March 31, 2010

F/V *Ocean Prowler*
Cruise Report OP-09-01
Longline Survey of the Gulf of Alaska and Eastern Bering Sea
May 26-August 28, 2009

Prepared by

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On August 28, 2009, the Alaska Fisheries Science Center (AFSC) completed the thirty-first annual longline survey of Alaska sablefish (*Anoplopoma fimbria*) and other groundfish resources of the upper continental slope (Figure 1). This survey was designed to continue the time series (1979-94) of the Gulf of Alaska portion of the Japan-U.S. cooperative longline survey that was discontinued after 1994. 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 Bering Sea were sampled in 2009.

OBJECTIVES

1. Determine the relative abundance and size composition of the most commercially important 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 (Rajadie), and spiny dogfish (*Squalus acanthias*).

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

4. Implant Greenland turbot and lingcod (*Ophiodon elongates*) with electronic tags that record water temperature, depth, and time.

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

VESSEL AND GEAR

Survey operations were conducted using the F/V *Ocean Prowler*, a chartered U.S. longline vessel. The 47 m (155 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, 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 that consists of 160 skates. 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 26 at Dutch Harbor, Alaska, and ended on August 28 at 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 Bering Sea 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 sperm whale depredation 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. In 2009 the survey starting and ending dates were several days earlier than previous years. This was done to accommodate the vessel's scheduling needs to finish to the survey as early as possible.

<u>Survey Operations</u>

A total of 16 stations along the upper continental slope of the eastern Bering Sea and 45 stations along the upper continental slope of the Gulf of Alaska were sampled at a rate of one station per day (Figure 1). 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. In addition, twenty-seven 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. 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 found in Table 2.

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 about 0630 hours Alaska Daylight Time. Retrieval began about 0930 hours and was completed by about 1930 hours.

<u>Data Collection</u>

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 (batied 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/data storage device. Length was measured by depth stratum for sablefish, Pacific cod, giant grenadier, Pacific grenadier, popeye grenadier, arrowtooth flounder, multiple rockfish species, and shortspine thornyheads. Lengths of sablefish, giant grenadier, 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-nine longline hauls were completed in 2009 (Table 3). Sablefish was the most frequently caught species, followed by giant grenadier, Pacific cod, shortspine thornyhead, and arrowtooth flounder (Table 4). A total of 74,444 sablefish, with an estimated total round weight of 240,831 kg (530,941 lb), were caught during the survey (Table 5). These weights include a small number of fish lost at the rail and fish that were tagged and released. The estimated total round weights of sablefish and other major species retained during the survey and depredation experiment are presented in Table 6. These weights do not include fish that were tagged and released or not landed.

A total of 3,374 sablefish, 783 shortspine thornyhead, and 28 Greenland turbot were tagged with external fly tags and released during the survey. Electronic archival tags were implanted in 42 Greenland turbot, 29 lingcod, and 14 sablefish. Length-weight data and otoliths were collected from 1,865 sablefish.

Killer whales depredating on the catch occurred at ten stations in the eastern Bering Sea, two stations in the western Gulf of Alaska, and one station in the central Gulf of Alaska (Table 7). It is unknown why depredation was so prevalent in 2009 but there were significant impacts on the catch. For example, in 2007 9,253 sablefish were caught at sixteen stations in the Bering Sea. In 2009, only 2,814 sablefish were caught at those same sixteen stations. 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. Following this methodology for 2009 led to a suspiciously severe decrease in abundance indices (~75% reduction in the abundance index). We believe a significant component of this reduction was due to killer whales depredating on stations that on average produce high catch rates. Of the six stations that were not depredated, five of those typically produce below average catches in the Bering Sea. Any catch rate analyses that are computed using 2009 Bering Sea catches should take into account the impact of killer whale depredation.

Sperm whale observations have been recorded during the longline survey since 1998. Sperm whales were observed during survey operations at twenty stations in 2009 (Table

8). Sperm whales were observed depredating on the gear at five stations in the central Gulf of Alaska, three stations in the West Yakutat region, and two stations in the East Yakutat/Southeast region (Table 8). 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 7 days before and 3 days after the planned sampling date (3 days allow for survey delays). In 2009 there were three recorded interactions between survey operations and fishing vessels. Interactions occurred at station numbers 70, 84, and 76 by three separate longline vessels. In all three cases 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 2009 gear issues occurred at three stations. The second set of station 92 parted at skate 40 but the entire set was successfully retrieved from the opposite end. The first set of station 105 parted at skate 26, but the entire set was successfully retrieved from the opposite end. On station 106 the buoy line parted during retrieval. The set was retrieved from the opposite end. Twenty-four skates were successfully hauled from the other end when the line parted. The vessel used a grappling hook to successfully retrieve fifty-four of the fifty-six skates. Data from the fifty-four skates retrieved was not scientifically sampled due to the long soak time and late time of retrieval.

For further information contact either

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or

Mr. Russ Nelson, Director, Resource Assessment and Conservation Engineering Division, National Marine Fisheries Service, 7600 Sand Point Way NE., Building 4, BIN C15700, Seattle, WA 98115-0070 -- Telephone (206) 526-4170.

Table 1. Leg numbers, dates, and personnel for the 2009 NMFS longline survey.

Leg	Dates	Personnel	Affiliation
1	May 26 - June 14	Larry Haaga	RACE
		Jason Wright	Contract Biologist
		Ken Orwig	Contract Biologist
2	June 14 - July 3	Cindy Tribuzio	ABL
		Ben Edwards	ABL Intern
		Jason Wright	Contract Biologist
		Ken Orwig	Contract Biologist
3	July 5 - July 19	Dave Csepp	ABL
		Doris Alcorn	ABL
		Jason Wright	Contract Biologist
		Ken Orwig	Contract Biologist
4*	July 20 - July 22	Kalei Shotwell	ABL
		Delphine Mathias	SEASWAP
		Lauren Wild	SEASWAP
		Jason Wright	Contract Biologist
		Ken Orwig	Contract Biologist
5	July 23 - August 2	Chris Lunsford	ABL
		Lauren Wild	SEASWAP
		Jason Wright	Contract Biologist
		Ken Orwig	Contract Biologist
6	August 4 - August 15	Cara Rodgveller	ABL
		Megan Stachura	ABL Intern
		Jason Wright	Contract Biologist
		Ken Orwig	Contract Biologist
7	August 16- August 29	Larry Haaga	RACE
		Jason Wright	Contract Biologist
		Ken Orwig	Contract Biologist

ABL - Auke Bay Laboratories, Alaska Fisheries Science Center
RACE - Resource Assessment and Conservation Engineering Division, Alaska Fisheries Science Center
SEASWAP – Southeast Alaska Sperm Whale Avoidance Project

* 2-day experiment

Table 2. Stations fished in 2009 NMFS longline survey. Sablefish management area refers to 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 calculating abundance indices.

Station Number	Sablefish Management Area	Station Type	Abundance Calculations
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

Table 2. Continued

Station Number	Sablefish Management Area	Station Type	Abundance Calculations
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
124	Central Gulf of Alaska	Gully	No
125	Central Gulf of Alaska	Gully	No
126	Central Gulf of Alaska	Gully	No
127	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

Table 3. Set information by station and haul for the 2009 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)
1	1	30-May	90	58.78	-177.58	58.82	-177.71	154	420
1	2	30-May	92	58.82	-177.72	58.86	-177.84	391	661
2	3	31-May	90	58.62	-176.64	58.57	-176.77	154	540
2	4	31-May	92	58.57	-176.78	58.55	-176.92	620	946
4	5	1-Jun	90	58.50	-175.67	58.48	-175.81	211	397
4	6	1-Jun	90	58.48	-175.81	58.51	-175.94	417	1071
6	7	2-Jun	90	58.33	-174.32	58.40	-174.37	170	420
6	8	2-Jun	90	58.40	-174.38	58.39	-174.51	350	700
8	9	3-Jun	90	57.63	-174.17	57.70	-174.24	154	507
8	10	3-Jun	90	57.71	-174.25	57.78	-174.30	388	772
10	11	4-Jun	90	56.83	-173.38	56.91	-173.42	210	520
10	12	4-Jun	90	56.91	-173.42	56.98	-173.48	518	678
12	13	5-Jun	90	56.63	-172.36	56.57	-172.44	183	584
12	14	5-Jun	90	56.57	-172.44	56.50	-172.51	584	700
13	15	6-Jun	90	56.47	-171.45	56.46	-171.59	204	529
13	16	6-Jun	90	56.46	-171.60	56.46	-171.73	358	756
18	17	7-Jun	90	56.25	-169.17	56.19	-169.27	161	649
18	18	7-Jun	90	56.19	-169.28	56.13	-169.38	628	834
17	19	8-Jun	90	56.03	-169.62	56.00	-169.73	179	341
17	20	8-Jun	90	57.00	-169.73	56.98	-169.88	360	756
15	21	9-Jun	90	56.16	-170.66	56.13	-170.76	139	751
15	22	9-Jun	90	56.13	-170.76	56.16	-170.89	503	739
20	23	10-Jun	90	55.81	-168.80	55.84	-168.93	210	657
20	24	10-Jun	90	55.85	-168.94	55.92	-169.02	673	753
22	25	11-Jun	90	55.46	-168.01	55.43	-168.15	158	270
22	26	11-Jun	90	55.42	-168.15	55.39	-168.29	296	349
34	27	12-Jun	90	53.35	-168.99	53.30	-168.89	614	870
34	28	12-Jun	90	53.30	-168.88	53.28	-168.79	636	912
33	29	13-Jun	90	53.59	-168.32	53.61	-168.18	117	619
33	30	13-Jun	90	53.61	-168.18	53.62	-168.05	158	715
32	31	14-Jun	90	53.77	-167.33	53.71	-167.38	119	430
32	32	14-Jun	92	53.71	-167.38	53.66	-167.47	160	591
65	33	16-Jun	80	53.58	-165.68	53.51	-165.72	121	283
65	34	16-Jun	80	53.51	-165.72	53.45	-165.78	293	463
62	35	17-Jun	80	52.67	-168.98	52.62	-169.08	134	519
62	36	17-Jun	80	52.62	-169.08	52.57	-169.17	359	732
63	37	18-Jun	80	52.96	-168.14	52.91	-168.21	109	407
63	38	18-Jun	80	52.91	-168.21	52.85	-168.22	334	790
64	39	19-Jun	80	53.19	-166.85	53.12	-166.89	212	313
64	40	19-Jun	80	53.12	-166.89	53.05	-166.93	325	613

Table 3. Continued

Station	Haul	Date	# Skates Retrieved	Start Latitude	Start Longitude	End Latitude	End Longitude	Start Depth (m)	End Depth (m)
66	41	20-Jun	80	53.74	-164.47	53.69	-164.55	128	280
66	42	20-Jun	80	53.70	-164.55	53.64	-164.63	281	582
67	43	21-Jun	80	53.97	-163.26	53.91	-163.32	113	362
67	44	21-Jun	80	53.91	-163.32	53.87	-163.43	355	732
68	45	22-Jun	80	54.13	-161.64	54.09	-161.73	119	404
68	46	22-Jun	80	54.09	-161.74	54.07	-161.85	285	849
69	47	23-Jun	80	54.32	-161.06	54.27	-161.16	172	363
69	48	23-Jun	80	54.27	-161.16	54.21	-161.24	371	858
70	49	24-Jun	80	54.37	-160.24	54.30	-160.29	141	330
70	50	24-Jun	80	54.29	-160.29	54.22	-160.30	356	646
71	51	25-Jun	80	54.50	-159.25	54.44	-159.32	146	273
71	52	25-Jun	80	54.44	-159.32	54.38	-159.40	340	661
72	53	26-Jun	80	54.63	-158.57	54.57	-158.64	132	332
72	54	26-Jun	80	54.57	-158.64	54.50	-158.70	338	740
73	55	27-Jun	80	54.85	-157.74	54.79	-157.82	187	368
73	56	27-Jun	80	54.79	-157.82	54.72	-157.86	368	543
74	57	28-Jun	80	55.24	-156.67	55.19	-156.72	165	346
74	58	28-Jun	80	55.18	-156.73	55.12	-156.74	332	671
75	59	29-Jun	80	55.64	-155.85	55.58	-155.86	139	208
75	60	29-Jun	80	55.57	-155.86	55.51	-155.84	210	220
148	61	5-Jul	80	54.65	-132.84	52.60	-132.93	148	383
149	62	5-Jul	80	54.60	-133.02	54.60	-133.14	407	418
108	63	6-Jul	80	54.46	-133.93	54.49	-134.02	249	687
108	64	6-Jul	80	54.49	-134.01	54.55	-134.06	440	977
107	65	7-Jul	80	54.90	-134.29	54.96	-134.35	240	687
107	66	7-Jul	80	54.96	-134.35	55.01	-134.43	478	907
106	67	8-Jul	80	55.35	-134.73	55.40	-134.83	371	599
106	68	8-Jul	13	55.40	-134.83	55.39	-134.96	770	813
105	69	9-Jul	80	55.56	-134.97	55.58	-135.05	204	529
105	70	9-Jul	80	55.58	-135.06	55.63	-135.13	482	889
144	71	10-Jul	80	55.93	-134.90	56.00	-134.91	202	361
145	72	10-Jul	80	56.03	-134.93	56.09	-135.02	353	387
104	73	11-Jul	80	55.98	-135.44	56.02	-135.53	340	627
104	74	11-Jul	80	56.02	-135.53	56.08	-135.61	629	867
103	75	12-Jul	80	56.38	-135.35	56.38	-135.48	143	186
103	76	12-Jul	80	56.38	-135.49	56.37	-135.61	190	239
102	77	13-Jul	80	56.85	-136.00	56.90	-136.09	236	880
102	78	13-Jul	80	56.90	-136.09	56.97	-136.12	675	947
101	79	14-Jul	80	57.19	-136.23	57.22	-136.34	238	676
101	80	14-Jul	80	57.22	-136.34	57.28	-136.37	621	950
100	81	15-Jul	80	57.62	-136.54	57.62	-136.66	270	830
100	82	15-Jul	80	57.62	-136.66	57.66	-136.75	680	765

Table 3. Continued

Station	Haul	Date	# Skates Retrieved	Start Latitude	Start Longitude	End Latitude	End Longitude	Start Depth (m)	End Depth (m)
142	83	16-Jul	80	57.92	-137.01	57.92	-137.14	401	445
143	84	16-Jul	80	57.97	-137.08	57.97	-137.21	260	422
99	85	17-Jul	80	57.88	-137.38	57.89	-137.50	224	742
99	86	17-Jul	80	57.89	-137.51	57.88	-137.61	567	735
98	87	18-Jul	80	58.14	-138.73	58.16	-138.86	218	764
98	88	18-Jul	80	58.16	-138.86	58.18	-138.98	447	816
97	89	19-Jul	80	58.47	-139.47	58.46	-139.60	195	631
97	90	19-Jul	80	58.46	-139.61	58.42	-139.71	540	942
138	91	24-Jul	80	59.42	-140.94	59.43	-141.08	201	296
139	92	24-Jul	80	59.41	-141.17	59.35	-141.26	319	326
96	93	25-Jul	80	58.68	-140.63	58.69	-140.77	231	618
96	94	25-Jul	80	58.69	-140.77	58.73	-140.88	439	732
95	95	26-Jul	80	59.05	-141.34	59.05	-141.48	305	525
95	96	26-Jul	80	59.05	-141.49	59.05	-141.63	555	849
94	97	27-Jul	80	59.39	-142.17	59.42	-142.28	235	537
94	98	27-Jul	80	59.42	-142.29	59.47	-142.38	409	756
93	99	28-Jul	80	59.55	-142.57	59.59	-142.68	125	601
93	100	28-Jul	82	59.59	-142.68	59.58	-142.80	572	646
136	101	29-Jul	80	59.67	-143.39	59.72	-143.50	294	313
137	102	29-Jul	80	59.75	-143.59	59.77	-143.72	157	297
92	103	30-Jul	80	59.56	-143.65	59.56	-143.80	169	835
92	104	30-Jul	78	59.56	-143.81	59.58	-143.93	539	837
91	105	31-Jul	80	59.52	-144.71	59.48	-144.85	180	526
91	106	31-Jul	82	59.48	-144.86	59.44	-144.99	485	973
90	107	1-Aug	80	59.53	-145.54	59.52	-145.68	158	807
90	108	1-Aug	80	59.52	-145.70	59.52	-145.84	354	730
89	109	2-Aug	80	59.26	-146.85	59.22	-146.97	190	570
89	110	2-Aug	80	59.22	-146.97	59.17	-147.07	580	850
134	111	5-Aug	80	59.51	-146.97	59.56	-147.07	208	213
135	112	5-Aug	80	59.52	-147.15	59.45	-147.15	209	217
88	113	6-Aug	80*	59.15	-147.60	59.08	-147.62	236	501
88	114	6-Aug	80	59.08	-147.61	59.00	-147.63	550	978
87	115	7-Aug	80	59.13	-148.65	59.05	-148.65	157	201
87	116	7-Aug	80	59.05	-148.65	58.97	-148.65	224	243
132	117	8-Aug	80	59.08	-149.40	59.04	-149.51	182	226
133	118	8-Aug	80	58.95	-149.51	58.92	-149.63	238	243
130	119	9-Aug	80	58.73	-149.19	58.77	-149.08	174	215
131	120	9-Aug	80	58.80	-149.05	58.84	-148.93	231	254
86	121	10-Aug	80	58.69	-148.34	58.62	-148.33	267	456
86	122	10-Aug	80	58.62	-148.33	58.55	-148.33	469	968
85	123	11-Aug	80	58.29	-148.62	58.22	-148.66	234	528

* Catch data was collected on 54 out of 80 skates fished

Table 3. Continued

Station	Haul	Date	# Skates Retrieved	Start Latitude	Start Longitude	End Latitude	End Longitude	Start Depth (m)	End Depth (m)
85	124	11-Aug	80	58.22	-148.66	58.15	-148.70	550	840
84	125	12-Aug	80	57.97	-149.17	57.91	-149.26	170	496
84	126	12-Aug	80	57.91	-149.26	57.85	-149.33	515	984
128	127	13-Aug	80	58.00	-149.84	57.98	-149.96	238	267
129	128	13-Aug	80	58.08	-149.90	58.07	-150.03	292	311
83	129	14-Aug	80	57.63	-149.92	57.56	-149.96	403	552
83	130	14-Aug	80	57.56	-149.95	57.49	-149.98	561	874
82	131	15-Aug	80	57.40	-150.58	57.33	-150.59	215	493
82	132	15-Aug	80	57.32	-150.59	57.25	-150.59	528	742
81	133	17-Aug	80	57.12	-151.21	57.05	-151.28	254	525
81	134	17-Aug	80	57.05	-151.28	56.98	-151.28	555	840
80	135	18-Aug	80	56.48	-152.22	56.42	-152.30	142	509
80	136	18-Aug	80	56.42	-152.30	56.35	-152.35	365	843
79	137	19-Aug	80	56.30	-153.08	56.26	-153.20	250	586
79	138	19-Aug	80	56.26	-153.20	56.21	-153.30	547	783
78	139	20-Aug	80	55.98	-154.02	55.92	-154.02	268	497
78	140	20-Aug	80	55.91	-154.02	55.85	-154.05	590	870
76	141	21-Aug	80	55.77	-155.14	55.70	-155.18	155	305
76	142	21-Aug	80	55.69	-155.18	55.64	-155.25	339	593
77	143	22-Aug	80	56.04	-154.57	55.97	-154.57	232	542
77	144	22-Aug	80	55.97	-154.57	55.89	-154.57	589	889
126	145	23-Aug	80	57.35	-155.04	57.35	-155.16	236	239
127	146	23-Aug	80	57.35	-155.25	57.33	-155.38	246	258
124	147	24-Aug	80	56.99	-155.06	57.00	-155.19	169	231
125	148	24-Aug	80	57.00	-155.31	57.04	-155.41	252	266
122	149	25-Aug	80	56.19	-155.96	56.18	-156.09	199	238
123	150	25-Aug	80	56.23	-156.13	56.25	-156.25	248	266
120	151	26-Aug	80	55.79	-156.08	55.76	-156.20	202	237
121	152	26-Aug	80	55.75	-156.20	55.73	-156.33	243	256

Table 4. Catch in number by species for the 2009 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 thornyheads, SK = skate, OS = other species.

Station	SF	PC	GR	PH	ATF	GT	RF	ST	SK	OS
					Eastern Bering Sea					
1*	19	459	1823	28	59	10	23	12	4	721
2*	19	159	2437	72	276	64	6	9	1	586
4	93	81	1628	181	282	133	49	22	5	456
6*	72	345	1221	313	305	29	80	18	2	790
8	217	236	1825	158	325	32	92	73	1	348
10	278	230	2881	171	377	36	74	53	1	366
12*	11	237	1875	90	141	7	18	87	1	686
13*	2	329	2091	43	100	2	157	78	0	445
15	303	993	1124	397	261	23	123	202	1	363
17*	23	447	946	26	182	1	131	39	0	225
18*	645	489	912	23	270	40	32	67	4	503
20*	11	197	158	126	302	26	3	135	1	836
22	44	982	108	253	1150	202	13	50	8	630
32*	186	1030	9	191	524	4	277	332	1	541
33*	129	1044	446	299	215	14	208	275	0	470
34	762	0	101	18	394	201	0	127	9	539
					Gulf of Alaska					
62	473	408	1870	110	216	0	504	446	11	68
63*	598	552	1927	168	99	0	368	454	10	138
64*	101	13	1040	46	132	0	245	360	9	269
65	911	562	1211	323	216	0	39	217	45	393
66	1605	489	852	103	154	0	22	226	51	400
67	970	328	910	109	190	0	235	229	33	186
68	1181	313	1147	206	168	0	405	143	46	94
69	1564	142	2135	65	115	0	45	155	30	48
70	1567	562	1801	75	148	0	22	75	13	56
71	1023	949	976	196	175	0	60	112	24	216
72	1489	371	1263	233	124	0	48	68	59	68
73	645	58	1807	27	286	0	145	109	53	68
74	1643	102	841	215	428	0	50	519	102	215
75	455	954	0	459	444	0	5	11	88	400
76	630	190	1118	102	267	0	31	162	6	603
77	1594	0	2110	3	95	0	30	464	0	213
78	738	0	1594	11	213	0	349	316	0	503
79	1709	0	1624	13	101	0	198	212	4	85
80*	1075	9	702	153	240	0	241	338	11	172
81	1506	0	2127	1	178	0	154	135	6	294
82	1570	0	1914	108	117	0	88	141	4	103
83	1357	0	2511	0	42	0	6	323	0	120
84	1149	136	1325	23	118	0	30	161	19	333
85	1720	0	997	26	195	0	83	367	27	96

Table 4. Continued

Station	SF	PC	GR	PH	ATF	GT	RF	ST	SK	OS
86	1258	2	844	56	87	0	183	279	27	345
87	1476	31	0	97	374	0	9	178	119	271
88	870	0	1173	0	94	0	97	249	0	350
89	901	51	1110	16	62	0	65	317	12	213
90	591	25	816	45	42	0	355	299	23	92
91	1212	61	447	80	113	0	216	251	20	316
92	1130	4	1159	20	30	0	180	210	1	50
93	1462	2	634	94	9	0	35	467	21	61
94	1144	4	419	29	72	0	202	246	24	96
95	1497	0	751	34	26	0	276	390	6	103
96	1652	0	549	37	93	0	598	121	26	76
97	942	0	336	11	47	0	96	279	18	1189
98	579	0	785	6	15	0	866	53	3	126
99	1315	3	414	8	29	0	124	185	14	334
100	1947	0	380	0	32	0	60	266	5	78
101	1821	5	442	9	121	0	118	346	14	111
102	1184	0	643	6	47	0	49	239	14	108
103	125	233	0	398	94	0	1	26	69	1493
104	1370	0	544	12	55	0	228	496	8	122
105	1425	62	390	51	35	0	240	427	27	294
106	685	0	79	0	31	0	457	124	6	70
107	1698	1	385	29	30	0	444	279	16	164
108	1505	1	320	16	65	0	244	208	8	279
120	164	728	0	91	162	0	0	1	31	624
121	541	141	0	62	323	0	0	31	50	551
122	640	900	0	80	145	0	0	3	19	478
123	580	643	0	35	97	0	0	3	12	583
124	184	647	0	113	445	0	2	0	21	725
125	606	540	1	44	183	0	0	1	11	525
126	300	458	0	28	230	0	0	0	16	675
127	251	605	0	38	168	0	4	1	15	744
128	627	112	0	109	125	0	5	56	13	173
129	1468	1	0	60	61	0	0	77	13	109
130	792	6	0	22	95	0	11	90	18	50
131	1056	6	0	22	104	0	30	244	24	112
132	534	20	0	17	170	0	2	83	90	150
133	492	3	0	34	196	0	18	209	48	278
134	242	1	0	38	60	0	23	84	41	456
135	218	0	0	33	26	0	47	70	62	134
136	546	0	0	22	4	0	22	73	35	37
137	391	0	0	34	23	0	24	70	32	118
138	762	0	0	60	72	0	15	121	55	145
139	1447	0	0	35	18	0	7	46	53	111
142	1168	0	152	0	15	0	5	135	15	64
143	1290	0	38	69	80	0	31	65	40	97

Table 4. Continued

Station	SF	PC	GR	PH	ATF	GT	RF	ST	SK	OS
144	115	66	0	142	234	0	160	288	87	233
145	1191	0	1	17	104	0	61	267	28	117
148	277	235	0	64	83	0	27	152	128	566
149	686	1	0	28	24	0	35	227	126	169
Total	74,444	18,994	66,199	7,515	14,474	824	10,361	15,654	2,254	28,011

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

Table 5. Mean length, round weight, mean dressed weight, number, and estimated total round weight of sablefish by station, for the 2009 NMFS longline survey.

Station	Mean Length	Mean Round Weight(kg)[1]	Mean Dressed Weight(lbs)[2]	Number of Sablefish	Est. Total Round Weight(kg)[3]
		Eastern Bering Sea			
1	65.2	3.0	4.2	19	57
2	67.8	3.4	4.7	19	65
4	67.0	3.2	4.5	93	300
6	71.1	3.9	5.5	72	283
8	70.1	3.8	5.2	217	818
10	67.7	3.4	4.7	278	934
12	67.5	3.4	4.7	11	37
13	69.0	3.5	4.9	2	7
15	72.3	4.2	5.8	303	1263
17	68.4	3.5	4.8	23	80
18	65.0	2.9	4.1	645	1898
20	66.0	3.3	4.6	11	36
22	64.1	2.8	3.9	44	123
32	64.7	2.9	4.1	186	544
33	60.3	2.3	3.2	129	294
34	66.8	3.3	4.5	762	2474
		Gulf of Alaska			
62	63.2	2.8	3.8	473	1307
63	62.7	2.7	3.7	598	1611
64	52.2	1.6	2.3	101	166
65	58.2	2.1	2.9	911	1868
66	59.5	2.2	3.1	1605	3571
67	63.0	2.8	3.9	970	2717
68	65.1	3.0	4.2	1181	3579
69	61.0	2.5	3.5	1564	3911
70	59.2	2.3	3.2	1567	3566
71	62.6	2.7	3.7	1023	2716
72	60.6	2.4	3.3	1489	3516
73	61.6	2.6	3.5	645	1644
74	65.3	3.0	4.2	1643	5000
75	59.1	2.3	3.1	455	1022
76	63.4	2.8	3.8	630	1739
77	66.2	3.2	4.5	1594	5107
78	67.6	3.4	4.7	738	2510
79	68.5	3.5	4.9	1709	6041
80	67.3	3.3	4.6	1075	3574
81	67.5	3.4	4.7	1506	5082
82	67.1	3.3	4.6	1570	5201
83	69.5	3.7	5.2	1357	5039
84	66.0	3.1	4.3	1149	3540
85	69.7	3.8	5.3	1720	6500

Table 5. Continued

Station	Mean Length	Mean Round Weight(kg)[1]	Mean Dressed Weight(lbs)[2]	Number of Sablefish	Est. Total Round Weight(kg)[3]
86	69.1	3.7	5.1	1258	4599
87	64.0	2.9	4.0	1476	4224
88	68.5	3.6	4.9	870	3092
89	67.0	3.3	4.6	901	2960
90	67.0	3.3	4.6	591	1974
91	70.7	4.0	5.5	1212	4838
92	68.5	3.6	5.0	1130	4066
93	69.5	3.8	5.2	1462	5501
94	68.5	3.6	5.0	1144	4112
95	69.0	3.6	5.1	1497	5445
96	69.5	3.7	5.2	1652	6180
97	69.2	3.7	5.2	942	3512
98	70.4	4.0	5.5	579	2311
99	71.6	4.2	5.8	1315	5462
100	69.4	3.7	5.1	1947	7204
101	70.0	3.8	5.3	1821	6981
102	69.8	3.8	5.3	1184	4484
103	58.3	2.3	3.2	125	291
104	67.7	3.5	4.9	1370	4783
105	69.3	3.7	5.2	1425	5323
106	68.2	3.6	4.9	685	2429
107	70.9	4.0	5.5	1698	6767
108	71.0	4.1	5.7	1505	6134
120	62.8	2.7	3.8	164	449
121	62.3	2.6	3.6	541	1416
122	61.2	2.4	3.3	640	1536
123	63.5	2.7	3.8	580	1591
124	63.3	2.7	3.8	184	499
125	59.4	2.2	3.1	606	1335
126	60.1	2.3	3.2	300	683
127	61.5	2.5	3.5	251	632
128	64.8	2.9	4.1	627	1830
129	65.1	3.0	4.1	1468	4340
130	66.2	3.1	4.4	792	2484
131	67.0	3.3	4.6	1056	3461
132	60.3	2.4	3.3	534	1264
133	64.1	2.9	4.0	492	1411
134	56.9	2.1	2.8	242	495
135	51.6	1.5	2.0	218	316
136	64.6	2.9	4.1	546	1596
137	66.7	3.4	4.7	391	1320
138	63.4	2.8	3.9	762	2129
139	66.6	3.2	4.5	1447	4653
142	64.8	3.0	4.1	1168	3451
143	65.7	3.1	4.3	1290	3977

Table 5. Continued

Station	Mean Length	Mean Round Weight(kg)[1]	Mean Dressed Weight(lbs)[2]	Number of Sablefish	Est. Total Round Weight(kg)[3]
144	67.3	3.4	4.7	115	390
145	69.2	3.8	5.3	1191	4556
148	64.6	3.0	4.1	277	819
149	62.7	2.6	3.6	686	1790
Total				74,444	240,831

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

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

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

[3] 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 tagged and released.

Table 6. Total estimated retained catch (kg) of major species caught in 2009 NMFS longline survey. These estimates do not include fish tagged and released or not landed.

Species	Bering Sea	Gulf of Alaska	2-Day Experiment (Leg 4)	Total Retained Catch
Sablefish	8,751	220,038	13,571	233,609
Pacific cod	12,705	19,360	0	19,360
Giant grenadier	95,323	172,659	5,882	178,541
Arrowtooth flounder	6,548	10,190	16	10,207
Greenland turbot	1,871		0	0
Thornyhead	1,259	6,048	130	6,178
Rougheye rockfish	438	5,381	8	5,389
Shortraker rockfish	1,707	6,700	27	6,727
Grand Total	128,601	440,378	19,634	460,012

Table 7. - Stations and skates that were depredated upon by killer whales in the 2009 NMFS longline survey. Start skate refers to skate where killer whales began affecting catch. End skate refers to the last skate that was affected

Station	Region	Start Skate	End Skate
1	Bering Sea	1	180
2	Bering Sea	81	180
6	Bering Sea	81	180
12	Bering Sea	27	180
13	Bering Sea	1	180
18	Bering Sea	1	180
17	Bering Sea	51	180
20	Bering Sea	1	180
33	Bering Sea	1	180
32	Bering Sea	1	180
63	Western Gulf of Alaska	98	160
64	Western Gulf of Alaska	1	160
80	Central Gulf of Alaska	104	160

Table 8. Stations that had sperm whales present during hauling operations in the 2009 NMFS longline survey. Depredation is defined as sperm whales being present with the occurrence of damaged fish on the line.

Station	Region	Depredation	Number of Whales
68	Western Gulf of Alaska	No	1
69	Western Gulf of Alaska	No	2
70	Western Gulf of Alaska	No	1
72	Central Gulf of Alaska	Yes	3
73	Central Gulf of Alaska	No	2
78	Central Gulf of Alaska	Yes	1
84	Central Gulf of Alaska	Yes	4
85	Central Gulf of Alaska	Yes	2
86	Central Gulf of Alaska	Yes	2
89	West Yakutat	Yes	6
90	West Yakutat	No	2
93	West Yakutat	No	1
95	West Yakutat	Yes	3
96	West Yakutat	Yes	2
98	East Yakutat / Southeast	No	1
99	East Yakutat / Southeast	Yes	2
100	East Yakutat / Southeast	Yes	3
102	East Yakutat / Southeast	No	1
105	East Yakutat / Southeast	No	1
106	East Yakutat / Southeast	No	1

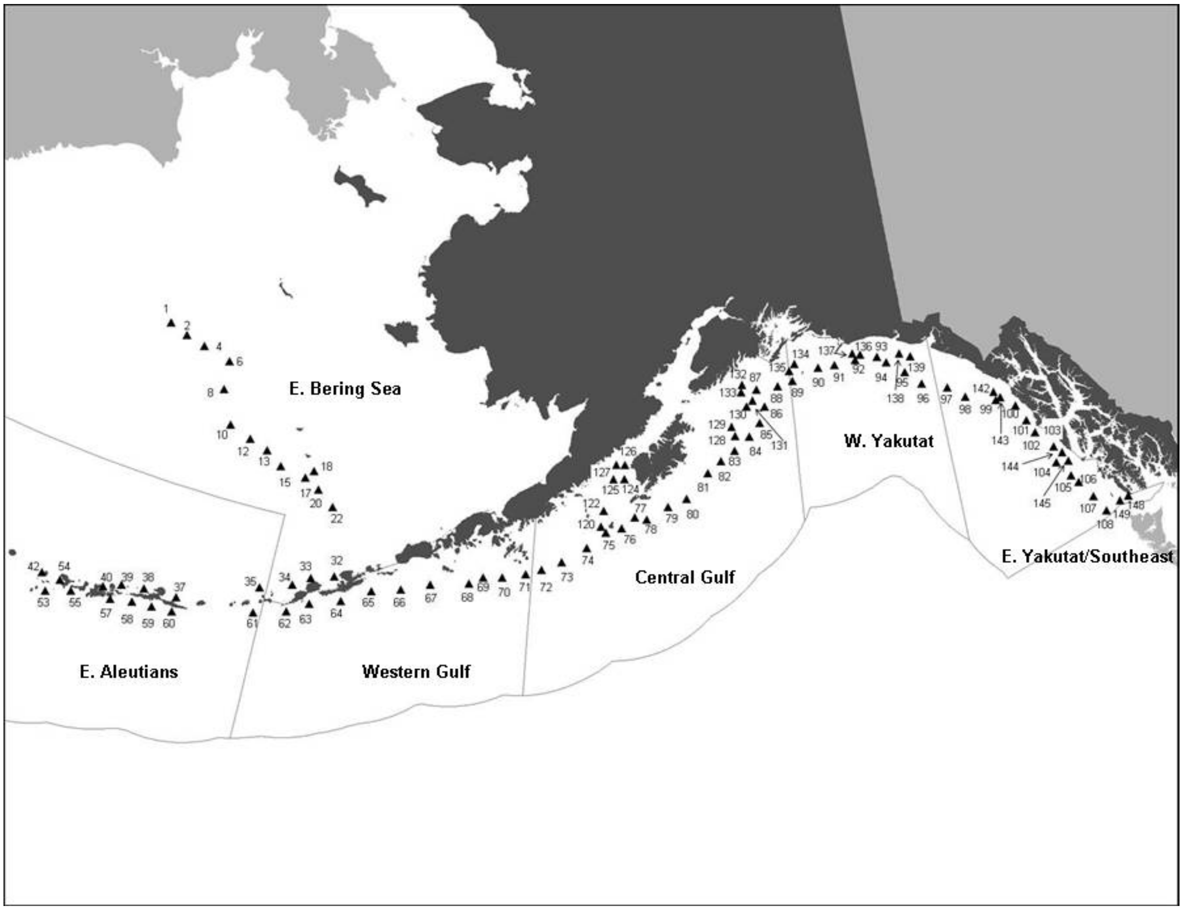

Figure 1. Map of NMFS longline survey station locations and corresponding management areas. Bering Sea stations are sampled in odd years; Aleutian Islands Region stations are sampled in even years; Gulf of Alaska stations sampled every year.

APPENDIX A: Sperm Whale Depredation Experiment

A sperm whale depredation experiment was conducted near Yakutat July 21-22 to test methods for quantifying depredation rates. Sperm whale depredation has become frequent enough during recent longline surveys that it may be starting to affect population estimates. Information regarding sperm whale depredation has been collected during the longline survey since 1998. Killer whales also depredate on the longline but defining depredation is much easier as catch is greatly reduced when killer whales are present. Efforts to quantify the amount of sablefish removed from the longline by sperm whales, however, have been attempted but are difficult due to the natural variation of catch at different locations and times. Accurate estimates of depredation are needed to effectively estimate the total number of sablefish lost to whale predation and to determine if depredation is increasing over time. If depredation is increasing over time, baseline removal estimates are needed in order to standardize survey catch rates which are used for setting annual harvest quotas.

The two-day experiment was a collaborative effort between the Southeast Alaska Sperm Whale Avoidance Project, the Alaska Longline Fishermen's Association, Scripps Institution of Oceanography, the University of Alaska, and the Alaska Fisheries Science Center. Researchers were on-board to assess whether acoustic recording of "creak" sounds produced by sperm whales for echolocation could provide a low-cost means for remotely measuring depredation activity around a longline vessel. A "creak" is a rapid series of clicks in short succession which may indicate that a whale is homing in on a prey item. Enumerating the number of "creaks" that occur during hauling operations may provide a quantitative means of evaluating sperm whale depredation.

Fishing operations for the sperm whale depredation experiment were conducted off Yakutat Bay. Standard survey operating procedures were followed except for set location. The vessel captain chose the specific fishing sites within a pre-described area with the requirement that the longline gear was set parallel to the depth contour so that catches were generally similar within a set and in areas where sperm whales are commonly observed. Two sites were fished each day for a total of four sites during the two-day experiment (Table A1).

Prior to the setting of gear an underwater camera was attached to the groundline. This camera was programmed to record events during gear retrieval in an effort to capture depredation events. Following the setting of gear, two acoustic recorders were deployed on independent buoy lines spaced evenly along the longline sets. These devices are designed to passively measure distinct sounds whales make when in the vicinity of the recorder. During fishing operations an observer was present to visually monitor the number of sperm whales present and collect photo documentation for whale identification. Catch was tallied for each hook and any indication of depredation was noted and was associated with a time stamp.

Four sets were successfully completed. The acoustic recorders yielded 22 hours of data and the camera successfully captured images during haulback. Visual observations counted one sperm whale on the first day and six whales on the second day. Initial analysis of a subset of the data indicates that the recorder data captured whale echolocation sounds and is high quality. Further analysis of this data is underway.

Table A1. Set information by station and haul for the 2009 NMFS longline survey 2-day experiment. Positions in decimal degree (DD) format.

Haul	Date	Start Lat	Start Lon	End Lat	End Lon	Start Depth (m)	End Depth (m)
1	21-Jul	59.14	-141.66	59.17	-141.77	470	747
2	21-Jul	59.17	-141.78	59.22	-141.88	589	790
3	22-Jul	59.12	-141.68	59.18	-141.77	601	736
4	22-Jul	59.18	-141.78	59.23	-141.88	480	736