

## **Appendix 3E. Catch Rates and Observations from the Fixed Gear Fleet**

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November, 2023

### **Management Measures and Recent Trends**

#### **Fishery Development**

This section is a brief history of sablefish fishery development. Sablefish have been exploited since the late 1800's in waters off of the U.S. Until 1957, catches were secondary to Pacific halibut and were on average 1,666 t from 1930-1957. Japan entered the fishery in 1958 and left in 1987, when the areas were closed to foreign fisheries. Other countries also participated in the fishery, but to a lesser degree. Catches were much higher during this period, peaking at 25,989 t in the Bering Sea in 1962 and at 36,776 t in the Gulf of Alaska (GOA) in 1972. Starting in 1972 catch was restricted to ~20% of the peak.

In 1985 (GOA) and 1990 (BSAI) the quota was divided among fixed gear and trawl fisheries, with different percentages in each area. The primary goal was to allow other target groundfish fisheries to intercept sablefish. The IFQ and CDQ catch share program began in 1995 for fixed gear Pacific halibut and sablefish fisheries in Alaska. This system extended the season from a “derby fishery” to approximately 8 months. The IFQ fixed gear component was primarily a hook-and-line (HAL) fishery until pot fishing was allowed in the Bering Sea in 1996 and in the Gulf of Alaska in 2017.

1983–1994: the U.S. longline fishery expanded in 1983 and was year-round until it was shortened to just 10 days in 1994

1985: sablefish quota in the GOA divided by gear type: 20% to trawl gear in the Western and Central GOA, 5% to trawl gear in the Eastern GOA, and the remainder to fixed gear

1986–1989: pot fishing banned in the eastern GOA in 1986, the Central GOA in 1987, and the Western GOA in 1989

1990: sablefish quota in the BS and AI divided by gear type: 50% to trawl in the BS and 25% in the AI, with the remainder going to fixed gear

1992: pot fishing banned in the BS

1995: the Individual Fishing Quota (IFQ) and Community Development Quota (CDQ) system was implemented

1996: pot fishing ban repealed in the BS

2000: pot fishing increased in the BSAI

2017: pot fishing allowed in the GOA

2018–2022: catch in pots increased rapidly

## Document Highlights

- 1) The fleet continues to shift to pot gear (84% of total Alaska fixed gear catch in 2023, as of October 3, 2023). Pot catch outweighs HAL in every management area. Many vessels continue to fish using two gears during the season.
- 2) On average, 65% of the catch in pots was harvested using slinky pots. The rate was especially high in West Yakutat and East Yakutat/Southeast at 86% and 94%, respectively.
- 3) In collaboration with the University of Alaska Fairbanks a relative, standardized fishery index of abundance has been developed and is used this year. The index includes data from pot and HAL gear and also combines data from both observers and logbooks. The previous index did not incorporate sets using pot gear. The rapid increase in recent years in the relative, standardized fishery index, compared to the nominal HAL-only index previously used, is presumably due to the catch per unit effort standardization process and the incorporation of pot gear data.
- 4) Pot gear is set in a narrower depth range than hook-and-line; approximately 80% of pot gear sets were in the 400–650 m depth range and 80% of HAL sets were at depths from 300–800 m.
- 5) The average length of sablefish caught in pots was highest in the WG at 61 cm and was 59 cm in the BS, from 2020–2023. Whereas the average length in HAL gear differed by 8 cm among areas: 65 cm in EY/SE and 57 in the BS.
- 6) The number of vessels with electronic monitoring has been decreasing in HAL gear and has increased for pot gear. East Yakutat/Southeast (EY/SE) continues to have the most electronic monitoring and the central GOA is second.
- 7) Logbook data shows that sperm whale presence may be decreasing in HAL gear in the eastern and western Gulf of Alaska. The decreasing trend is only seen in EY/SE for pot gear.
- 8) There is some evidence of whales depredating pot gear. In logbooks there were 21–45 pot hauls depredated annually. Now that slinky and hard pots are being differentiated, the majority of depredation in 2022 was on slinky pots. The two are not yet separated by observers, but will be in 2024.

## Increased Catch in Pot Gear

In response to increased interest in using pot gear to catch sablefish, partially due to an increase in sperm whale depredation in the GOA, the North Pacific Fishery Management Council (NPFMC) passed a regulation to allow pot fishing in the GOA starting in the 2017 fishery (81 FR 95435, January 27, 2017). Since pot fishing became legal in the GOA it has rapidly expanded; in 2023 84% of the total fixed gear catch in Alaska was taken in pots, up from 15% in 2017 (Figure 3E.1). This rapid transition has been possible because of the development of collapsible, light weight “slinky pots” that take up less space than hard pots, can be fished on smaller vessels, and require less upfront capital investment. Pot fishing has been legal in the BSAI over a much longer period.

The number of vessels fishing pot gear in the GOA and the BS has increased rapidly since 2017 (Figure 3E.1). Pot gear deliveries have also climbed steeply, particularly in 2021. At the same time, the delivery weight from HAL vessels is decreasing as well as the number of vessels fishing. The transition to pot gear can also be detected by the number of vessels fishing two gears type, potentially testing pot gear. This increased in the Central GOA (CGOA), West Yakutat (WY), and East Yakutat/Southeast (EY/SE) in 2020 and again in 2021 and appears to have stabilized. The number of vessels fishing pot gear continues to increase in most areas, but has leveled in the CG and WY. Despite this, catch in pots continues to increase in all areas.

Sablefish catch attributed to each pot type is available from the Alaska Regional Office Catch Accounting System (CAS) for 2022 and for a partial year in 2023 (as of October 3, 2023; akfin.org). For all of Alaska the percent of catch in slinky pot gear, out of all pot catch, was on average 65% (Table 3E.2). In each management area, on average 50% of the pot catch was in slinky pots in the AI, 45% in the BS, 30% in

WG, and 66% in the CG. Slinky pots are more common in the eastern GOA: 86% of catch in WY and 94% in EY/SE. Overall, rates were higher in 2023 than 2022. The largest percentage increases in pot catch in slinky pots were in the BS (12%) and the WG (15%).

## **Hook-and-Line and Pot Fishery Index**

### **Index Results**

Historically the index of abundance only included HAL sets covered by observers and logbooks. Matthew Cheng and Professor Dr. Curry Cunningham from the University of Alaska Fairbanks collaborated with Auke Bay Laboratories to create a standardized, combined relative index of abundance for sablefish. This index combines observer and logbook data for both HAL and pot gear types, which is critical given that pot gear catch has increased rapidly over the past several years (Figure 3E.1). This year, the combined standardized index of abundance replaces the previously used nominal index that included HAL gear only. The standardized index of abundance was presented in the 2022 sablefish SAFE as a sensitivity run, and appeared to have negligible impacts on model results (Goethel et al. 2022). In the standardized fishery index model, various candidate explanatory variables were included to control for observed differences in catch per unit effort that are unrelated to interannual variation in sablefish abundance (e.g., geospatial effects, depth data source, day of year, and fishery management areas). Furthermore, explanatory variables for year, vessel length, target strategy, processed type (eastern vs. western cut), and gear type were retained in every model to control for assumed differences in fishery dynamics, where the year variable represents the underlying index of abundance.

Target was declared by the fisher in the logbook data set. However, targets are not recorded by observers. Thus, a hierarchical clustering procedure was implemented using sablefish catch and other species commonly encountered in the sablefish fishery. Using the catch composition of the entire observer data set, three primary clusters were identified, which were included to the model as a factor. Note that pot gear used in indices are only reflective of the BSAI region before 2017. Standardized abundance indices are presented for each gear type to elucidate the impact of the addition of respective gears in developing a combined standardized index. Only the combined standardized index is incorporated within the assessment. In all standardized indices, there has been an increase in relative abundance in recent years (Figure 3E.2, Table 3E.3). Since 2020 the combined index increased rapidly, which was subsequent to a more than 20-year steady decline. The rapid and steep increase in relative abundance of the combined gear index is presumably due to the standardization process and the incorporation of pot gear data, which comprises a large portion of the fishery-dependent data in recent years. The increase in the relative index for pot gear only has taken place over a longer period.

Note that pot fishing in the GOA was introduced in 2017. Data in the current year are not included because there are only partial observer data for the current season and no logbook data is available for the current season. Trends among relative indices should be compared and not the actual estimates.

### **Sample Sizes**

Sets utilized in the combined standardized index were first filtered if required fields were null, there was an obvious error, or if there was killer whale depredation. In addition, when a set was documented in both logbook and observer data, the set was retained only in the observer data. Data from the HAL fishery have decreased in both the observer and logbook data sets (Table 3E.4). The decrease started in 2016 in the observer data and 2019 in the logbook data; at the same time pot sets increased rapidly. For example, pot gear sets used in the combined index model increased from 1,633 in 2017 to 6,860 in 2022. This shift in gear lends credence to the need for a combined gear index. The inclusion of the largest sector of the

fishery improves sample sizes from areas with sparse HAL data. This was problematic in recent years when there was no/sparse data in the BS and AI (Goethel et al. 2022).

Logbook sample sizes are substantially higher than observer samples sizes. Participation increased sharply in 2004 in all areas, primarily because the International Pacific Halibut Commission (IPHC) started collecting logbooks dockside for Auke Bay Laboratories. The quantity of data is due to the strong working relationship the IPHC has with the fleet and their diligence in collecting logbooks dockside.

Electronic monitoring (EM) has replaced human observers on some vessels fishing pot and HAL gear in the sablefish fishery as well as other fixed gear fisheries. A sub-sample of video is reviewed and a count of each species is recorded. Unlike data from sets with human observers, the EM data stream made available to authors does not include measured weights nor a measure of effort, such as the number of hooks and hook spacing. Therefore, as of this time we do not use EM data in the index. However, there are efforts to enter HAL effort data from EM logbooks; this started in 2022 and has continued in 2023. Data entry lags behind catch data availability.

## **Fishing Depths and Fish Lengths by Gear**

There was a difference in the average lengths by gear type between the eastern GOA (WY, EY/SE) and other areas, measured by observers from 2020–2023 (Figure 3E.3). In the eastern areas the mean length of HAL-caught sablefish was longer than from pot gear. The largest difference in average length was in EY/SE at 5 cm. Fish caught in pots were slightly larger in the WG, CGOA, and BS; all differences were small and ranged from 1-2 cm. The AI did not fit this spatial trend; however, it had the least data available. The mean lengths of fish from pot gear were similar for the 5 management areas (59-61 cm). For HAL gear it was more variable: from 62 cm in WY and 65 cm in EY to 57-60 cm in the other areas (an 8 cm difference).

Pot and HAL gear that have sablefish catch are set at depths ranging from 200-1,100 m (Figure 3E.4). The frequency of HAL sets by depth lacks a visible peak depth and has a flat distribution relative to pots; there was a similar frequency of HAL sets from 300–750 m. The peak frequency of pot gear sets is from 500–550 m, with a substantial proportion of pot sets also from 400–450 and 550–600. HAL gear was also set at more extreme depths than pot gear, both shallow and deep. For example, 14% of HAL sets were 800m+ and only 3% of pot sets. On the shallow side, 22% of HAL sets were set at <400 m compared to only 9% of pot sets.

## **Pot Gear Projects**

Fishing practices and the gear being used by the pot sector are rapidly evolving. Collapsible, light weight, slinky pots are becoming prevalent, allowing vessels previously unable to fish hard pot gear to switch to slinky pots. Little is understood regarding the differences in fishing power among the different pot designs. Observations of pot type and gear configurations from the fishery would provide the first measures of the rapidly changing fishery.

During this rapid increase of pot gear and slinky pot use in the GOA, vessels have experimented with using escape rings to help minimize catch of small sablefish; however, currently no regulations exist requiring the use of escape rings. The use of escape rings and escape ring size affects the size distribution of catch and resultant CPUE, but currently there is no information on the size of escape rings or their prevalence in the fishery.

The following projects have been initiated to better monitor the pot fishery:

- 1) EM video review now includes slinky and hard pot categories (2022 and forward). This will be an important component as EM use continues to grow.
- 2) EM HAL logbook data are being entered and can be linked to EM catch data. Data entry started in 2022 and has continued.
- 3) Fishery catch in CAS now includes pot gear type (slinky or hard). Results for 2022–2023 are described in the “Increased Catch in Pot Gear” section.
- 4) Observers will start to collect pot gear specifications as part of their protocols in 2024. This will include escape rings presence, count, size, and efficacy (open or tied closed). Tunnel measurements will be collected as well as the pot type. This will be coupled with the size distribution of the catch, when available, to evaluate the gear selectivity and to describe and quantify the different gear configurations used in the fishery.
- 5) Slinky pot and HAL CPUE and size distribution data, collected during experimental studies during the Alaska Fisheries Science Center hook-and-line survey (AFSC) longline survey, were compared and few differences were found in CPUE trends and fish lengths (Sullivan et al. 2022). There are plans to continue this research on the experimental leg of the AFSC hook-and-line survey.

## Whales

### At-sea Observer

Observers document whale depredation on all fixed gear sets. Whale depredation in the HAL fishery is used to estimate the amount of whale take in this fishery (Figure 3E.5). This is included in the assessment by adding the quantity taken by whale depredation to the total catch to get the total sablefish removals. Killer whale depredation has been recorded by observers since 1995. They typically depredate on longline gear in the BS and WG areas, and typically at lower rates in the AI. The percentage of killer whale depredated sets is irregular in the BS due to low sample sizes (3–26%) and in some years data can't be shown due to confidentiality regulations. Overall, whale depredation rates recorded by observers ranged from 3–14% annually on 17–139.

Observers also record sperm whale depredation (Figure 3E.5); however, it is important to remember that determining if sperm whales are depredating can be subjective, because they do not leave as much evidence of depredation as killer whales do. In the observer data, sperm whale depredation occurs in the CG, WY, and EY/SE and less so in the WG. Removals in the fishery are not estimated for use in management. Like killer whale data, depredation rates fluctuate rapidly and there are no trends.

Depredation rates for both species for HAL gear have declined in recent years to 0–1% (Figure 3E.5). It is possible that this is related to declines in the number of sets observed. Observed HAL sets will likely continue to decrease with declining effort in this fishery. For example, the number of HAL sets observed decreased by 63% from the early period average, 2013–2019, to the 2020–2022 average. Preliminary looks at 2023 show increases in depredation to 5–6% for sperm whales in some areas and increases in killer whale depredation in the BSAI, to 23% in the BS as of October 3, 2023. As sample sizes remain low or continue to decrease data will be less unreliable. The sporadic nature of the whale presence data will likely continue in the future.

There is very little depredation of pot gear documented by observers; a single set was depredated by killer whales in 2020 and again in 2021. There was an uptick in 2023 when 13 pot sets were depredated.

## Electronic Monitoring

EM video reviewers have noted when there are whales present and when there is evidence of fish depredation since 2020. They do not identify damage to pot gear. The data presented here include counts of sets where whales were present and there was evidence of depredation. Whale presence is only noted when the camera provides images of the whales. EM does not provide a wide-angle view outside of the hauling area; therefore, EM does not accurately reflect the amount of whale depredation in the fishery. In 2020 there were 12 HAL sets with killer whales present and evidence of depredation and 1 set with sperm whale(s). In 2021 there was 1 HAL set with killer whales. For pot gear, there were 2 sets with killer whales and 4 with sperm whales in 2021 and only 1 set with killer whales in 2022.

## Logbook – Hook and Line

Since 2017, whale presence during hauling and a tabulation of the number of fish or hooks with evidence of depredation have been included in logbooks as voluntary fields. Most logbook sets include mammal presence data, with rates from 85–95% being common in all areas. The quantity of sets with mammal data far outnumber those from observer data. For example, on average 10–35% of logbook sets had whales present by area (where the total number of sets includes those where mammal presence or absence was recorded and was not null); this included presence on 440–1,384 sets annually from 2017–2022. For comparison, whale depredation, not just presence, recorded by observers ranged from 3–14% annually on 17–139 sets.

On average from 2017–2022 killer whales were present in the AI on 6% of sets and 8% in the WG (Figure 3E.6). Conversely, sperm whale presence is predominantly in the CG (21% of sets), WY (35%), and EY/SE (25%). There was a downward trend in sperm whale presence in the WG and WY and less so in EY/SE (Figure 3E.6). Data in the BS is not presented because there is insufficient data.

The number of fish or hooks depredated is tabulated and is a voluntary field in logbooks. We examined the depredation rates when killer and sperm whales were present, and may have been the species depredating (termed species depredation– species is either killer or sperm whale). Overall, sperm whale depredation was 5% for all years and all areas and was 0.3% for killer whales. The number of sets with killer whale depredation was <50 sets per year and for sperm whales it ranged from ~100–800 sets per year. Depredation when killer whales were present was highest in the WG at 3%. Sperm whale depredation was highest in the eastern GOA, 7% in WY and EY/SE.

As for sample size trends in HAL gear, the number of sets with killer whale depredation has decreased over time, to 15 in 2022 and sperm whales to 196 (an 84% decrease from 2019). This reflects the same decreasing trends as observer HAL data. In terms of the number of sets with mammal data, including no mammals present, the number of HAL sets per year has decreased from ~7,000 in 2019 to 300 in 2022. Although decreasing, logbook sample sizes are higher than observers and trends are less sporadic (Figure 3E.7).

## Logbook - Pot

In 2022 there were 7,951 sets with marine mammal data (including no mammals present). Marine mammals were present on 14–28% (average 19%) of sets. Whales were present when hauling pot gear in all areas except the BS, where logbook sample sizes are very low. Killer whale presence in logbooks was prevalent in the AI, until 2019, when it decreased from 38% in 2018 to an average of 8% from 2019–2022. There are relatively low sample sizes in the AI and this may be associated with the large shift. Like HAL data, there were sperm whales present at the highest rates in the CG (11%), WY (23%), and EY/SE

(21%) areas. Overall there was a decreasing trend in presence in EY over the time series and there was a steep drop in WY in 2022 (Figure 3E.7).

Depredation, not just presence, of pot gear is most common in the CG and eastern GOA when sperm whales are present (Table 3E.5). All pot gear was reported as one type prior to 2020 and then was split into hard and slinky types in 2021. In 2022 slinky pots had more depredation than hard pots (31 vs. 9 sets). Gear, sablefish, halibut, and unknown species were all recorded as having damage in at least one year, with sablefish being the most common. Sets with damage have been similar each year (0.4–0.6% of pot sets with mammal data).

## **Electronic Monitoring Program**

Starting in 2019 for pot gear and 2018 for HAL gear, EM has replaced observers on some vessels in the fixed gear sector, including the sablefish fishery. Data from 2015 to 2017 are considered test years. A sub-sample of video is reviewed and a count of each species is recorded. This fish count is extrapolated to the whole set and the extrapolated set weight is calculated as the extrapolated count times the average weight for the vessel strata (e.g., the area, gear, target). Unlike data from sets with observers, the processed EM data does not include measured weights by set nor a measure of effort, such as the number of hooks from 2017–2021. The EM logbooks do include effort information when submitted and the effect data starting in 2022 is being entered. Table 3E.6 provides the number of sets, vessels, and the extrapolated number and weight of sablefish observed using EM, where there were at least 3 vessels observed in each area/year combination. These sets have been defined as targeting sablefish because they had the highest weight in the set, as defined by the Alaska Regional Office Catch Accounting System. Data is updated through 2022 because of incomplete data in 2023. Data entry is not up-to-date or in real-time with the availability of catch estimates.

HAL and pot gear EM numbers can be presented in the GOA and not in the BSAI due to confidentiality. In the GOA, EM HAL data is most prevalent in the CG, WY, and EY/SE areas (Table 3E.6). The shift to EM was initiated on HAL vessels in EY/SE and this area has the highest participation, particularly because small vessels are prevalent. The peak number of participating vessels fishing HAL gear in EY/SE was 30 from 2019–2020; this declined 40% to 18 in 2022. HAL vessel counts also decreased in 2020 in CG and WY, which could be related to COVID-19. Conversely, EM vessels fishing pot gear increased in most of the GOA. Since the inception of EM on vessels fishing pot gear, there was an increase in the number of pot vessels in EY/SE (by 2.6 times) and in the CG (3.2 times) (Table 3E.6). Likewise, the total number of vessels delivering IFQ sablefish in the EY/SE increased 7.7 times (Table 3E.1). Only in CG and WG has the number of pot vessels equipped with EM surpassed HAL vessels (Table 3E.6).

## Tables

Table 3E.1. The count of vessels and the pounds of IFQ sablefish sold by gear type, area, and year. Areas include the Aleutian Islands (AI), Bering Sea (BS), Western GOA (WG), Central GOA (CG), West Yakutat (WY), and East Yakutat/Southeast (EY/SE). The column on the right (Count Vessels with 2 Gears) is the number of vessels that fished both pot and hook-and-line (HAL) gear in that area and year.

Source: AKFIN.org on October 3, 2023.

FMP Subarea	Year	HAL		Pot		Count Vessels with 2 Gears
		Count Vessels	IFQ Sold (lbs)	Count Vessels	IFQ Sold (lbs)	
AI	2019	16	396,310	5	358,281	0
	2020	10	221,848	5	377,738	0
	2021	12	425,946	6	610,375	0
	2022	10	359,843	10	900,225	2
	2023*	6	232,260	9	896,805	1
BS	2019	17	180,040	7	602,809	0
	2020	15	148,579	12	895,506	3
	2021	12	70,608	16	2,142,475	3
	2022	9	60,760	21	2,768,510	4
	2023*	11	68,744	16	3,925,148	3
WG	2019	41	1,523,938	14	876,154	3
	2020	24	393,294	27	2,314,832	6
	2021	13	273,419	38	3,592,745	4
	2022	11	200,502	47	5,680,478	7
	2023*	11	193,446	38	4,634,982	7
CG	2019	117	5,491,692	24	2,426,375	10
	2020	85	2,713,925	72	5,557,283	39
	2021	71	1,248,595	98	11,377,475	38
	2022	75	1,250,805	97	12,939,719	35
	2023*	64	1,119,601	74	9,317,182	25
WY	2019	83	3,068,413	14	318,659	7
	2020	68	2,372,225	39	1,178,772	25
	2021	57	1,379,438	64	3,360,961	34
	2022	41	1,017,861	61	4,651,463	32
	2023*	47	768,127	62	3,907,646	29
EY/SE	2019	157	5,741,841	14	508,811	4
	2020	143	5,420,364	44	1,067,486	26
	2021	125	5,334,465	82	2,845,161	55
	2022	101	4,656,339	108	6,396,021	54
	2023*	85	2,668,476	104	5,694,524	44

\*Data in 2023 do not include the entire fishing season.



Table 3E.2. Percent of sablefish catch from IFQ trips, both retained and discarded, in slinky pots (% Slinky) opposed to hard pots. Catch and target were determined by Alaska Regional Office Catch Accounting System algorithms. Source: AKFIN.org on October 3, 2023.

Area	Year	% Slinky
BS	2022	40%
	2023	52%
AI	2022	48%
	2023	51%
WG	2022	23%
	2023	38%
CG	2022	66%
	2023	65%
WY	2022	86%
	2023	86%
EY/SE	2022	93%
	2023	95%
Combined	2022	64%
	2023	67%
All	All	65%

Table 3E.3. Relative fishery abundance indices for pot and hook-and-line (HAL) gears separately, for both gears combined, and the percent annual change (% change). Indices should be compared to one another for trends only and values among indices are not comparable.

Year	Combined	%	HAL	% change	Pot	% change
1995	0.35		0.43			
1996	0.34	-4%	0.41	-3%		
1997	0.37	11%	0.47	12%		
1998	0.33	-11%	0.41	-11%		
1999	0.33	-2%	0.42	1%		
2000	0.33	1%	0.41	-3%		
2001	0.31	-7%	0.37	-10%		
2002	0.32	6%	0.41	11%		
2003	0.35	7%	0.46	13%	5.64	
2004	0.33	-3%	0.42	-8%	6.77	20%
2005	0.36	8%	0.43	2%	15.00	121%
2006	0.30	-17%	0.37	-14%	7.94	-47%
2007	0.31	2%	0.38	3%	9.38	18%
2008	0.32	5%	0.41	7%	9.36	0%
2009	0.28	-13%	0.38	-6%	5.55	-41%
2010	0.26	-8%	0.33	-13%	4.15	-25%
2011	0.25	-3%	0.35	4%	3.57	-14%
2012	0.27	7%	0.34	-3%	6.14	72%
2013	0.22	-20%	0.26	-22%	5.05	-18%
2014	0.21	-1%	0.26	0%	5.15	2%
2015	0.19	-10%	0.23	-11%		
2016	0.17	-13%	0.20	-15%	7.38	43%
2017	0.19	14%	0.22	9%	14.09	91%
2018	0.17	-10%	0.19	-13%	14.97	6%
2019	0.19	8%	0.19	3%	22.14	48%
2020	0.20	5%	0.20	0%	17.72	-20%
2021	0.27	37%	0.25	29%	23.44	32%
2022	0.37	38%	0.26	4%	25.74	10%

Table 3E.4. The number of sets recorded by observers (OBS) or in logbooks (Log) used in the Alaska-wide, combined gear, standardized fishery index.

Year	HAL		Pot	
	OBS sets	Log sets	OBS Sets	Log Sets
1995	2,303			
1996	1,532		7	
1997	1,349			
1998	1,343		5	
1999	1,854		66	
2000	1,820		73	
2001	1,549		97	
2002	1,632	88	129	
2003	1,910	285	355	
2004	1,662	1,972	342	123
2005	1,587	2,583	312	131
2006	1,612	3,422	264	240
2007	1,509	3,747	278	640
2008	986	3,374	337	741
2009	1,287	3,664	377	1,026
2010	1,126	4,886	269	440
2011	741	5,094	517	911
2012	846	5,960	246	616
2013	1,470	7,066	64	410
2014	1,351	6,107	48	320
2015	1,447	6,423	36	0
2016	1,191	6,817	64	351
2017	719	5,940	181	1,633
2018	818	6,987	332	1,558
2019	917	7,113	209	1,886
2020	286	3,449	385	5,164
2021	363	1,942	1,108	5,879
2022	457	1,113	1,750	6,860

Table 3E.5. The number of logbook pot gear sets (sets) with damaged gear or fish and the whale species present. The whale species is either killer whale (K) or sperm whale (S). Sets are recorded as one type in 2020 (“both”) and then are split into hard and slinky in 2021. “Sets with data” are all pot gear sets with whale presence data collected (including no marine mammals present). Data has not been filtered for data quality in catch or effort related fields. Areas are the Central Gulf (CG), West Yakutat (WY), or East Yakutat/Southeast (EY/SE).

Year	Area	Species	Damaged	Sets (Hard or both)	Sets (Slinky)
2020	CG	S	gear	1	-
	CG	S	sablefish	3	-
	WY	S	sablefish	5	-
	WY	S	gear	6	-
	WY	S	halibut	3	-
	WY	S	unknown	3	-
	Total				21
Sets with data				5,065	-
2021	CG	K	sablefish	14	-
	CG	S	sablefish	22	-
	EY/SE	K	gear	1	-
	EY/SE	S	gear	1	-
	WY	S	gear	3	1
	WY	S	sablefish	4	1
	Total				45
Sets with data				4,202	3,094
2022	AI	K	sablefish	-	1
	CG	S	sablefish	1	-
	EY/SE	S	sablefish	-	4
	EY/SE	S	gear	-	5
	EY/SE	S	unknown	-	5
	EY/SE	S	halibut	-	1
	WY	S	halibut	1	-
	WY	S	gear	-	1
	WY	S	unknown	-	1
	WY	S	sablefish	6	10
	WG	K	sablefish	1	1
	WG	S	sablefish	-	2
Total				9	31
Sets with data				2,463	5,488

Table 3E.6. The number of vessels and sets observed by electronic monitoring (EM) by year, FMP sub-area, and the extrapolated weight and number of sablefish in all EM sablefish directed sets. Data is listed separately for hook-and-line and pot gears. C indicates that the data is confidential, because there are fewer than three vessels. No data is displayed in the BSAI because of confidentiality. Management areas include the Western Gulf of Alaska (WG), Central Gulf of Alaska (CG), West Yakutat (WY), and East Yakutat/Southeast (EY/SE). Source: AKFIN.org on October 10, 2023.

Sub-area	Year	Hook-and-line				Pot			
		Vessels	Sets	Extrap. Wt	Extrap. #	Vessels	Sets	Extrap. Wt.	Extrap. #
WG	2015	No data	-	-	-				
	2016	No data	-	-	-	No data			
	2017	C	-	-	-	No data	-	-	-
	2018	C	-	-	-	C	-	-	-
	2019	4	20	4,386	2,372	C	-	-	-
	2020	C	-	-	-	6	26	18,185	10,087
	2021	C	-	-	-	C	-	-	-
	2022	C	-	-	-	8	31	50,007	24,033
CG	2015	C	-	-	-				
	2016	3	71	39,697	13,078				
	2017	4	50	23,018	7,679	No data	-	-	-
	2018	19	159	79,679	30,844	No data	-	-	-
	2019	21	161	68,255	31,299	5	100	94,046	47,314
	2020	6	29	18,062	8,461	14	55	34,344	18,698
	2021	3	9	4,045	2,358	15	84	80,478	26,956
	2022	5	6	3,796	1,462	16	158	156,955	73,338
WY	2015	C	-	-	-				
	2016	3	23	32,014	9,769				
	2017	3	16	30,214	9,434	No data	-	-	-
	2018	9	37	41,882	14,423	C	-	-	-
	2019	12	46	33,065	12,988	C	-	-	-
	2020	8	23	23,241	8,649	7	36	12,609	5,296
	2021	7	20	10,884	5,126	10	62	73,705	24,313
	2022	7	16	12,285	4,746	7	46	46,103	20,482
EY/SE	2015	5	32	59,762	15,662				
	2016	12	77	97,363	27,204				
	2017	12	64	61,560	19,328	C	-	-	-
	2018	26	84	81,985	24,512	No data	-	-	-
	2019	30	137	121,810	37,127	6	64	29,921	16,532
	2020	30	95	93,696	31,278	7	23	12,465	4,484
	2021	26	80	86,327	27,395	12	53	41,489	15,513
	2022	18	66	92,953	33,846	13	51	49,868	22,579

## Figures

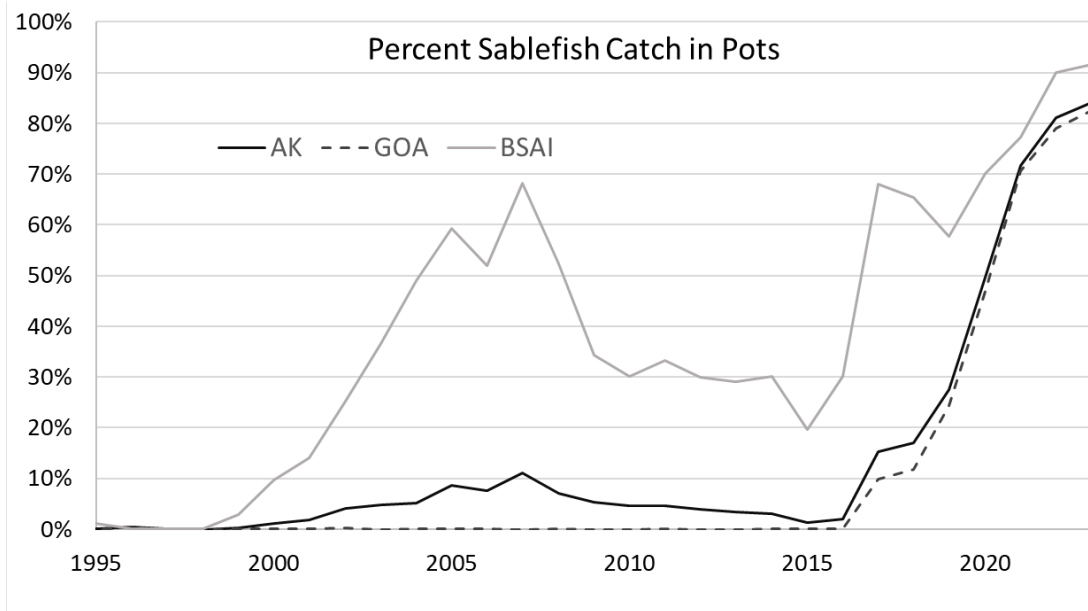


Figure 3E.1. The percent of sablefish catch in pot gear in either Alaska (AK), Gulf of Alaska (GOA), or the Bering Sea and Aleutian Islands (BSAI) management areas. Source: AKRO through AKFIN.org on October 3, 2023.

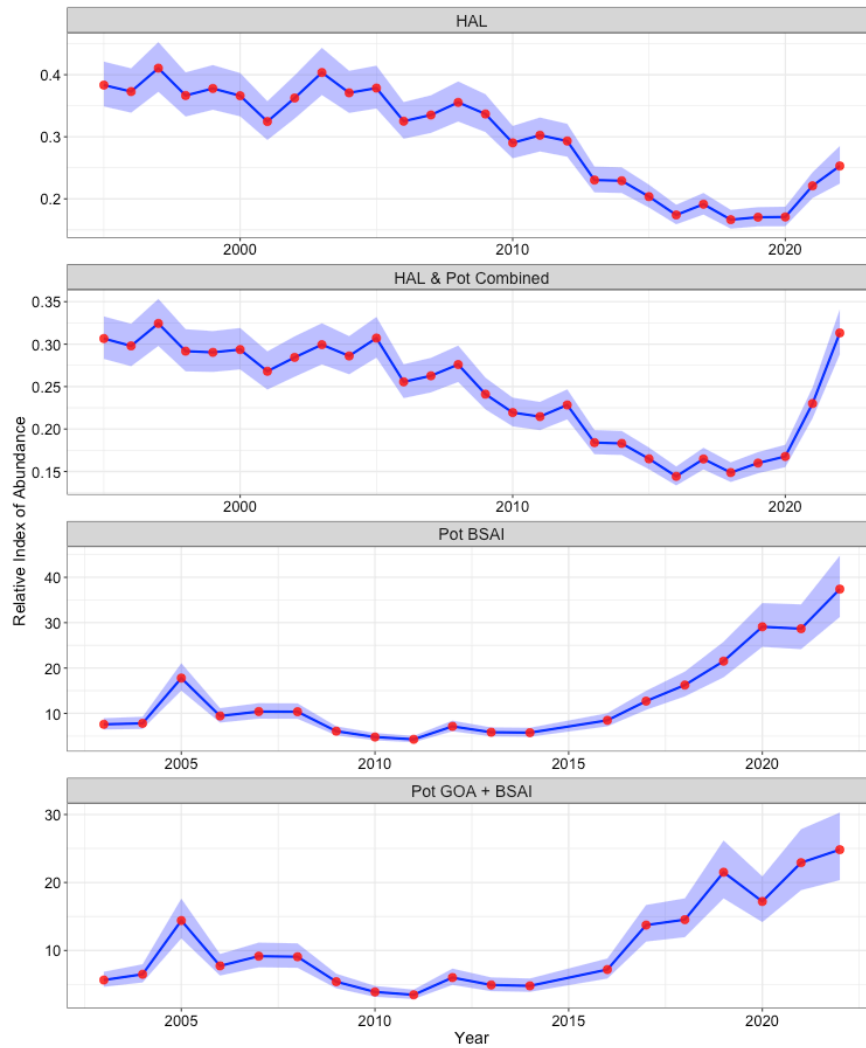


Figure 3E.2. Standardized fishery indices of relative abundance developed using general additive models. All standardized indices are developed using data from both observer and logbook data sources. Blue shading represents approximate 95% confidence intervals. The top panel includes only hook-and-line (HAL) sets. The second panel down includes HAL and pot gear data; this index is used in the sablefish assessment. Indices in the bottom two panels include pot gear data from either the Bering Sea and Aleutian Islands (BSAI) or the BSAI and Gulf of Alaska (GOA) combined. There is a missing value in 2015 for pot indices due to data sparsity. Pot data prior to 2017 are only from the BSAI.

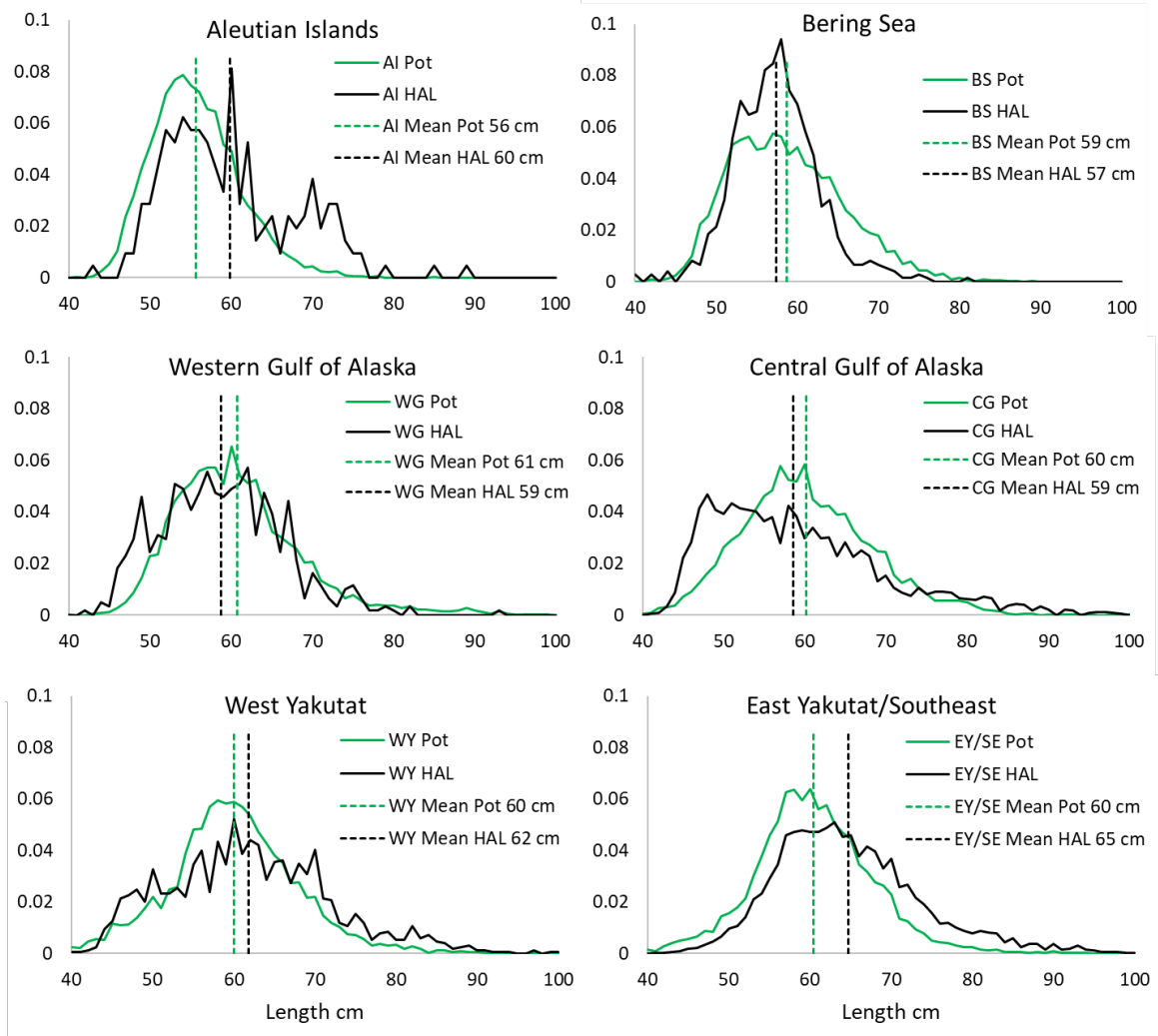


Figure 3E.3. Proportion of sablefish at each length sampled by observers in pot and hook-and-line (HAL) fisheries by FMP subareas for 2020-2023. Management areas include the Aleutian Islands (AI), Bering Sea (BS), Western Gulf of Alaska (WG), Central Gulf of Alaska (CG), West Yakutat (WY), and East Yakutat/Southeast (EY/SE). Source AKFIN.org on October, 8 2023.



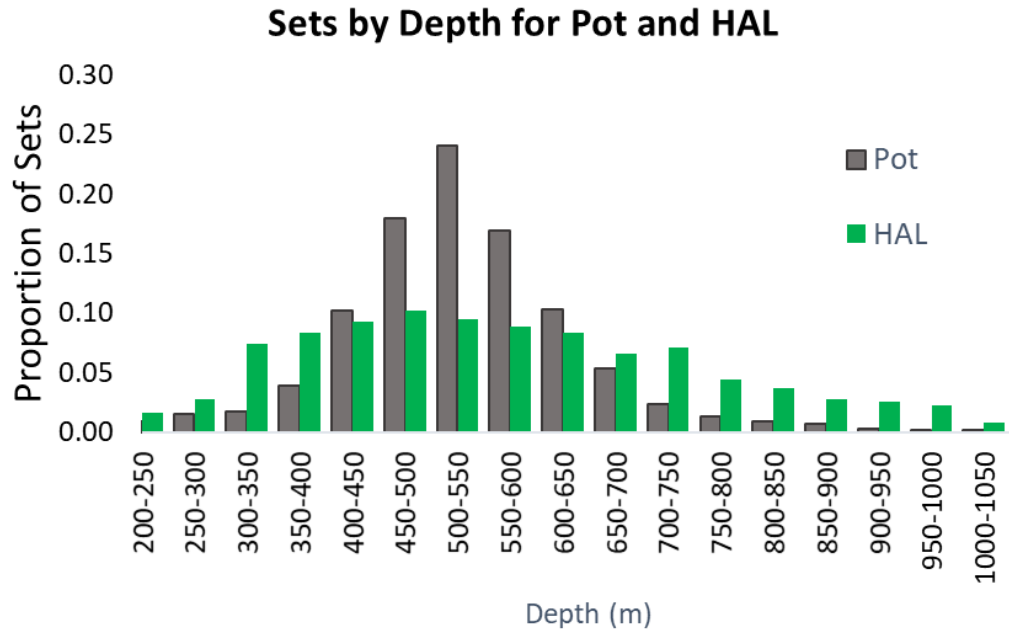


Figure 3E.4. Depths of observed pot and hook-and-line (HAL) sets from 2020-2023 in the Gulf of Alaska. Total number of pot sets is 4,083 and 1,822 hook-and-line sets. Data was included only if it was flagged as targeting sablefish and the vessel was fishing under an IFQ permit. Source AKFIN.org on October, 8 2023.

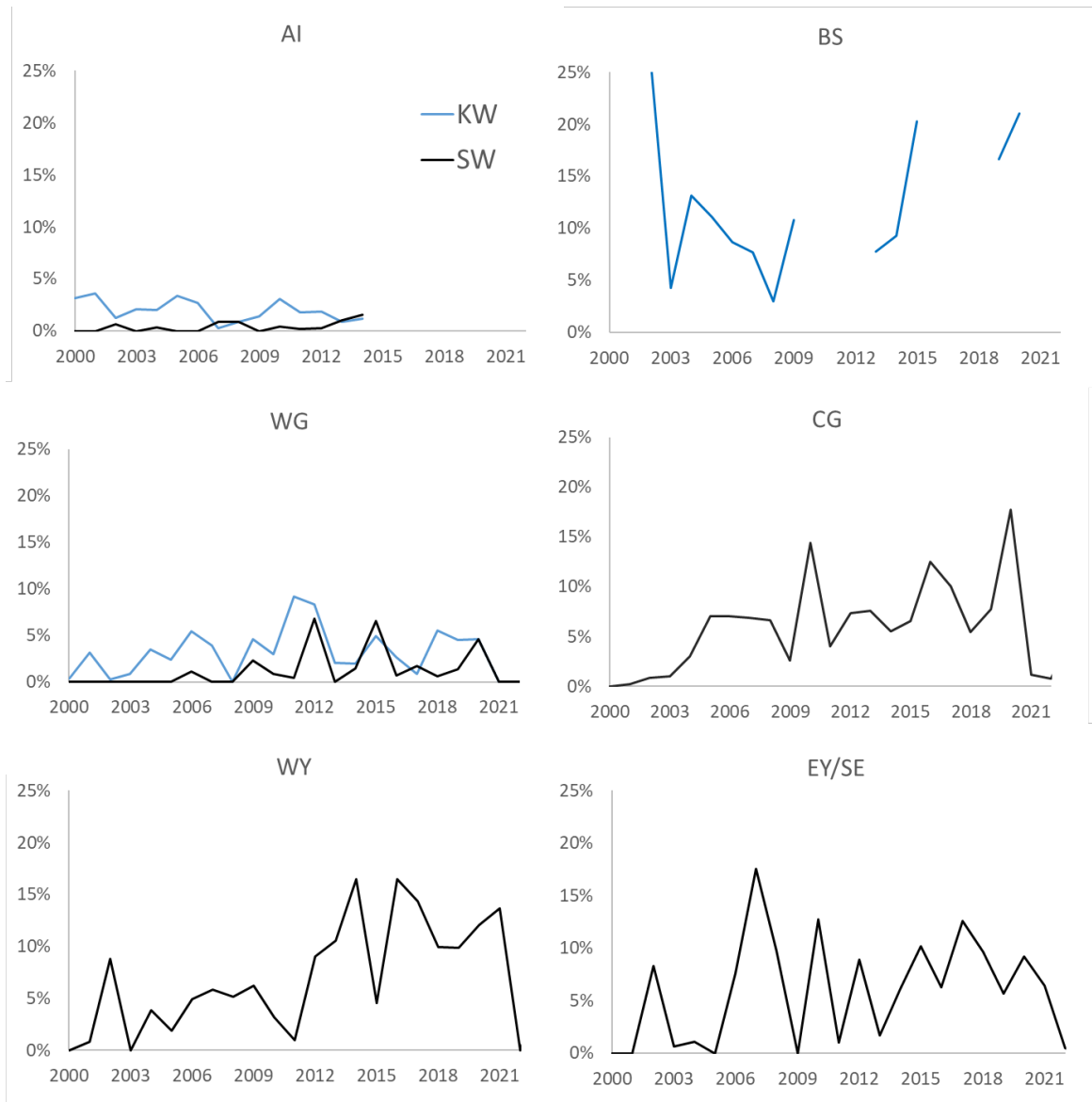


Figure 3E.5. Percent observed hook-and-line sets with sablefish catch depredated by killer whales (KW) or sperm whales (SW). Management areas include the Aleutian Islands (AI), Bering Sea (BS), Western Gulf of Alaska (WG), Central Gulf of Alaska (CG), West Yakutat (WY), and East Yakutat/Southeast (EY/SE). Data in some years is missing due to small sample sizes (confidentiality).

Percent of Hook and Line Sets with Whales Present - Logbooks

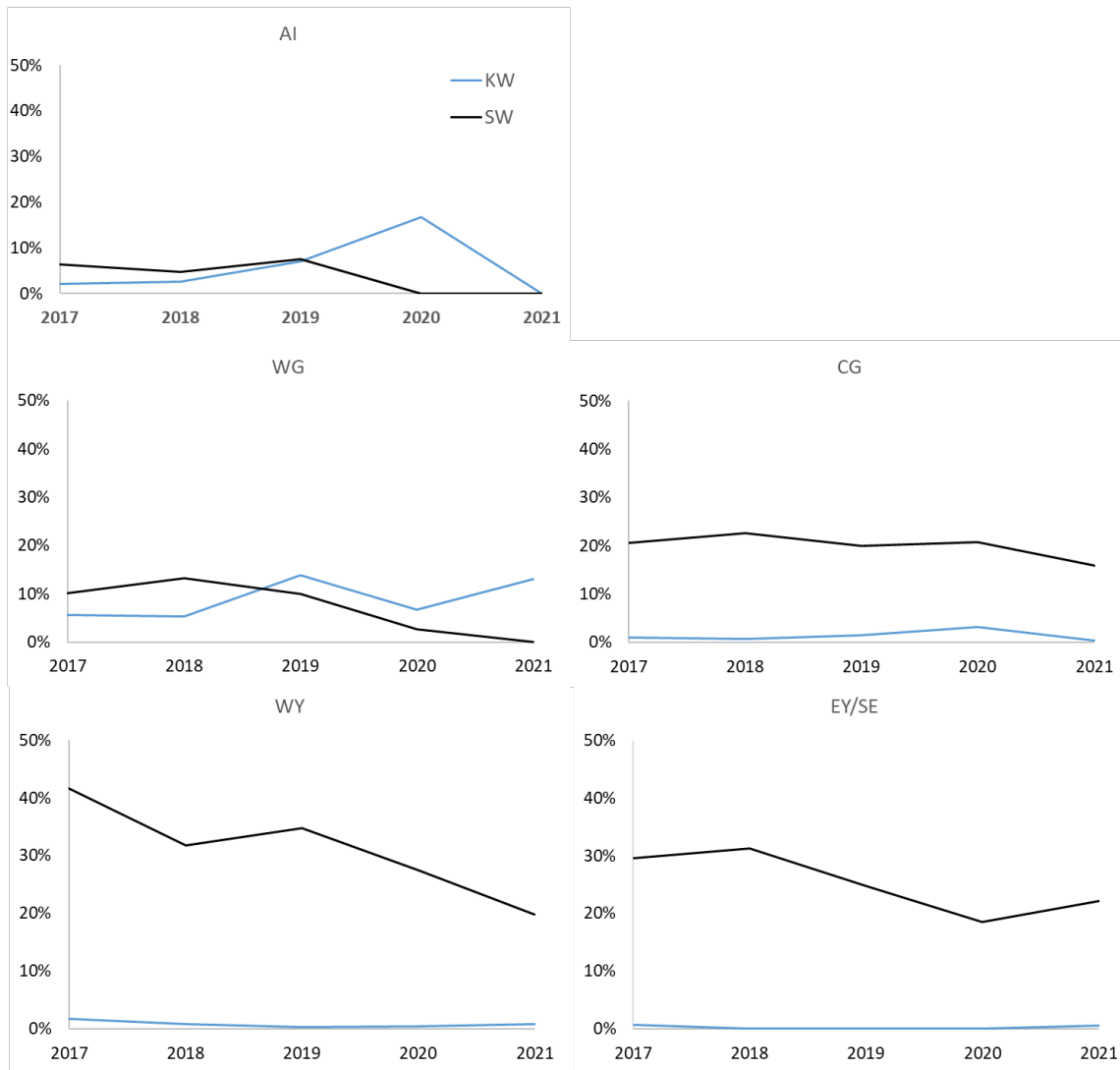


Figure 3E.6. Percent of hook-and-line sets recorded in logbooks with killer whales (KW) or sperm whales (SW) present during hauling, where the total number of sets only includes those with marine mammal data (including “none”). Management areas include the Aleutian Islands (AI), Bering Sea (BS), Western Gulf of Alaska (WG), Central Gulf of Alaska (CG), West Yakutat (WY), and East Yakutat/Southeast (EY/SE). No data is presented for the Bering Sea due to small sample sizes (confidentiality).

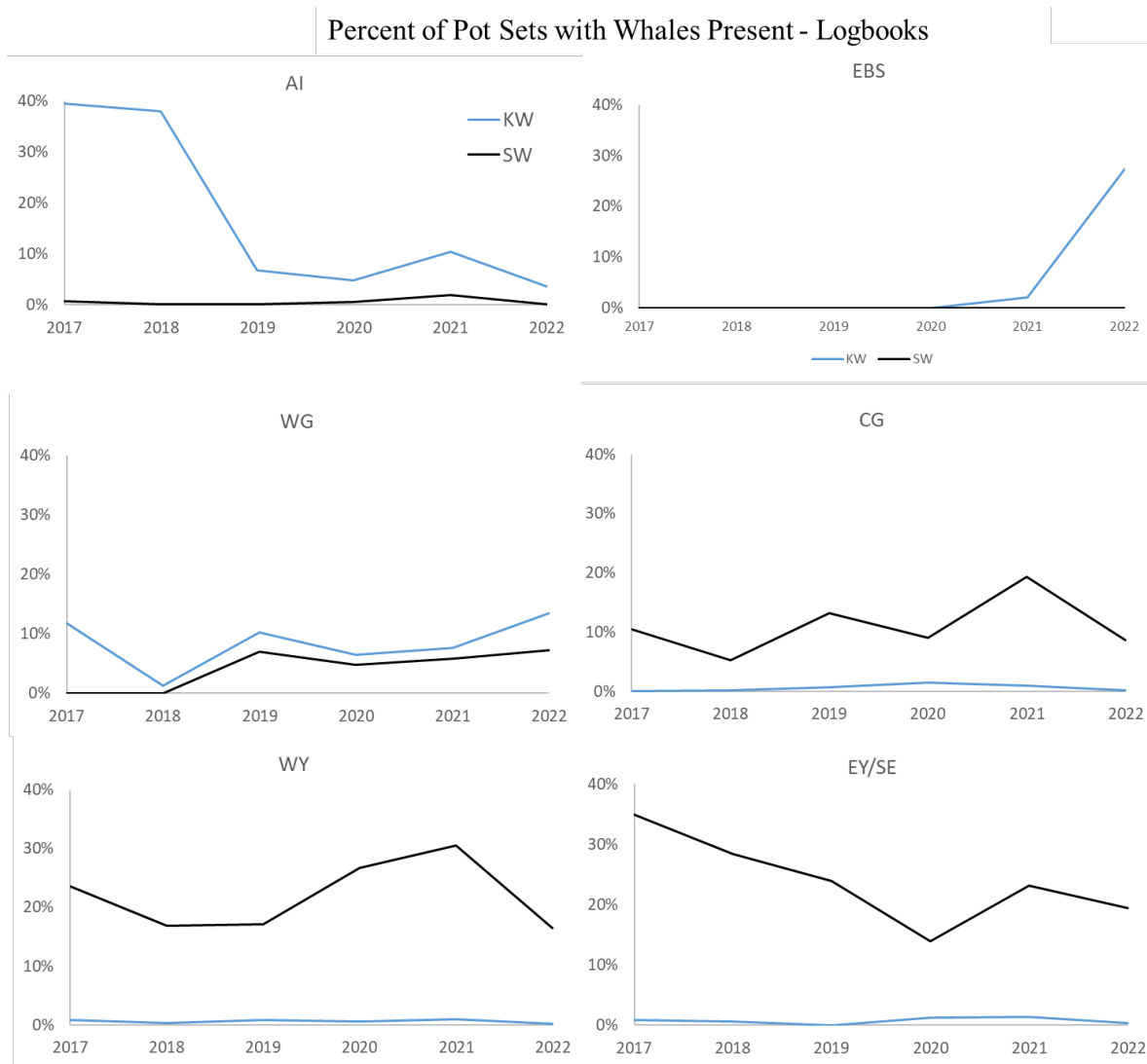


Figure 3E.7. Percent of pot sets recorded in logbooks with killer whales (KW) or sperm whales (SW) present during hauling, where the total number of sets includes those with marine mammal data. Management areas include the Aleutian Islands (AI), Bering Sea (BS), Western Gulf of Alaska (WG), Central Gulf of Alaska (CG), West Yakutat (WY), and East Yakutat/Southeast (EY/SE).

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