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Juvenile Halibut Surveys, 1973-1980

by

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and

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ABSTRACT

The International Pacific Halibut Commission conducts surveys in the Bering Sea and the Gulf of Alaska to estimate the abundance of juvenile halibut and changes in year-class strength. Standard trawl nets are fished at identical stations each year. Data from earlier surveys were provided in previous IPHC reports. This report updates the results to 1980, including the size and age of halibut caught and a list of species found in association with halibut. The stomach contents of juvenile halibut were recorded during the 1976 and 1977 surveys.

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INTRODUCTION

The International Pacific Halibut Commission (IPHC) annually surveys selected nursery areas in the eastern Bering Sea and the Gulf of Alaska to estimate the relative abundance of juvenile (less than 65 cm long) Pacific halibut *(Hippoglossus stenolepis).* The survey program was initiated in northern British Columbia in 1955 (Hardman and Southward 1957) and was subsequently extended into southeastern Alaska and across the Gulf of Alaska as far west as Unimak Island. In the southeastern Bering Sea juvenile surveys of offshore areas began in 1963 and have been conducted annually since 1965.

The results of the surveys in the Gulf of Alaska for the years 1967 through 1972 were published in earlier reports (Best 1969a, 1969b, 1974). A summary of the Bering Sea surveys through 1977 was presented by Best (1977).

The catch data for halibut and other species caught during the surveys of 1973 through 1980 for the southeastern Bering Sea and the Gulf of Alaska are recorded in this report. The stomach contents of juvenile halibut caught during the 1976 and 1977 surveys are described and the length frequencies of halibut tagged during the juvenile surveys are also given.

METHODS

In the Gulf of Alaska, a grid of "offshore" index stations was established along parallel north-south lines, 15 minutes of longitude apart. The stations were located each 6 minutes of latitude along these lines from the beach to depths in excess of 50 fathoms (91 m). The Bering Sea sampling grid consisted of lines of stations approximately perpendicular to the shore. Stations on each line were separated by 15 minutes of latitude and longitude, e.g., station 5C is located at 57° 00′ N, 160° 00′ W and station 5D is at 57° 15′ N, 160° 15′ W.

Information on smaller halibut has been collected from groups of "inshore" stations in selected areas close to shore. These stations are at depths of less than 15 fathoms (27 m) and are fished with a small-mesh trawl.

The U.S. trawler M/V TORDENSKJOLD was chartered for each survey during the period 1973 to 1978. Canadian trawlers M/V HOPE BAY and M/V PACIFIC HARVESTER were used in 1979 and 1980, respectively. The surveys began in the eastern Bering Sea about the first of June each year, progressed into the Pacific Ocean, and proceeded in an easterly direction across the Gulf of Alaska. The survey of each index area (Figure 1) was scheduled for the same time each year, but the actual fishing dates varied slightly from year to year. A mechanical breakdown of the vessel in 1973 delayed the beginning of sampling in the Bering Sea until June 18, with a subsequent delay of sampling in the Gulf of Alaska. This was the largest departure from normal timing.

The offshore stations are fished with a standard 400-mesh eastern trawl having a 71-foot (21.6 m) headrope of 7/16-inch (11 mm) wire rope wrapped with 1/4-inch (6 mm) polypropolene rope with nine 8-inch (203 mm) metal floats attached; 94-foot (28.7 m) groundrope of 1/2-inch (13 mm) wire rope filled with 3-inch (76 mm) rubber washers; the wings and body of the net are 4-inch (102 mm) #36 synthetic netting; intermediate of 4-inch (102 mm) #60 synthetic netting; and codend of 3-1/2-inch (90 mm) #96 synthetic netting with chafing gear of 8-inch (203 mm) mesh of 3/8-inch (10 mm) polypropolene rope.

Halibut spend their first two summers in shallow areas close to shore. To effectively sample these younger halibut, a small scale version of the same type trawl is fished at the inshore stations: 47-foot (14.3 m) headrope of 3/8-inch (10 mm) wire rope wrapped with 1/4-inch (6 mm) polypropolene rope with three 8-inch (203 mm) metal floats attached; 57-foot (17.4 m) footrope of 1/2-inch (13 mm) wire rope wrapped with 1/2-inch (13 mm) rope; wings and body of 2-1/2-inch (64 mm) #18 synthetic netting; intermediate of 1-1/4-inch (32 mm) #15 synthetic netting; and codend of 1-1/4-inch (32 mm) #21 synthetic netting with no chafing gear.

A standard haul was 60 minutes at offshore stations and 15 minutess at inshore stations. Beginning in 1979, the haul time at the offshore stations was shortened to 30 minutes, but all catch data reported herein have been converted to the equivalent of a standard 1-hour haul.

All halibut were measured (fork length) and those not needed for age determination were returned to the sea. At each of the index areas the left otolith was collected from three fish in each centimeter size group through 64 cm for age determination in 1973. Following an increase in the minimum legal size, an additional five otoliths were also collected from each 5 cm group from 65 through 79 cm during the 1974 to 1980 surveys. Ages of these fish were determined from the otoliths, and an age-length key, as described by Hardman and Southward (1965), was constructed annually for each index area to estimate the age of the halibut not included in the age sample. The sex of the fish in the age sample was determined by visual examination of the gonads. During the 1976 and 1977 surveys, stomachs of fish in the age sample were examined at sea to obtain information on the food of the halibut. The remaining catch was sampled to determine the species found in association with halibut.

A few days were usually scheduled for tagging juvenile halibut when adequate numbers were caught. The subsequent return of these tags provided information on the movement of the young fish and their contribution to the fishery (Skud 1978).

Surface and air temperatures were obtained at each station in the Bering Sea and at least once a day in the Gulf of Alaska. Corresponding bottom temperatures were also recorded with a mechanical bathythermograph or reversing theremometer. In 1980, an expendable bathythermograph was used to obtain bottom temperature data.

CATCH DATA

Length and Age Composition

The length and age compositions of all halibut less than 65 cm long are given for the inshore stations in Appendix Tables 1 through 8 for the years 1973 through 1980 respectively. Few halibut caught at the inshore stations are larger than 64 cm and they have been placed in a single size group (>64 cm) from which no otoliths were collected and no ages were determined.

At the offshore stations in 1973, otoliths were collected only from fish less than 64 cm in length. The age distribution was calculated for each index area from these otoliths. These age distributions and the length frequencies of halibut less than 79 cm from the offshore stations in 1973 are reported in Appendix Table 9. Following the increase in the minimum legal size in 1973, otoliths were collected from fish through 79 cm. The length distribution and age frequency of halibut through 79 cm at the offshore stations are given for the years 1974 through 1980 in Appendix Tables 10 through 16. Fish larger than 79 cm are grouped in a single category (>79 cm) for which no age information was collected. These larger fish were usually viable when released. Length frequencies of halibut tagged during the survey are included in Appendix Tables 9 to 14 for years 1973-1978 and are given separately for 1979 and 1980 in Appendix Tables 17 and 18.

Species Composition

The sampling areas, inshore and offshore, were selected primarily for the availability of juvenile halibut; also, the nets used were relatively low-opening nets designed for fishing flounders. These factors bias the catches towards shallow-water flatfishes and underestimate the abundance of roundfish and deep-water species. The average percentage occurrence, by weight, of the important species at the offshore stations during the 1973-1980 surveys is shown in the Figure 2.

Some species occurred in every location, while others were present only in some of the areas. Some species that were caught in the Gulf of Alaska were not taken in the Bering Sea and vice versa. Generally, the species composition at the inshore areas is similar to that at the offshore areas, but the size of fish captured is smaller due to the use of a net with a 1-1/4-inch codend compared to the 3-1/2-inch codend used at the offshore stations. The species composition for individual hauls, or summaries of hauls by area and year, are available from IPHC upon request.

WATER TEMPERATURE

Bottom and surface water temperatures were obtained at every station in the Bering Sea surveys. The distribution of halibut catches in relation to the bottom temperature has been plotted in Figures 3 to 10. Thompson and Van Cleve (1936) defined the temperature range for commercial concentrations of halibut as between 3° and 8°C, and Best (1977) reported the catch of juvenile halibut decreased in the southeastern Bering Sea when bottom temperatures dropped below 2° C. Halibut were not totally absent at temperatures as low as 0° C; however, catches were usually larger at temperatures near 4° C. This same pattern has prevailed for the period of 1973-1980. An exception to this pattern occurred in 1976 when large catches were made when bottom temperatures were near 0° C (Figure 6).

Temperature observations in the Gulf of Alaska were reduced because the stations are much closer together and bottom temperatures were usually taken only once a day. Temperatures near bottom in the Gulf of Alaska are warmer than the Bering Sea and fall within the tolerance range of halibut; consequently, changes in temporal and spatial distribution of halibut are not as noticeable as in the Bering Sea.

A comparison of bottom temperatures obtained at the index stations in the Gulf of Alaska and the Bering Sea is given in Figure 11. When these data were plotted the three eastern Gulf of Alaska areas (Chirikof Island, Cape Chiniak, and Cape St. Elias) were very similar, so the three data points were averaged for each year and plotted as a single point (Eastern Gulf Stations) for clarity in Figure 11. The annual average bottom temperature increases from the Bering Sea, Unimak Island, and eastward. There is a progression in the time of observation of about 2 weeks as the survey progresses from west to east. However, there is a similarity in the trend lines for all areas, with warmer or colder temperatures occurring over the same time period.

FOOD OF YOUNG HALIBUT

A qualitative study of the stomach contents of 1,763 young halibut was undertaken in 1976 and 1977 to determine the organisms eaten. Only the fish sacrificed for age determinations were used in this food habits study. Food items were identified at sea whenever possible, but no attempt was made to record the quantity of food consumed. Food organisms for young halibut are given by frequency of occurrence in Appendix Table 19. The frequency of occurrence is the number of stomachs from which an identifiable food item was observed. A food item was counted only once from each stomach, regardless of the number of individuals of that species in the stomach. Some stomachs contained more than one food item. The results were generally similar to those reported for 0- and 1-year-old halibut from northern British Columbia and southeastern Alaska (Hardman and Southward 1957, IPHC 1960). The smallest halibut ate small forms of crustacea, mainly shrimp and small crabs. As the size of the halibut increased, the frequency and the size of fish in the diet increased. Species important in the diet, by frequency of occurrence, were: Tanner crab, hermit crab, sand lance, sand fish, and walleye pollock. Of special note was the large number of 0-age rock sole consumed by young halibut in some areas in 1977, whereas very few were observed in 1976. The diet of halibut of the same size varied considerably, indicating that halibut are opportunistic feeders utilizing whatever food is available.

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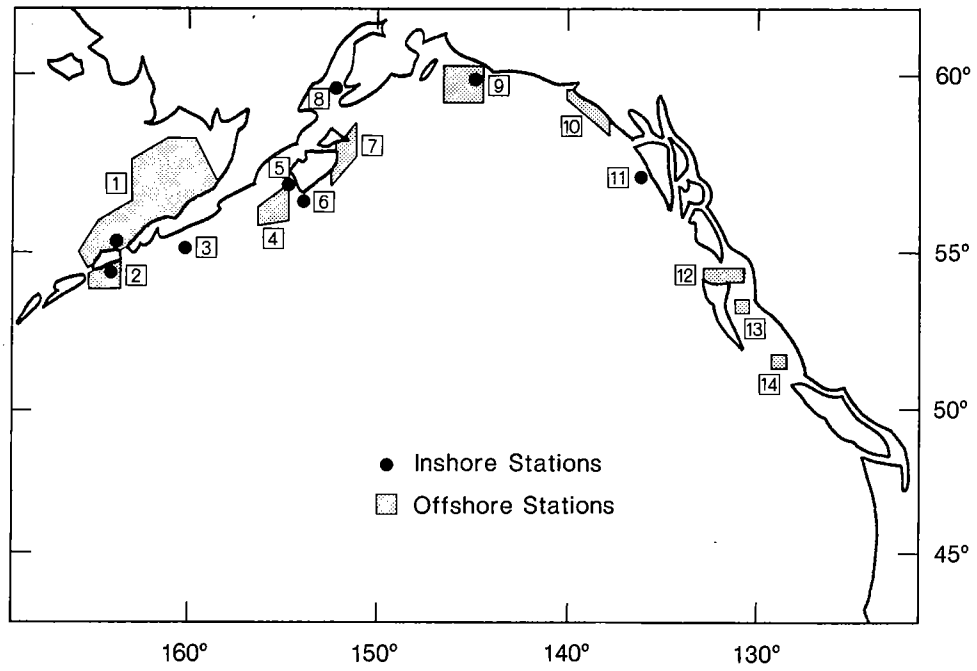

Figure 1. **Approximate locations of sampling areas in the Bering Sea and Gulf of Alaska: 1 - Bering Sea; 2 - Unimak Bight; 3 - Shumagin Islands; 4 - Chirikof Island; 5 - Alitak Bay; 6 - Trinity Islands; 7 - Cape Chiniak; 8 - Kachemak Bay; 9 - Cape St. Elias; 10 - Cape Fairweather; 11 - Shelikof Bay; 12 - Dixon Entrance; 13 - Hecate Strait; and 14 - Queen Charlotte Sound.**

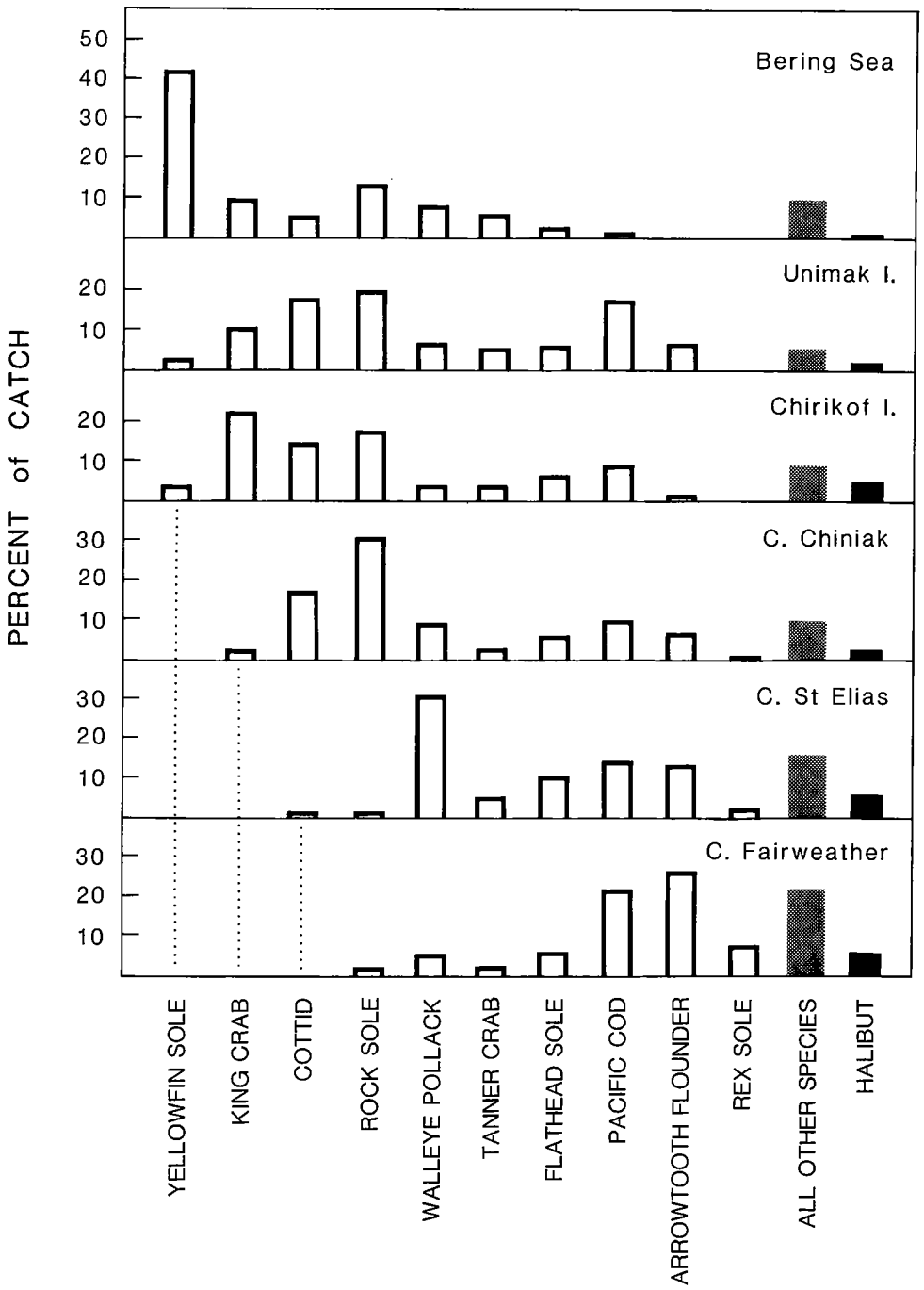

Figure 2. Average percentage occurrence by weight, of the important species at offshore stations during the 1973-1980 surveys.

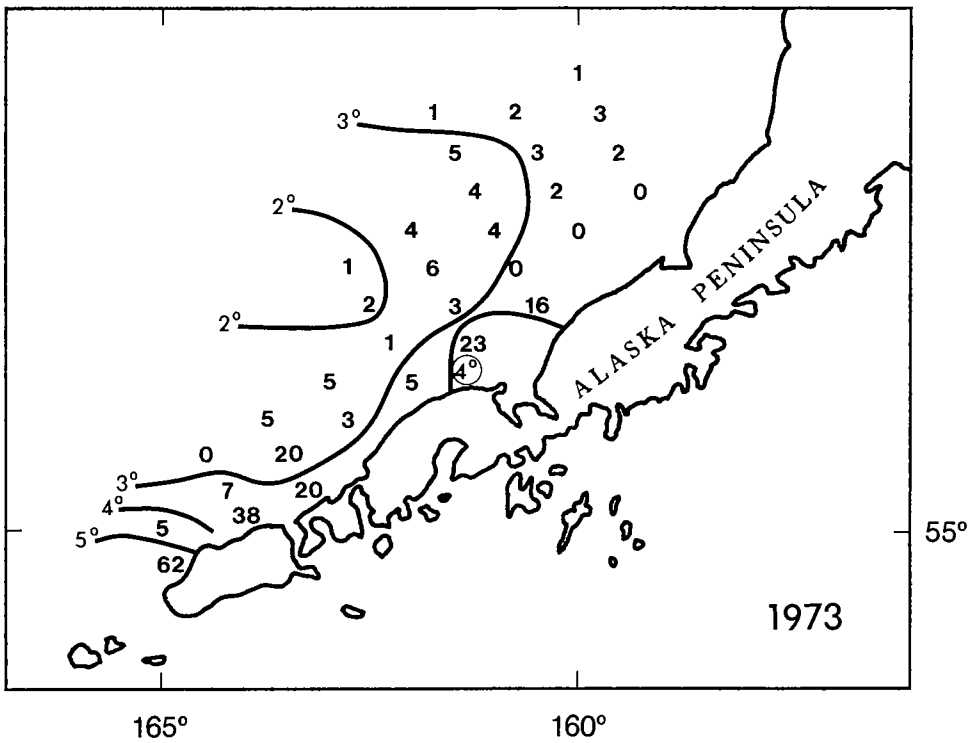

Figure 3. Distribution of juvenile halibut catches in number per hour haul, and bottom temperature contours in 1973.

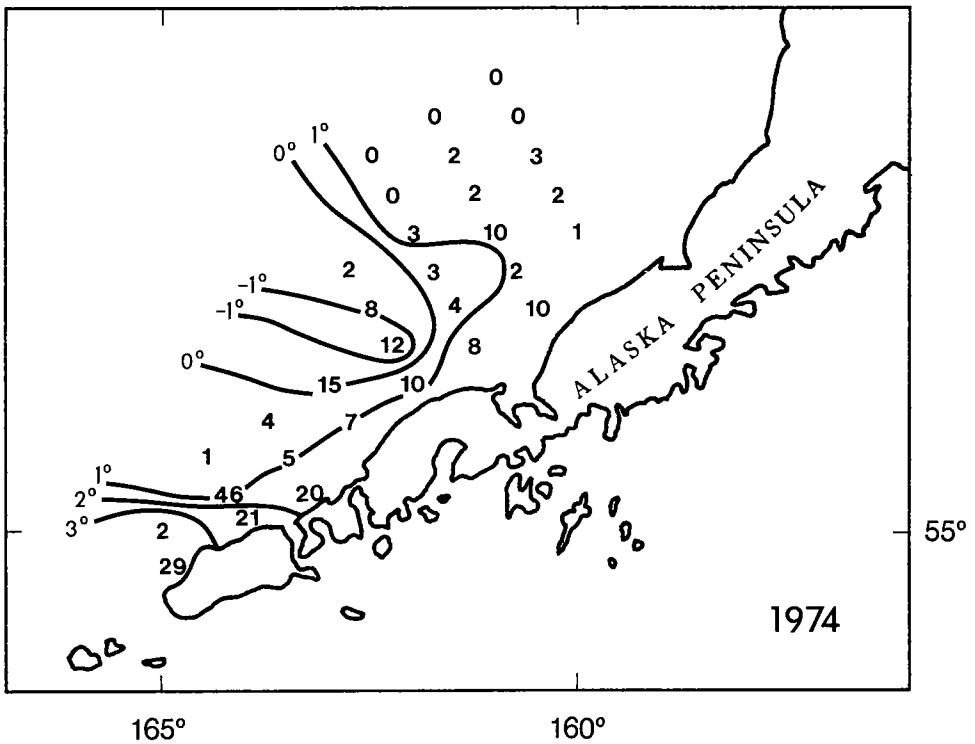

Figure 4. Distribution of juvenile halibut catches in number per hour haul, and bottom temperature contours in 1974.

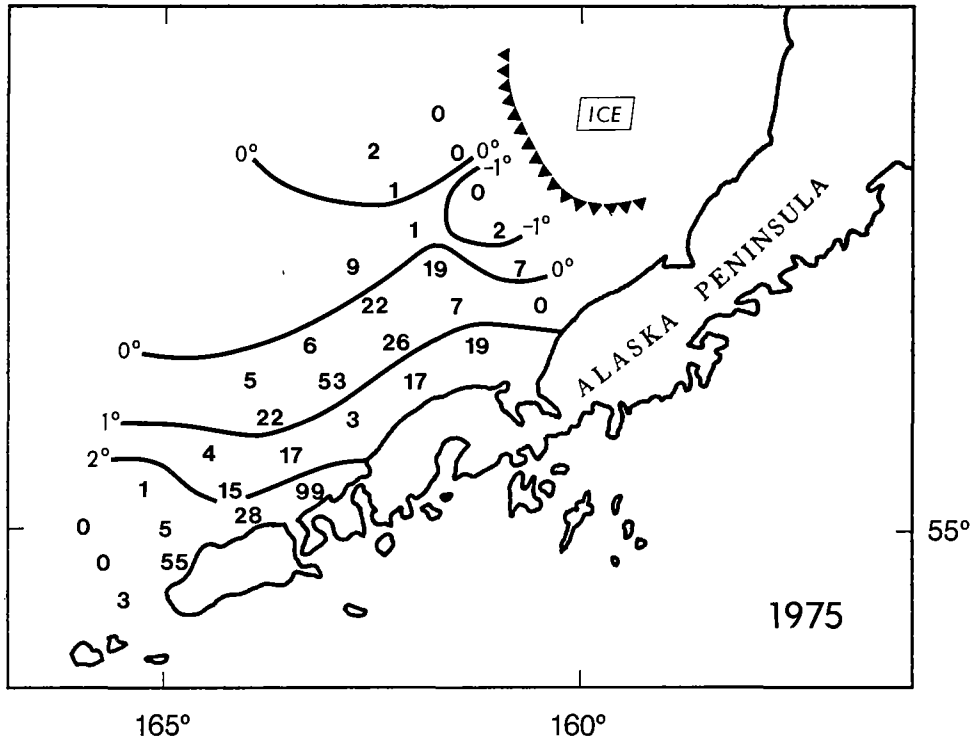

Figure 5. Distribution of juvenile halibut catches in number per hour haul, and bottom temperature contours in 1975.

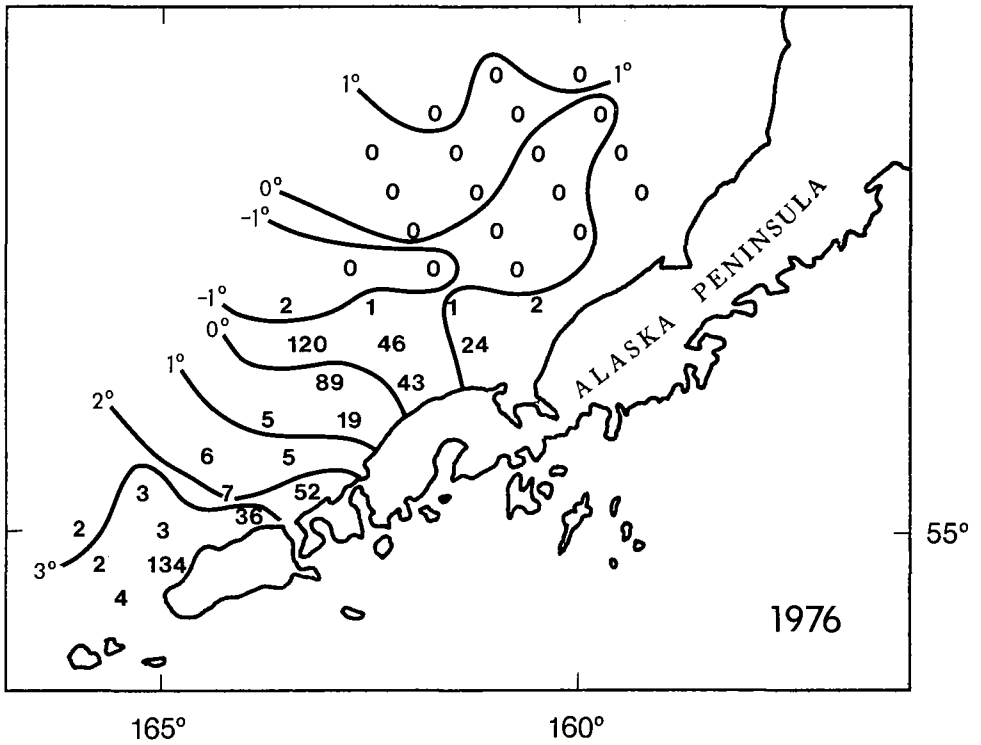

Figure 6. Distribution of juvenile halibut catches in number per hour haul, and bottom temperature contours in 1976.

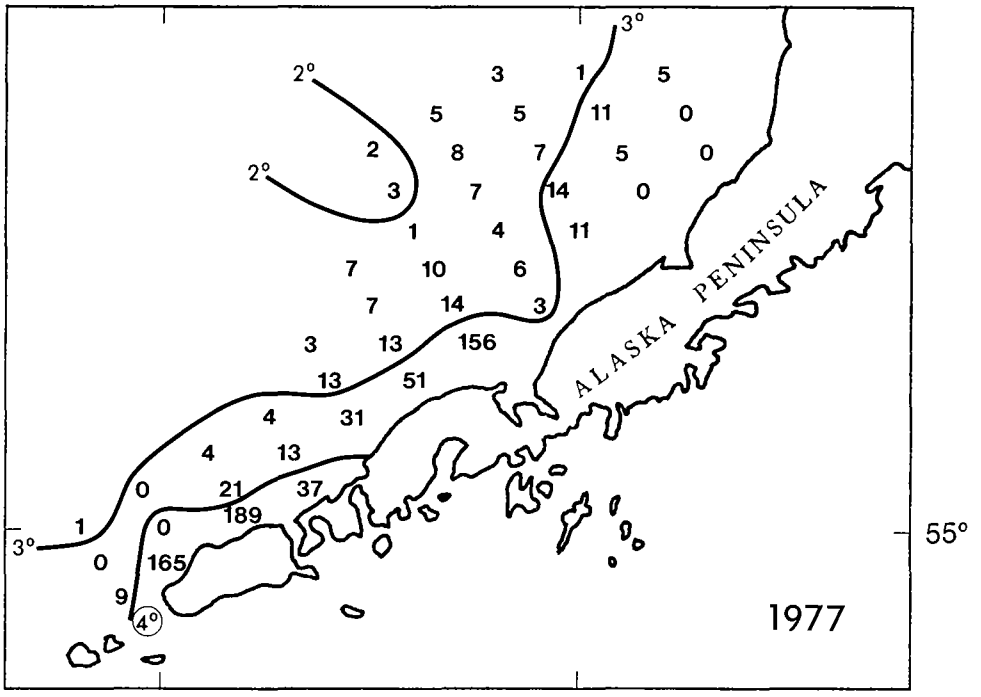

Figure 7. Distribution of juvenile halibut catches in number per hour haul, and bottom temperature contours in 1977.

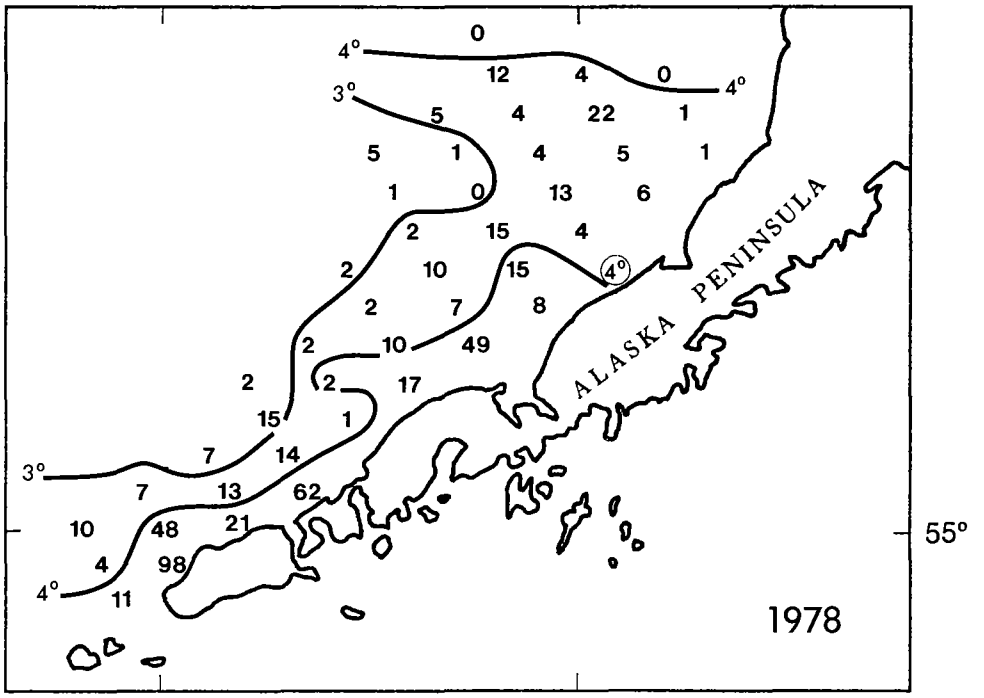

Figure 8. Distribution of juvenile halibut catches in number per hour haul, and bottom temperature contours in 1978.

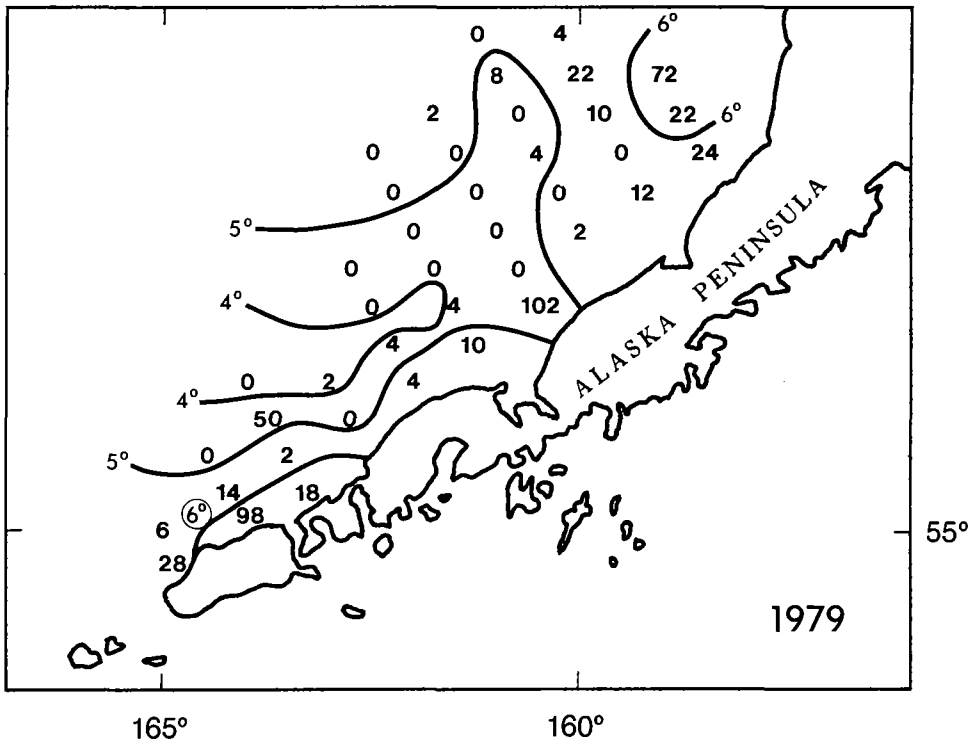

Figure 9. Distribution of juvenile halibut catches in number per hour haul, and bottom temperature contours in 1979.

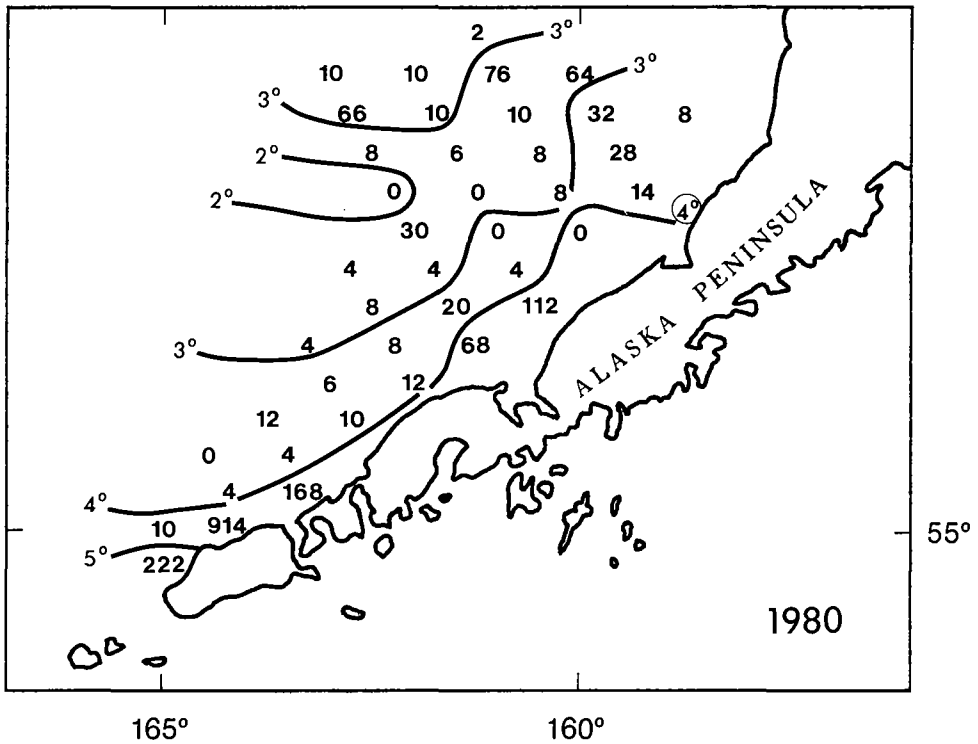

Figure 10. Distribution of juvenile halibut catches in number per hour haul, and bottom temperature contours in 1980.

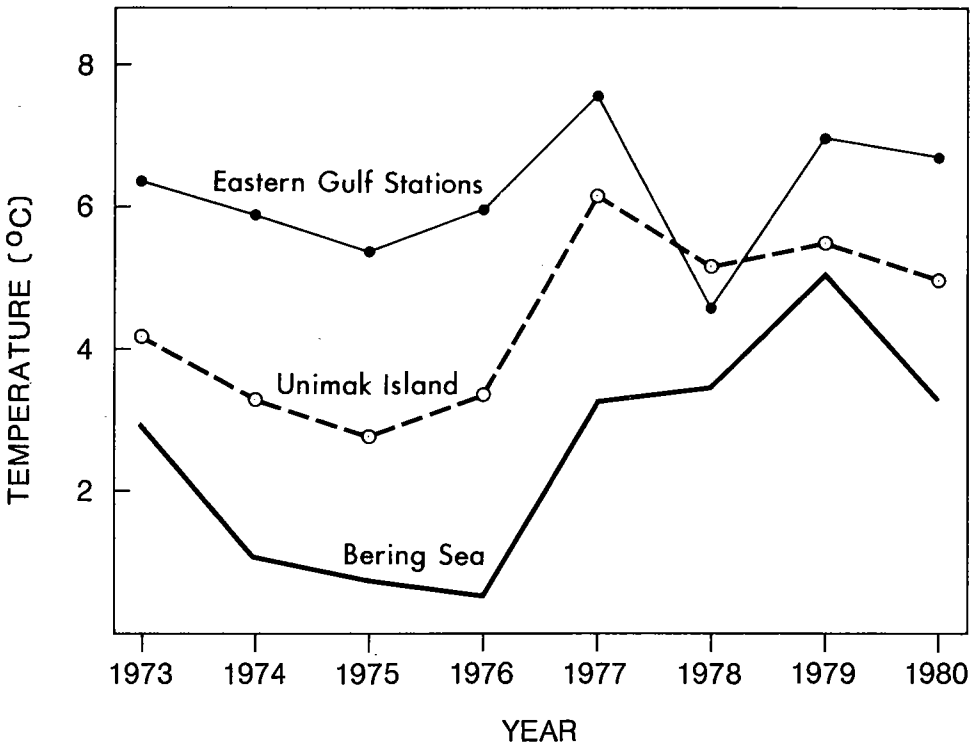

Figure 11. Annual average bottom water temperatures at the index stations in the Bering Sea, Unimak Island, and Eastern Gulf of Alaska.

APPENDIX

Appendix Table 1. Length and age frequencies of halibut caught at inshore areas, 1973.

Area	Bering Sea	Unimak Bight	Alitak Bay	Trinity Islands	Cape St. Elias	Shelikof Bay
Date	6/28-29	6/29-7/1	7/16-17	7/14-15	8/14-15	8/17-18
Min. fished	78	150	180	150	180	150
Length (cm)						
5-7	—	1	—	—	—	2
8-10	—	7	178	3	31	0
11-13	—	4	202	58	291	0
14-16	1	28	51	12	104	0
17-19	10	85	193	18	111	8
20-22	11	21	161	63	62	2
23-25	76	3	41	80	20	1
26-28	132	16	12	14	8	0
29-31	40	33	11	1	24	0
32-34	17	10	7	1	17	5
35-37	10	2	10	1	27	2
38-40	3	2	5	0	33	6
41-43	0	3	0	1	23	6
44-46	0	2	1	—	10	10
47-49	1	0	1	—	1	3
50-52	0	0	1	—	3	5
53-55	0	0	0	—	1	3
56-58	0	0	1	—	2	1
59-61	0	1	1	—	2	3
62-64	0	0	0	—	2	0
>64	2	1	1	—	13	2
Total	303	219	877	252	785	59
Age						
0	—	—	—	—	—	2
1	—	9	395	65	615	11
2	13	133	418	141	42	3
3	219	61	38	44	55	8
4	59	9	15	1	24	7
5	9	2	7	1	24	16
6	1	3	2	—	10	9
7	—	1	1	—	2	1
Total	301	218	876	252	772	57

Appendix Table 2. Length and age frequencies of halibut caught at inshore areas, 1974.

Area	Bering Sea	Unimak Bight	Alitak Bay	Trinity Islands	Kachemak Bay	Cape St. Elias	Shelikof Bay
Date	6/9-10	6/13-14	6/22-24	6/24-25	7/23-24	7/26-27	8/10-13
Min. fished	136	150	180	151	180	180	150
Length (cm)							
5-7	—	1	2	1	—	—	—
8-10	14	47	378	386	—	—	—
11-13	5	1	72	260	—	43	3
14-16	95	17	8	10	2	52	34
17-19	121	59	81	1	36	85	27
20-22	47	22	70	12	125	119	13
23-25	71	44	27	34	83	49	5
26-28	68	99	7	12	17	41	3
29-31	10	53	13	6	7	33	0
32-34	10	14	5	2	8	26	4
35-37	4	14	9	3	15	11	3
38-40	1	4	5	1	13	2	4
41-43	—	3	2	—	14	2	3
44-46	—	1	8	—	9	0	4
47-49	—	1	1	—	6	5	2
50-52	—	—	3	—	8	0	3
53-55	—	—	2	—	2	2	1
56-58	—	—	0	—	3	2	—
59-61	—	—	0	—	—	3	—
62-64	—	—	0	—	—	7	—
>64	—	—	11	—	13	19	—
Total	446	380	704	728	361	501	109
Age							
1	16	49	452	657	—	87	85
2	220	81	183	52	174	218	9
3	146	81	30	17	95	150	2
4	62	137	18	2	41	14	6
5	2	28	7	—	31	6	7
6	—	4	3	—	5	5	—
7	—	—	—	—	2	2	—
Total	446	380	693	728	348	482	109

Appendix Table 3. Length and age frequencies of halibut caught at inshore areas, 1975.

Area	Bering Sea	Unimak Bight	Shumagin Islands	Alitak Bay	Trinity Islands	Cape St. Elias	Shelikof Bay
Date	6/12-13	6/18-19	6/25	6/28-29, 7/15	6/27-28	7/29-30	8/10-11
Min. fished	**150**	**150**	**60**	**270**	**150**	**180**	**150**
Length (cm)							
8-10	7	8	2	166	38	—	—
11-13	8	4	6	41	18	2	1
14-16	48	10	2	181	1	5	3
17-19	103	51	9	302	20	1	4
20-22	54	63	16	170	48	14	1
23-25	45	15	26	66	33	43	0
26-28	69	13	3	18	3	95	0
29-31	17	39	1	10	0	95	2
32-34	4	12	0	12	0	105	3
35-37	7	7	1	6	1	78	0
38-40	4	7	—	6	0	46	6
41-43	3	2	—	4	0	32	7
44-46	1	0	—	6	1	22	7
47-49	1	1	—	2	0	11	9
50-52	2	2	—	1	0	9	4
53-55	0	1	—	1	0	6	7
56-58	1	1	—	2	0	1	4
59-61	2	0	—	1	0	4	3
62-64	—	0	—	4	0	3	0
>64	—	3	—	9	1	6	3
Total	376	239	66	1,008	164	578	64
Age							
1	13	12	8	195	57	8	9
2	176	131	53	739	104	131	8
3	114	56	4	33	1	361	2
4	57	19	1	19	1	24	11
5	12	8	—	9	—	36	24
6	3	9	—	3	—	7	5
7	1	1	—	1	—	4	2
8	—	—	—	—	—	1	—
Total	376	236	66	999	163	572	61

Appendix Table 4. Length and age frequencies of halibut caught at inshore areas, 1976.

Area	Bering Sea	Unimak Bight	Alitak Bay	Trinity Islands	Kachemak Bay	Cape St. Elias	Shelikof Bay
Date	6/18-19	6/25-26	7/10-11	7/8-9	7/26-27	8/4-5	8/7-8
Min. fished	150	150	180	150	207	180	150
Length (cm)							
5-7	1	2	—	—	—	—	—
8-10	1	3	53	8	1	—	—
11-13	0	0	18	5	12	13	—
14-16	7	0	12	3	24	37	3
17-19	51	5	100	4	4	57	4
20-22	39	20	95	48	27	6	11
23-25	32	13	16	35	49	6	6
26-28	54	20	16	10	22	39	2
29-31	32	25	11	8	3	39	0
32-34	12	4	3	3	2	20	5
35-37	4	2	3	0	0	7	3
38-40	2	—	2	0	5	15	14
41-43	5	—	1	0	8	20	8
44-46	0	—	0	0	5	7	5
47-49	0	—	0	0	4	7	6
50-52	0	—	1	0	4	5	2
53-55	0	—	0	0	0	4	6
56-58	1	—	1	1	0	1	2
59-61	0	—	1	0	3	3	2
62-64	2	—	2	0	1	4	2
>64	1	—	9	1	9	19	4
Total	244	94	344	126	183	309	85
Age							
1	2	5	67	16	37	113	26
2	92	11	219	78	85	92	12
3	109	57	26	25	17	14	13
4	31	21	15	5	29	38	14
5	6	—	6	0	3	12	4
6	1	—	1	1	3	16	7
7	2	—	1	—	—	5	5
Total	243	94	335	125	174	290	81

Appendix Table 5. Length and age frequencies of halibut caught at inshore areas, 1977.

Area	Bering Sea	Unimak Bight	Alitak Bay	Trinity Islands	Cape St. Elias	Shelikof Bay
Date	6/19-20	6/21-22	6/29-30	7/10-11	8/13	8/16
Min. fished	150	150	180	150	90	75
Length (cm)						
5-7	—	—	—	—	18	25
8-10	—	6	95	30	513	52
11-13	1	34	605	330	18	0
14-16	0	3	53	125	157	0
17-19	15	20	49	11	36	1
20-22	16	49	138	47	17	1
23-25	29	32	113	79	8	1
26-28	144	7	31	65	16	0
29-31	63	5	11	13	22	0
32-34	13	11	19	12	23	0
35-37	21	20	6	3	7	0
38-40	18	12	6	6	3	0
41-43	9	3	1	4	0	0
44-46	4	2	3	4	1	2
47-49	2	0	2	2	0	0
50-52	0	0	3	3	3	0
53-55	3	1	3	0	0	1
56-58	1	1	4	1	0	0
59-61	1	0	3	0	0	0
62-64	0	0	2	0	0	0
>64	4	5	12	1	1	4
Total	344	211	1,159	736	843	87
Age						
0	—	—	—	—	531	77
1	1	43	637	475	228	3
2	31	88	395	218	73	0
3	199	42	91	19	4	2
4	99	29	9	15	2	0
5	8	3	12	8	4	1
6	2	1	1	—	—	—
7	—	—	2	—	—	—
Total	340	206	1,147	735	842	83

Appendix Table 6. Length and age frequencies of halibut caught at inshore areas, 1978.

Area	Bering Sea	Unimak Bight	Alitak Bay	Trinity Islands	Cape St. Elias	Shelikof Bay
Date	6/20-22	6/23-25	7/12-13	7/13-14	8/2-3	8/12-13
Min. fished	150	150	180	150	180	150
Length (cm)						
5-7	1	—	—	—	10	6
8-10	149	12	8	—	5	30
11-13	182	37	324	17	180	0
14-16	17	1	96	52	1,023	11
17-19	1	0	36	13	510	87
20-22	26	2	250	36	77	98
23-25	37	28	435	61	36	46
26-28	23	83	268	28	59	12
29-31	31	22	67	4	50	2
32-34	24	26	6	4	27	1
35-37	11	21	8	4	8	—
38-40	22	16	9	3	6	—
41-43	8	17	7	1	5	—
44-46	3	11	4	0	9	—
47-49	5	11	8	0	5	—
50-52	0	7	7	0	3	—
53-55	0	3	5	1	3	—
56-58	0	3	4	1	0	—
59-61	0	5	5	0	2	—
62-64	1	3	6	0	0	—
65-67	0	2	1	0	0	—
68-70	2	3	7	0	0	—
71-73	—	0	2	0	1	—
74-76	—	2	5	1	1	—
77-79	—	0	0	0	—	—
>79	—	3	11	1	—	—
Total	543	318	1,579	227	2,020	293
Age						
0	—	—	—	—	15	36
1	346	50	436	79	1,751	257
2	61	54	783	129	224	—
3	76	124	285	13	14	—
4	53	40	31	3	11	—
5	2	31	20	1	2	—
6	4	13	11	1	2	—
7	1	0	2	—	—	—
8	—	3	—	—	—	—
9	—	—	—	—	—	—
Total	543	315	1,568	226	2,019	293

Appendix Table 7. Length and age frequencies of halibut caught at inshore areas, 1979.

Area	Bering Sea	Unimak Bight	Alitak Bay	Trinity Islands	Cape St. Elias	Shelikof Bay
Date	6/15, 20-21	6/22-24	6/27-28, 7/16-17	6/26-27	8/16-17	8/27-29
Min. fished	150	153	180	150	180	150
Length (cm)						
5-7	—	—	—	—	41	—
8-10	—	2	4	13	43	—
11-13	1	0	205	147	4	—
14-16	2	4	165	64	68	—
17-19	28	48	13	2	74	1
20-22	93	80	7	0	33	8
23-25	25	37	38	5	37	2
26-28	3	12	69	12	60	0
29-31	2	1	16	7	47	4
32-34	2	3	8	5	21	6
35-37	6	14	8	7	8	5
38-40	4	11	6	4	7	6
41-43	1	11	2	3	9	3
44-46	3	3	0	1	6	3
47-49	0	1	0	0	1	2
50-52	1	0	1	2	3	0
53-55	1	0	2	0	0	0
56-58	1	0	0	0	0	0
59-61	2	0	0	0	0	0
62-64	1	0	2	0	0	1
65-67	0	0	0	0	2	—
68-70	0	0	1	0	—	—
71-73	1	1	0	0	—	—
74-76	—	—	0	0	—	—
77-79	—	—	2	0	—	—
>79	—	—	2	1	—	—
Total	177	228	551	273	464	41
Age						
0	—	—	—	8	84	—
1	1	2	387	218	208	11
2	155	181	128	25	136	24
3	12	19	24	18	31	3
4	4	11	4	3	1	1
5	1	14	2	—	4	1
6	3	0	2	—	—	1
7	0	1	2	—	—	—
8	0	—	—	—	—	—
9	0	—	—	—	—	—
10+	1	—	—	—	—	—
Total	177	228	549	272	464	41

Appendix Table 8. Length and age frequencies of halibut caught at inshore areas, 1980.

Area	Bering Sea	Unimak Bight	Alitak Bay	Trinity Islands	Cape St. Elias	Shelikof Bay
Date	6/1, 6/11	6/12-13	6/25-26	6/26-27	7/30-31	8/5-6
Min. fished	144	150	180	150	180	172
Length (cm)						
5-7	—	—	—	—	—	—
8-10	1	8	11	4	4	—
11-13	9	6	154	21	186	—
14-16	1	0	29	12	104	—
17-19	0	0	2	1	35	1
20-22	2	1	20	12	18	0
23-25	6	1	59	14	15	0
26-28	38	9	78	20	22	4
29-31	122	11	23	10	37	0
32-34	62	73	10	5	36	0
35-37	6	58	1	5	26	1
38-40	7	15	8	6	15	2
41-43	2	2	4	3	25	3
44-46	4	4	3	4	15	2
47-49	1	2	4	2	5	1
50-52	1	4	1	1	1	1
53-55	0	0	1	2	5	1
56-58	1	0	1	1	2	0
59-61	0	1	0	1	1	1
62-64	1	0	0	0	2	—
65-67	1	0	0	0	2	—
68-70	0	0	0	1	0	—
71-73	0	0	1	0	3	—
74-76	1	0	0	0	4	—
77-79	0	0	1	1	0	—
>79	2	1	6	1	4	—
Total	268	196	417	127	567	17
Age						
0	—	—	—	—	—	—
1	11	14	194	37	334	1
2	14	8	105	32	87	4
3	222	151	92	32	82	8
4	12	16	14	17	35	3
5	5	6	4	4	12	1
6	1	—	1	2	6	—
7	1	—	1	2	7	—
8	—	—	—	—	—	—
9	—	—	—	—	—	—
Total	266	195	411	126	563	17

Appendix Table 9. Length and age frequencies of halibut caught at offshore areas, 1973. (Only fish between 14 and 64 cm were aged).

Area	Bering Sea	Unimak Bight	Chirikof Islands	Cape Chiniak	Cape Chiniak (Tagging)	Cape St. Elias	Dixon Entrance
Date	6/18-25	7/1-5	7/8-18	7/19-31	8/1-6	8/8-15	8/21-23
Min. fished	1,900	1,464	1,291	1,519	1,393	2,140	365
Length (cm)							
14-16	—	4	11	—	—	—	—
17-19	—	5	32	1	—	—	—
20-22	16	9	32	5	8	2	—
23-25	66	39	65	34	168	0	—
26-28	59	128	116	81	356	0	—
29-31	23	150	187	71	241	3	—
32-34	34	190	112	45	117	3	2
35-37	23	168	125	59	88	10	2
38-40	3	89	145	64	76	22	1
41-43	5	62	115	72	100	41	4
44-46	11	36	103	81	81	67	1
47-49	1	23	77	63	66	63	3
50-52	1	10	50	41	38	77	12
53-55	1	7	45	26	24	69	8
56-58	1	3	28	16	12	56	18
59-61	0	2	22	18	12	43	35
62-64	1	3	27	10	6	29	42
65-67	—	3	11	4	4	20	62
68-70	—	2	11	4	9	18	59
71-73	—	0	7	4	1	13	43
74-76	—	0	10	2	1	4	27
77-79	—	0	4	0	0	10	14
>79	—	4	31	23	14	37	24
Total	245	937	1,366	724	1,422	587	357
Age							
1	—	—	3	—	—	2	—
2	3	16	155	—	—	7	5
3	146	429	321	239	882	36	5
4	66	299	255	112	162	45	9
5	23	73	371	246	267	212	24
6	7	90	113	75	71	153	43
7	—	18	61	15	11	30	34
8	—	3	10	—	—	—	8
9	—	—	3	—	—	—	—
Total	245	928	1,292	687	1,393	485	128

Appendix Table 10. Length and age frequencies of halibut caught at offshore areas, 1974.

Area	Bering Sea	Unimak Bight	Chirikof Island	Cape Chiniak	Cape Chiniak (Tagging)	Cape St. Elias	Cape Fairweather	Queen Charlotte Sound
Date	6/2-9	6/14-18	6/21-30	7/11-21	7/15-17	7/27-8/3	8/4-9	8/17
Min. fished	2,095	1,478	1,356	1,860	624	2,073	1,905	165
Length (cm)								
14-16	—	2	—	—	—	—	—	—
17-19	2	1	—	—	—	—	—	—
20-22	11	1	4	—	1	—	—	—
23-25	18	13	162	—	0	9	—	—
26-28	26	48	435	5	4	33	1	—
29-31	56	61	305	10	59	38	0	—
32-34	50	143	136	22	160	24	1	—
35-37	35	110	114	48	297	17	5	—
38-40	14	94	117	47	274	19	13	—
41-43	2	49	97	38	218	28	26	—
44-46	4	31	77	31	180	44	34	—
47-49	5	18	62	34	141	47	42	—
50-52	3	11	54	26	117	41	52	—
53-55	3	9	37	25	77	56	61	—
56-58	0	1	29	17	46	47	40	—
59-61	1	3	21	11	42	39	54	1
62-64	0	4	22	14	23	25	32	1
65-67	0	1	12	4	16	13	27	0
68-70	1	0	13	3	6	20	22	1
71-73	0	0	11	4	8	9	23	0
74-76	0	1	10	2	7	13	10	1
77-79	0	0	6	3	0	11	13	1
>79	2	1	43	9	17	38	30	2
Total	233	602	1,767	353	1,693	571	486	7
Age								
2	7	3	37	1	1	50	—	—
3	45	30	1,079	23	130	64	4	—
4	141	296	225	107	646	123	35	3
5	26	183	253	81	445	109	59	0
6	11	62	66	95	348	75	150	0
7	1	22	52	27	86	67	115	0
8	—	5	8	5	7	18	51	1
9	—	—	4	3	10	9	25	1
10	—	—	—	2	3	18	17	2
Total	231	601	1,724	344	1,676	533	456	7

Appendix Table 11. Length and age frequencies of halibut caught at offshore areas, 1975.

Area	Bering Sea	Unimak Bight	Chirikof Island	Cape Chiniak	Cape St. Elias	Cape Fairweather (Tagging)
Date	6/2-14	6/17-24	7/9-14	7/16-25	7/26-8/4	8/5-9
Min. fished	2,274	1,477	1,356	1,482	2,142	1,686
Length (cm)						
14-16	—	—	1	—	—	—
17-19	2	4	3	—	—	—
20-22	26	0	21	—	—	—
23-25	83	8	63	1	—	—
26-28	93	19	52	5	—	—
29-31	76	30	50	17	13	—
32-34	97	49	58	53	19	10
35-37	66	102	82	59	19	30
38-40	55	95	100	68	15	73
41-43	47	87	65	75	29	95
44-46	30	53	58	68	28	149
47-49	17	37	50	50	29	158
50-52	13	23	34	43	37	205
53-55	8	6	26	26	34	268
56-58	3	3	26	16	34	300
59-61	2	3	20	18	42	244
62-64	2	2	16	10	24	167
65-67	0	1	15	6	17	124
68-70	1	1	13	7	8	71
71-73	0	—	15	5	15	29
74-76	3	—	8	5	8	24
77-79	1	—	5	5	7	10
>79	4	—	35	33	48	17
Total	629	523	816	570	426	1,974
Age						
2	27	4	132	8	2	—
3	150	83	174	75	43	51
4	272	84	253	132	32	142
5	121	112	100	162	74	367
6	41	189	93	93	89	560
7	9	32	15	47	86	578
8	3	18	14	19	42	234
9	2	1	—	1	10	25
Total	625	523	781	537	378	1,957

Appendix Table 12. Length and age frequencies of halibut caught at offshore areas, 1976.

Area	Bering Sea	Bering Sea (Tagging)	Unimak Bight	Chirikof Island	Cape Chiniak	Cape St. Elias	Dixon Entrance (Tagging)*
Date	6/4-15	6/13-16	6/20-24	7/11-15	7/16-24	7/29-8/5	8/10-13
Min. fished	2,442	881	1,410	1,451	1,547	2,160	1,363
Length (cm)							
14-16	—	—	1	—	—	—	—
17-19	—	2	6	—	—	—	—
20-22	4	22	10	4	1	—	—
23-25	56	177	28	9	1	—	—
26-28	131	374	77	113	9	3	—
29-31	127	206	78	147	79	13	—
32-34	79	148	43	70	76	14	—
35-37	58	80	47	44	60	11	1
38-40	33	52	37	23	47	30	1
41-43	29	32	53	29	35	47	2
44-46	14	15	33	27	44	68	1
47-49	15	13	23	28	43	74	6
50-52	8	4	28	18	35	59	11
53-55	4	3	11	16	32	49	18
56-58	4	2	12	15	20	51	41
59-61	3	1	3	9	22	23	35
62-64	1	1	1	12	15	22	44
65-67	1	0	1	7	10	20	51
68-70	3	0	1	5	7	10	75
71-73	1	2	1	4	7	10	58
74-76	1	2	0	8	3	8	59
77-79	1	0	0	8	4	6	33
>79	3	4	1	39	20	29	77
Total	576	1,140	495	635	570	547	513
Age							
2	9	40	10	7	4	23	
3	254	655	148	211	188	17	
4	218	338	109	200	110	133	
5	62	81	45	95	80	55	
6	20	16	88	39	97	129	
7	10	6	82	30	47	101	
8	—	—	10	8	20	47	
9	—	—	2	4	4	8	
10	—	—	—	2	—	5	
Total	573	1,136	494	596	550	518	

*No age sample taken

Appendix Table 13. Length and age frequencies of halibut caught at offshore areas, 1977.

Area	Bering Sea	Unimak Bight	Chirikof Island	Cape Chiniak	Cape St. Elias
Date	6/6-18	6/22-26	7/11-17	7/18-30	8/4-13
Min. fished	2,583	1,444	1,331	1,440	1,860
Length (cm)					
11-13	—	2	6	—	—
14-16	—	1	6	1	—
17-19	6	10	2	0	—
20-22	11	45	17	0	—
23-25	57	12	65	1	1
26-28	79	19	60	0	2
29-31	125	64	42	9	3
32-34	142	64	69	41	8
35-37	160	91	94	79	12
38-40	104	86	76	88	24
41-43	60	43	90	89	51
44-46	46	23	70	84	103
47-49	26	27	52	49	89
50-52	10	18	34	37	77
53-55	8	6	37	32	69
56-58	10	17	28	26	58
59-61	4	4	22	33	58
62-64	3	5	22	20	45
65-67	0	8	19	7	29
68-70	1	3	16	7	23
71-73	3	4	9	10	5
74-76	4	4	7	4	17
77-79	1	0	8	7	15
>79	11	4	65	31	68
Total	871	560	916	655	757
Age					
1	—	3	14	1	1
2	23	62	102	1	15
3	273	143	186	88	36
4	409	219	284	214	76
5	92	31	97	157	258
6	50	34	90	72	125
7	10	19	30	76	113
8	3	35	36	8	52
9	—	10	12	7	13
Total	860	556	851	624	689

Appendix Table 14. Length and age frequencies of halibut caught at offshore areas, 1978.

Area	Bering Sea	Unimak Bight	Chirikof Island	Cape Chiniak	Cape St. Elias	Dixon Entrance	Hecate Strait
Date	6/6-19	6/25-29	7/14-19	7/22-28	8/3-7	8/15-16	8/16-17
Min. fished	2,640	1,489	1,355	619	2,142	282	136
Length (cm)							
8-10	—	—	—	—	—	—	—
11-13	1	1	2	—	—	—	—
14-16	1	0	10	—	1	—	—
17-19	3	0	0	—	3	—	—
20-22	0	1	64	—	5	5	—
23-25	4	28	361	9	8	16	—
26-28	23	32	469	17	12	22	—
29-31	45	37	232	10	34	13	—
32-34	79	79	98	21	37	7	—
35-37	49	58	63	54	13	0	—
38-40	70	80	46	85	23	0	—
41-43	55	83	47	79	52	0	—
44-46	37	57	58	85	78	0	—
47-49	37	46	44	64	104	1	1
50-52	40	38	56	51	123	2	0
53-55	34	18	49	52	125	0	1
56-58	32	9	38	40	110	2	1
59-61	21	13	28	25	106	2	2
62-64	9	8	18	24	94	1	0
65-67	11	11	12	24	76	0	0
68-70	4	5	22	15	71	1	1
71-73	1	8	7	8	34	0	2
74-76	5	5	14	12	28	1	2
77-79	1	1	11	7	29	1	1
>79	22	15	52	51	117	5	3
Total	584	633	1,801	733	1,283	79	14
Age							
1	1	1	11	—	9	59	—
2	5	50	1,029	23	85	4	—
3	189	117	273	95	68	1	1
4	127	198	122	174	179	2	2
5	176	158	210	234	320	5	8
6	50	34	32	104	236	0	—
7	9	16	61	26	149	3	—
8	5	19	7	19	110	—	—
9	—	25	4	7	9	—	—
Total	562	618	1,749	682	1,165	74	11

Appendix Table 15. Length and age frequencies of halibut caught at offshore areas, 1979.

Area	Bering Sea	Unimak Bight	Chirikof Island	Cape Chiniak	Cape St. Elias
Date	6/7-20	6/21-24	7/14-16	7/3-9	8/13-20
Min. fished	1,248	683	656	775	1,057
Length (cm)					
5-7	—	—	—	—	—
8-10	—	—	—	—	—
11-13	—	—	—	—	—
14-16	—	—	1	—	1
17-19	2	1	1	—	2
20-22	13	17	8	—	6
23-25	50	28	34	—	13
26-28	8	2	78	1	11
29-31	7	1	44	7	22
32-34	15	5	84	44	28
35-37	19	15	131	68	45
38-40	34	14	77	63	38
41-43	15	21	36	37	31
44-46	20	18	29	30	31
47-49	14	15	30	21	28
50-52	24	7	18	23	26
53-55	10	8	25	19	28
56-58	16	3	24	11	25
59-61	9	3	17	10	20
62-64	8	1	15	3	23
65-67	2	2	11	9	16
68-70	1	0	11	2	8
71-73	1	1	11	1	10
74-76	1	0	5	2	6
77-79	0	1	4	1	3
>79	1	2	43	9	13
Total	270	165	737	361	434
Age					
1	—	—	2	—	24
2	67	48	142	3	103
3	38	12	312	140	99
4	93	36	110	61	35
5	47	44	37	90	60
6	23	17	87	54	65
7	1	2	4	2	23
8	—	0	—	2	6
9	—	3	—	—	6
10	—	1	—	—	—
Total	269	163	694	352	421

Appendix Table 16. Length and age frequencies of halibut caught at offshore areas, 1980.

Area	Bering Sea	Unimak Bight	Chirikof Island	Cape Chiniak	Cape St. Elias
Date	6/6-10	6/16-19	6/20-24	7/8-17	7/27-8/2
Min. fished	1,230	723	676	690	1,032
Length (cm)					
8-10	—	—	—	—	—
11-13	—	—	2	—	—
14-16	—	—	1	—	—
17-19	—	—	12	—	—
20-22	2	1	57	—	2
23-25	30	3	105	3	0
26-28	335	15	114	6	6
29-31	245	86	96	4	18
32-34	115	188	107	8	43
35-37	74	134	123	34	38
38-40	27	34	120	66	30
41-43	13	26	118	78	57
44-46	17	22	107	58	49
47-49	36	36	62	39	51
50-52	19	37	52	26	40
53-55	21	15	27	16	28
56-58	19	15	21	18	33
59-61	12	12	21	18	38
62-64	3	6	20	15	35
65-67	5	5	17	11	29
68-70	3	7	12	6	19
71-73	1	2	11	4	22
74-76	3	2	9	6	11
77-79	4	1	4	4	15
>79	8	5	28	26	46
Total	992	652	1,246	446	610
Age					
1	—	—	3	—	2
2	325	19	213	11	61
3	487	375	362	149	54
4	45	93	335	97	177
5	63	24	211	85	90
6	50	84	48	28	98
7	10	49	39	44	56
8	4	3	7	6	16
9	—	—	—	—	0
10+	—	—	—	—	10
Total	984	647	1,218	420	564

Appendix Table 17. Length frequencies of halibut tagged by the survey vessel, 1979.

Area	Bering Sea	Unimak Bight	Chirikof Island	Cape Chiniak	Cape St. Elias	Icy Strait	Shelikof Bay
Date	6/7-21	6/21-24	7/14-16	7/3-9	8/13-26	8/30-9/3	8/27-29
Length (cms)							
11-13	—	—	—	—	—	—	—
14-16	—	—	—	—	—	—	—
17-19	—	—	—	—	24	—	—
20-22	—	—	—	—	51	—	—
23-25	—	—	3	1	110	—	—
26-28	—	—	26	1	203	—	—
29-31	—	—	27	15	188	1	—
32-34	1	1	102	308	156	9	2
35-37	19	22	399	1,293	93	11	9
38-40	31	19	409	1,266	62	37	9
41-43	9	25	252	721	55	23	6
44-46	17	15	169	484	40	18	2
47-49	8	9	142	345	27	11	1
50-52	19	2	93	268	29	17	—
53-55	7	4	90	197	29	16	—
56-58	9	0	67	116	20	7	—
59-61	5	1	47	67	17	7	—
62-64	5	0	43	34	23	6	—
65-67	1	0	35	29	16	5	—
68-70	0	1	24	20	8	7	—
71-73	1	1	26	15	8	0	—
74-76	0	0	16	9	6	1	—
77-79	0	0	15	8	3	—	—
80-82	0	0	12	7	3	—	—
83-85	0	0	12	15	5	—	—
86-88	0	0	6	3	3	—	—
89-91	0	0	6	11	1	—	—
92-94	0	0	8	7	0	—	—
95-97	0	0	4	11	0	—	—
98-100	0	2	2	15	1	—	—
>100	1	—	10	40	2	—	—
Total	133	102	2,045	5,306	1,183	176	29

Appendix Table 18. Length frequencies of halibut tagged by the survey vessel, 1980.

Area Date	Bering Sea 6/1-11	Unimak Island 6/16-19	Chirikof Island 6/20-24	Two-headed Island 6/22-23	Ugak Island 7/19-24	Cape Chiniak 7/6-17	Cape St. Elias 7/27-8/2	Yakutat 8/4	Shelikof Bay 8/5-6
Length (cms)									
11-13	—	—	—	—	—	—	—	—	—
14-16	—	—	—	—	—	1*	—	—	—
17-19	—	—	—	1	—	—	—	—	—
20-22	—	—	—	1	5	—	—	—	—
23-25	—	—	—	17	96	—	1	—	—
26-28	3	—	—	51	453	1	9	—	1
29-31	45	3	2	51	544	6	41	—	0
32-34	97	84	12	36	315	9	68	—	0
35-37	68	93	41	9	205	42	55	—	0
38-40	26	33	81	12	194	93	37	—	1
41-43	9	31	110	3	155	103	76	—	—
44-46	14	24	106	4	139	79	58	—	—
47-49	30	42	62	10	92	60	50	1	—
50-52	14	44	46	3	85	32	35	0	—
53-55	15	10	27	7	42	19	27	0	—
56-58	14	11	18	5	32	27	29	0	—
59-61	6	12	19	2	23	25	35	1	—
62-64	0	6	14	0	10	18	32	1	—
65-67	3	4	14	1	18	17	27	—	—
68-70	1	7	10	3	19	8	16	—	—
71-73	0	3	10	3	16	7	22	—	—
74-76	2	4	6	4	5	9	12	—	—
77-79	1	1	5	0	6	6	13	—	—
80-82	0	2	8	1	15	8	8	—	—
83-85	1	0	6	—	—	3	9	—	—
86-88	1	1	3	—	—	1	4	—	—
89-91	2	1	1	—	—	5	5	—	—
92-94	0	0	10	—	—	3	7	—	—
95-97	3	0	1	—	—	4	5	—	—
98-100	0	2	3	—	—	5	3	—	—
>100	3	1	9	—	—	16	9	—	—
Total	358	419	624	224	2,469	607	693	3	2

*length probably erroneous; such small halibut impractical to tag.

Appendix Table 19. Food organisms observed in stomachs of young halibut in 1976 and 1977.

Length of halibut (cms)	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	>80	Total
Number of stomachs examined	**42**	**262**	**370**	**350**	**303**	**229**	**121**	**62**	**24**	**1,763**
Food Organisms					**Frequency of Occurrence**					
Amphipod	9	1	3	1						14
Euphausid	4	9		2						15
Annelid worm	1		1	1		1				4
Hermit crab	2	24	32	51	19	17	5			150
Poacher	2	1		3	7	3	2			18
Shrimp	14	111	144	70	35	22	14	1		411
Rock sole	2	20	12	3	1	1		1		40
Tanner Crab	1	6	18	22	41	42	19	8	11	168
Unidentifiable fish	1	42	65	94	72	53	40	20	7	394
Unidentifiable crab	2	13	20	30	32	12	6		1	116
Greenling		7	6							13
Isopod		6	2		1					9
Eelpout		3	13	4	10	6	3			39
Sand lance		10	41	39	36	16	9	4		155
Sand fish		8	31	11	5	10	13	4		82
Sculpin		12	4	2	6	3	4	1		32
Unidentified ova		2	1		1			1		5
Smelt			3		1					4
Dungeness crab			1		2	1				4
Tom cod			1	3	7	4	3			18
Octopus			1	2	11	18	4	4		40
Ronquil			1	1	3	5	4	1		15
Pacific cod			1	3		1	1	1		7
Sand sole			1				1	2		4
Walleye pollock			1	2	7	13	6	9	4	42
Prickleback			4	5	6	8	4		1	28
Herring			1		1	5	5	4	2	18
Clam				5	11	5	6			27
Squid				1			1			2
Flathead sole					1					1
Wrymouth					1					1
Scallop					1					1
Brittle star					1					1
Starfish						1				1
Sablefish						1				1
Box crab							1			1
Arrowtooth flounder							1			1
Dover sole							1			1
Shad							1			1
Snailfish								1		1
Salmon									2	2
Empty	8	34	53	79	64	44	17	11	4	314
Total	46	309	461	434	383	292	171	73	32	2,201

Appendix Table 20. Glossary of common and scientific names listed in this report.

INVERTEBRATES	
Phylum Annelida	
Annelid worm	Class Polychaeta
Phylum Mollusca	
Scallop	Family Pectinidae
Clam	Family Cardidae
Squid	Family Gonatidae
Octopus	Family Octopodidae
Phylum Arthropoda	
Isopod	Class Isopoda
Amphipod	Class Amphipoda
Euphasid	Class Euphasiacea
Shrimp	Family Pandalidae
Hermit crab	Family Paguridae
King crab	*Paralithodes camtschatica*
Box crab	*Lopholithodes foraminatus*
Tanner crab	*Chionoecetes bairdi*
Dungeness crab	*Cancer magister*
Phylum Echinodermata	
Starfish	Class Asteroidea
Brittle star	Family Gorgonocephalidae
Family Clupeidae	
American shad	*Alosa sapidissima*
Pacific herring	*Clupea pallasi*
Family Salmonidae	
Salmon	Genus *Oncorhynchus*
Family Osmeridae	
Smelt	Family Osmeridae
Family Gadidae	
Pacific cod	*Gadus macrocephalus*
Pacific tomcod	*Microgadus proximus*
Walleye pollock	*Theragra chalcogramma*

	Family Anoplopomatidae	
Sablefish		*Anoplopoma fimbria*
	Family Hexagrammidae	
Greenling		Genus *Hexagrammos*
	Family Cottidae	
Sculpin		Family Cottidae
	Family Agonidae	
Poacher		Family Agonidae
	Family Cyclopteridae	
Snailfish		Family Cyclopteridae
	Family Trichodontidae	
Sandfish		*Trichodon trichodon*
	Family Ammodytidae	
Sand lance		*Ammodytes hexapterus*
	Family Bathymasteridae	
Ronquil		*Bathymaster signatus*
	Family Stickaeidae	
Wrymouth		*Delolepis gigantea*
Prickleback		Family Stichaeidae
	Family Zoarcidae	
Eelpout		Family Zoarcidae
	Family Pleuronectidae	
Arrowtooth flounder		*Atheresthes stomias*
Rex sole		*Glyptocephalus zachirus*
Flathead sole		*Hippoglossoides elassodon*
Halibut		*Hippoglossus stenolepis*
Rock sole		*Lepidopsetta bilineata*
Yellowfin sole		*Limanda aspera*
Dover sole		*Microstomus pacificus*
Sand sole		*Psettichthys melanostictus*