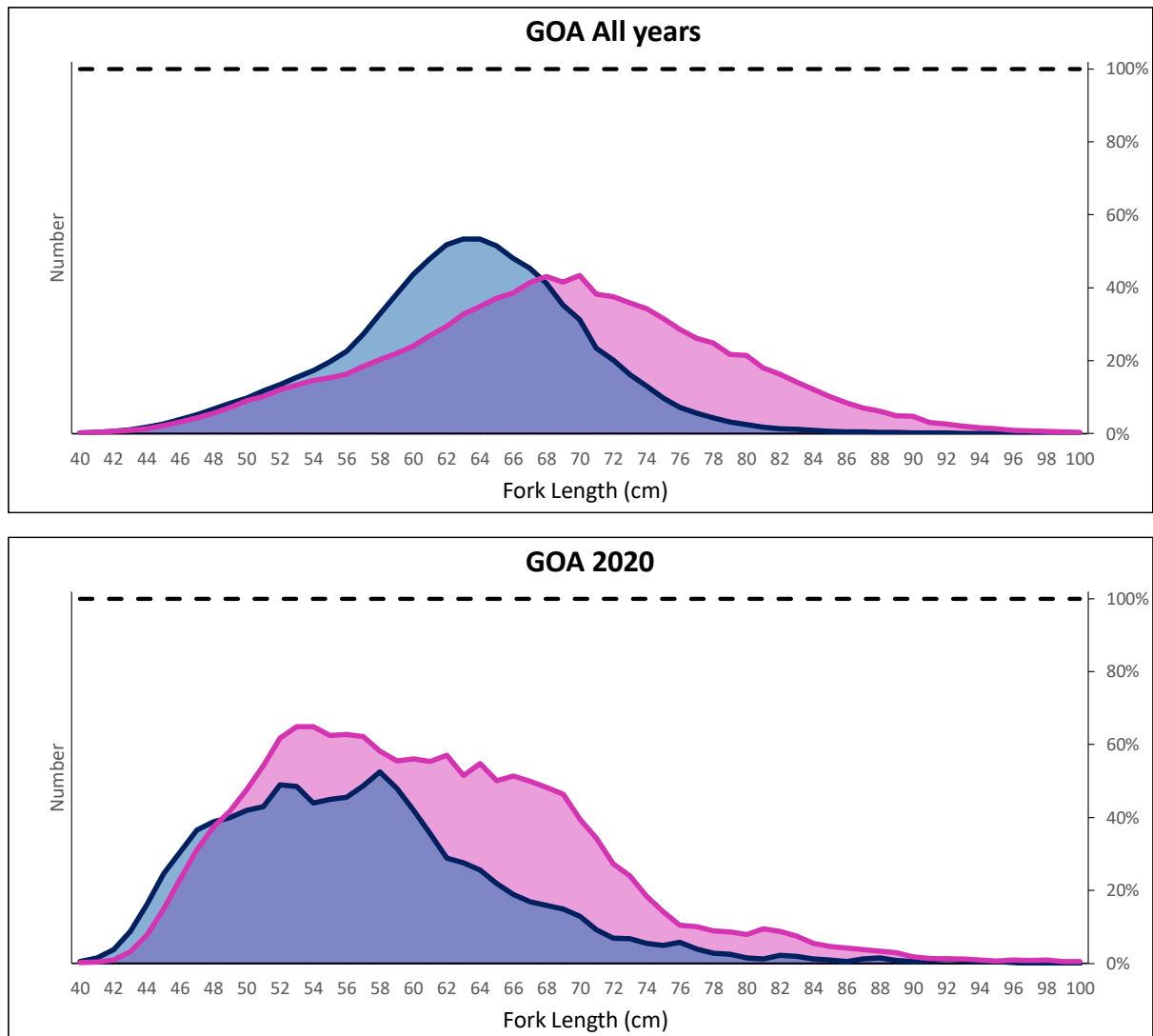


Figure 2. Diagram showing the length frequency of retained male (■) and female (■) Sablefish sampled by observers from the fixed gear fleet in the GOA fishery during all years (top) and during 2020 only (bottom).

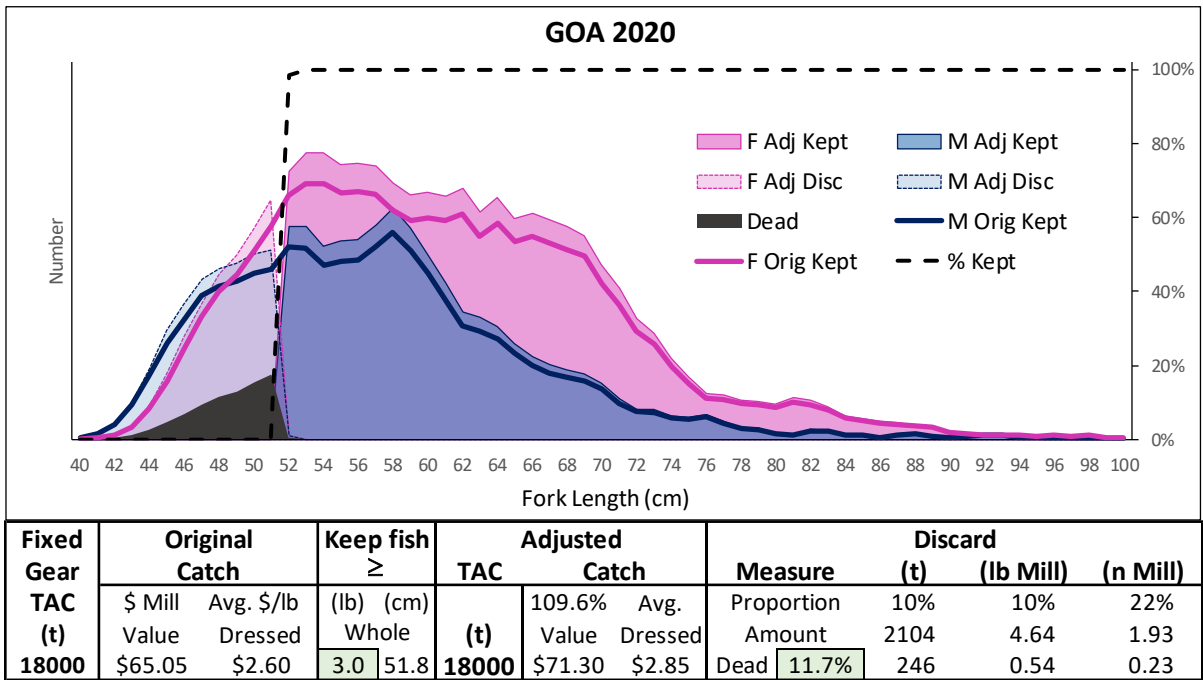


Figure 3. Diagram of the estimated length frequency of retained male (■) and female (■) and discarded male (■) and female (■) sablefish resulting from retention of fish \geq 3 lb (51.8 cm) in the GOA fixed gear during 2020. The estimated length frequency distribution of dead fish resulting from the discards is shown (■). Discard mortality weight *IS NOT* deducted from TAC.

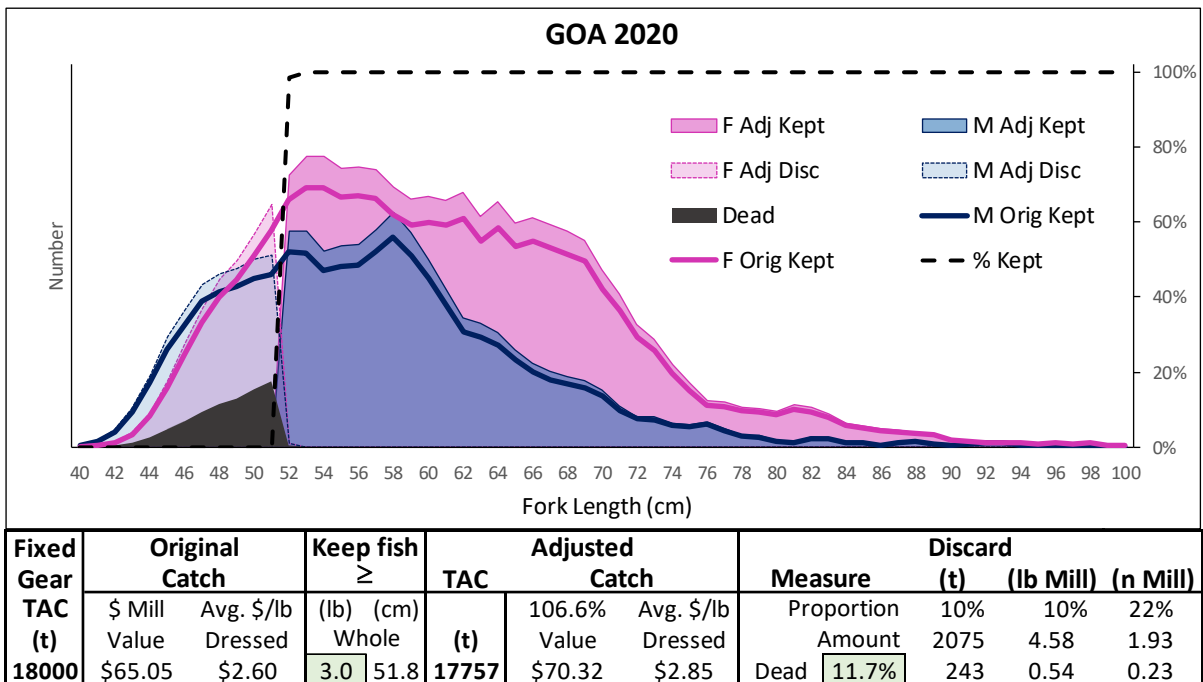


Figure 4. Diagram of the estimated length frequency of retained male (■) and female (■) and discarded male (■) and female (■) sablefish resulting from retention of fish \geq 3 lb (51.8 cm) in the GOA fixed gear during 2020. The estimated length frequency distribution of dead fish resulting from the discards is shown (■). Discard mortality weight *IS* deducted from TAC.

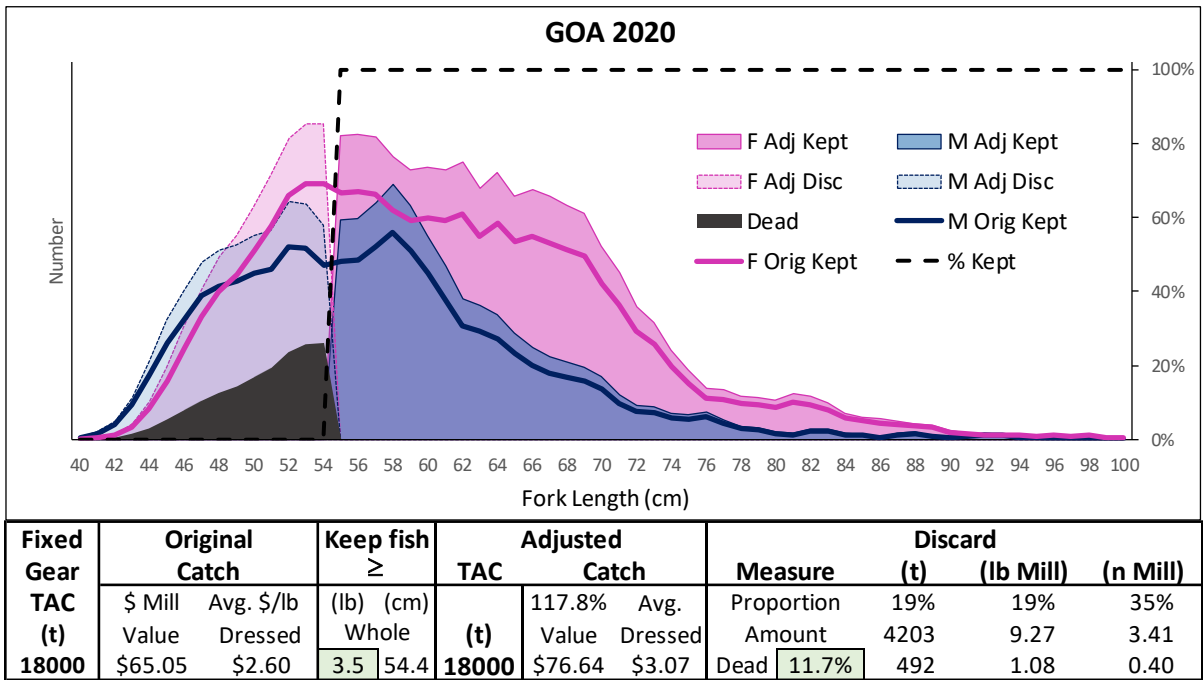


Figure 5. Diagram of the estimated length frequency of retained male (■) and female (■) and discarded male (■) and female (■) sablefish resulting from retention of fish $\geq 3\frac{1}{2}$ lb (54.4 cm) in the GOA fixed gear during 2020. The estimated length frequency distribution of dead fish resulting from the discards is shown (■). Discard mortality weight *IS NOT* deducted from TAC.

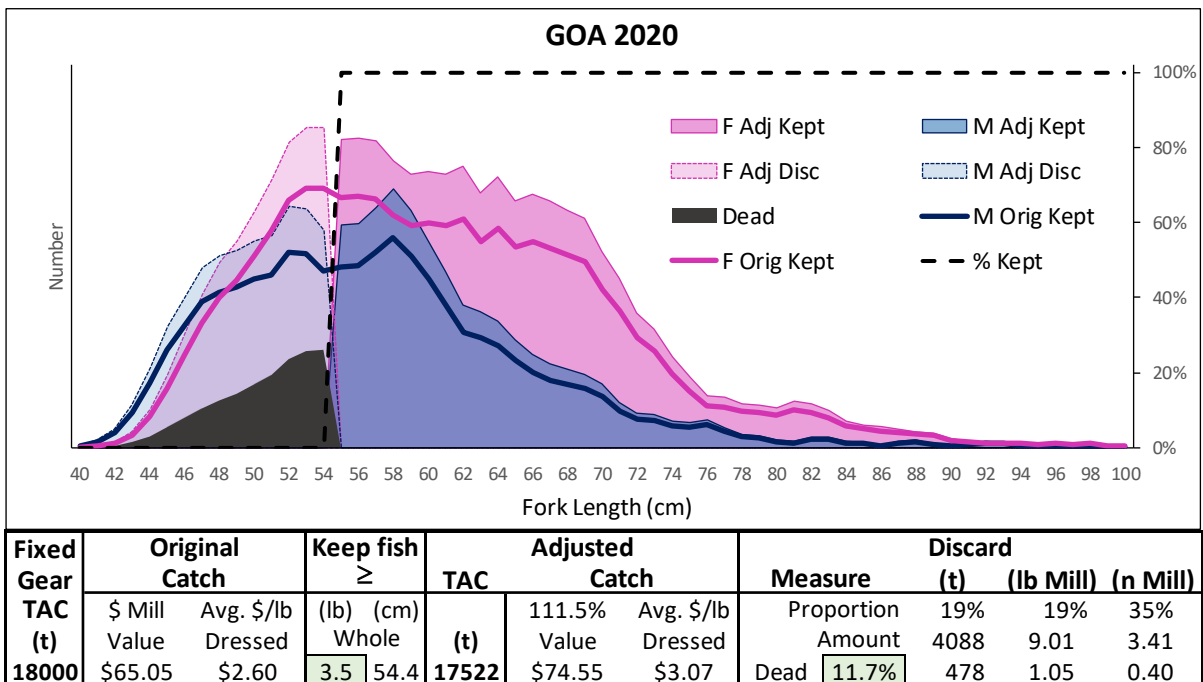


Figure 6. Diagram of the estimated length frequency of retained male (■) and female (■) and discarded male (■) and female (■) sablefish resulting from retention of fish $\geq 3\frac{1}{2}$ lb (54.4 cm) in the GOA fixed gear during 2020. The estimated length frequency distribution of dead fish resulting from the discards is shown (■). Discard mortality weight *IS* deducted from TAC.

Table 3. Scenarios for the on-board retention of whole fish (lb) from retaining all fish (≥ 0.0 lb) to only fish ≥ 5.0 lb based on observer length frequency of male and female catch by the fixed fleet in the Gulf of Alaska for all years (top) and 2020 only (bottom). From left to right, table columns present: 1) Average value (\$/lb) of the “Eastern dressed” catch weight across the entire catch; 2) total annual value (\$ million); 3) percentage of the total catch weight that is discarded; 4) total dead discarded catch weight (at 11.7% mortality); and, the relative proportion dead to 5) the fixed-fleet TAC and 6) total biomass.

All years – discard mortality weight *IS NOT* deducted from TAC.

Fish kept (\geq lb)	TAC (t)	Fish \$/lb ED	Fishery \$Mil	% Disc weight	Dead 11.7%	Dead / TAC	Dead / Biomass
0.00	18000	\$3.54	\$88.45	0.0%	0	0.0%	0.0%
1.50	18000	\$3.54	\$88.46	0.0%	0	0.00%	0.00%
2.00	18000	\$3.54	\$88.59	0.2%	4	0.02%	0.00%
2.50	18000	\$3.56	\$89.01	0.7%	15	0.08%	0.00%
3.00	18000	\$3.60	\$89.93	1.9%	41	0.23%	0.01%
3.50	18000	\$3.66	\$91.53	4.1%	90	0.50%	0.01%
4.00	18000	\$3.72	\$93.04	6.3%	141	0.79%	0.02%
4.50	18000	\$3.82	\$95.43	9.9%	232	1.29%	0.04%
5.00	18000	\$3.95	\$98.67	14.9%	369	2.05%	0.06%

2020 only – discard mortality weight *IS NOT* deducted from TAC

Fish kept (\geq lb)	TAC (t)	Fish \$/lb ED	Fishery \$Mil	% Disc weight	Dead 11.7%	Dead / TAC	Dead / Biomass
0.00	18000	\$2.60	\$65.05	0.0%	0	0.0%	0.0%
1.50	18000	\$2.60	\$65.07	0.0%	1	0.00%	0.00%
2.00	18000	\$2.63	\$65.71	1.2%	25	0.14%	0.00%
2.50	18000	\$2.71	\$67.83	4.8%	106	0.59%	0.02%
3.00	18000	\$2.85	\$71.30	10.5%	246	1.37%	0.04%
3.50	18000	\$3.07	\$76.64	18.9%	492	2.73%	0.08%
4.00	18000	\$3.24	\$80.88	25.3%	714	3.97%	0.11%
4.50	18000	\$3.46	\$86.52	33.2%	1048	5.82%	0.16%
5.00	18000	\$3.70	\$92.46	40.8%	1451	8.06%	0.22%

Table 4. Scenarios for the on-board retention of whole fish (lb) from retaining all fish (≥ 0.0 lb) to only fish ≥ 5.0 lb based on observer length frequency of male and female catch by the fixed fleet in the Gulf of Alaska for 2020 only, where discard mortality weight is deducted from the TAC. From left to right, table columns present: 1) Average value (\$/lb) of the “Eastern dressed” catch weight across the entire catch; 2) total annual value (\$ million); 3) percentage of the total catch weight that is discarded; 4) total dead discarded catch weight (at 11.7% mortality); and, the relative proportion dead to 5) the fixed-fleet TAC and 6) total biomass.

2020 only – discard mortality weight *IS* deducted from TAC

Fish kept (\geq lb)	TAC (t)	Value \$/lb	Value \$M \$Mil	% Disc weight	Dead (t) 11.7%	Dead / TAC	Dead / Biomass
0.00	18000	\$1.86	\$73.84	0.0%	0	0.0%	0.0%
1.50	17999	\$1.86	\$73.85	0.0%	1	0.00%	0.00%
2.00	17975	\$1.88	\$74.49	1.2%	25	0.14%	0.00%
2.50	17894	\$1.94	\$76.38	4.8%	106	0.59%	0.02%
3.00	17757	\$2.02	\$79.21	10.5%	243	1.37%	0.04%
3.50	17522	\$2.16	\$83.31	18.9%	478	2.73%	0.07%
4.00	17315	\$2.27	\$86.33	25.3%	685	3.96%	0.11%
4.50	17013	\$2.41	\$89.97	33.2%	987	5.80%	0.15%
5.00	16666	\$2.56	\$93.29	40.8%	1334	8.01%	0.21%

Table 5. Scenarios for the on-board retention of whole fish (lb) from retaining all fish (≥ 0.0 lb) to only fish ≥ 5.0 lb based on observer length frequency of male and female catch by the fixed fleet in the Gulf of Alaska for 2020 only, where discard mortality weight is deducted from the TAC. From left to right, table columns present: 1) Average value (\$/lb) of the “Eastern dressed” catch weight across the entire catch; 2) total annual value (\$ million); 3) percentage of the total catch weight that is discarded; 4) total dead discarded catch weight (at 30.0% mortality); and, the relative proportion dead to 5) the fixed-fleet TAC and 6) total biomass.

2020 only – discard mortality weight (assuming 30% mortality) *IS* deducted from TAC

Fish kept (\geq lb)	TAC (t)	Value \$/lb	Value \$M \$Mil	% Disc weight	Dead (t) 30.0%	Dead / TAC	Dead / Biomass
0.00	18000	\$1.86	\$73.84	0.0%	0	0.0%	0.0%
1.50	17998	\$1.86	\$73.85	0.0%	2	0.01%	0.00%
2.00	17935	\$1.88	\$74.33	1.2%	65	0.36%	0.01%
2.50	17732	\$1.94	\$75.67	4.8%	268	1.51%	0.04%
3.00	17391	\$2.02	\$77.49	10.5%	609	3.50%	0.09%
3.50	16827	\$2.16	\$79.65	18.9%	1173	6.97%	0.18%
4.00	16356	\$2.27	\$80.76	25.3%	1644	10.05%	0.25%
4.50	15714	\$2.41	\$81.27	33.2%	2286	14.55%	0.35%
5.00	15048	\$2.56	\$80.49	40.8%	2952	19.62%	0.45%

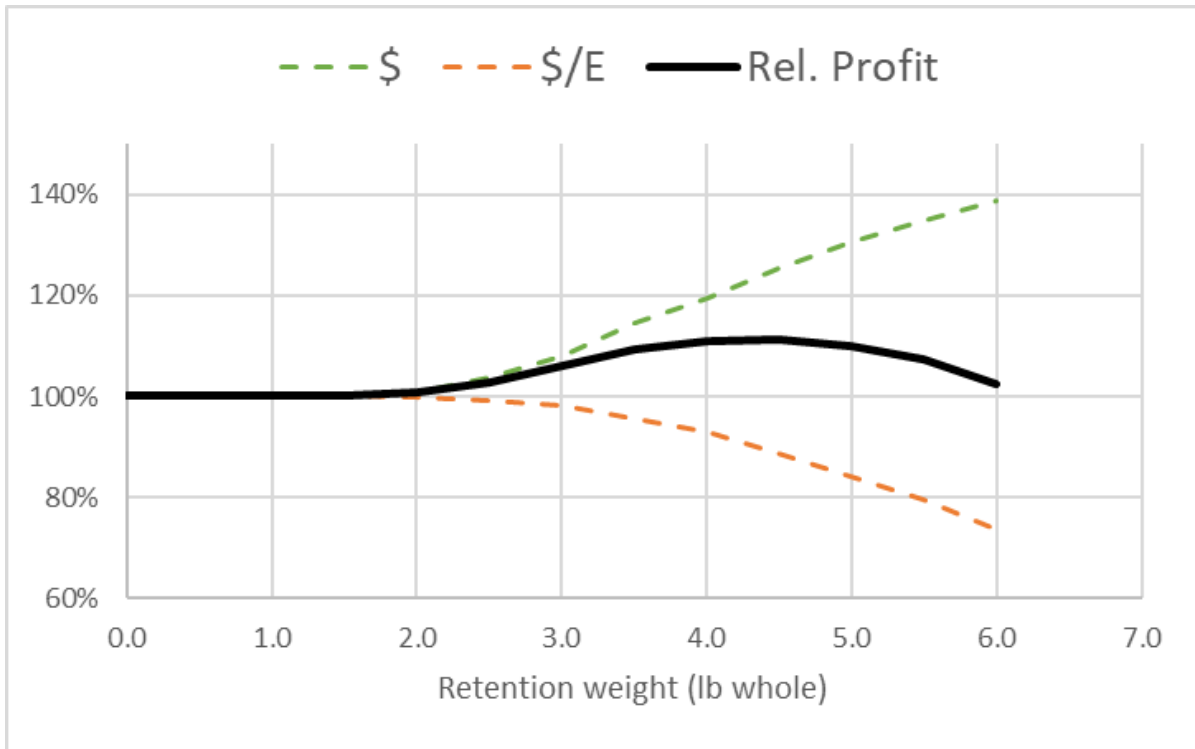


Figure 7. Relative impacts of different retention weights on the GOA fixed gear fleet based on 2020 length frequency distribution compared to no retention: relative total fishery value (- - -); relative value per fishing effort (- - -); and, relative overall profit (—) for a scenario where discard mortality weights are deducted from the TAC.

Bering Sea and Aleutian Islands

A fixed gear TAC of 1000 t was used for the BSAI as an example (Alverson pers com).

A comparison of the length frequency of the fixed gear BSAI catch in 2020 against the “average” length frequency across all years (1988-2020) is shown in Figure 8. On average years, the modal length of fish ranges 63 – 66 cm fork length, equating to an estimated fishery value of about \$3.5 M. Due to the recent high numbers of small fish in the fishery the modal length-frequency has dropped to between 52 – 54 cm fork length, and because of their lower value per pound, the current value of the catch of the BSAI fixed gear fleet is reduced by about 62% compared to the average (Table 6). Figure 9 to Figure 12 show examples of 3 lb and 3 ½ lb retention with scenarios where discard mortality weights are not, and are deducted of the TAC. Table 7 and **Error! Reference source not found.** explore the impacts of different retention weights on the BSAI fishery when the discard mortality weight is deducted from the fixed gear TAC.

Table 7 explores the impacts of different retention weights on the BSAI fishery when the discard mortality weight is deducted from the fixed gear TAC, and a 30% mortality rate of discards is assumed.

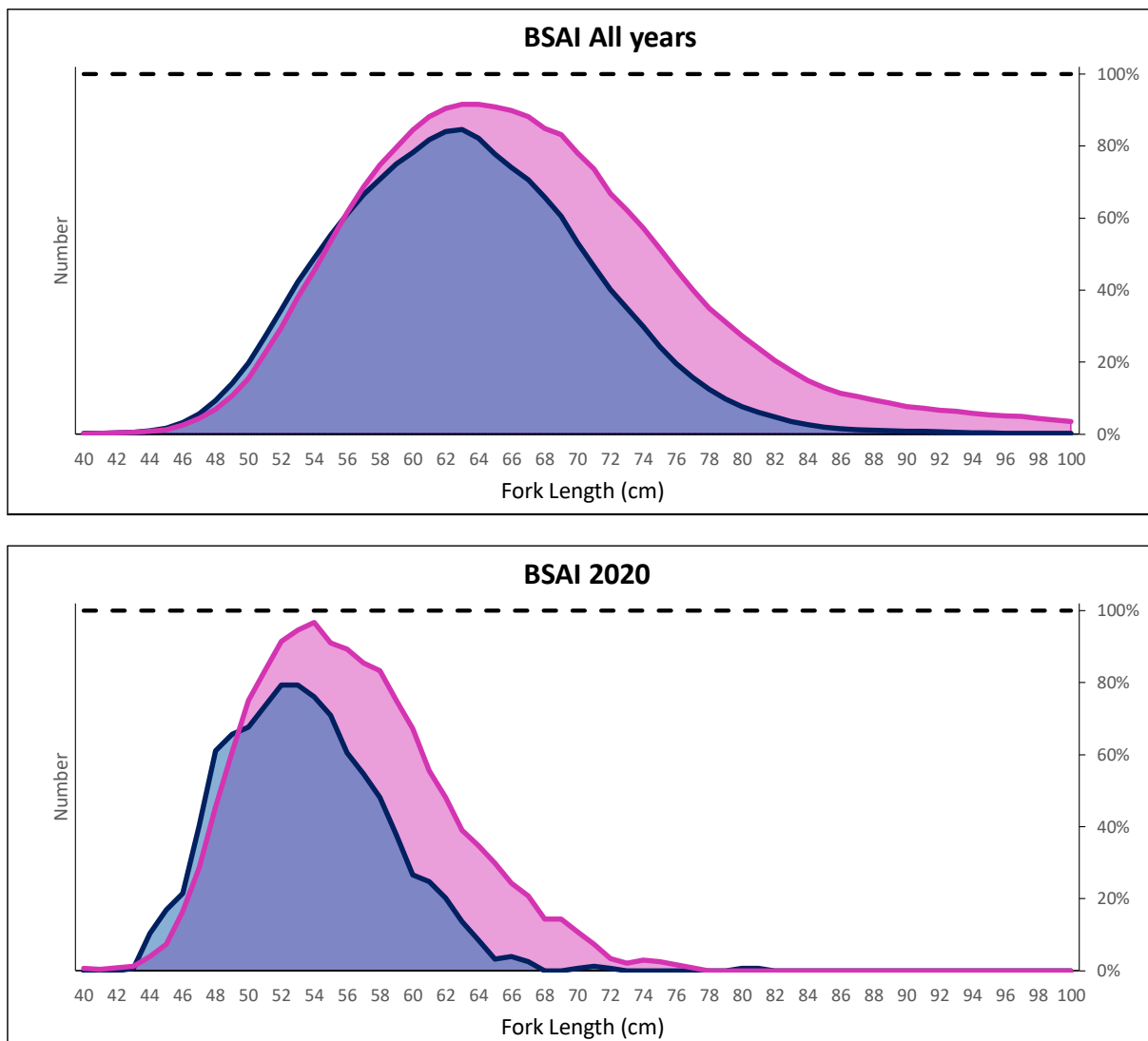


Figure 8. Diagram showing the length frequency of retained male (■) and female (■) Sablefish sampled by observers from the fixed gear fleet in the BSAI fishery during all years (top) and during 2020 only (bottom).

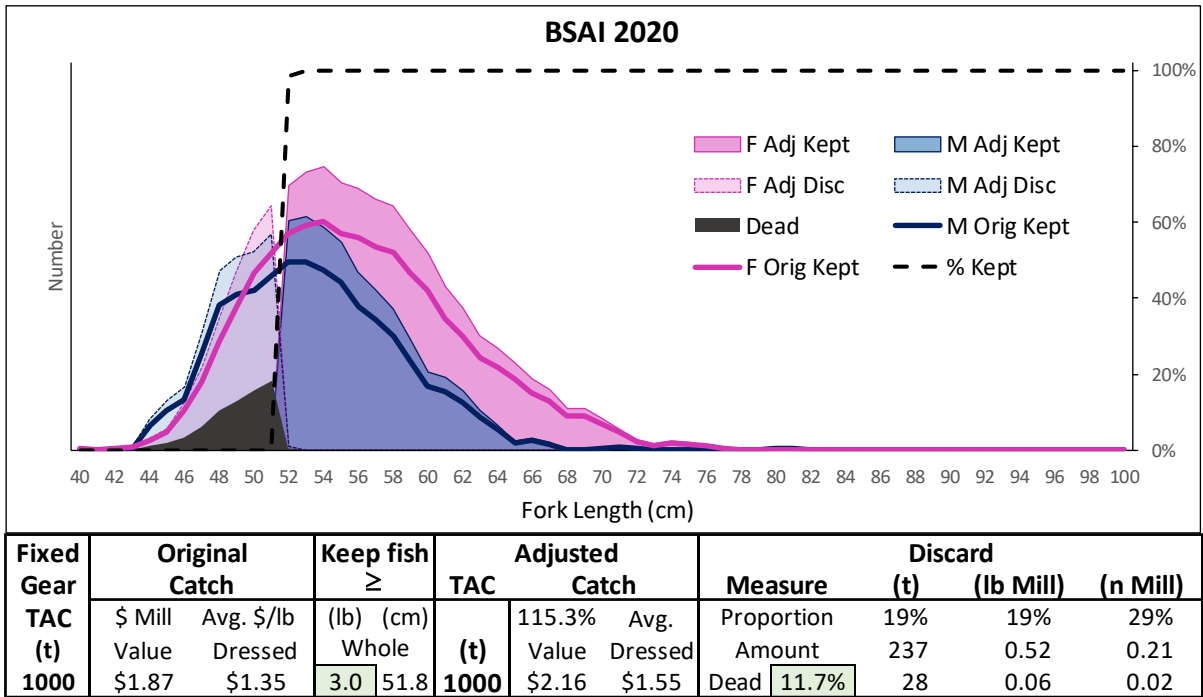


Figure 9. Diagram of the estimated length frequency of retained male (■) and female (■) and discarded male (■) and female (■) Sablefish resulting from retention of fish ≥ 3 lb (51.8 cm) in the BSAI fishery. The estimated length frequency distribution of dead fish resulting from the discards is shown (■). Discard mortality weight *IS NOT* deducted from TAC.

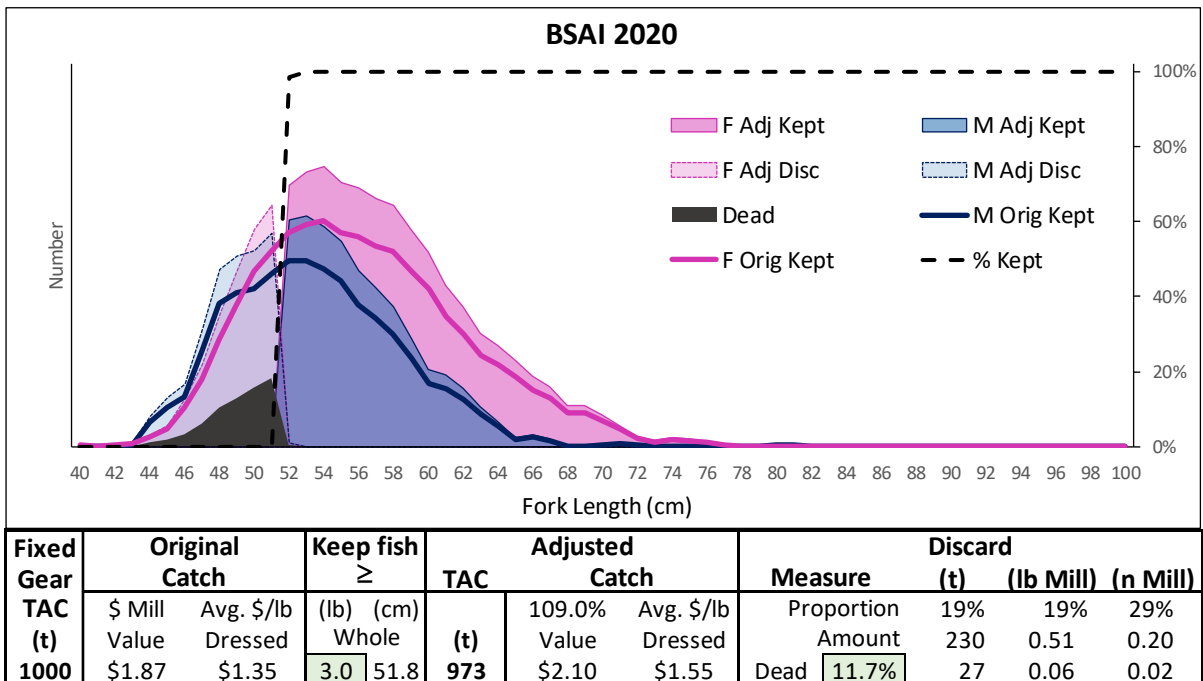


Figure 10. Diagram of the estimated length frequency of retained male (■) and female (■) and discarded male (■) and female (■) Sablefish resulting from retention of fish ≥ 3 lb (51.8 cm) in the BSAI fishery. The estimated length frequency distribution of dead fish resulting from the discards is shown (■). Discard mortality weight *IS* deducted from TAC.

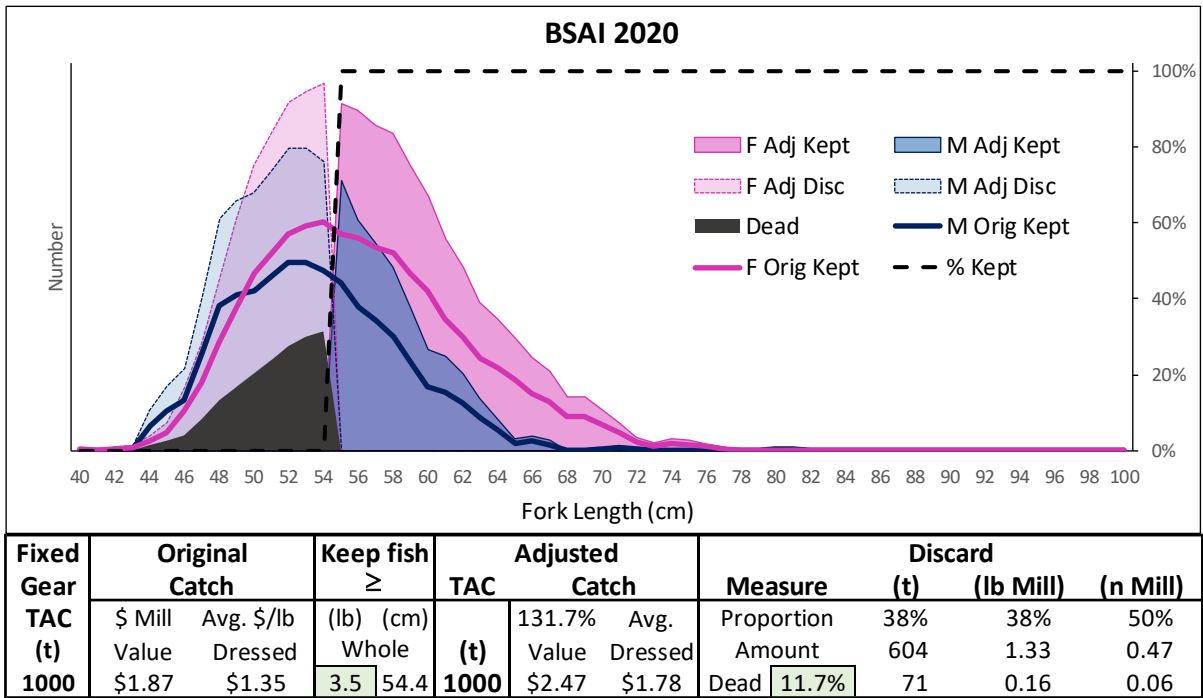


Figure 11. Diagram of the estimated length frequency of retained male (■) and female (■) and discarded male (■) and female (■) Sablefish resulting from retention of fish ≥ 3½ lb (54.4 cm) in the BSAI fishery. The estimated length frequency distribution of dead fish resulting from the discards is shown (■). Discard mortality weight *IS NOT* deducted from TAC.

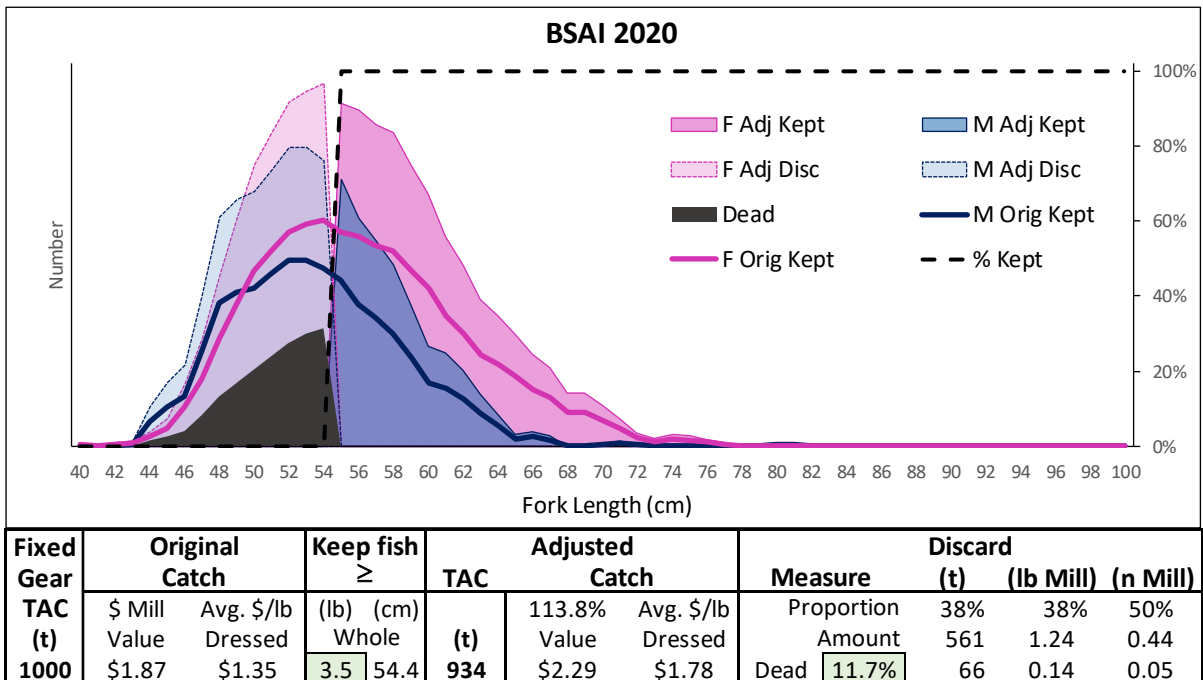


Figure 12. Diagram of the estimated length frequency of retained male (■) and female (■) and discarded male (■) and female (■) Sablefish resulting from retention of fish ≥ 3½ lb (54.4 cm) in the BSAI fishery. The estimated length frequency distribution of dead fish resulting from the discards is shown (■). Discard mortality weight *IS* deducted from TAC.

Table 6. Scenarios for the on-board retention of whole fish (lb) from retaining all fish (≥ 0.0 lb) to only fish ≥ 5.0 lb based on observer length frequency of male and female catch by the fixed fleet in the Bering Straits and Aleutian Islands for all years (top) and 2020 only (bottom). From left to right, table columns present: 1) Average value (\$/lb) of the “Eastern dressed” catch weight across the entire catch; 2) total annual value (\$ million); 3) percentage of the total catch weight that is discarded; 4) total dead discarded catch weight (at 11.7% mortality); and, the relative proportion dead to 5) the fixed-fleet TAC and 6) total biomass.

All years – discard mortality weight *IS NOT* deducted from TAC.

Keep Whole Fish (\geq lb)	TAC (t)	Fish \$/lb ED	Fishery \$Mil	% Disc weight	Dead 11.7%	Dead / TAC	Dead / Biomass
0.00	1000	\$3.48	\$4.83	0.0%	0	0.0%	0.0%
1.50	1000	\$3.48	\$4.83	0.0%	0	0.00%	0.00%
2.00	1000	\$3.48	\$4.83	0.1%	0	0.01%	0.00%
2.50	1000	\$3.49	\$4.85	0.4%	0	0.04%	0.00%
3.00	1000	\$3.52	\$4.90	1.6%	2	0.18%	0.00%
3.50	1000	\$3.61	\$5.02	4.7%	6	0.57%	0.00%
4.00	1000	\$3.71	\$5.15	8.1%	10	1.03%	0.00%
4.50	1000	\$3.85	\$5.35	13.3%	18	1.79%	0.00%
5.00	1000	\$4.02	\$5.59	19.5%	28	2.83%	0.00%

2020 only – discard mortality weight *IS NOT* deducted from TAC

Keep Whole Fish (\geq lb)	TAC (t)	Fish \$/lb ED	Fishery \$Mil	% Disc weight	Dead 11.7%	Dead / TAC	Dead / Biomass
0.00	1000	\$1.35	\$1.87	0.0%	0	0.0%	0.0%
1.50	1000	\$1.35	\$1.87	0.0%	0	0.00%	0.00%
2.00	1000	\$1.36	\$1.88	0.9%	1	0.10%	0.00%
2.50	1000	\$1.41	\$1.96	6.5%	8	0.82%	0.00%
3.00	1000	\$1.55	\$2.16	19.2%	28	2.77%	0.00%
3.50	1000	\$1.78	\$2.47	37.7%	71	7.07%	0.01%
4.00	1000	\$1.96	\$2.72	50.6%	120	11.98%	0.02%
4.50	1000	\$2.20	\$3.05	64.1%	209	20.91%	0.03%
5.00	1000	\$2.45	\$3.40	74.8%	347	34.71%	0.05%

Table 7. Scenarios for the on-board retention of whole fish (lb) from retaining all fish (≥ 0.0 lb) to only fish ≥ 5.0 lb based on observer length frequency of male and female catch by the fixed fleet in the Bering Straits and Aleutian Islands for 2020 only, where discard mortality weight is deducted from the TAC. From left to right, table columns present: 1) Average value (\$/lb) of the “Eastern dressed” catch weight across the entire catch; 2) total annual value (\$ million); 3) percentage of the total catch weight that is discarded; 4) total dead discarded catch weight (at 11.7% mortality); and, the relative proportion dead to 5) the fixed-fleet TAC and 6) total biomass.

2020 only – discard mortality weight *IS* deducted from TAC

Fish kept (\geq lb)	TAC (t)	Value \$/lb	Value \$M \$Mil	% Disc weight	Dead (t) 11.7%	Dead / TAC	Dead / Biomass
0.00	1000	\$1.35	\$1.87	0.0%	0	0.00%	0.00%
1.50	1000	\$1.35	\$1.87	0.0%	0	0.00%	0.00%
2.00	999	\$1.36	\$1.88	0.9%	1	0.10%	0.00%
2.50	992	\$1.41	\$1.95	6.5%	8	0.82%	0.00%
3.00	973	\$1.55	\$2.10	19.2%	27	2.77%	0.00%
3.50	934	\$1.78	\$2.29	37.7%	66	7.03%	0.01%
4.00	895	\$1.96	\$2.40	50.6%	105	11.79%	0.02%
4.50	835	\$2.20	\$2.41	64.1%	165	19.81%	0.03%
5.00	773	\$2.45	\$2.22	74.8%	227	29.30%	0.03%

Table 8. Scenarios for the on-board retention of whole fish (lb) from retaining all fish (≥ 0.0 lb) to only fish ≥ 5.0 lb based on observer length frequency of male and female catch by the fixed fleet in the Bering Straits and Aleutian Islands for 2020 only, where discard mortality weight is deducted from the TAC. From left to right, table columns present: 1) Average value (\$/lb) of the “Eastern dressed” catch weight across the entire catch; 2) total annual value (\$ million); 3) percentage of the total catch weight that is discarded; 4) total dead discarded catch weight (at 30% mortality); and, the relative proportion dead to 5) the fixed-fleet TAC and 6) total biomass.

2020 only – discard mortality weight (assumed at 30% mortality) *IS* deducted from TAC

Fish kept (\geq lb)	TAC (t)	Value \$/lb	Value \$M \$Mil	% Disc weight	Dead (t) 30.0%	Dead / TAC	Dead / Biomass
0.00	1000	\$1.35	\$1.87	0.0%	0	0.00%	0.00%
1.50	1000	\$1.35	\$1.87	0.0%	0	0.00%	0.00%
2.00	997	\$1.36	\$1.88	0.9%	3	0.27%	0.00%
2.50	980	\$1.41	\$1.92	6.5%	20	2.09%	0.00%
3.00	934	\$1.55	\$2.01	19.2%	66	7.07%	0.01%
3.50	852	\$1.78	\$2.02	37.7%	148	17.42%	0.02%
4.00	787	\$1.96	\$1.89	50.6%	213	27.04%	0.03%
4.50	751	\$2.20	\$1.42	64.1%	249	33.10%	0.04%

NB. No value left in the fishery with discarding >5 lb

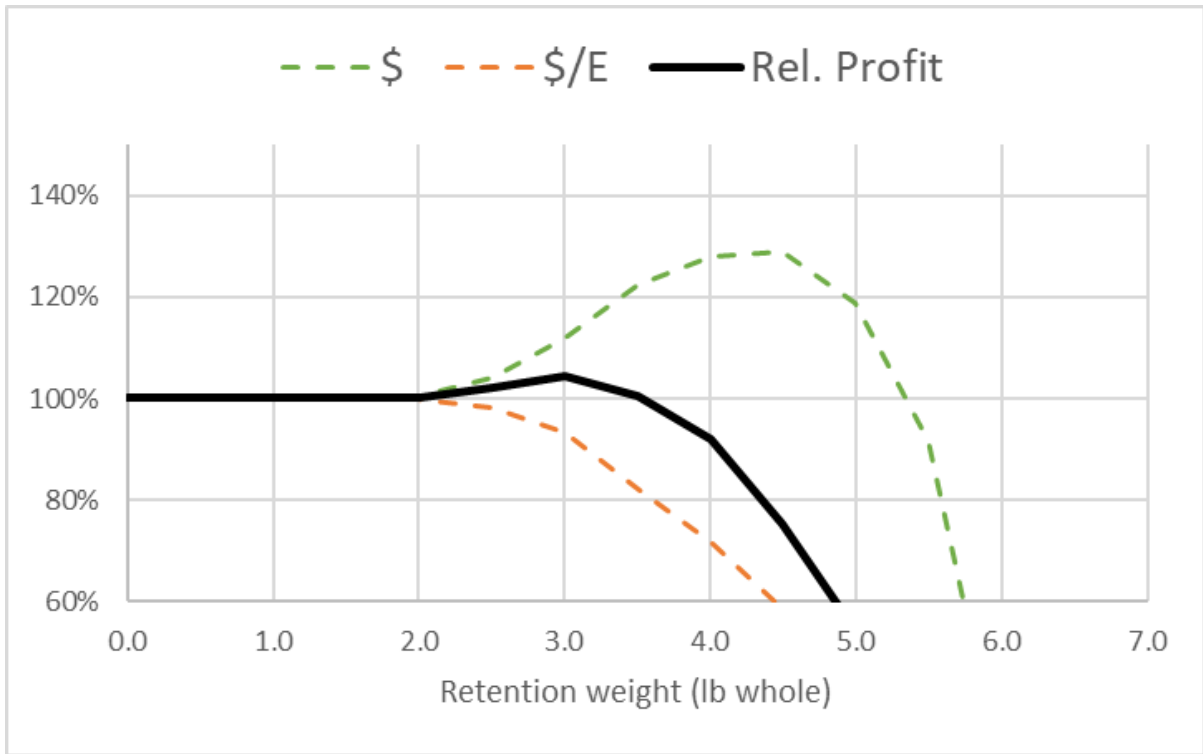


Figure 13. Relative impacts of different retention weights on the BSAI fixed gear fleet based on 2020 length frequency distribution compared to no retention: relative total fishery value (- - -); relative value per fishing effort (- - -); and, relative overall profit (—) for a scenario where discard mortality weights are deducted from the TAC.

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