AFSC PROCESSED REPORT 2022-01

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Marine Ecology and Stock Assessment Program

The 2021 Longline Survey of the Gulf of Alaska and Eastern Bering Sea on the FV *Alaskan Leader*: Cruise Report AL-21-01

MARCH 2022

U.S. Department of Commerce | National Oceanic and Atmospheric Administration | National Marine Fisheries Service

AFSC Processed Report

This document should be cited as follows:

Siwicke, K., P. Malecha, and C. Rodgveller. 2022. The 2021 longline survey of the Gulf of Alaska and eastern Bering Sea on the FV *Alaskan Leader*: Cruise Report AL-21-01. AFSC Processed Rep. 2022-01, 27 p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv., Auke Bay Laboratories,17109 Pt. Lena Loop Road, Juneau, AK, 99801.

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The 2021 Longline Survey of the Gulf of Alaska and Eastern Bering Sea on the FV *Alaskan Leader*: Cruise Report AL-21-01

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March 2022

ABSTRACT

In 2021, the Alaska Fisheries Science Center completed the 44th annual longline survey in the eastern Bering Sea and the Gulf of Alaska. The survey sampled demersal waters of the upper continental slope and provided stock assessment information on sablefish (*Anoplopoma fimbria*) and several other groundfish species. The primary objectives of the survey were to determine 1) relative abundance of groundfish species through a standardized longline survey, 2) age composition of sablefish through otolith collection, and 3) movement patterns of selected groundfish species through a tag and recapture program. This processed report provides a summary of raw data and operations details from the 2021 longline survey.

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INTRODUCTION

On 31 August 2021, the Alaska Fisheries Science Center (AFSC) completed the 44th annual longline survey of Alaska sablefish (*Anoplopoma fimbria*) and other groundfish resources of the upper continental slope (Fig. 1). This survey was designed to continue the time series (1978–1994) of the Gulf of Alaska portion of the Japan-U.S. cooperative longline survey that was discontinued after 1994 (Kimura and Zenger 1997). The National Marine Fisheries Service (NMFS) has surveyed the Gulf of Alaska annually since 1988 (a preliminary survey was conducted in 1987). Since 1996, the eastern and central Aleutian Islands have been surveyed in even years and the eastern Bering Sea has been surveyed in odd years (Rutecki et al. 2016). The Gulf of Alaska and the eastern Bering Sea region were sampled in 2021. The purpose of this report is to summarize raw survey data and detail survey operations. Data generated from the longline survey is used for calculating relative population numbers and weights and is used for assessing stock status of Alaska groundfish. Stock Assessment and Fishery Evaluation (SAFE) Reports can be found at: https://www.npfmc.org/safe-stock-assessment-and-fishery-evaluation-reports, and population indices are available by management area and station for a subset of species at: https://www.fisheries.noaa.gov/resource/map/alaska-longline-survey-data-map.

METHODS

Survey Objectives

1. Collect relative abundance and size composition data of the most commercially important groundfish species: sablefish, shortspine thornyhead (*Sebastolobus alascanus*), Greenland turbot (*Reinhardtius hippoglossoides*), Pacific cod (*Gadus macrocephalus*), rougheye rockfish (*Sebastes aleutianus*), blackspotted rockfish (*S. melanostictus*), and shortraker rockfish (*S. borealis*).
2. Collect relative abundance and size composition data of other federally managed and abundant groundfish species caught during the survey including arrowtooth flounder

(*Atheresthes stomias*), Kamchatka flounder (*A. evermanni*), grenadiers (Macrouridae), skates (Rajidae), and spiny dogfish (*Squalus acanthias*).

3. Collect sablefish otoliths to study the age composition of the population.
4. Tag and release sablefish, shortspine thornyhead, and Greenland turbot throughout the cruise to determine migration patterns.
5. Conduct special projects investigating hydrocorals as an indicator of environmental history and stable isotopes in sablefish eyes as they relate to ontogenetic feeding.

Vessel and Gear

Survey operations in 2021 were conducted using the FV *Alaskan Leader*, a chartered U.S. freezer longline vessel. The 46-m (150-ft) long vessel carried standard longline hauling gear and was equipped with radios, radars, GPS receivers, a processing line, plate freezers, and refrigerated holds. Vessel personnel consisted of a captain, mate, two engineers, cook, one chief scientist, one contract scientist, two contract biologists, six fishermen, and five processors.

Gear configuration was standardized and has been consistent for all survey years starting in 1988 (Sigler and Zenger 1989). Each longline set consisted of a flag and buoy array at each end followed sequentially by varying lengths by depth of 9.5-mm diameter nylon buoy line, a 92-m (50-fm) section of 9.5-mm (0.375-in) polypropylene floating line, a 16-kg (35-lb) piece of chain (to dampen the effect of wave surge on the buoy line), 92 m (50 fm) of 9.5-mm nylon line, a 27-kg (60-lb) halibut anchor, and 366 m (200 fm) of 9.5-mm (0.375-in) nylon running line. Units of gear (skates) were 100-m (55-fm) long and contained 45 size 13/0 Mustad circle hooks. Hooks were attached to 38-cm (15-in) gangions that were secured to beckets tied into the groundline at 2-m (6.5-ft) intervals. Five meters (16 ft) of groundline were left bare at each skate end. Gangions were constructed of medium lay #60 thread nylon, becket material was medium lay #72 thread nylon, and groundline was medium lay 9.5-mm (0.375-in) diameter nylon. The groundline was weighted with 3.2-kg (7-lb) lead balls between each skate. Hooks were hand baited with chopped squid (*Illex* sp.) at a rate of about 5.7 kg (12.5 lb) per 100 hooks. Squid eyes and tentacles were not used for bait. Additional details can be found at:

https://media.fisheries.noaa.gov/dam-migration/alaska_fisheries_science_center_-_survey_protocol_for_the_alaska_sablefish_longline_survey-508.pdf.

Operations

The 2021 charter began on 26 May in Dutch Harbor, Alaska, and ended on 31 August in Dutch Harbor. The charter period was divided into six legs, staffed by NMFS staff, one contracted scientist (Jason Wright of Saltwater, Inc.), and two contracted biologists (Greg Jay and Sarah Atkins of Alaskan Observers, Inc.). Due to the COVID-19 pandemic continuing through 2021, additional precautions were taken for staff coming and going on the survey. Four NMFS staff participated as chief scientist on four legs: Leg 1, Kevin Siwicke; Leg 3, Pete Hulson; Leg 4, Jane Sullivan; and Leg 5, Katy Echave, with contractor Jason Wright fulfilling this role on Leg 2 and Leg 6; during normal operations (i.e., pre-COVID-19), two NMFS survey staff were present per leg. NMFS staff in Juneau remained in regular communications with the vessel and scientific party throughout the survey.

Sampling during each leg was as follows: Leg 1 (May 28 to June 15), along the upper continental slope of the eastern Bering Sea region; Leg 2 (June 16 to July 4), from the western end of Umnak Island and extending eastward to Sand Point; Leg 3 (July 5 to 20), off Dixon Entrance near the U.S.-Canada boundary toward Yakutat; Leg 4 (July 21 to August 4), between Yakutat and Cordova including a three-day experiment (see Appendix); Leg 5 (August 5 to 16), from Cordova to Kodiak; and Leg 6 (August 17 to 31), from Kodiak to Sand Point (Fig. 1).

The longline survey has gone through changes throughout its history, and a brief history from Rutecki et al. (2016) follows. From 1988 to 1990 the survey period was from 26 June to 12 September. The survey periods in 1991 through 1994 were about 18 days later than in 1988 through 1990. The 1991–1994 surveys were delayed to avoid the commercial trawl fishery that started 45 days later than in 1988 through 1990. Starting in 1995, the survey period was moved back to near the 1988–1990 time periods because of the extensive increase in length of the fishing season resulting from the implementation of the Individual Fishing Quota (IFQ) system in the sablefish and Pacific halibut (*Hippoglossus stenolepis*) longline fisheries. Beginning in 1998, the order in which the stations were

sampled was changed to avoid conflicting with an early July rockfish fishery in the central Gulf of Alaska. Instead of continuing to sample in an easterly direction from Sand Point to Dixon Entrance, the survey vessel transited to Dixon Entrance at the end of Leg 2 during early July and resumed sampling in a westerly direction going from Dixon Entrance to Sand Point. Sampling order has been the same since 1998. From 2009 to present, the survey starting and ending dates were several days earlier than previous years. This was done to accommodate the vessel's schedule and desire to finish the survey prior to the fall Pacific cod fishing start date.

The gear was set from shallow to deep and was retrieved in the same order, except on occasions when the groundline parted or sea conditions dictated that it be pulled from the opposite direction. Setting began at about 0630 hours Alaska Daylight Time. Retrieval began at about 0930 hours and was completed by about 1730 hours. At each station along the upper continental slope, two baited groundlines were laid end-to-end; the total groundline set each day was 18 km (9.7 nautical miles [nmi]) long and contained 180 skates and 8,100 hooks (note that in past years, 160 skates [7,200 hooks] were fished in a typical day). A single groundline of 90 skates was set at each station in the gullies, except Amatuli Gully (station 87) where 180 skates were set. Specific information regarding longline survey protocols and additional details about the survey gear can be found at: https://www.fisheries.noaa.gov/resource/document/survey-protocol-alaska-sablefish-longline-survey.

Data Collection

Catch data were recorded on hand-held ruggedized computers. During gear retrieval, a biologist stationed at the vessel's rail recorded the species of each hooked fish and the condition of each unoccupied hook (baited or ineffective [i.e., absent, straightened, broken, or tangled]). Time of day was recorded as each hook was tabulated, and depth was entered at the beginning of the first, last, and every fifth skate, in addition to when crossing into a new depth stratum (0–100 m, 101–200 m, 201–300 m, 301–400 m, 401–600 m, 601–800 m, 801–1,000 m, and 1,001–1,200 m).

Length data were collected with a custom-built barcode-configured measuring board and barcode readers connected to ruggedized computers running customized software. Length was recorded by depth stratum for sablefish, Pacific cod, grenadiers, arrowtooth flounder, Kamchatka flounder, Greenland turbot, shortspine thornyhead, spiny dogfish, rougheye/blackspotted rockfish, shortraker rockfish, and multiple other rockfish species. Lengths of sablefish, giant grenadier (*Albatrossia pectoralis*), spiny dogfish, Pacific cod, and Greenland turbot were recorded by sex. Sablefish, shortspine thornyhead, and Greenland turbot were tagged at a rate of 4.4% of the gear by selecting these species caught on skates 10, 30, 50, and 70 of each set. Catch and length frequency data were transferred to a computer and electronic backup media twice a day. As in previous surveys, the charter vessel was allowed to retain species of value (except prohibited species such as salmon, halibut, and crab) once the scientific data were recorded.

RESULTS AND DISCUSSION

In 2021, a total of 16 stations along the upper continental slope of the eastern Bering Sea region and 47 stations along the upper continental slope of the Gulf of Alaska were sampled at a rate of one station per day (Fig. 1). Surveyed depths ranged from approximately 200 to 1,000 m, although at some stations depths less than 200 m or more than 1,000 m were sampled. In addition, 24 stations were sampled in gullies at the rate of one or two stations per day. The sampled gullies were Shelikof Trough, Amatuli Gully, W-grounds, Yakutat Valley, Spencer Gully, Ommaney Trench, and Dixon Entrance. One station (103) was sampled on the continental shelf off Baranof Island. Stations spanned a variety of management areas and habitat types, and not all were used in abundance index calculations reported for sablefish, notably gully stations on the continental shelf (Table 1). However, abundance calculations are performed for all species at all stations and are available at the station level for slope and gully stations.

One hundred fifty-two longline hauls were completed during normal survey operations in 2021 (Table 2); six additional hauls (three longline and three collapsible

slinky pot sets) were completed during three days of experimental fishing during Leg 4 in July (Sullivan et al. AFSC Progress Report, in preparation and expected in 2022). During normal survey operations, sablefish was the most frequently caught species, followed by giant grenadier, Pacific cod, shortspine thornyhead, Pacific halibut, and rougheye/blackspotted rockfish (Table 3). Catch of the most abundant species by station is presented in Table 4. Sablefish was also the highest catch by weight, followed by giant grenadier, Pacific cod, and Pacific halibut, which was estimated from the average weight of fish caught in hook-and-line fisheries (halibut not brought on board and no lengths were measured) (Table 5). Length and sex were recorded for 91,599 sablefish by region and depth stratum (Fig. 2).

A total of 6,156 sablefish, 312 shortspine thornyhead, and 27 Greenland turbot were tagged with external numbered tags and released during the survey. Otoliths, sex, and length-weight data were collected from 3,480 sablefish. The survey caught 31 previously tagged sablefish (including six from the Alaska Department of Fish and Game and seven from Fisheries and Oceans Canada) and re-tagged and released eight of them. Information on tagged fish can found at: https://www.fisheries.noaa.gov/resource/map/alaska-groundfish-tagging-map.

Killer whale (*Orcinus orca*) depredation on the catch occurred at ten stations in the eastern Bering Sea and one station in the western Gulf of Alaska (Table 6). Since 1990, portions of the gear affected by killer whale depredation during domestic longline surveys have been excluded from abundance index calculations. The raw data reported in this report include instances impacted by killer whale depredation.

Sperm whale (*Physeter macrocephalus*) observations have been recorded during the longline survey since 1998 (Hill et al. 1999). Sperm whales were observed during survey operations at ten stations in 2021, which was down from 2020 and includes slope and gully stations (Table 7). Apparent sperm whale depredation is defined as sperm whales being present with the occurrence of damaged sablefish (Hanselman et al. 2018). Sperm whales were observed at five stations in the central Gulf of Alaska with depredation evident at all, one station in the West Yakutat region with depredation evident, and four stations in the

East Yakutat/Southeast region with depredation evident at two. Using depredation correction factors estimated in Hanselman et al. (2018), sablefish catches used for abundance index calculations are adjusted at stations with evidence of sperm whale depredation (e.g., missing body parts, crushed tissues, blunt tooth marks, or shredded bodies), and variance estimates are inflated at all stations where sperm whale presence is recorded within 100 m of the survey vessel. Longline survey catch rates and abundance indices for all other species are not adjusted for sperm whale depredation. The raw data reported in this report include instances impacted by sperm whale depredation.

It was requested that fishermen stay at least 5 nmi from each survey station for 7 days before and 3 days after the planned sampling date (the three days allow for survey delays). Survey calendars were available to each IFQ holder before the beginning of each fishing season. In 2019, a letter was included with the calendar that included details of the request for the fleet to avoid survey stations and the rationale. Starting in 2021, the survey calendar was made available online (https://www.fisheries.noaa.gov/resource/document/alaska-sablefish-longline-survey-station-schedule) to reduce printing and mailing expenses. Additionally, throughout the survey, the skipper of the survey vessel made announcements on the radio detailing the planned set locations for the upcoming days. Vessels encountered near survey stations were contacted by the survey vessel captain and interviewed to determine potential effects on survey catches.

Typically, vessels have been aware of the survey and have not fished close to survey locations. There are some instances where survey gear was fished nearby commercial fishing gear or where commercial fishing had recently occurred. In 2021 there were a few instances of vessel interactions. In the Gulf of Alaska, there were four interactions with pot boats (two in East Yakutat/Southeast, one in the West Yakutat, and one in the Central GOA).

Gear damage and loss occurs during survey operations and may have impacts on catch. In 2021, the gear parted at 11 stations (12, 32, 34, 62, 85, 98, 99, 105, 121, 128, and 145). When gear parted, it was retrieved by hauling from the opposite end of the set. At

station 98 a few hooks from the last skate of gear were lost with an anchor, chain, buoy line, and buoy. No other gear loss occurred.

In 2021, collections of hydrocorals was continued to investigate the use of their matrix chemistry as an indicator of environmental history. Hydrocorals produce a calcium carbonate hard structure that incorporates carotenoids into its matrix producing a pink, yellow, orange, or brown color (e.g., Elde et al. 2012). Carotenoids are a purely plant-based protein and cannot be produced by coral but must be obtained through diet, stemming primarily from phytoplankton and secondarily zooplankton. The color patterns in a cross section of coral bases show a ring pattern indicating an interrupted pattern of carotenoid incorporation into the matrix. An investigation into the use of these patterns to indicate environmental history is ongoing.

A pilot project in 2021 collected 60 pairs of sablefish eyeballs from across the survey region to test if serial isotope patterns can be observed, and if so, to see if there are differences in the serial foraging profiles between the regions sampled. The Resource Energetics and Conservation Assessment group at Auke Bay Laboratories will measure stable isotopes (d13C and d15N) in growth layers of the eye lens of adult sablefish to obtain individual chronologies (young-of-year to time of collection) of their dietary and migratory behavior. These collections may help resolve questions pertaining to movement and mixing, as well as assessing spatiotemporal differences in ontogenetic feeding.

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Table 1. -- Stations fished in 2021 AFSC longline survey. "Region" refers to the North Pacific Fishery Management Council sablefish management areas, "Habitat" refers to the station habitat type, and "Abundance" indicates whether or not station catches were used in abundance index calculations.

Station	Region	Habitat	Abundance
1	Bering Sea	Slope	Yes
2	Bering Sea	Slope	Yes
4	Bering Sea	Slope	Yes
6	Bering Sea	Slope	Yes
8	Bering Sea	Slope	Yes
10	Bering Sea	Slope	Yes
12	Bering Sea	Slope	Yes
13	Bering Sea	Slope	Yes
15	Bering Sea	Slope	Yes
17	Bering Sea	Slope	Yes
18	Bering Sea	Slope	Yes
20	Bering Sea	Slope	Yes
22	Bering Sea	Slope	Yes
32	Bering Sea	Slope	Yes
33	Bering Sea	Slope	Yes
34	Bering Sea	Slope	Yes
62	Western Gulf of Alaska	Slope	Yes
63	Western Gulf of Alaska	Slope	Yes
64	Western Gulf of Alaska	Slope	Yes
65	Western Gulf of Alaska	Slope	Yes
66	Western Gulf of Alaska	Slope	Yes
67	Western Gulf of Alaska	Slope	Yes
68	Western Gulf of Alaska	Slope	Yes
69	Western Gulf of Alaska	Slope	Yes
70	Western Gulf of Alaska	Slope	Yes
71	Western Gulf of Alaska	Slope	Yes
72	Central Gulf of Alaska	Slope	Yes
73	Central Gulf of Alaska	Slope	Yes
74	Central Gulf of Alaska	Slope	Yes
75	Central Gulf of Alaska	Slope	Yes
76	Central Gulf of Alaska	Slope	Yes

77	Central Gulf of Alaska	Slope	Yes
78	Central Gulf of Alaska	Slope	Yes
79	Central Gulf of Alaska	Slope	Yes
80	Central Gulf of Alaska	Slope	Yes
81	Central Gulf of Alaska	Slope	Yes
82	Central Gulf of Alaska	Slope	Yes
83	Central Gulf of Alaska	Slope	Yes
84	Central Gulf of Alaska	Slope	Yes
85	Central Gulf of Alaska	Slope	Yes
86	Central Gulf of Alaska	Slope	Yes
87	Central Gulf of Alaska	Gully	No
88	Central Gulf of Alaska	Slope	Yes
89	West Yakutat	Slope	Yes
90	West Yakutat	Slope	Yes
91	West Yakutat	Slope	Yes
92	West Yakutat	Slope	Yes
93	West Yakutat	Slope	Yes
94	West Yakutat	Slope	Yes
95	West Yakutat	Slope	Yes
96	West Yakutat	Slope	Yes
97	East Yakutat/Southeast	Slope	Yes
98	East Yakutat/Southeast	Slope	Yes
99	East Yakutat/Southeast	Slope	Yes
100	East Yakutat/Southeast	Slope	Yes
101	East Yakutat/Southeast	Slope	Yes
102	East Yakutat/Southeast	Slope	Yes
103	East Yakutat/Southeast	Gully	No
104	East Yakutat/Southeast	Slope	Yes
105	East Yakutat/Southeast	Slope	Yes
106	East Yakutat/Southeast	Slope	Yes
107	East Yakutat/Southeast	Slope	Yes
108	East Yakutat/Southeast	Slope	Yes
120	Central Gulf of Alaska	Gully	No
121	Central Gulf of Alaska	Gully	No
122	Central Gulf of Alaska	Gully	No
123	Central Gulf of Alaska	Gully	No

128	Central Gulf of Alaska	Gully	No
129	Central Gulf of Alaska	Gully	No
130	Central Gulf of Alaska	Gully	No
131	Central Gulf of Alaska	Gully	No
132	Central Gulf of Alaska	Gully	No
133	Central Gulf of Alaska	Gully	No
134	Central Gulf of Alaska	Gully	No
135	Central Gulf of Alaska	Gully	No
136	West Yakutat	Gully	No
137	West Yakutat	Gully	No
138	West Yakutat	Gully	No
139	West Yakutat	Gully	No
142	East Yakutat/Southeast	Deep Gully	Yes
143	East Yakutat/Southeast	Deep Gully	Yes
144	East Yakutat/Southeast	Deep Gully	Yes
145	East Yakutat/Southeast	Deep Gully	Yes
148	East Yakutat/Southeast	Deep Gully	Yes
149	East Yakutat/Southeast	Deep Gully	Yes
523	Central Gulf of Alaska	Slope	No
535	Central Gulf of Alaska	Slope	No

Table 2. -- Set information by station and haul for the 2021 AFSC longline survey. Positions are in decimal degrees (DD) format and depths are in meters (m).

Station	Haul	Date	Skates retrieved	Start latitude	Start longitude	End latitude	End longitude	Start depth	End depth
17	1	05/30	90	56.04	-169.63	55.99	-169.72	197	631
17*	2	05/30	90	55.99	-169.73	55.98	-169.87	497	653
12*	3	05/31	90	56.63	-172.35	56.58	-172.44	193	570
12*	4	05/31	90	56.57	-172.44	56.51	-172.50	596	650
8*	5	06/01	90	57.63	-174.16	57.70	-174.24	153	439
8*	6	06/01	90	57.71	-174.24	57.77	-174.31	333	990
2*	7	06/02	90	58.62	-176.64	58.57	-176.75	155	517
2*	8	06/02	90	58.55	-176.92	58.57	-176.79	988	643
1	9	06/03	90	58.78	-177.58	58.81	-177.71	162	273
1	10	06/03	90	58.82	-177.72	58.85	-177.83	375	615
4*	11	06/04	90	58.50	-175.67	58.49	-175.80	226	400
4*	12	06/04	90	58.48	-175.83	58.50	-175.95	436	691
6*	13	06/05	90	58.33	-174.31	58.40	-174.37	169	402
6*	14	06/05	90	58.40	-174.37	58.38	-174.49	495	442
10*	15	06/06	90	56.82	-173.38	56.90	-173.42	218	543
10*	16	06/06	90	56.91	-173.42	56.97	-173.45	515	507
13	17	06/07	90	56.47	-171.46	56.46	-171.59	202	492
13	18	06/07	90	56.46	-171.61	56.46	-171.73	323	557
15	19	06/08	90	56.13	-170.78	56.16	-170.68	452	146
15	20	06/08	90	56.16	-170.90	56.13	-170.80	583	514
18	21	06/09	90	56.24	-169.17	56.19	-169.26	168	639
18*	22	06/09	90	56.18	-169.28	56.12	-169.36	656	738
20*	23	06/10	90	55.81	-168.80	55.84	-168.93	202	627
20	24	06/10	90	55.85	-168.94	55.90	-169.01	665	787
22	25	06/11	90	55.46	-168.00	55.43	-168.12	155	249
22*	26	06/11	90	55.43	-168.13	55.40	-168.25	261	488
34	27	06/12	90	53.29	-168.80	53.32	-168.84	759	719
34	28	06/12	90	53.32	-168.88	53.35	-168.99	618	885
33	29	06/13	90	53.60	-168.31	53.61	-168.18	706	162
33	30	06/13	90	53.61	-168.17	53.63	-168.03	450	724
32	31	06/14	90	53.77	-167.33	53.71	-167.39	133	469
32	32	06/14	90	53.71	-167.40	53.68	-167.46	342	616

63	33	06/16	90	52.96	-168.14	52.91	-168.22	110	288
63	34	06/16	90	52.91	-168.22	52.84	-168.24	346	648
62	35	06/17	90	52.66	-169.01	52.61	-169.11	136	504
62	36	06/17	90	52.61	-169.12	52.59	-169.17	354	587
64*	37	06/18	90	53.20	-166.86	53.12	-166.90	205	315
64*	38	06/18	90	53.11	-166.91	53.05	-166.96	316	755
65	39	06/19	90	53.58	-165.69	53.51	-165.73	118	295
65	40	06/19	90	53.50	-165.74	53.44	-165.80	285	465
66	41	06/20	90	53.74	-164.47	53.68	-164.56	135	319
66	42	06/20	90	53.68	-164.57	53.62	-164.66	297	693
67	43	06/21	90	53.97	-163.27	53.90	-163.33	112	462
67	44	06/21	90	53.91	-163.34	53.87	-163.43	268	532
68	45	06/22	90	54.13	-161.64	54.09	-161.73	120	360
68	46	06/22	90	54.09	-161.75	54.06	-161.88	266	800
69	47	06/23	90	54.25	-161.17	54.31	-161.07	452	172
69	48	06/23	90	54.26	-161.17	54.20	-161.23	406	1040
70	49	06/24	90	54.37	-160.24	54.30	-160.31	142	284
70	50	06/24	90	54.30	-160.29	54.23	-160.34	304	617
71	51	06/25	90	54.51	-159.26	54.44	-159.32	158	282
71	52	06/25	90	54.44	-159.33	54.38	-159.43	273	521
72	53	06/26	90	54.63	-158.58	54.56	-158.65	128	398
72	54	06/26	90	54.57	-158.66	54.50	-158.72	312	800
73	55	06/27	90	54.85	-157.74	54.79	-157.81	178	352
73	56	06/27	90	54.79	-157.82	54.72	-157.86	353	679
74	57	06/28	90	55.24	-156.68	55.17	-156.75	172	316
74	58	06/28	90	55.17	-156.74	55.10	-156.75	346	796
77	59	06/29	90	56.05	-154.57	55.98	-154.56	217	487
77	60	06/29	90	55.98	-154.57	55.91	-154.56	483	864
108	61	07/04	90	54.46	-133.91	54.49	-134.02	404	585
108	62	07/04	90	54.50	-134.01	54.56	-134.08	492	688
148	63	07/06	90	54.65	-132.83	54.60	-132.92	146	380
149	64	07/06	90	54.59	-133.02	54.60	-133.13	412	402
107	65	07/07	90	54.90	-134.28	54.97	-134.35	223	355
107	66	07/07	90	54.96	-134.36	55.02	-134.46	398	838
106	67	07/08	90	55.35	-134.73	55.39	-134.83	304	612
106	68	07/08	90	55.40	-134.82	55.39	-134.94	412	815

105	69	07/09	90	55.56	-134.96	55.58	-135.05	246	535
105	70	07/09	90	55.59	-135.06	55.63	-135.14	468	552
144	71	07/10	90	55.93	-134.91	56.00	-134.91	195	358
145	72	07/10	90	56.03	-134.92	56.09	-135.03	354	340
104	73	07/11	90	55.99	-135.44	56.02	-135.53	322	665
104	74	07/11	90	56.03	-135.53	56.08	-135.62	450	862
103	75	07/12	90	56.39	-135.35	56.38	-135.49	156	188
103	76	07/12	90	56.38	-135.50	56.36	-135.63	196	336
102	77	07/13	90	56.85	-136.00	56.90	-136.09	208	615
102	78	07/13	90	56.90	-136.10	56.97	-136.13	686	959
101	79	07/14	90	57.19	-136.23	57.22	-136.34	216	748
101	80	07/14	90	57.23	-136.33	57.29	-136.38	740	820
100	81	07/15	90	57.62	-136.53	57.61	-136.64	228	708
100	82	07/15	90	57.62	-136.66	57.67	-136.76	530	634
142	83	07/16	90	57.88	-137.01	57.88	-137.16	442	396
143	84	07/16	90	57.97	-137.08	57.97	-137.23	416	183
99	85	07/17	90	57.88	-137.38	57.88	-137.50	216	708
99	86	07/17	90	57.89	-137.52	57.90	-137.66	620	810
98	87	07/18	90	58.14	-138.73	58.16	-138.87	226	580
98	88	07/18	90	58.16	-138.86	58.18	-138.98	564	718
97	89	07/19	90	58.47	-139.47	58.46	-139.59	196	514
97	90	07/19	90	58.46	-139.61	58.42	-139.72	438	1013
138	91	07/21	90	59.42	-140.93	59.43	-141.08	200	296
139	92	07/21	90	59.41	-141.17	59.35	-141.26	319	327
96	93	07/22	90	58.69	-140.64	58.69	-140.79	233	500
96	94	07/22	90	58.70	-140.79	58.74	-140.92	512	642
95	95	07/23	90	59.05	-141.35	59.05	-141.50	304	564
95	96	07/23	90	59.06	-141.51	59.06	-141.65	544	904
94	99	07/25	90	59.39	-142.17	59.43	-142.32	232	474
94	100	07/25	90	59.43	-142.30	59.47	-142.41	427	926
93	101	07/26	90	59.55	-142.57	59.58	-142.68	128	600
93	102	07/26	90	59.59	-142.70	59.57	-142.82	581	658
92	103	07/27	90	59.55	-143.66	59.55	-143.79	171	775
92	104	07/27	90	59.56	-143.81	59.58	-143.93	632	669
91	109	07/30	90	59.52	-144.72	59.48	-144.85	181	508
91	110	07/30	90	59.49	-144.85	59.45	-144.98	438	796

136	111	08/01	90	59.76	-143.71	59.75	-143.59	158	299
137	112	08/01	90	59.72	-143.50	59.67	-143.38	310	296
90	113	08/02	90	59.50	-145.53	59.51	-145.67	161	673
90	114	08/02	90	59.52	-145.68	59.52	-145.82	615	456
89	115	08/03	90	59.26	-146.85	59.22	-146.97	190	594
89	116	08/03	90	59.21	-146.98	59.17	-147.08	616	812
134	117	08/05	90	59.62	-146.96	59.56	-147.05	207	210
135	118	08/05	90	59.52	-147.15	59.45	-147.15	217	209
88	119	08/06	90	59.16	-147.61	59.09	-147.62	235	478
88	120	08/06	90	59.09	-147.64	59.01	-147.63	435	932
87	121	08/07	90	59.13	-148.66	59.05	-148.65	153	211
87	122	08/07	90	59.05	-148.64	58.97	-148.64	220	248
132	123	08/08	90	59.08	-149.40	59.04	-149.52	182	227
133	124	08/08	90	58.95	-149.51	58.92	-149.60	245	240
130	125	08/09	90	58.77	-149.07	58.73	-149.20	213	174
131	126	08/09	90	58.85	-148.92	58.80	-149.04	260	236
86	127	08/10	92	58.54	-148.35	58.62	-148.33	858	470
86	128	08/10	90	58.62	-148.34	58.69	-148.33	497	285
85	129	08/11	90	58.29	-148.62	58.21	-148.68	242	538
85	130	08/11	90	58.22	-148.66	58.16	-148.69	515	807
84	131	08/12	90	57.97	-149.17	57.91	-149.25	171	497
84	132	08/12	90	57.92	-149.26	57.85	-149.31	468	747
128	133	08/13	90	58.00	-149.84	57.98	-149.97	225	261
129	134	08/13	90	58.08	-149.91	58.07	-150.05	294	305
83	135	08/14	90	57.64	-149.91	57.56	-149.94	383	563
83	136	08/14	90	57.57	-149.95	57.50	-149.98	572	813
82	137	08/15	90	57.40	-150.58	57.32	-150.59	211	533
82	138	08/15	90	57.32	-150.61	57.25	-150.59	519	763
535	139	08/17	90	57.36	-150.68	57.29	-150.67	206	512
535	140	08/17	90	57.28	-150.68	57.21	-150.66	472	763
523	141	08/18	90	57.22	-151.04	57.15	-151.04	158	543
523	142	08/18	90	57.15	-151.05	57.07	-151.05	548	554
81	143	08/19	90	57.12	-151.23	57.05	-151.28	239	558
81	144	08/19	90	57.04	-151.30	56.97	-151.28	589	855
80	145	08/20	90	56.49	-152.22	56.42	-152.30	134	538
80	146	08/20	90	56.43	-152.31	56.35	-152.36	362	566

79	147	08/21	90	56.30	-153.09	56.26	-153.19	220	692
79	148	08/21	90	56.27	-153.21	56.22	-153.29	520	715
78	149	08/22	90	55.99	-154.03	55.93	-154.02	218	476
78	150	08/22	90	55.92	-154.03	55.86	-154.04	524	865
76	151	08/23	90	55.76	-155.14	55.69	-155.18	164	354
76	152	08/23	90	55.69	-155.20	55.63	-155.27	338	608
75	153	08/24	90	55.64	-155.85	55.57	-155.85	152	212
75	154	08/24	90	55.57	-155.87	55.49	-155.83	210	212
122	155	08/25	90	56.18	-155.96	56.18	-156.10	190	240
123	156	08/25	90	56.23	-156.12	56.25	-156.23	244	264
120	157	08/26	90	55.79	-156.07	55.76	-156.20	192	238
121	158	08/26	90	55.75	-156.21	55.73	-156.34	242	248

*Station catch was entirely or partially impacted by killer whale depredation.

Table 3. -- Total estimated catch in numbers of major species (>100 individuals) caught in the 2021 AFSC longline survey by management area: BS = Bering Sea, WGOA = Western Gulf of Alaska, CGOA = Central Gulf of Alaska, WY = West Yakutat, and EYSE = East Yakutat/Southeast.

Species common name	BS	WGOA	CGOA	WY	EYSE	Total
Sablefish	29,476	27,220	64,756	20,037	28,124	169,613
Giant grenadier	13,047	10,696	11,157	3,212	4,412	42,524
Pacific cod	6,654	1,980	1,056	143	630	10,463
Shortspine thornyhead	982	1,266	2,823	1,516	1,831	8,418
Pacific halibut	687	860	2,098	1,026	1,063	5,734
Rougheye/blackspotted rockfish	299	1,392	626	836	2,147	5,300
Shortraker rockfish	702	497	792	1,510	1,292	4,793
Arrowtooth flounder	798	398	1,937	261	279	3,673
Aleutian/Bering/Alaska skate	1,227	129	569	51	51	2,027
Longnose skate	2	119	550	413	509	1,593
Pacific grenadier	7	57	681	384	117	1,246
Redbanded rockfish	0	16	208	139	731	1,094
Spiny dogfish	0	3	219	49	660	931
Greenland turbot	859	1	0	0	0	860
Sea anemone	34	70	374	64	284	826
Walleye pollock	630	47	79	9	4	769
Lips/jaws - depredation	511	61	67	18	22	679
Whiteblotched skate	644	6	0	0	0	650
Commander skate	516	4	2	0	9	531
Kamchatka flounder	481	5	0	0	0	486
Yelloweye rockfish	1	62	28	58	185	334
Skates unidentified	203	11	18	3	17	252
Sea pen/whip	18	0	199	13	7	237
Yellow Irish lord	161	32	0	0	0	193
Brittle star	33	14	102	10	32	191
Dover sole	0	4	73	13	47	137
Lingcod	0	0	32	39	56	127

Table 4. -- Catch in numbers by station for major species in the 2021 AFSC longline survey. SF = sablefish; PC = Pacific cod; GR = giant grenadier; PH = Pacific halibut; ATF = arrowtooth flounder; GT = Greenland turbot; RF = rougheye, blackspotted, and shortraker rockfish; ST = shortspine thornyhead; SK = skate; OS = Other Species.

Station	SF	PC	GR	PH	ATF	GT	RF	ST	SK	OS
1	1,483	536	931	40	59	64	11	54	262	354
2*	258	426	2,188	3	14	6	2	11	65	204
4*	662	172	1,069	0	6	3	5	7	97	383
6*	229	219	1,235	6	18	2	95	31	142	207
8*	914	277	1,058	11	35	6	109	33	62	238
10*	2,792	97	672	6	42	2	55	54	145	374
12*	139	228	1,409	0	4	4	7	46	53	249
13	3,144	39	1,444	3	29	70	55	149	49	107
15	1,718	1,306	1,099	42	63	69	72	194	55	282
17*	1,508	663	599	40	129	34	38	71	101	311
18*	1,000	74	497	10	110	149	2	57	64	117
20*	3,230	211	576	17	106	224	3	57	37	127
22*	1,557	1,402	5	50	13	3	6	2	58	131
32	4,177	215	21	126	39	5	367	119	19	63
33	3,441	789	146	276	36	35	171	51	137	228
34	3,224	0	98	57	95	183	3	46	63	57
62	1,924	125	1,953	40	13	1	346	101	12	64
63	2,617	128	1,049	47	36	0	567	244	24	56
64*	1,457	0	290	4	1	0	296	76	7	126
65	2,675	398	1,488	60	54	0	32	59	15	92
66	3,927	165	935	21	18	0	43	80	20	36
67	3,889	270	562	33	34	0	169	116	8	101
68	2,463	288	846	194	51	0	263	281	13	56
69	2,639	302	1,528	103	36	0	55	114	14	21
70	2,603	60	1,105	170	41	0	88	117	13	22
71	3,026	244	940	188	114	0	30	78	18	35
72	2,453	134	1,460	87	35	0	111	95	15	37
73	3,054	10	741	27	114	0	67	132	13	29
74	3,033	1	1,517	18	30	0	14	277	2	28
75	3,503	141	0	57	65	0	0	1	9	24
76	2,856	56	197	30	85	0	59	87	1	293

77	3,072	0	1,140	21	22	0	19	168	7	85
78	2,618	1	416	127	52	0	72	199	3	261
79	3,483	0	879	5	21	0	49	158	0	58
80	2,390	28	389	240	105	0	341	132	13	103
81	2,420	0	622	1	56	0	28	92	1	331
82	2,589	7	609	63	58	0	29	103	4	32
83	2,344	0	621	0	9	0	6	67	0	67
84	2,904	13	303	180	68	0	26	127	9	135
85	2,148	0	598	22	32	0	46	139	6	138
86	1,811	0	346	163	81	0	142	164	36	24
87	2,957	161	0	303	275	0	8	49	70	139
88	1,836	126	504	36	34	0	158	176	57	149
89	2,133	37	452	75	69	0	47	101	46	206
90	1,745	28	324	150	33	0	169	81	26	116
91	1,494	63	347	142	25	0	276	270	38	110
92	2,634	12	747	65	12	0	48	87	39	42
93	3,029	0	186	100	12	0	59	228	8	43
94	1,477	0	272	63	12	0	458	164	42	168
95	2,118	0	391	63	8	0	577	219	19	85
96	2,196	0	493	22	12	0	425	145	20	53
97	1,940	7	531	43	13	0	195	140	25	154
98	1,946	0	664	4	8	0	251	73	5	18
99	1,288	0	876	28	16	0	94	51	12	128
100	2,297	18	336	12	19	0	35	89	10	47
101	2,331	12	404	36	31	0	118	138	14	106
102	1,801	2	569	18	11	0	43	98	13	75
103	922	417	1	524	49	0	24	13	97	744
104	2,512	0	229	7	3	0	258	176	17	45
105	1,980	43	279	37	4	0	163	147	33	178
106	1,245	0	171	0	5	0	608	169	8	58
107	1,178	27	99	29	5	0	887	100	29	164
108	1,549	0	158	3	0	0	502	110	22	141
120	1,813	92	0	59	17	0	0	1	11	55
121	1,903	2	0	54	32	0	0	2	5	74
122	1,037	108	0	71	96	0	0	1	16	121
123	1,333	4	0	55	77	0	0	0	17	159

128	1,520	16	0	42	61	0	4	32	10	20
129	1,718	0	0	9	94	0	8	46	42	11
130	1,136	22	0	63	98	0	18	67	28	40
131	916	5	0	43	59	0	9	105	38	32
132	1,383	117	0	51	79	0	4	60	35	129
133	474	0	0	59	69	0	2	138	53	39
134	286	1	0	3	13	0	2	11	30	77
135	454	1	0	20	15	0	33	13	35	103
136	481	3	0	177	4	0	68	42	37	68
137	572	0	0	40	3	0	113	36	37	7
138	588	0	0	75	59	0	58	121	40	33
139	1,570	0	0	54	12	0	48	22	69	9
142	1,560	0	84	3	14	0	17	103	9	6
143	1,994	2	11	127	34	0	45	27	9	137
144	585	40	0	125	40	0	116	129	89	78
145	1,389	0	0	11	8	0	72	147	26	102
148	477	62	0	36	15	0	4	28	51	248
149	1,130	0	0	20	4	0	7	93	76	48
523	2,724	8	435	54	25	0	19	77	10	33
535	2,588	2	380	135	60	0	144	104	0	45

*Station catch was entirely or partially impacted by killer whale depredation.

Table 5. -- Total estimated catch in weight (kg) of major species (>100 kg) caught in the 2021 AFSC longline survey by management area: BS = Bering Sea, WGOA = Western Gulf of Alaska, CGOA = Central Gulf of Alaska, WY = west Yakutat, and EYSE = East Yakutat/Southeast. Catch biomass was estimated by converting numbers caught to weight using species-specific length-weight relationships when length data were collected or proxy average weights from longline fisheries when survey length data were not available.

Species common name	BS	WGOA	CGOA	WY	EYSE	Total
Sablefish	66,104	58,466	137,775	55,664	74,888	392,897
Giant grenadier	54,567	33,414	35,935	10,782	15,357	150,055
Pacific cod	26,629	7,419	3,381	441	1,810	39,680
Pacific halibut	4,054	5,075	12,380	6,054	6,273	33,836
Longnose skate	15	887	4,100	3,079	3,795	11,876
Rougheye/blackspotted rockfish	574	1,913	923	1,447	4,035	8,892
Shortraker rockfish	1,283	756	1,337	3,196	2,191	8,763
Shortspine thornyhead	1,433	1,098	2,256	1,080	1,649	7,516
Arrowtooth flounder	1,455	663	4,105	589	509	7,321
Whiteblotched skate	3,469	32	0	0	0	3,501
Greenland turbot	2,892	3	0	0	0	2,895
Spiny dogfish	0	6	513	122	1,727	2,368
Redbanded rockfish	0	28	369	247	1,298	1,942
Commander skate	1,645	13	6	0	29	1,693
Skates unidentified	1,030	56	91	15	86	1,278
Pacific grenadier	9	56	674	374	104	1,217
Kamchatka flounder	1,095	18	0	0	0	1,113
Walleye pollock	895	67	112	13	6	1,093
Lingcod	0	0	263	320	460	1,043
Yelloweye rockfish	3	179	81	167	534	964
Pacific sleeper shark	0	289	0	0	58	347
Spotted ratfish	0	0	0	0	240	240
Sea anemone	9	19	104	18	79	229
Dover sole	0	6	109	19	70	204
Yellow Irish lord	135	27	0	0	0	162

Table 6. -- Stations and skates depredated by killer whales during the 2021 AFSC longline survey. Number of skates affected refers to skates determined to be depredated and removed from abundance calculations.

Station	Region	Number of skates affected	Number of skates fished
2	Bering Sea	142	180
4	Bering Sea	180	180
6	Bering Sea	118	180
8	Bering Sea	141	180
10	Bering Sea	174	180
12	Bering Sea	180	180
17	Bering Sea	59	180
18	Bering Sea	79	180
20	Bering Sea	39	180
22	Bering Sea	52	180
64	Western Gulf of Alaska	170	180

Table 7. -- Stations that had sperm whale interactions during hauling operations in the 2021 AFSC longline survey. Depredation is defined as sperm whales being present with the occurrence of damaged fish on the line.

Station	Region	Present	Depredation
79	Central Gulf of Alaska	Yes	Yes
81	Central Gulf of Alaska	Yes	Yes
82	Central Gulf of Alaska	Yes	Yes
83	Central Gulf of Alaska	Yes	Yes
85	Central Gulf of Alaska	Yes	Yes
91	West Yakutat	Yes	Yes
97	East Yakutat/Southeast	Yes	No
102	East Yakutat/Southeast	Yes	No
105	East Yakutat/Southeast	Yes	Yes
106	East Yakutat/Southeast	Yes	Yes

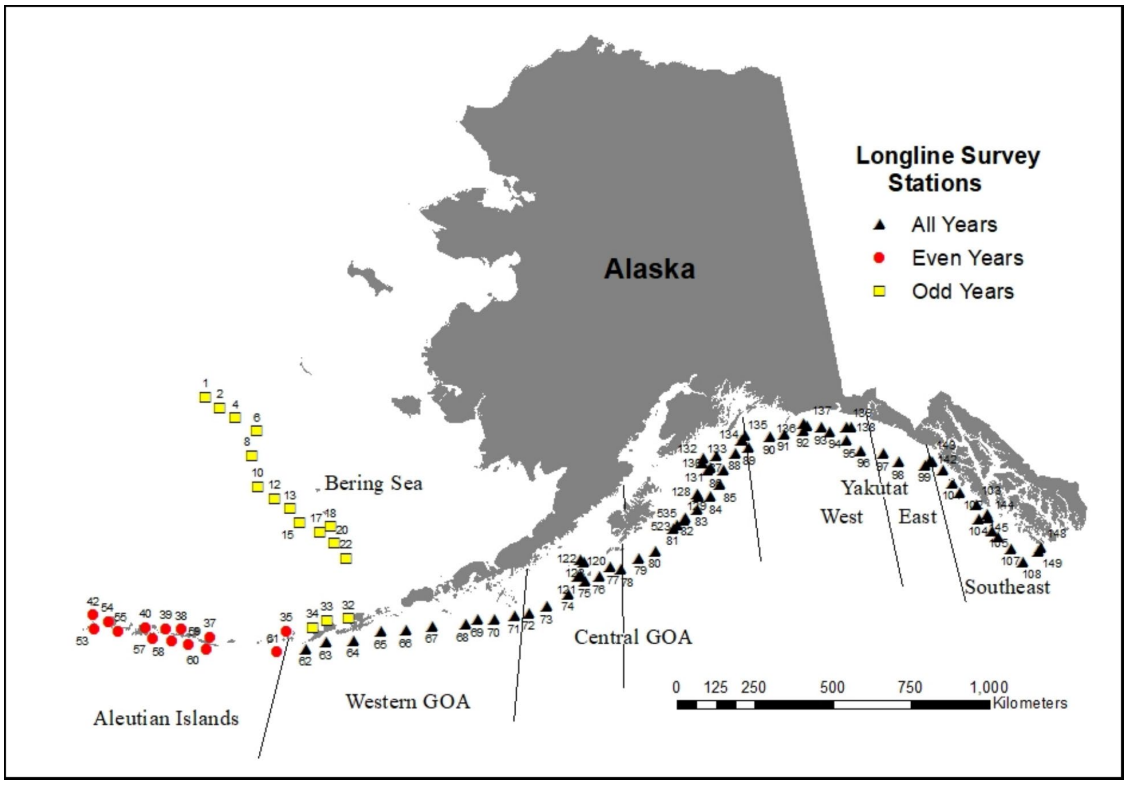

Figure 1. -- Map of NMFS longline survey station locations. Bering Sea stations are sampled in odd years; stations in the eastern and central Aleutian Islands are sampled in even years; Gulf of Alaska (GOA) stations are sampled every year.

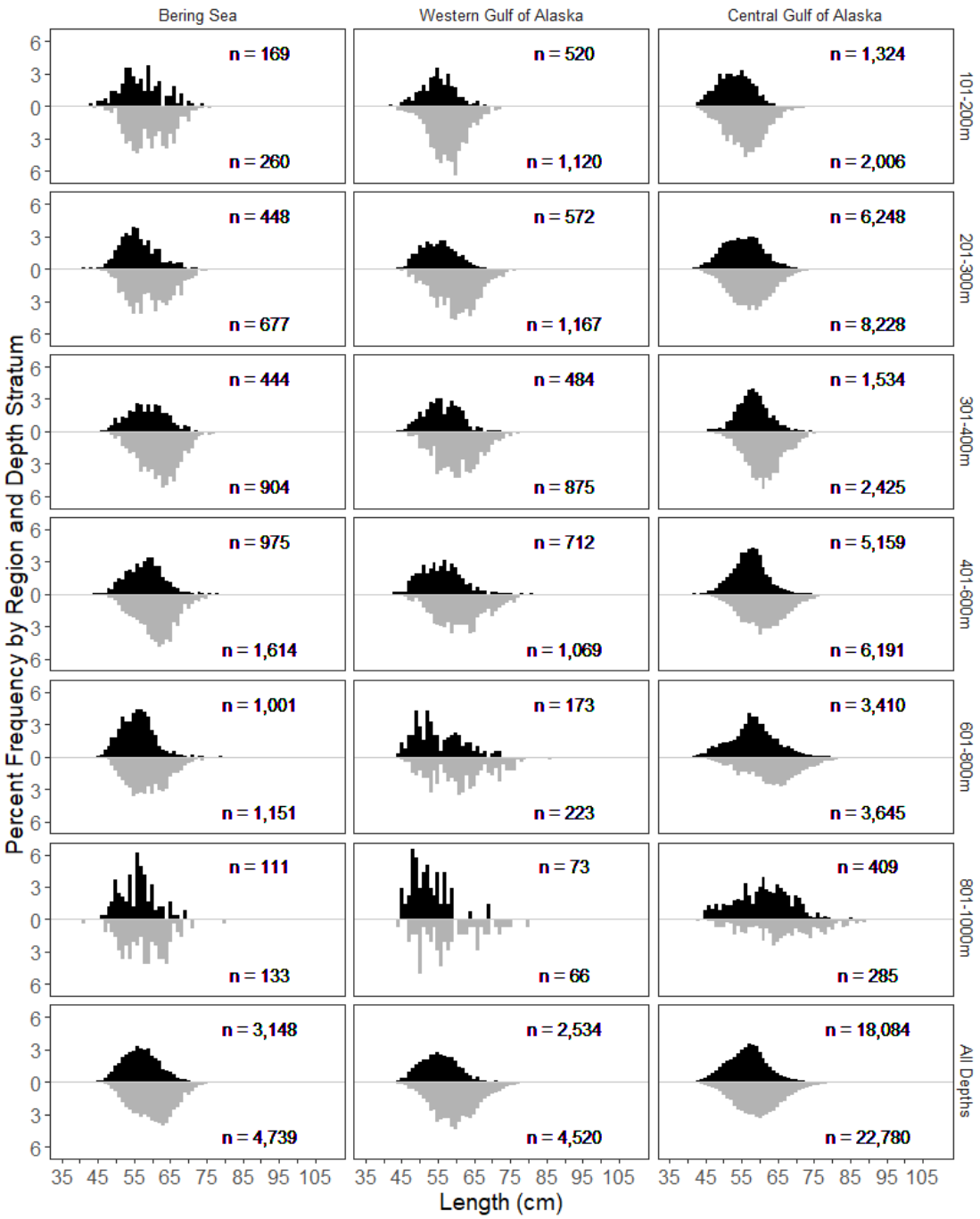

Figure 2. -- Size (fork length) composition of sablefish measured during the 2021 AFSC longline survey by region and depth stratum. Males are shown in black and females are shown in grey below the x-axis.

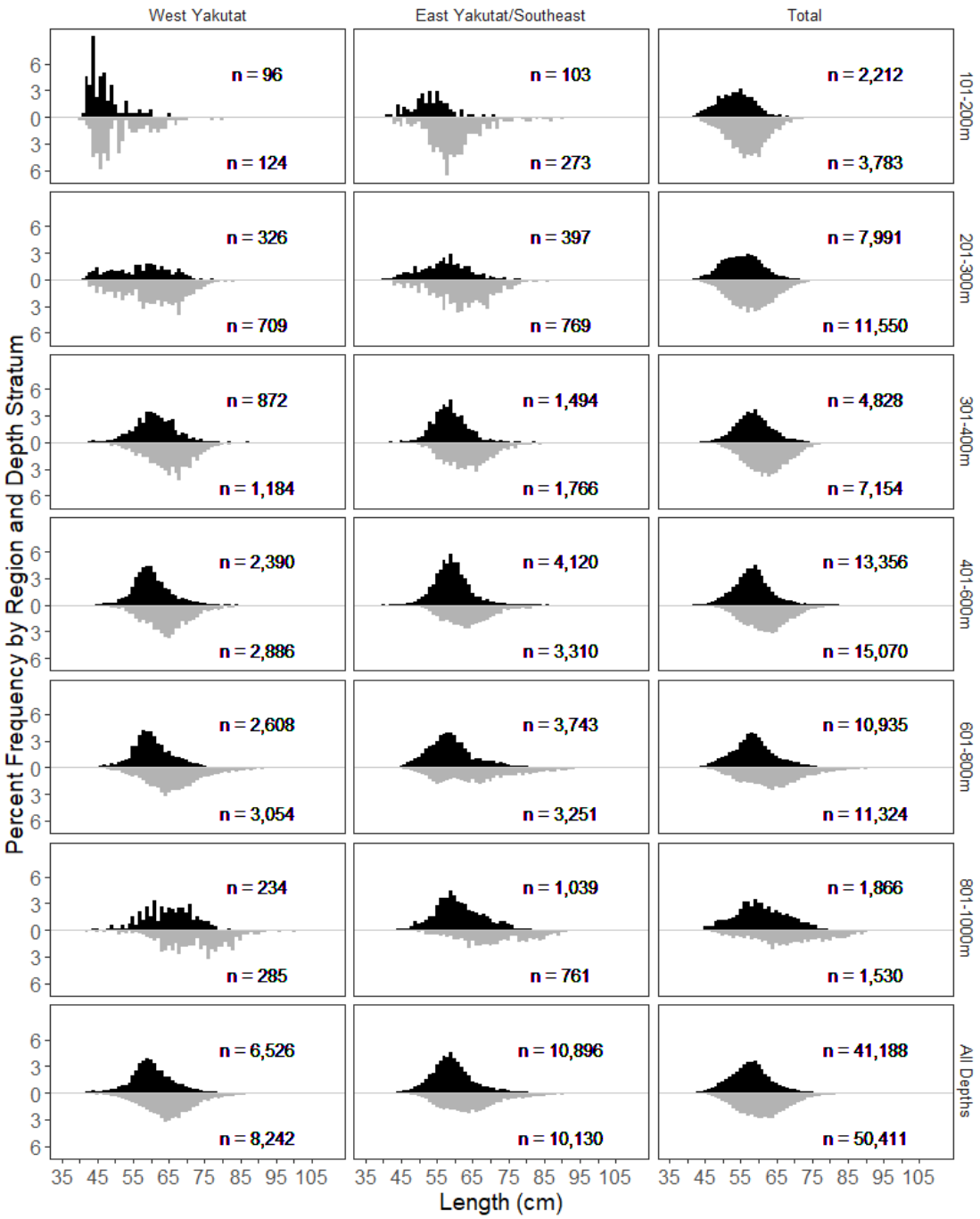

Figure 2. -- Continued.

U.S. Secretary of Commerce
Gina M. Raimondo

Under Secretary of Commerce for Oceans and Atmosphere
Dr. Richard W. Spinrad

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March 2022

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