F/V *Alaskan Leader*
Cruise Report AL-16-01
Longline Survey of the Gulf of Alaska and Eastern Aleutian Islands
May 25-August 28, 2016

Prepared by

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On August 28, 2016, the Alaska Fisheries Science Center (AFSC) completed the 39th annual longline survey of Alaska sablefish (*Anoplopoma fimbria*) and other groundfish resources of the upper continental slope (Figure 1). The Japan-U.S. cooperative longline survey was initiated in 1978 (experimental year) and discontinued after 1994, resulting in a time series of the Gulf of Alaska from 1979 to 1994. As a continuation of the cooperative survey, the National Marine Fisheries Service (NMFS) has surveyed the Gulf of Alaska annually since 1987, the eastern Aleutian Islands biennially since 1996, and the eastern Bering Sea biennially since 1997. The Gulf of Alaska and eastern Aleutian Islands were sampled in 2016.

OBJECTIVES

1. Determine the relative abundance and size composition of the most commercially important groundfish species: sablefish, shortspine thornyhead (*Sebastolobus alascanus*), Greenland turbot (*Reinhardtius hippoglossoides*), Pacific cod (*Gadus macrocephalus*), and rougheye and shortraker rockfishes (*Sebastes aleutianus* and *S. borealis*).

2. Determine the relative abundance and size composition of other groundfish species caught during the survey: arrowtooth flounder (*Atheresthes stomias*), grenadiers (Macrouridae), skates (Rajidae), and spiny dogfish (*Squalus acanthias*).

3. Tag and release sablefish, shortspine thornyhead, and Greenland turbot throughout the cruise to determine migration patterns.

4. Externally tag sablefish with pop-up satellite tags that record water temperature, pressure, and location.

5. Collect sablefish otoliths to study the age composition of the population.

VESSEL AND GEAR

Survey operations were conducted using the F/V *Alaskan Leader*, a chartered U.S. 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, three sets of plate freezers, and refrigerated holds. Vessel personnel consisted of a captain, a mate, an engineer, a cook, a quality-control technician, two contract biologists, six fishermen, and five processors.

Gear configuration is standardized and has been consistent for all survey years since 1988. Units of gear (skates) were 100 m (55 fm) long and contained 45 size 13/0 Mustad[1] 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 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 (3/8 in) diameter nylon.

A set of gear consisted of a flag and buoy array at each end followed sequentially by varying lengths by depth of 9.5 mm diameter nylon buoyline, a 92 m (50 fm) section of 9.5 mm polypropylene floating line, a 16 kg (35 lb) piece of chain (to dampen the effect of wave surge on the buoyline), 92 m of 9.5 mm nylon line, a 27 kg (60 lb) halibut anchor, and 366 m (200 fm) of 9.5 mm nylon line. The groundline was weighted with 3.2 kg (7 lb) lead balls at the end of each skate. Hooks were hand baited with chopped squid (*Illex*) at a rate of about 5.7 kg (12.5 lb) per 100 hooks. Squid heads and tentacles were not used for bait.

Total groundline set each day was 16 km (8.6 nmi) long and contained 160 skates and 7,200 hooks, except in the eastern Bering Sea where 180 skates with 8,100 hooks were set. Additional effort is placed in this region due to the lower densities of sablefish. Two eighty-skate groundlines, laid end to end, were set at each station along the upper continental slope. A single groundline of eighty skates was set at each station in the gullies, except Amatuli Gully (station 87) where 160 skates were set. Specific information regarding longline survey protocols and details of the survey gear can be found at: http://www.afsc.noaa.gov/ABL/MESA/pdf/LSprotocols.pdf

OPERATIONS

The charter began on May 28 in Dutch Harbor, Alaska, and ended on August 28 in Dutch Harbor. The charter period was divided into seven legs (Table 1). During leg 1, the stations along the upper continental slope of the eastern Aleutian Islands were sampled (Figure 1). During leg 2 stations in the Gulf of Alaska were sampled near the western end of Umnak Island and extending eastward to Sand Point. At the conclusion of Leg 2, the vessel then transited the Gulf of Alaska to southeastern Alaska. Leg 3 began off Dixon

[1] Citation of the above brand name does not constitute U.S. government endorsement.

Entrance near the U.S.-Canada boundary and continued north and westward to Yakutat. During leg 4, a two-day experiment was conducted in the Yakutat vicinity (See Appendix A). During leg 5, the area between Yakutat and Cordova was sampled, and during leg 6 the area from Cordova to Kodiak was sampled. During leg 7, the area from Kodiak to Sand Point was sampled.

From 1988 to 1990 the survey period was from June 26 to September 12. The survey periods in 1991 through 1994 were 2-1/2 weeks 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 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 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 as early as possible.

Survey Operations

In previous surveys, a total of fourteen stations along the upper continental slope of the eastern Aleutian Islands and forty-six stations along the upper continental slope of the Gulf of Alaska were sampled at a rate of one station per day (Figure 1). In addition, twenty-seven stations were sampled in gullies and on the continental shelf at the rate of one or two stations per day.

Starting in 2016, several permanent survey station changes were made: one station in the eastern Aleutian Islands was permanently re-located and two gully stations in the central Gulf of Alaska were dropped and replaced with two new slope stations.

Station 61 in the eastern Aleutian Islands has a history of lost gear due to strong currents and bottom snags. In an attempt to avoid gear loss and maintain consistent data collections, station 61 was repositioned slightly while trying to maintain similar habitat and depth characteristics throughout the set. The new sets crisscross the previous sets and start/end positions have been slightly altered from previous surveys.

Four stations (124, 125, 126, 127) have been sampled from 1995-2015 in the Shelikof Trough located in the central Gulf of Alaska. These stations have had relatively poor catch rates of sablefish and other major groundfish species. The bottom habitat is relatively shallow and muddy and does not likely represent productive sablefish habitat. Additionally, to sample locations in Shelikof trough involves extra transit time and increases fuel costs for the survey vessel. In 2016 it was determined these stations were

not beneficial to the survey and were dropped. In response, two slope stations (523, 535) in the central Gulf were added to the survey sampling plan. These stations had previously been fished as experimental random test stations in 1994. These station locations were chosen because these stations were previously fished, catch rates of sablefish and other commercially important species were comparable to nearby stations, and resampling previously fished stations allows catch comparisons that newly designed stations could not. Locations and catches of these new stations are included in subsequent tables in this document.

In 2016, a total of forty-eight stations along the upper continental slope of the Gulf of Alaska were sampled at a rate of one station per day and twenty-two gully stations were sampled at the rate of two stations per day (Figure 1). In addition, one station (103) was sampled on the continental shelf of Baranof Island. Surveyed depths ranged from approximately 200 to 1,000 m, although at some stations depths less than 150 m or more than 1,000 m were sampled. The sampled gullies were 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. A list of stations and which management areas they correspond to, what type of habitat type they represent, and whether or not they were used in abundance index calculations is in Table 2. Not all stations are used in abundance index calculations reported for sablefish, notably gully stations on the continental shelf. However, these abundance calculations are performed for all species at all stations and are available at the station level for slope and gully stations.

The gear was set from shallow to deep and was retrieved in the same order, except on occasions when groundlines 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 1930 hours.

Data Collection

Catch data were recorded on a hand-held electronic data logger. During gear retrieval a scientist 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 when the first hook of each fifth skate was retrieved or when crossing into a new depth interval (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 bar code based measuring board and a bar code reader connected to a ruggedized computer. Length was measured by depth stratum for sablefish, Pacific cod, giant grenadier (*Albatrossia pectoralis*), arrowtooth flounder, Greenland turbot, shortspine thornyhead, spiny dogfish, and multiple rockfish species. Lengths of sablefish, giant grenadier, spiny dogfish, and Pacific cod were recorded by sex. Pacific halibut were counted and released at the rail without measuring. Catch and length frequency data were transferred to a computer and electronic backup media twice

a day. As in the previous surveys, the charter vessel was allowed to retain most of the catch once the scientific data were recorded.

RESULTS

One hundred forty eight longline hauls were completed in 2016 (Table 3). Sablefish was the most frequently caught species, followed by giant grenadier, Pacific cod, shortspine thornyhead, and Pacific halibut (Table 4). Catch of the most abundant species by station is presented in Table 5. Giant grenadier was the highest catch in weight, followed by sablefish, Pacific halibut, and Pacific cod (Table 6). Average length and weight of sablefish varied by station (Table 7).

A total of 3,320 sablefish, 767 shortspine thornyhead, and two Greenland turbot were tagged with external floy tags and released during the survey. Pop-off satellite tags were externally attached to fourteen sablefish. Length-weight data and otoliths were collected from 2,238 sablefish.

Killer whales depredating on the catch occurred at five stations in the western Gulf of Alaska (Table 8). Since 1990, portions of the gear affected by killer whale depredation during domestic longline surveys have been excluded from the analysis of the survey data.

Sperm whale observations have been recorded during the longline survey since 1998. Sperm whales were observed during survey operations at eighteen stations in 2016. Sperm whales were observed depredating on the gear at one station in the Aleutian Islands, five stations in the central Gulf of Alaska, five stations in the West Yakutat region, and six stations in the East Yakutat/Southeast region (Table 9). Apparent sperm whale depredation is defined as sperm whales being present with the occurrence of damaged sablefish. Longline survey catch rates and abundance indices are not adjusted for sperm whale depredation.

NMFS has requested the assistance of the fishing fleet to avoid the annual sablefish longline survey since the inception of sablefish IFQ management in 1995. We requested that fishermen stay at least five nautical miles away from each survey station for seven days before and three days after the planned sampling date (three days allow for survey delays). In 2016 there were three recorded interactions between survey operations and fishing vessels. Interactions occurred at station numbers 96, 88, and 142 by three separate longline vessels. The vessels were contacted by the survey vessel and were encouraged to avoid survey stations.

Gear damage and loss occurs during survey operations and may have impacts on catch. In 2016 gear was lost at two stations due to snagging the bottom (Table 3). Fifteen skates were lost on the second set of station 75 and nineteen skates were lost on station. In addition, gear was hauled in reverse order at nine other stations either due to the line breaking because of hanging up on the bottom or because of strong currents. All gear at these nine states was successfully retrieved.

For further information contact:

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Table 1. Leg numbers, dates, and personnel for the 2016 NMFS longline survey.

Leg	Dates	Personnel	Affiliation
1	May 25 - June 14	Katy Echave	ABL
		Steve Fenske	Volunteer
		Jason Wright	Contract Biologist
		Sabrina Cobb	Contract Biologist
2	June 14 - July 3	Dana Hanselman	ABL
		Karson Coutré	ABL Contractor
		Jason Wright	Contract Biologist
		Sabrina Cobb	Contract Biologist
3	July 5 - July 19	Cindy Tribuzio	ABL
		Rachel Cashman	Volunteer
		Jason Wright	Contract Biologist
		Sabrina Cobb	Contract Biologist
4*	July 20 - July 22	Chris Lunsford	ABL
		Jason Wright	Contract Biologist
		Sabrina Cobb	Contract Biologist
5	July 23 - Aug 2	Pete Hulson	ABL
		Jason Wright	Contract Biologist
		Sabrina Cobb	Contract Biologist
6	Aug 4 - Aug 15	Dave Csepp	ABL
		Jason Wright	Contract Biologist
		Sabrina Cobb	Contract Biologist
7	Aug 16- Aug 28	Pat Malecha	ABL
		Jason Wright	Contract Biologist
		Sabrina Cobb	Contract Biologist

ABL - Auke Bay Laboratories Division, Alaska Fisheries Science Center

* 2-day experiment

Table 2. Stations fished in 2016 NMFS longline survey. Sablefish management area refers to the North Pacific Fisheries Management Council areas, station type refers to station habitat type, and abundance calculations indicates whether or not station catches were used in abundance index calculations.

Station Number	Sablefish Management Area	Station Type	Abundance Calculations
35	Aleutian Islands	Slope	Yes
37	Aleutian Islands	Slope	Yes
38	Aleutian Islands	Slope	Yes
39	Aleutian Islands	Slope	Yes
40	Aleutian Islands	Slope	Yes
54	Aleutian Islands	Slope	Yes
42	Aleutian Islands	Slope	Yes
53	Aleutian Islands	Slope	Yes
55	Aleutian Islands	Slope	Yes
57	Aleutian Islands	Slope	Yes
58	Aleutian Islands	Slope	Yes
59	Aleutian Islands	Slope	Yes
60	Aleutian Islands	Slope	Yes
61	Aleutian Islands	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

Station Number	Sablefish Management Area	Station Type	Abundance Calculations
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	Shelf	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

Station Number	Sablefish Management Area	Station Type	Abundance Calculations
525	Central Gulf of Alaska	Slope	No

Table 3. Set information by station and haul for the 2016 NMFS longline survey. Positions in decimal degree (DD) format.

Station	Haul	Date	# Skates Retrieved	Start Latitude	Start Longitude	End Latitude	End Longitude	Start Depth (m)	End Depth (m)
				Aleutian Islands					
35	1	1-Jun	80	53.03	-170.11	53.06	-170.20	168	182
35	2	1-Jun	80	53.06	-170.20	53.09	-170.29	185	586
37	3	2-Jun	80	52.28	-173.49	52.33	-173.49	145	585
37	4	2-Jun	80	52.34	-173.50	52.39	-173.50	612	724
38	5	3-Jun	80	52.25	-174.84	52.31	-174.78	176	558
38	6	3-Jun	80	52.32	-174.77	52.34	-174.68	379	805
39	7	4-Jun	80	52.13	-175.57	52.15	-175.66	109	458
39	8	4-Jun	80	52.15	-175.68	52.17	-175.75	447	653
40	9	5-Jun	80	51.97	-176.45	52.02	-176.44	111	410
40	10	5-Jun	80	52.03	-176.41	52.07	-176.33	538	860
54	11	6-Jun	80	51.78	-178.97	51.74	-178.88	114	404
54	12	6-Jun	80	51.72	-178.87	51.66	-178.83	454	717
42	13	7-Jun	80	51.41	-178.62	51.36	-178.56	191	542
42	14	7-Jun	80	51.35	-178.55	51.36	-178.45	588	802
53	15	8-Jun	80	51.76	-178.16	51.74	-178.25	93	336
53	16	8-Jun	80	51.73	-178.37	51.76	-178.28	574	694
55	17	9-Jun	80	51.59	-177.61	51.55	-177.70	197	262
55	18	9-Jun	80	51.55	-177.71	51.53	-177.81	312	832
57	19	10-Jun	80	51.73	-176.00	51.66	-176.02	188	359
57	20	10-Jun	80	51.65	-176.03	51.59	-176.07	414	722
58	21	11-Jun	80	51.86	-175.14	51.78	-175.15	177	365
58	22	11-Jun	80	51.78	-175.11	51.71	-175.11	367	734
59	23	12-Jun	80	51.90	-174.33	51.83	-174.40	122	271
59	24	12-Jun	80	51.83	-174.41	51.78	-174.49	325	981
60	25	13-Jun	80	51.92	-173.51	51.88	-173.59	115	158
60	26	13-Jun	80	51.88	-173.60	51.87	-173.71	148	488
61	27	14-Jun	80	52.38	-170.29	52.38	-170.41	233	549
61	28	14-Jun	80	52.38	-170.41	52.38	-170.52	486	606
				Gulf of Alaska					
64	29	16-Jun	80	53.19	-166.85	53.13	-166.88	214	306
64	30	16-Jun	80	53.12	-166.89	53.06	-166.92	322	494
65	31	17-Jun	80	53.58	-165.69	53.52	-165.72	118	263
65	32	17-Jun	80	53.51	-165.73	53.46	-165.77	295	512
62	33	18-Jun	80	52.66	-169.01	52.61	-169.10	134	646
62	34	18-Jun	80	52.61	-169.10	52.56	-169.20	165	832
63	35	19-Jun	80	52.97	-168.13	52.92	-168.18	110	382
63	36	19-Jun	80	52.91	-168.20	52.85	-168.21	380	790

Station	Haul	Date	# Skates Retrieved	Start Latitude	Start Longitude	End Latitude	End Longitude	Start Depth (m)	End Depth (m)
66	37	20-Jun	80	53.73	-164.47	53.68	-164.54	135	288
66	38	20-Jun	80	53.68	-164.56	53.64	-164.64	306	574
67	39	21-Jun	80	53.97	-163.26	53.91	-163.33	114	418
67	40	21-Jun	80	53.90	-163.36	53.86	-163.44	325	710
68	41	22-Jun	80	54.13	-161.63	54.09	-161.72	136	308
68	42	22-Jun	80	54.09	-161.73	54.11	-161.83	346	550
69	43	23-Jun	80	54.31	-161.06	54.27	-161.14	180	360
69	44	23-Jun	80	54.26	-161.15	54.21	-161.22	395	831
70	45	24-Jun	80	54.36	-160.24	54.30	-160.29	144	352
70	46	24-Jun	80	54.29	-160.30	54.23	-160.32	346	630
71	47	25-Jun	80	54.51	-159.26	54.44	-159.31	147	283
71	48	25-Jun	80	54.44	-159.32	54.38	-159.38	289	756
72	49	26-Jun	80	54.63	-158.59	54.56	-158.64	132	408
72	50	26-Jun	80	54.57	-158.66	54.51	-158.71	341	702
73	51	27-Jun	80	54.85	-157.75	54.79	-157.82	187	374
73	52	27-Jun	80	54.72	-157.88	54.79	-157.84	347	478
74	53	28-Jun	80	55.24	-156.69	55.17	-156.74	165	338
74	54	28-Jun	80	55.17	-156.75	55.10	-156.76	294	788
75	55	29-Jun	80	55.64	-155.85	55.58	-155.86	149	208
[1]75	56	29-Jun	66	55.57	-155.86	55.53	-155.84	212	218
148	57	5-Jul	80	54.65	-132.84	54.60	-132.94	146	374
[1]149	58	5-Jul	61	54.60	-133.02	54.60	-133.15	389	413
108	59	6-Jul	80	54.47	-133.92	54.50	-134.02	250	598
108	60	6-Jul	80	54.50	-134.02	54.56	-134.07	348	900
107	61	7-Jul	80	54.90	-134.29	54.96	-134.35	223	550
107	62	7-Jul	80	54.96	-134.35	55.01	-134.44	420	830
106	63	8-Jul	80	55.35	-134.72	55.39	-134.83	340	572
106	64	8-Jul	80	55.40	-134.83	55.41	-134.94	468	807
105	65	9-Jul	80	55.56	-134.97	55.58	-135.05	215	564
105	66	9-Jul	80	55.58	-135.05	55.63	-135.13	474	895
144	67	10-Jul	80	55.92	-134.90	56.00	-134.91	208	360
145	68	10-Jul	80	56.04	-134.93	56.09	-135.03	327	377
104	69	11-Jul	80	55.98	-135.44	56.02	-135.53	333	635
104	70	11-Jul	80	56.03	-135.52	56.08	-135.62	619	900
103	71	12-Jul	80	56.38	-135.35	56.38	-135.48	138	188
103	72	12-Jul	80	56.39	-135.49	56.37	-135.61	190	257
102	73	13-Jul	80	56.85	-136.00	56.90	-136.10	216	686
102	74	13-Jul	80	56.90	-136.10	56.97	-136.12	727	900
101	75	14-Jul	80	57.19	-136.24	57.21	-136.33	223	675
101	76	14-Jul	80	57.22	-136.33	57.28	-136.38	595	995

Station	Haul	Date	# Skates Retrieved	Start Latitude	Start Longitude	End Latitude	End Longitude	Start Depth (m)	End Depth (m)
100	77	15-Jul	80	57.62	-136.54	57.62	-136.66	197	760
100	78	15-Jul	80	57.61	-136.65	57.66	-136.75	663	950
142	79	16-Jul	80	57.92	-137.00	57.92	-137.13	400	443
143	80	16-Jul	80	57.97	-137.08	57.97	-137.18	267	421
99	81	17-Jul	80	57.88	-137.37	57.88	-137.50	180	705
99	82	17-Jul	80	57.88	-137.51	57.89	-137.63	582	860
98	83	18-Jul	80	58.14	-138.73	58.15	-138.86	240	759
98	84	18-Jul	80	58.15	-138.87	58.18	-138.97	490	800
96	85	19-Jul	80	58.68	-140.64	58.68	-140.79	259	745
96	86	19-Jul	80	58.69	-140.78	58.73	-140.89	440	680
138	91	24-Jul	80	59.42	-140.93	59.43	-141.08	200	296
139	92	24-Jul	80	59.41	-141.17	59.36	-141.26	320	325
97	93	25-Jul	80	58.47	-139.45	58.46	-139.61	195	511
97	94	25-Jul	80	58.46	-139.61	58.42	-139.70	443	836
95	95	26-Jul	80	59.05	-141.34	59.05	-141.47	300	500
95	96	26-Jul	80	59.05	-141.48	59.05	-141.61	513	800
94	97	27-Jul	80	59.39	-142.16	59.42	-142.28	233	465
94	98	27-Jul	80	59.43	-142.30	59.48	-142.38	402	825
93	99	28-Jul	80	59.55	-142.55	59.58	-142.67	130	600
93	100	28-Jul	80	59.58	-142.67	59.59	-142.78	570	600
136	101	29-Jul	80	59.76	-143.70	59.75	-143.57	163	303
137	102	29-Jul	80	59.72	-143.53	59.68	-143.41	299	312
92	103	30-Jul	80	59.56	-143.67	59.56	-143.80	196	611
92	104	30-Jul	80	59.57	-143.81	59.59	-143.93	544	800
91	105	31-Jul	80	59.52	-144.72	59.48	-144.84	182	496
91	106	31-Jul	80	59.48	-144.85	59.45	-144.97	455	763
90	107	1-Aug	80	59.50	-145.53	59.52	-145.67	157	800
90	108	1-Aug	80	59.52	-145.68	59.53	-145.75	482	800
89	109	2-Aug	80	59.27	-146.86	59.23	-146.95	190	515
89	110	2-Aug	80	59.23	-146.96	59.19	-147.04	495	735
134	111	5-Aug	80	59.61	-146.99	59.55	-147.06	208	214
135	112	5-Aug	80	59.52	-147.16	59.45	-147.15	205	214
88	113	6-Aug	80	59.15	-147.61	59.08	-147.61	240	539
88	114	6-Aug	80	59.08	-147.62	59.01	-147.63	499	916
87	115	7-Aug	80	59.13	-148.65	59.06	-148.65	157	188
87	116	7-Aug	80	59.05	-148.64	58.99	-148.65	203	242
132	117	8-Aug	80	59.08	-149.40	59.04	-149.52	186	227
133	118	8-Aug	80	58.95	-149.51	58.92	-149.62	236	242
130	119	9-Aug	80	58.73	-149.19	58.77	-149.08	180	212
131	120	9-Aug	80	58.81	-149.04	58.84	-148.93	230	251

Station	Haul	Date	# Skates Retrieved	Start Latitude	Start Longitude	End Latitude	End Longitude	Start Depth (m)	End Depth (m)
86	121	10-Aug	80	58.69	-148.33	58.61	-148.33	275	479
86	122	10-Aug	80	58.61	-148.34	58.53	-148.34	447	875
85	123	11-Aug	80	58.69	-148.33	58.63	-148.33	273	391
85	124	11-Aug	80	58.62	-148.34	58.56	-148.34	407	810
84	125	12-Aug	80	58.29	-148.62	58.23	-148.65	231	478
84	126	12-Aug	80	58.22	-148.67	58.16	-148.70	518	803
128	127	13-Aug	80	57.97	-149.15	57.92	-149.25	172	487
129	128	13-Aug	80	57.91	-149.25	57.86	-149.33	490	850
83	129	14-Aug	80	58.00	-149.84	57.98	-149.98	218	266
83	130	14-Aug	80	58.08	-149.91	58.07	-150.04	292	307
82	131	15-Aug	80	57.65	-149.92	57.56	-149.95	396	590
82	132	15-Aug	80	57.56	-149.95	57.49	-149.98	567	889
535	133	17-Aug	80	57.40	-150.58	57.32	-150.59	213	518
535	134	17-Aug	80	57.32	-150.60	57.25	-150.60	509	727
523	135	18-Aug	80	57.36	-150.67	57.29	-150.67	223	485
523	136	18-Aug	80	57.28	-150.68	57.22	-150.67	496	748
81	137	19-Aug	80	57.22	-151.04	57.15	-151.05	185	508
81	138	19-Aug	80	57.14	-151.05	57.07	-151.05	547	642
80	139	20-Aug	80	57.11	-151.23	57.06	-151.27	270	500
80	140	20-Aug	80	57.04	-151.29	56.98	-151.29	573	843
79	141	21-Aug	80	56.48	-152.22	56.42	-152.29	194	505
79	142	21-Aug	80	56.42	-152.31	56.35	-152.35	382	796
78	143	22-Aug	80	56.30	-153.08	56.27	-153.17	242	421
78	144	22-Aug	80	56.27	-153.20	56.23	-153.28	474	654
77	145	23-Aug	80	55.98	-154.03	55.93	-154.02	257	476
77	146	23-Aug	80	55.91	-154.03	55.95	-154.23	567	900
76	147	24-Aug	80	56.04	-154.57	55.97	-154.56	242	563
76	148	24-Aug	80	55.96	-154.57	55.90	-154.57	579	881
122	149	25-Aug	80	55.77	-155.14	55.71	-155.17	153	290
123	150	25-Aug	80	55.69	-155.18	55.64	-155.25	336	531
120	151	26-Aug	80	56.19	-155.96	56.18	-156.08	190	236
121	152	26-Aug	80	56.23	-156.13	56.25	-156.25	245	263

[1] Station catch partially impacted by gear loss

Table 4. Total estimated catch in numbers of major species (>100 individuals) caught in the 2016 NMFS longline survey by management area.

Species/Complex	Aleutian Islands	Western GOA	Central GOA	West Yakutat	East Yakutat Southeast	Total
Sablefish	6,654	11,723	28,649	11,205	15,908	74,139
Giant grenadier	19,570	16,389	17,313	2,900	3,159	59,331
Pacific cod	7,948	4,040	3,838	268	523	16,617
Shortspine thornyhead	1,831	2,854	4,665	2,273	3,760	15,383
Pacific halibut	2,595	985	3,840	1,266	1,364	10,050
Rougheye rockfish	1,756	1,473	886	504	1,893	6,513
Arrowtooth flounder	1,267	657	2,278	190	618	5,010
Shortraker rockfish	792	592	724	695	989	3,791
Spiny dogfish	0	4	1,742	191	321	2,258
Aleutian/Bering/Alaska Skate Complex	935	438	545	80	132	2,130
Yellow Irish lord	2,090	14	0	0	0	2,104
Longnose skate	2	199	509	284	461	1,455
Redbanded rockfish	15	37	228	213	650	1,143
Brittlestarfish	53	236	702	23	60	1,074
Sea anemone unident.	29	102	375	151	361	1,018
whiteblotched skate	1,004	0	0	0	0	1,004
Sea pen or Sea Whip	28	8	618	51	5	710
Pacific grenadier	94	0	457	10	24	585
Yelloweye rockfish	0	63	23	44	316	446
commander skate	381	4	0	0	8	393
Sponge, unidentified	227	95	32	4	9	367
Dover sole	0	13	167	49	80	309
Lips or Jaws - Whale Predation	20	96	64	36	35	251
Gorgonian Coral unident.	208	17	6	0	7	238
hydrocoral unident.	186	10	14	0	6	216
Starfish unident.	19	43	38	19	60	179
mud skate	169	7	1	0	0	177
Greenland turbot	163	0	0	0	0	163
Walleye pollock	53	22	61	9	18	163
Darkfin sculpin	156	3	0	0	0	159
Crinoid, unidentified	2	6	141	3	3	155
Canary rockfish	0	0	0	0	150	150
Spotted ratfish	0	0	0	0	124	124

Table 5. Catch in number by station for major species in the 2016 NMFS longline survey. SF = sablefish, PC = Pacific cod, GR = giant grenadier, PH = Pacific halibut, ATF = arrowtooth flounder, GT = Greenland turbot, RF = rougheye and shortraker rockfish, ST = shortspine thornyhead, SK = skate, OS = Other Species.

Station	SF	PC	GR	PH	ATF	GT	RF	ST	SK	OS
Aleutian Islands										
35	30	2,237	138	404	125	3	56	4	720	304
37	1,270	181	2,135	32	176	73	4	42	247	70
38	944	482	2,021	52	194	51	107	282	56	15
39	536	490	2,450	734	140	9	45	55	46	317
40	406	291	2,506	148	62	19	41	108	102	100
42	355	323	597	190	80	2	273	50	287	165
53	620	43	1,793	18	63	2	61	525	82	105
54	224	764	1,182	223	172	3	232	58	157	1,010
55	498	344	1,420	104	44	1	35	126	104	253
57	402	372	1,494	108	82	0	83	101	170	76
58	371	219	1,196	149	39	0	223	187	235	33
59	191	584	1,028	180	57	0	403	51	140	620
60[1]	272	1,152	346	178	26	0	972	22	130	498
61[2]	535	466	1,264	75	7	0	20	220	147	80
Gulf of Alaska										
62[1]	188	414	2,935	28	9	0	184	140	66	55
63	860	792	1,648	159	78	0	400	468	101	69
64[1]	623	27	375	22	30	0	411	471	39	99
65	1,664	507	1,909	110	36	0	27	171	132	44
66	1,826	393	1,852	97	52	0	38	226	75	76
67	1,287	436	1,674	179	91	0	305	174	85	142
68	1,523	727	241	216	164	0	586	709	83	101
69	1,496	140	2,534	33	38	0	25	189	6	12
70[1]	681	252	1,995	66	19	0	6	79	24	277
71	1,575	352	1,226	75	140	0	83	227	40	29
72[1]	2,126	333	1,623	79	35	0	60	167	18	37
73	1,775	67	1,205	33	71	0	64	169	34	53
74[1]	1,924	168	504	103	67	0	55	377	43	110
75[2]	792	745	0	536	130	0	7	7	61	111
76	1,182	250	1,058	114	42	0	55	135	111	432
77	1,587	4	1,343	3	61	0	77	277	0	283
78	1,323	5	1,268	16	37	0	272	320	4	649
79	1,741	0	1,274	28	68	0	68	358	0	21
80	1,121	39	1,093	238	173	0	230	319	7	58
81	1,454	3	1,228	48	73	0	58	200	1	172
82	1,294	8	569	267	61	0	61	155	4	37
83	981	0	2,412	1	30	0	7	202	1	350
84	1,191	451	638	376	79	0	63	224	26	172
85	989	41	441	84	104	0	112	249	26	124

Station	SF	PC	GR	PH	ATF	GT	RF	ST	SK	OS
86	766	12	222	178	52	0	111	279	12	71
87	430	69	0	285	82	0	10	74	105	232
88	587	7	429	29	34	0	84	238	9	112
89	772	91	330	41	24	0	28	144	56	130
90	943	43	308	380	7	0	214	220	61	144
91	1,395	70	318	250	27	0	78	210	41	69
92	1,454	5	299	14	8	0	29	196	7	28
93	1,288	3	581	117	10	0	19	369	19	63
94	1,664	13	466	127	28	0	92	263	47	39
95	1,153	5	320	70	5	0	237	367	9	92
96	1,002	0	278	13	24	0	386	206	9	75
97	1,227	20	422	43	24	0	359	153	13	68
98	892	1	401	35	8	0	309	58	9	81
99	876	70	308	164	23	0	41	110	22	87
100	1,521	5	270	13	38	0	55	180	4	82
101	1,222	53	423	76	54	0	185	215	9	104
102	943	10	332	41	40	0	38	155	16	69
103	272	190	0	557	107	0	0	17	58	697
104	1,179	0	238	11	4	0	311	481	13	87
105	1,432	17	227	67	6	0	89	386	21	112
106	1,206	0	137	1	1	0	597	242	5	109
107	986	11	196	20	8	0	408	328	14	112
108	955	6	147	11	3	0	357	143	6	136
120	578	629	0	124	141	0	0	8	78	28
121	355	8	0	88	55	0	0	9	57	18
122	541	495	0	76	167	0	0	1	77	11
123	585	188	0	7	83	0	0	2	45	17
128	330	201	0	342	104	0	10	46	13	19
129	644	1	0	168	144	0	4	73	21	11
130	221	1	0	32	24	0	1	46	37	28
131	611	38	0	42	39	0	21	165	38	37
132	188	35	0	36	28	0	1	55	85	52
133	82	1	0	19	60	0	16	107	31	33
134	63	0	0	5	13	0	1	13	49	671
135	147	0	0	20	15	0	14	29	56	795
136	237	8	0	50	11	0	1	72	23	180
137	374	0	0	61	3	0	9	83	35	9
138	276	30	0	112	30	0	52	79	38	48
139	647	0	0	31	13	0	55	64	35	5
142	274	0	39	6	5	0	1	246	4	6
143	645	0	18	54	149	0	8	176	34	81
144	148	34	0	95	38	0	70	231	26	69

Station	SF	PC	GR	PH	ATF	GT	RF	ST	SK	OS
145	909	0	1	37	24	0	46	270	49	89
148	398	106	0	93	80	0	6	255	156	451
149[2]	823	0	0	40	6	0	4	114	149	24
523	1610	22	585	212	98	0	105	129	6	27
535	1431	17	1421	251	108	0	69	232	8	74

[1] Station catch was entirely or partially impacted by killer whale depredation.
[2] Station catch was partially impacted by gear loss.

Table 6. Total estimated catch in weight (kg) of major species (>100 kg) caught in the 2016 NMFS longline survey by management area. Weight derived from length-weight relationship when lengths available. For all others an average weight proxy from longline fisheries was applied to numbers caught.

Species/Complex	Aleutian Islands	Western GOA	Central GOA	West Yakutat	East Yakutat Southeast	Total
Giant grenadier	69,610	49,742	61,451	9,263	10,659	200,725
Sablefish	16,161	22,610	67,655	38,023	54,775	199,224
Pacific halibut	15,313	5,812	22,660	7,471	8,049	59,305
Pacific cod	19,682	11,962	9,956	713	1,609	43,922
Shortspine thornyhead	2,018	1,938	2,974	1,472	2,785	11,188
Longnose skate	15	1,484	3,795	2,117	3,437	10,847
Arrowtooth flounder	3,419	1,121	4,348	390	1,102	10,380
Rougheye rockfish	2,169	2,070	1,365	708	3,564	9,876
Shortraker rockfish	675	925	1,118	1363	1,594	5,676
whiteblotched skate	5,408	0	0	0	0	5,408
Spiny dogfish	0	13	3,667	403	733	4,815
Redbanded rockfish	27	66	405	378	1,154	2,029
Yellow Irish lord	1,752	12	0	0	0	1,763
Yelloweye rockfish	0	182	66	127	911	1,286
commander skate	1,214	13	0	0	25	1,253
Pacific grenadier	118	0	456	14	28	617
Greenland turbot	614	0	0	0	0	614
mud skate	572	24	3	0	0	599
Dover sole	0	19	248	73	119	460
Spotted ratfish	0	0	0	0	451	451
Skates unidentified	370	5	5	0	20	401
Lingcod	0	0	41	148	131	320
Sea anemone unident.	8	28	104	42	100	282
Canary rockfish	0	0	0	0	276	276
big skate	0	10	60	159	10	239
Walleye pollock	75	31	87	13	26	232
Darkfin sculpin	137	3	0	0	0	139
roughtail skate	126	3	3	0	6	139
Sea pen or Sea Whip	5	2	117	10	1	134
Sponge, unidentified	65	27	9	1	3	105

Table 7. Mean length, round weight, mean dressed weight, number, and estimated total round weight of sablefish by station caught during the 2016 NMFS longline survey.

Station	Mean Length	Mean Round Weight(kg)[a]	Mean Dressed Weight(lbs)[b]	Number of Sablefish	Est. Total Round Weight(kg)[c]
			Aleutian Islands		
35	58.85	2.27	3.16	30	68
37	57.11	1.96	2.73	1,270	2,493
38	57.98	2.10	2.92	944	1,981
39	61.60	2.55	3.55	536	1,369
40	61.42	2.52	3.50	406	1,024
42	64.41	2.95	4.10	355	1,048
53	61.44	2.52	3.51	620	1,565
54	68.02	3.67	5.10	224	823
55	52.71	1.62	2.25	498	807
57	55.31	1.84	2.56	402	740
58	60.34	2.44	3.39	371	906
59	66.76	3.26	4.53	191	623
60	72.28	4.28	5.94	272	1,164
61	63.09	2.90	4.02	535	1,550
			Gulf of Alaska		
62[1]	58.58	2.30	3.19	188	432
63	56.47	1.98	2.76	860	1,706
64[1]	49.26	1.17	1.63	623	731
65	55.87	1.83	2.55	1,664	3,053
66	56.47	1.96	2.72	1,826	3,575
67	57.03	2.09	2.90	1,287	2,685
68	60.49	2.51	3.48	1,523	3,816
69	55.34	1.84	2.55	1,496	2,748
70[1]	51.62	1.39	1.92	681	943
71	55.85	1.86	2.58	1,575	2,922
72[1]	58.55	2.18	3.03	2,126	4,643
73	54.52	1.70	2.36	1,775	3,010
74[1]	57.10	2.00	2.78	1,924	3,855
75[2]	48.57	1.14	1.58	792	899
76	58.01	2.11	2.94	1,182	2,500
77	59.60	2.55	3.54	1,587	4,043
78	64.64	2.99	4.15	1,323	3,956
79	63.11	2.74	3.80	1,741	4,767
80	66.84	3.27	4.54	1,121	3,661
81	61.19	2.53	3.51	1,454	3,672
82	62.66	2.69	3.73	1,294	3,476
83	64.30	3.00	4.16	981	2,940

Station	Mean Length	Mean Round Weight(kg)[a]	Mean Dressed Weight(lbs)[b]	Number of Sablefish	Est. Total Round Weight(kg)[c]
84	65.82	3.17	4.40	1,191	3,777
85	64.01	2.88	4.00	989	2,851
86	63.38	2.81	3.90	766	2,150
87	56.13	1.90	2.63	430	816
88	62.71	2.67	3.71	587	1,568
89	64.39	2.99	4.15	772	2,307
90	66.43	3.35	4.65	943	3,155
91	66.25	3.26	4.53	1,395	4,545
92	66.32	3.33	4.62	1,454	4,841
93	70.04	3.95	5.49	1,288	5,088
94	66.50	3.32	4.61	1,664	5,524
95	70.02	3.91	5.43	1,153	4,509
96	70.60	4.03	5.60	1,002	4,038
97	67.78	3.53	4.90	1,227	4,332
98	71.87	4.32	6.00	892	3,856
99	73.59	4.63	6.43	876	4,058
100	70.23	3.93	5.46	1,521	5,974
101	66.18	3.29	4.57	1,222	4,017
102	68.32	3.66	5.08	943	3,452
103	58.94	2.30	3.19	272	625
104	65.52	3.21	4.46	1,179	3,785
105	68.20	3.64	5.06	1,432	5,214
106	64.39	2.94	4.08	1,206	3,543
107	67.06	3.46	4.80	986	3,411
108	67.88	3.60	5.01	955	3,442
120	50.36	1.25	1.74	578	724
121	50.81	1.30	1.80	355	461
122	49.91	1.21	1.69	541	657
123	49.73	1.20	1.67	585	701
128	56.02	1.87	2.60	330	617
129	60.79	2.37	3.29	644	1,526
130	56.95	1.95	2.70	221	430
131	62.26	2.58	3.58	611	1,576
132	56.70	1.99	2.76	188	374
133	59.81	2.27	3.15	82	186
134	49.88	1.28	1.78	63	81
135	51.28	1.38	1.91	147	203
136	61.84	2.67	3.71	237	634
137	63.45	2.74	3.81	374	1,026
138	56.93	2.10	2.92	276	580

Station	Mean Length	Mean Round Weight(kg)[a]	Mean Dressed Weight(lbs)[b]	Number of Sablefish	Est. Total Round Weight(kg)[c]
139	63.21	2.74	3.81	647	1,775
142	62.06	2.57	3.57	274	705
143	61.19	2.47	3.43	645	1,595
144	68.89	3.74	5.20	148	554
145	67.60	3.57	4.96	909	3,249
148	58.77	2.20	3.05	398	874
149[2]	62.14	2.54	3.53	823	2,089
523	61.18	2.49	3.46	1,610	4,009
535	60.78	2.46	3.42	1,431	3,525

[1] Station catch was entirely or partially impacted by killer whale depredation.
[2] Station catch was partially impacted by gear loss.

[a] Mean weight was estimated by applying a length-weight relationship to the length frequency distribution from each station.

[b] Mean dressed weight was estimated using a recovery rate of 0.6 of round weight (in pounds).

[c] Estimated total round weight is the product of mean round weight and the number of hooked sablefish that came to the surface, including a small percentage that were lost during landing and fish that were tagged and released.

Table 8. Stations and skates depredated by killer whales during the 2016 NMFS longline survey. Number of skates affected refers to skates determined to be depredated and were removed from abundance calculations.

Station	Region	Number of skates affected	Number of skates fished
62	Western Gulf of Alaska	137	160
64	Western Gulf of Alaska	160	160
70	Western Gulf of Alaska	95	160
72	Western Gulf of Alaska	80	160
74	Western Gulf of Alaska	156	160

Table 9. Stations that had sperm whales present during hauling operations in the 2016 NMFS longline survey. Depredation is defined as sperm whales being present with the occurrence of damaged fish on the line.

Station	Region	Depredation
54	Aleutian Islands	Yes
80	Central Gulf	No
81	Central Gulf	Yes
83	Central Gulf	Yes
88	Central Gulf	Yes
89	West Yakutat	Yes
91	West Yakutat	Yes
92	West Yakutat	Yes
95	West Yakutat	Yes
96	West Yakutat	Yes
97	West Yakutat	Yes
101	East Yakutat/Southeast	Yes
102	East Yakutat/Southeast	Yes
105	East Yakutat/Southeast	Yes
106	East Yakutat/Southeast	Yes
108	East Yakutat/Southeast	Yes
523	Central Gulf	Yes
535	Central Gulf	Yes

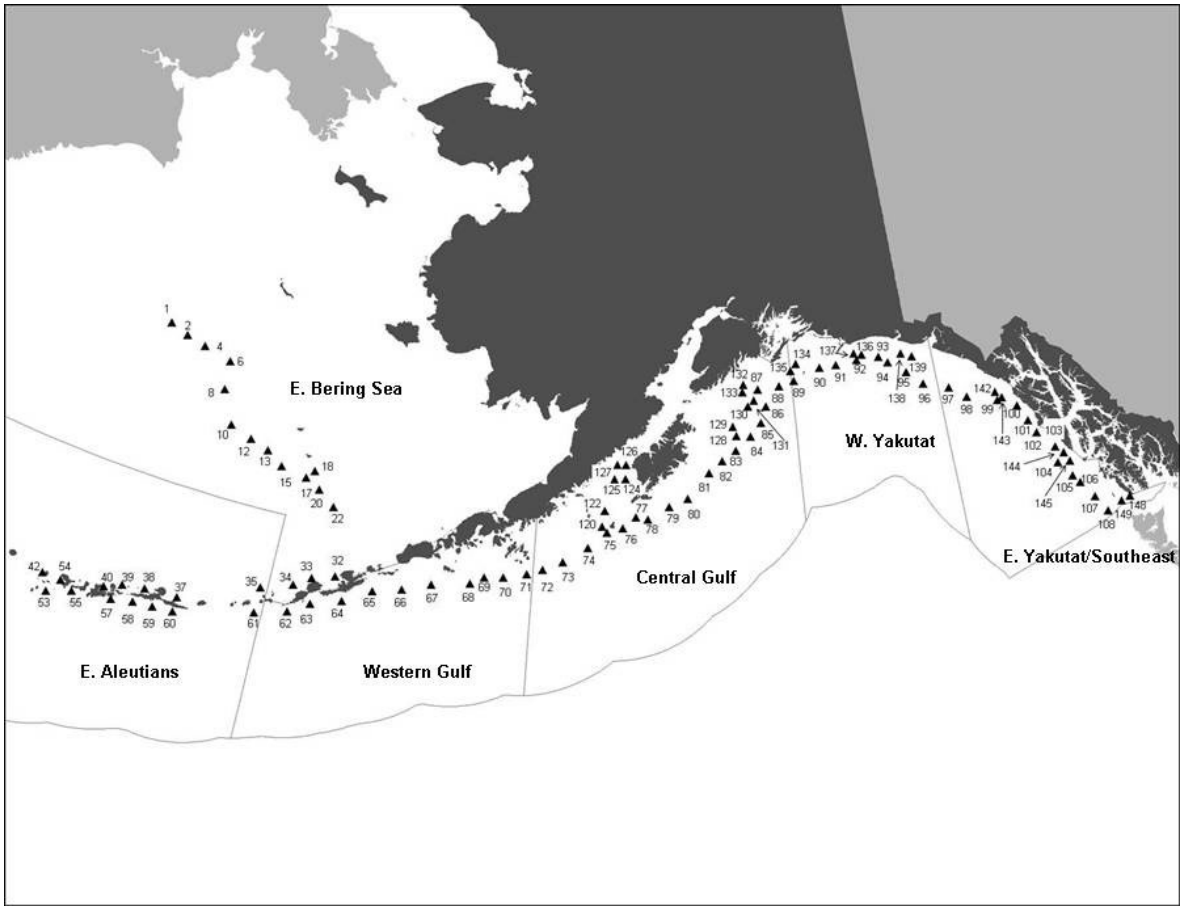

Figure 1. Map of NMFS longline survey station locations and corresponding management areas. Bering Sea stations are sampled in odd years; Aleutian Islands Region stations are sampled in even years; Gulf of Alaska stations are sampled every year.

APPENDIX A: Hook Type Experiment

A two-day experiment was conducted near Yakutat from July 21-22 to compare the catch rates of randomly selected stations to the catch rates of standard survey stations. The longline survey is a predicated on a systematic survey design which samples the same locations every year to detect changes in catch rates and fish abundance from year to year. Previous unpublished work tested various regions and determined no significant difference in sablefish catch rates between randomly selected stations and the systematically sampled survey stations. This experiment sampled two randomly selected stations chosen near existing survey stations in the West Yakutat management region. Random stations had similar depth and habitat characteristics throughout the station track of the closest standard survey stations.

During the two-day experiment, two sets were made each day for a total of four sets (Table A1). Each set consisted of 80 skates. All gear characteristics were identical to what's fished during standard survey sets for standardization among random and standard stations. On all sets combined, 2,818 sablefish, 1,549 giant grenadier, 720 shortspine thornyheads, and 200 shortraker rockfish were caught in 2016. The experiment will be repeated in 2017. Results from both years will be tabulated and used to determine CPUE for each hook type.

Table A1. Set information by station and haul for the 2016 NMFS longline survey 2-day experiment. Positions in decimal degree (DD) format.

Set	Date	Start Lat	Start Lon	End Lat	End Lon	Start Depth (m)	End Depth (m)
1	21-Jul	58.98	-141.17	58.97	-141.27	696	800
2	21-Jul	58.94	-141.08	58.98	-141.16	674	820
3	22-Jul	58.86	-141.05	58.92	-141.08	700	806
4	22-Jul	58.77	-140.97	58.86	-141.04	674	900