

INTERNATIONAL PACIFIC HALIBUT COMMISSION

**ESTABLISHED BY A CONVENTION BETWEEN
CANADA AND THE UNITED STATES OF AMERICA**

Technical Report No. 43

**Diet of juvenile Pacific halibut,
1957-1961**

by

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**SEATTLE, WASHINGTON
2000**

The International Pacific Halibut Commission has three publications: Annual Reports (U.S. 0074-7238), Scientific Reports, and Technical Reports (U.S. ISSN 0579-3920). Until 1969, only one series was published (U.S. ISSN 0074-7426). The numbering of the original series has been continued with the Scientific Reports.

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Introduction

Investigations of the life history of Pacific halibut (*Hippoglossus stenolepis*) by the International Pacific Halibut Commission (IPHC) began in 1924. The early work focused on fish larger than the 65-cm commercial minimum size limit in effect at the time, and expanded in 1955 to include trawl surveys targeting smaller halibut. The first objectives of the research on small fish were to establish the geographical and depth distribution of young Pacific halibut, to learn the extent and nature of their habitats, food habits, growth rates, and movements, and to develop efficient sampling gears (IPHC 1956, 1959). These yearly trawl surveys, generally referred to as Small Fish Surveys, occurred through 1986. The surveys were initially (1955-1963) conducted near shore, usually in depths from 10-50 m. The objectives of the original surveys gradually broadened to encompass deeper waters, normally less than 120 m depth, of the Gulf of Alaska and the Bering Sea flats.

Concurrently, between May 1961 and April 1963, the IPHC conducted a second, more comprehensive, trawl survey in the Gulf of Alaska from Unimak Pass to Cape Spencer using otter trawl gear. This investigation was referred to as the IPHC Trawl Survey. The purposes of this second survey were to investigate the potential for bottom trawling in the region, to collect data on the distribution and availability of halibut and other associated bottom and demersal species, and to investigate the impact that the incidental capture of halibut from a commercial trawl fishery might have on the stock of juvenile and adult halibut (IPHC 1963).

Halibut caught during the Small Fish Surveys and the Trawl Survey were measured and biological data on age and sex were collected. Stomach content data from dead halibut on the Small Fish Surveys were collected between 1957-1961 and on the Trawl Survey in 1961. Numerous halibut captured in good condition were also tagged to study their movements.

This report summarizes and presents the data collected during both surveys on food habits of halibut smaller than 66-cm standard length (from tip of snout to middle of tail fin). The stomach contents of 8,702 halibut were examined, identified, and summarized for small halibut at various ages, at different locations, at different times within the same location, and among years. These data comprise the largest study ever conducted by the IPHC on the food habits of juvenile Pacific halibut. Pieces of the information accumulated between 1957 and 1961 were occasionally cited in IPHC reports but the comprehensive data were never published. Various aspects of the food habits of Pacific halibut have been previously documented by Thompson (1915), Novikov (1964), Hunter (1979), Best and Hardman (1982), Best and St-Pierre (1986), Brodeur and Livingston (1988) and Livingston et al. (1993).

Sampling methods

Sampling gear

The first three years of the Small Fish Survey were used to search for concentrations of halibut less than 66 cm in length that would be suitable for quantitative, annual assessment, and to test the effectiveness of various fishing gears. Small otter trawls with 9.7-m head ropes and 12.1-m foot ropes made up the main sampling gear for the Small Fish Surveys (Hardman and Southward 1957). Over the course of the experiments, otter trawls used 32-, 64-, and 108-mm mesh in the cod-end (IPHC 1957). Exploratory gears consisted of a small beam trawl of 32-mm mesh, a beach seine with 25-mm mesh, ring nets of 19-mm mesh, and a gill net with of 7.6-m sections of 25-, 51-, 64-, and 90-mm mesh panels. Setlines rigged with fine gangions and small hooks were used to search for concentrations of young halibut on untrawlable bottom (IPHC 1957, 1958).

The otter trawl nets proved the most effective gear and the otter trawl with 32-mm codend mesh was adopted in 1958 as the standard gear for Small Fish Surveys (IPHC 1959). The much less effective beam trawl was kept only as a qualitative exploratory tool on grounds where the otter trawl could not be used. Experimental fishing using the setline and beach seine gear produced very low catches. No halibut catches were obtained using the ring nets and gill net gears. Therefore, the IPHC discontinued the use of the latter four experimental fishing gears after the 1958 field season.

Otter trawls with codend meshes of 108-mm were used more extensively in 1960 and 1961 along with the standard otter trawl in an attempt to increase the catches of larger and older sub-commercial sized halibut. On the same grounds, the larger-meshed otter trawls caught no more of the larger fish than the standard-mesh trawl and significantly fewer of the smaller halibut (IPHC 1961). The larger-mesh net showed an advantage only in areas where debris clogged the smaller-mesh net.

Halibut from the Small Fish Survey used in the food study were captured almost exclusively with the standard otter trawl gear in 1957 and predominately by the standard gear from 1958 through 1961. This food study also includes halibut captured by otter trawls equipped with the 64-mm codend meshes in 1958 and 1959, and with the 108-mm codend in 1960 and 1961. A few individuals captured by the beam trawl and the beach seine are also included in this study. Halibut captured by the small-hook setline are excluded from this study to avoid possible bias caused by the high incidence of empty stomachs (82%) found in halibut caught by that type of gear, given the possibility of regurgitation by captured halibut.

Vessels participating on the 1961-1963 Trawl Surveys were equipped with standard Pacific Coast bottom trawls with codends of 90-mm stretched mesh, and head rope/foot rope dimensions of 28.6 and 21.6 m, respectively (IPHC 1964). The small halibut obtained from the Trawl Survey for the juvenile halibut food study were collected only in 1961, and were captured exclusively with the 90-mm mesh codend otter trawls.

Trawl hauls from the Small Fish Surveys lasted 15 minutes, while the hauls from the Trawl Survey lasted an hour.

Locations and depth fished

In 1955, the experimental fishing was conducted only in British Columbia waters. Because of consistently low catch per unit of effort, the experimental fishing was reduced to occasional research in Canadian waters, and shifted into southeastern Alaska in 1956

and into the central Gulf of Alaska and Kodiak Island region in 1957. The experimental fishing was generally conducted in waters shallower than 50 m at the outset. The locations sampled for the food habits study during the 1957-1961 Small Fish Survey and the 1961 Trawl Survey are shown in Figure 1. Those sampling locations for the Small Fish Survey are listed in Table 1 in the geographical order on occurrence, from east to west along the shore of the Gulf of Alaska, and then counterclockwise around Kodiak Island. The locations sampled for the food habits study during the 1961 Trawl Survey were the Portlock Bank, Chirikof Island, Shumagin Islands, and Unimak Pass grounds.

Fishing during the Small Fish Survey was conducted in relatively shallow waters, at depths ranging from 11 and 68 m. The majority of the 1957 catch occurred at depths less than 37 m, and at depths less than 46 m for the years 1958-1961 (IPHC 1958, 1959, 1960, 1961, and 1962). Fishing during the 1961 Trawl Survey reached depths of 457 m, but the majority of the catch came from grounds of less than 100-m depth (IPHC 1964).

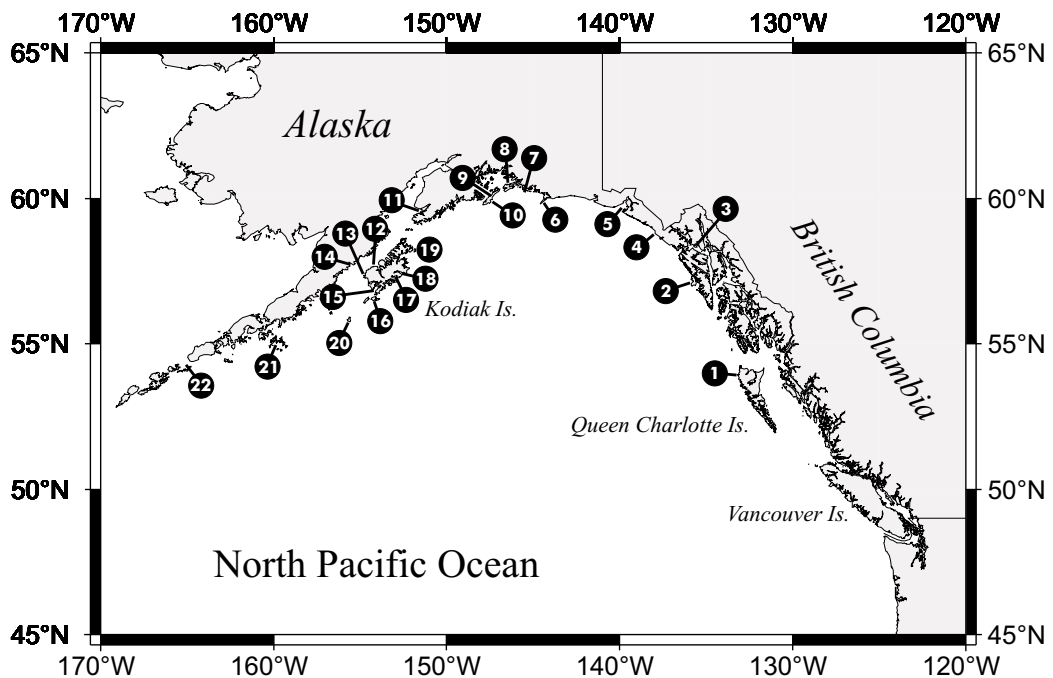


Figure 1. The collection sites for the Small Fish Survey were: 1) Graham Island, 2) Shelikof Bay, 3) Pleasant Island, 4) Cape Fairweather, 5) Yakutat Bay, 6) Kayak Island, 7) Kayak-Hinchinbrook Islands, 8) Hinchinbrook Island, 9) Montague Island, 10) Box Point-Patton Bay, 11) Kachemak Bay, 12) Cape Uyak-Karluk-Sturgeon River, 13) Halibut Bay-Grant Lagoon, 14) Puale Bay, 15) Alitak Bay, 16) Sitkinak Island, 17) Kiliuda Bay, and 18) Ugak Bay. The collection sites for the 1961 Trawl Survey were: 19) Portlock Bank, 20) Chirikof Island, 21) Shumagin Islands, and 22) Unimak Pass.

Table 1. The number of halibut stomachs examined during the 1957-1961 Small Fish Survey, the locations where sampling took place, and the number of empty stomachs.

Locations Fished	Number Of Stomachs Examined/Year Sampled					Total
	1957	1958	1959	1960	1961	
Goose and Triangle Islands	-	4	-	28	3	35
Northern Hecate Strait	-	16	5	-	10	31
McIntyre Bay	25	35	22	-	-	82
Cape Addington	-	-	-	-	6	6
Shelikof Bay	301	164	326	560	67	1,418
Stephen Passage	-	-	-	-	1	1
Pleasant Island	-	-	-	-	104	104
Cape Fairweather-Ustay River	22	-	-	-	35	57
Yakutat Bay	122	18	-	15	-	155
Kayak Island	-	-	-	290	328	618
Kayak-Hinchinbrook Is.	-	-	-	148	-	148
Hinchinbrook Island	61	6	-	-	8	75
Montague Island	123	-	-	-	-	123
Box Pt.-Patton Bay	-	-	-	-	155	155
Macleod Harbor	-	55	-	32	-	87
Kachemak Bay	196	145	163	365	183	1,052
Viekoda-Uganik-Spiridon Bays	-	-	31	-	-	31
Uyak B.-Karluk B.-Sturgeon R.	133	165	134	311	27	770
Halibut B.-Grant lagoon	-	-	105	270	64	439
Puale Bay	62	21	-	-	-	83
Alitak Bay	57	91	152	341	116	757
Sitkinak-Tugidak Islands	-	-	-	114	42	156
Chirikof Island	-	-	-	-	27	27
Little Konuiji Island	-	25	-	-	-	25
Albatross Bank	-	-	-	7	-	7
Kiliuda-Boulder Bays	-	-	-	144	77	221
Ugak Bay	-	-	-	125	-	125
Pillar Cape	-	9	-	-	-	9
No. of Stomachs Examined	1,102	754	938	2,750	1,253	6,797
No. of Empty Stomachs	196	137	139	440	182	1,094
% of Stomachs with Food	82.2	81.8	85.2	84.0	85.5	83.9

Stomach collection

Halibut needed to determine the length, age, and sex composition of the catch were randomly selected and killed. Halibut used in this food habit study were taken from those that were sacrificed for age determination and were chosen to represent the length composition of the catch. Samples were selected on a time-available basis to obtain a predetermined number of stomachs for a series of length intervals. Consequently, age, sex, and length data were available for all halibut selected for this food habit study. Stomachs

were examined at sea, and prey items recorded as present or absent. In addition, the numbers of individuals from each prey species were recorded from stomachs collected in 1957. No volumetric or weight data for prey items were taken during the Small Fish or Trawl Surveys.

Treatment of the data

In this report, food items in each stomach are reported only by species or species group, regardless of the number of that species present. We reported stomach contents by sex for 1957, to verify the similarity of feeding behavior between sexes. The females and males from 1957 were added together to increase sample size when presenting data for food habits of halibut by locations and years.

It was not unusual to find some halibut stomachs filled exclusively with individuals of one species, and occasionally with individuals from two or more species. Consequently, all identified species in a stomach were tabulated. Unidentified digested fish remains are reported as a single category even if multiple species may have occurred. Although the majority of flatfishes were identifiable, all except halibut are reported as miscellaneous flatfish because of their relatively low importance in number for any given species. Crabs were seldom separated by species until the 1960 and 1961 sampling years. This might be explained by the fact that no well-established North American commercial crab fisheries were in operation during those years in the Alaskan waters and that only the king crab species were part of a directed research study to establish their potential as a commercial fishery.

Items such as stone, sand, pumice, gravel, and discarded leftover human food or fish offal from the sampling or nearby commercial vessels are considered as non-food items and are excluded from this compilation. Some species that experience a low incidence of halibut predation, such as marine worms, echinoderms, other invertebrates, and kelp, are compiled under "other species group" in the presentation of the summary tables.

Results and conclusions

Of the 6,797 stomachs examined from small halibut caught during the Small Fish Survey, food was observed in 5,703 or 83.9% (Table 1). The number of stomachs observed per sampling location per year ranged from one to several hundred. Of the 1,905 stomachs examined during the 1961 Trawl Survey, food was observed in 1,432 or 75.2% (Table 2).

Table 2. The number of halibut stomachs examined during the 1961 Trawl Survey, the locations where sampling took place, and the number of empty stomachs.

Location	Number of stomachs examined	Number of empty stomachs	Percent of stomachs with food
Portlock	234	29	87.6
Chirikof I.	1,200	302	74.8
Shumagin Is.	208	45	78.4
Unimak Pass	263	97	63.1
Total	1,905	473	75.2

Prey species in the stomach contents of halibut for the 1957 Small Fish Survey are reported in Appendix Tables 1-76 by sex, age and length of halibut, and by location and date of capture. The 1957 survey data show no apparent differences in the feeding habits of halibut by sex at the same age and location. The sex ratio of the catch in each region for each year was about equal (IPHC 1960). Appendix Tables 77 to 164 present the prey species of halibut by age, location, and date of capture for the years 1958 to 1961. The prey species data for the 1961 Trawl Survey are presented by age of halibut, location, and month of capture in the Appendix Tables 165- 176. The Appendix tables are not printed in this report, but are available on the internet at the following address: <http://www.iphc.washington.edu/>. Once there, click on “Literature” and then “Tech Reports.” The Appendix tables are summarized by year and are presented in Table 3 for the 1957-1961 Small Fish Survey and in Table 4 for the 1961 Trawl Survey. The tables show the percent frequency by species of crab, shrimps, other crustaceans, fish, mollusks, and “other species group” observed in stomachs with food contents. Pacific sanddab, sand, butter, dover, rex, and rock soles, and arrowtooth flounder were the flatfish species most often identified. Only one instance of halibut cannibalism was documented for either survey. The grey shrimp was the dominant prey species of the shrimp group, with only a trace of true shrimp found. Species making-up the “other species group” from the Small Fish Surveys (Table 3) are primarily invertebrates and marine worms, and are mostly marine worms from the Trawl Survey (Table 4).

Table 3. Percent frequency of prey species observed during the 1957-1961 Small Fish Survey in stomachs of halibut with food contents.

Food Species	1957	1958	1959	1960	1961	Weighted Average
Crab	17.4	22.5	12.8	11.5	24.4	16.3
Shrimp	26.6	30.9	17.6	24.0	24.7	24.4
Other Crustacean	5.6	5.9	12.6	7.4	1.4	6.5
Total Crustacean	49.6	59.3	43.0	42.9	50.5	47.2
Fish	46.8	34.8	55.5	51.5	43.7	48.0
Mollusk	0.9	0.4	1.3	1.3	3.2	1.5
Other Species Group	2.7	0.1	0.2	0.1	0.5	0.7
Digested Material	-	5.4	-	4.2	2.1	2.6

Table 4. Percent frequency of prey species observed during the 1961 Trawl Survey in stomachs of halibut with food contents.

Food Species	Portlock Bank	Chirikof Island	Shumagin Islands	Unimak Pass	Weighted Average
Crab	4.3	32.0	13.6	23.8	25.4
Shrimp	53.0	9.0	42.1	9.5	18.7
Other Crustacean	-	0.2	3.4	1.2	0.6
Total Crustacean	57.3	41.2	59.1	34.5	44.7
Fish	39.7	48.6	19.3	42.3	43.6
Mollusk	0.4	0.4	1.1	3.6	0.8
Other Species Group	-	0.3	15.4	1.2	1.9
Digested Material	2.6	9.5	5.1	18.4	9.0

The differences observed between years in the percent frequency of prey species (Table 3) probably reflect sampling and natural variability among years. The locations sampled are not exactly the same among years, the proportion of stomachs examined varied among locations, and the size distribution of halibut varied over the years. The prey species are almost equally divided among the crustacean and the fish groups, with shrimp and sand lance being respectively the predominant species. Crustaceans, especially shrimp, are the most numerous food prey group on the Portlock Bank and the Shumagin Islands region, whereas the fish group dominated food prey species for the Chirikof Island and the Unimak Pass regions. Our study does not provide data to determine if prey selection or different abundance accounts for the variability of prey species.

Tables 5 and 6 summarize the various food types found in the halibut stomachs, at different halibut ages, for the 1957-1961 Small Fish Survey and the 1961 Trawl survey, respectively. Small crustaceans (amphipods, copepods, isopods, euphausiids, and mysids, in that order), grey shrimp, larval crabs, and small crabs are the food species most often found in the stomachs of the 0-year group halibut (Table 5). Grey shrimp, crabs, small round fish, mostly sand lance, and crustaceans are the items most often found in the stomachs of the 1-year group. Fish species, especially sand lance, followed by shrimp and crabs, are the food items most often utilized by the 2 and 3-year-old halibut. The food species of the 4, 5, 6, and >6-year-old halibut are relatively stable and rank in order of importance with fish species, followed by the crab and shrimp species.

Table 5. Number of occurrences of various food types and percent frequency by prey species in the stomachs of 6,797 Pacific halibut, by ages, from the 1957-1961 Small Fish Survey.

Stomach Contents	Ages								Total
	0	1	2	3	4	5	6	>6	
Crab (Unident.)	24	225	206	123	71	50	15	4	718
Crab Larvae (Unident.)	42	-	-	-	-	-	-	-	42
Decorator Crab (Unident.)	-	-	2	1	4	3	-	-	10
Dungeness Crab	-	-	-	-	-	1	-	-	1
Hermit Crab (Unident.)	13	113	48	21	28	16	2	5	246
King Crab (Unident.)	-	-	-	-	1	-	-	-	1
Spider Crab (Unident.)	-	1	1	-	-	1	-	-	3
Tanner Crab (Unident.)	-	48	22	15	25	14	8	8	140
Mysid (Unident.)	3	-	-	-	-	-	-	-	3
Copepod (Unident.)	27	44	11	1	-	1	-	-	84
Isopod (Unident.)	2	33	27	16	12	4	2	-	96
Amphipod (Unident.)	177	68	6	3	3	-	1	-	258
Euphausiid (Unident.)	12	-	-	-	-	-	-	-	12
Shrimp Larvae (Unident.)	2	-	-	-	-	-	-	-	2
Shrimp (Unident.)	116	787	393	248	119	53	15	11	1,742
Ellpout (Unident.)	-	-	-	1	1	-	-	-	2
Greenling (Unident.)	-	-	1	-	-	-	-	-	1

Table 5. (continued)

Stomach Contents	Ages								Total
	0	1	2	3	4	5	6	>6	
Lanternfish (Unident.)	-	-	4	3	2	1	-	-	10
Lingcod	-	-	-	1	-	-	-	-	1
Pacific Cod	-	1	8	5	4	-	-	-	18
Pacific Halibut	-	1	-	-	-	-	-	-	1
Pacific Herring	-	-	2	15	20	5	5	1	48
Pacific Tomcod	-	-	6	5	1	2	-	-	14
Pacific Sandfish	-	6	11	12	15	9	2	-	55
Pacific Sand Lance	-	218	404	360	214	121	55	15	1,387
Prickleback (Unident.)	1	61	89	54	21	16	1	-	243
Rockfish Larvae (Unident.)	4	-	1	-	-	-	-	-	5
Rockfish (Unident.)	-	-	-	2	1	-	-	1	4
Salmon (Unident.)	-	-	-	-	1	1	-	-	2
Sculpin (Unident.)	-	24	30	10	6	3	-	1	74
Sea Poacher (Unident.)	-	15	3	7	11	5	3	1	45
Smelt (Unident.)	-	3	20	17	18	6	7	-	71
Fish Larvae, Ova (Unident.)	2	2	1	2	3	-	-	-	10
Round Fish (Unident.)	-	4	5	2	1	1	-	-	13
Flat Fish (Unident.)	-	32	72	59	19	12	2	3	199
Digested Fish Remains	6	296	355	246	196	79	36	12	1,226
Bivalve Larvae (Unident.)	1	-	-	-	-	-	-	-	1
Bivalve (Unident.)	-	5	34	24	5	8	3	3	82
Squid Larvae (Unident.)	1	-	-	-	-	-	-	-	1
Octopus (Unident.)	-	4	2	-	2	2	2	3	15
Snails (Unident.)	-	-	1	2	4	1	-	-	8
Marine Worm (Unident.)	2	3	2	2	2	3	1	-	15
Crustacean	8	1	1	1	-	-	-	-	11
Echinoderm	-	-	-	1	2	-	-	-	3
Invertebrate	-	1	6	3	11	7	2	-	30
Kelp	-	1	-	-	-	-	-	-	1
Digested Material	39	83	12	34	14	-	2	2	186
Total Food Prey	482	2,080	1,786	1,296	837	425	164	70	7,140
Number Of Stomachs Examined	444	2,170	1,657	1,236	732	358	146	54	6,797
Number Of Empty Stomachs	39	362	244	248	114	59	22	5	1,093
Crab	16.4	18.6	15.6	12.4	15.4	20.0	15.2	24.3	16.3
Shrimp	24.5	37.8	22.0	19.1	14.2	12.5	9.2	15.7	24.4
Other Crustacean	47.5	7.0	2.5	1.6	1.8	1.2	1.8	-	6.5
Total Crustacean	88.4	63.4	40.1	33.1	31.4	33.7	26.2	40.0	47.2
Mollusk	0.4	0.4	2.1	2.0	1.3	2.6	3.1	8.6	1.5
Fish	2.7	31.9	56.7	61.8	63.8	61.4	67.7	48.6	48.0
Other Species Group	0.4	0.3	0.4	0.5	1.8	2.3	1.8	-	0.7
Digested Material	8.1	4.0	0.7	2.6	1.7	-	1.2	2.8	2.6

Table 6. Number of occurrences of various food types and percent frequency by prey species found in the stomachs of 1,905 Pacific halibut, by ages, from the 1961 Gulf of Alaska Trawl Survey.

Stomach Contents	Ages								Total
	0	1	2	3	4	5	6	>6	
Crab (Unidentified)	-	15	76	150	88	30	34	8	401
Hermit Crab (Unident.)	-	-	2	9	5	3	2	-	21
Spider Crab (Unident.)	-	-	1	-	-	-	-	-	1
Tanner Crab (Unident.)	-	-	-	2	-	-	-	-	2
Amphipod (Unident.)	-	1	-	1	1	-	-	-	3
Shrimp (Unident.)	-	8	33	128	94	30	14	6	313
Ellpout (Unident.)	-	-	-	-	3	2	-	-	5
Pacific Sandfish	-	-	-	3	2	3	-	-	8
Pacific Sand Lance	-	1	11	46	44	19	4	4	129
Prickleback (Unident.)	-	-	3	4	3	-	1	2	13
Ronquil (Unident.)	-	-	1	-	-	-	-	-	1
Sculpin (Unident.)	-	-	-	4	6	2	3	1	16
Smelt (Unident.)	-	-	-	6	-	2	-	-	8
Walleye Pollock (Unident.)	-	-	-	-	2	-	1	-	3
Wrymouth (Unident.)	-	-	-	24	28	8	11	-	71
Round Fish (Unident.)	-	3	4	26	10	7	3	-	53
Flat Fish (Unident.)	-	-	-	3	5	1	-	-	9
Digested Fish Remains	-	8	59	111	146	43	35	12	414
Bivalves (Unident.)	-	-	-	-	-	1	-	-	1
Octopus (Unident.)	-	1	4	4	1	1	1	-	12
Marine Worm (Unident.)	-	25	2	1	2	-	-	-	30
Crustacean (Unident.)	-	5	-	2	-	-	-	-	7
Echinoderm	-	1	-	-	-	-	-	-	1
Invertebrate	-	-	-	1	-	-	-	-	1
Digested Material	-	7	35	68	30	5	3	2	150
Total Food Prey	-	75	231	593	470	157	112	35	1,673
Number Of Stomachs Examined	1	89	280	681	555	164	99	36	1,905
Number Of Empty Stomachs	1	18	60	173	161	34	21	5	473
Crab	-	20.0	34.2	27.1	19.8	21.0	32.1	22.9	25.4
Shrimp	-	10.7	14.3	21.6	20.0	19.1	12.5	17.1	18.7
Other Crustacean	-	8.0	-	0.5	0.2	-	-	-	0.6
Total Crustacean	-	38.7	48.5	49.2	40.0	40.1	44.6	40.0	44.7
Mollusk	-	1.3	1.7	0.7	0.2	1.3	0.9	-	0.8
Fish	-	16.0	33.8	38.3	53.0	55.4	51.8	54.3	43.6
Other Species Group	-	34.7	0.9	0.3	0.4	-	-	-	1.9
Digested Material	-	9.3	15.1	11.5	6.4	3.2	2.7	5.7	9.0

The “other species group” (marine worms), followed by crab, fish, and shrimp, are the most frequent prey species for 1-yr old halibut captured during the 1961 Gulf of Alaska part of the Trawl Survey (Table 6). The diet of 2-yr old halibut in that area consists in almost equal numbers of crab and fish species, followed by shrimp. Fish, crab, and shrimp are the principal prey species consumed by halibut of 3 or more years of age.

The data from the 1957-1961 Small Fish Survey indicate that young halibut feed on numerous prey species. Crustaceans, primarily shrimp and crab, and both benthic and nektonic fishes are the predominant species found in the stomachs of young halibut. The stomach contents of halibut from five separate locations were compiled to investigate if food consumption was similar among localities. Locations were chosen among those where over 750 halibut stomachs have been examined. The five locations, generally separated by hundred of miles of coast, accounted for 76.5% of the number of stomachs examined during the Small Fish Survey. The resulting data are presented in Table 7 by age class and location.

The data in Table 7 show variable importance of different prey items by location. The 0-year age group halibut feed almost exclusively on crustaceans, but on different species. For example, crab accounted for 50 percent of the species present in Alitak Bay,

Table 7. Percent frequency of food species found in the stomachs of 5,202 Pacific halibut, by ages, and originating from five locations in the Gulf of Alaska.

Location / Species Group	Age								Total
	0	1	2	3	4	5	6	>6	
<i>Shelikof Bay</i>									
Crab	4.9	2.5	4.7	4.2	3.9	8.0	9.4	-	4.1
Shrimp	24.7	50.0	36.9	23.9	13.5	12.0	6.2	-	32.5
Other Crustacean	57.1	13.7	15.9	6.5	9.7	4.0	9.4	-	18.5
Total Crustacean	86.7	66.2	57.5	34.6	27.1	24.0	25.0	-	55.1
Mollusk	0.4	0.4	0.9	1.2	1.9	-	-	-	0.7
Fish	1.6	32.7	41.2	64.2	71.0	76.0	75.0	85.7	42.0
Other Groups	-	-	-	-	-	-	-	-	-
Digested Material	11.3	0.7	0.4	-	-	-	-	14.3	2.2
No. Of Stomachs Examined	196	539	194	232	130	89	31	7	1,418
No. Of Empty Stomachs	9	78	24	34	17	13	3	1	179
<i>Kayak-Hinchinbrook Is.</i>									
Crab	20.0	40.4	5.6	3.6	9.2	15.6	6.7	10.0	12.5
Shrimp	13.3	25.3	11.1	1.0	2.3	-	-	-	6.4
Other Crustacean	60.0	-	-	-	-	-	-	-	1.4
Total Crustacean	93.3	65.7	16.7	4.6	11.5	15.6	6.7	10.0	20.3
Mollusk	-	1.0	-	-	0.6	-	-	-	0.3
Fish	-	22.2	81.9	79.6	79.8	84.4	90.0	80.0	70.0
Other Groups	-	-	-	-	-	-	-	-	-
Digested Material	6.7	11.1	1.4	15.8	8.1	-	3.3	10.0	9.4
No. Of Stomachs Examined	26	106	81	268	183	59	32	11	766
No. Of Empty Stomachs	12	23	20	86	34	18	7	1	201

Table 7. (continued)

Location / Species Group	Age								Total
	0	1	2	3	4	5	6	>6	
<i>Kachemak Bay</i>									
Crab	11.1	51.6	28.3	24.6	23.5	28.6	-	-	35.2
Shrimp	44.5	36.7	22.5	25.1	14.7	9.5	-	-	27.7
Other Crustacean	33.3	0.5	0.2	1.0	-	-	-	-	1.0
Total Crustacean	88.9	88.8	51.0	50.7	38.2	38.1	-	-	63.9
Mollusk	-	-	5.9	8.2	5.9	28.6	-	-	4.6
Fish	-	4.6	42.4	40.6	55.9	33.3	-	-	28.7
Other Groups	-	0.3	0.2	0.5	-	-	-	-	0.3
Digested Material	11.1	6.3	0.5	-	-	-	-	-	2.5
No. Of Stomachs Examined	18	377	401	205	33	17	1	-	1052
No. Of Empty Stomachs	2	50	61	55	6	4	1	-	179
<i>Cape Uyak-Halibut Bay Area</i>									
Crab	39.4	16.9	13.4	19.2	25.9	22.2	26.1	25.0	19.3
Shrimp	20.2	20.5	7.4	3.8	5.8	1.6	4.3	-	10.7
Other Crustacean	31.3	2.5	0.3	0.4	-	-	-	-	3.1
Total Crustacean	90.9	39.9	21.1	23.4	31.7	23.8	30.4	25.0	33.1
Mollusk	-	0.3	-	1.2	1.4	1.6	8.7	-	0.7
Fish	-	56.0	77.2	74.6	64.7	71.4	56.5	75.0	63.4
Other Groups	1.0	0.5	0.7	0.8	2.2	3.2	4.4	-	1.0
Digested Material	8.1	3.3	1.0	-	-	-	-	-	1.8
No. Of Stomachs Examined	99	404	352	195	98	42	15	4	1209
No. Of Empty Stomachs	9	73	31	21	7	4	1	-	146
<i>Alitak Bay</i>									
Crab	50.0	10.8	10.2	12.3	33.3	31.8	-	-	12.7
Shrimp	21.4	40.2	25.4	38.6	4.8	18.2	-	-	30.7
Other Crustacean	28.6	3.3	0.3	-	-	-	-	-	1.9
Total Crustacean	100.0	54.3	35.9	50.9	38.1	50.0	-	-	45.3
Mollusk	-	-	1.2	-	4.8	-	-	50.0	0.9
Fish	-	38.6	62.3	45.6	57.1	50.0	-	50.0	50.8
Other Groups	-	-	-	-	-	-	-	-	-
Digested Material	-	7.1	0.6	3.5	-	-	-	-	3.0
No. Of Stomachs Examined	15	298	353	55	18	16	1	1	757
No. Of Empty Stomachs	1	75	68	8	4	2	1	-	159

nine times more than in Shelikof Bay. Fish became the dominant prey species at different ages for different locations. Fish accounted for 50 percent or more of the species present for age-1 halibut in the Cape Uyak-Halibut Bay area, for age-2 halibut in the Kayak-Hinchinbrook and Alitak Bay areas, for age-3 halibut in the Shelikof Bay area, and for age-4 halibut in Kachemak Bay. The prey species present for halibut for all ages combined were dominated by crustaceans in the Kachemak Bay and Shelikof Bay areas, while fish were most present in the other areas.

Summary

The stomach contents data show that Pacific halibut appears to be an opportunistic feeder capable of consuming a large assortment of prey species. We cannot tell from our data if stomach contents contain few or many individuals of the species noted as present. Prey items included benthic and pelagic species. The data from the two trawl surveys suggest that crustacean and fish species occur at about the same frequency. While crabs were present about equally in both surveys, shrimp, small crustacean, and mollusk species occurred more frequently in the Small Fish Surveys. This difference may result from the shallower sampling that occurred on the Small Fish Surveys. Valuable commercial and non-commercial species of fish and crustaceans constitute the diet of young halibut. However, in term of species present, the non-commercial crustacean and fish species appear to sustain a significant share of the halibut predation.

Acknowledgements

We are particularly grateful to Steve Hoag, Gregg Williams, and Lauri Sadorus of the IPHC staff for critically reviewing the manuscript and providing helpful suggestions. We also thank former staff of the IPHC for collecting and processing the stomach samples, and Richard A. Kautz and Ian R. McGregor who organized and condensed the data.

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