

**REPORT OF THE
INTERNATIONAL PACIFIC HALIBUT COMMISSION**

APPOINTED UNDER THE CONVENTION BETWEEN CANADA AND THE
UNITED STATES OF AMERICA FOR THE PRESERVATION OF THE
NORTHERN PACIFIC HALIBUT FISHERY

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**REGULATION AND INVESTIGATION
OF THE PACIFIC HALIBUT
FISHERY IN 1956**

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FOREWORD

The 1953 Convention between the United States and Canada for the Preservation of the Halibut Fishery of the Northern Pacific Ocean and Bering Sea provides that the International Pacific Halibut Commission, formerly designated the International Fisheries Commission, shall report upon its activities and investigations from time to time.

Twenty-four reports have been issued prior to the present one which is the tenth of a series of annual reports that were commenced in 1947 to provide a brief summary of the Commission's activities during the year.

Those desiring more extensive background material than included herein are referred to previous reports.

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HALIBUT FISHERY IN 1956**
BY
INTERNATIONAL PACIFIC HALIBUT COMMISSION

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HISTORICAL BACKGROUND

The Pacific halibut fishery from its beginning in 1888 has been prosecuted jointly by the fishing fleets of Canada and the United States. The annual catches increased with the growth of the fishery and the exploitation of new fishing grounds until 1915, in which the catch was 69 million pounds. Thereafter, in spite of greatly augmented fishing and the inclusion of more and more grounds, annual catches declined to a level of about 50 million pounds.

International control of the fishery was urged as early as 1915 on account of indications of a decline in the yield from the longer-fished grounds. Subsequent trends demonstrated the need for such action and culminated in a convention for the preservation and development of the fishery. This was signed by the United States and Canada in 1923 and ratified in 1924.

The Convention of 1923 established a three-month winter closed season, first effective in November 1924. It provided for the appointment of the International Fisheries Commission with two members from each country to investigate the fishery and to recommend measures for its preservation. Each country undertook to pay the expenses of its own members and one-half of the joint expenses of the Commission.

After intensive scientific investigations had shown that the stocks of halibut were in an overfished, low-yielding state and that the statutory three-month winter closed season alone was not effective in stopping intensification of the fishery and further decline, the Commission recommended additional remedial measures to the two Governments.

A new convention was signed in 1930 and ratified in 1931. This continued the Commission and the closed season. It empowered the Commission to change or suspend the closed season; to divide the convention waters into areas and to limit the catch of halibut to be taken from each during its fishing season; to regulate the licensing and departure of vessels for purposes of the convention; to collect statistics; to fix the type of gear to be used; to close grounds found to be populated by small immature halibut; and to conduct such investigations as were necessary into the life history of the halibut. Implementing legislation made enforcement of any regulations that might be adopted under the Convention the responsibility of the individual governments.

A third convention was signed and ratified in 1937, extending the Commission's previous regulatory authority. It provided for control of the capture of halibut caught incidentally to fishing for other species in areas closed to halibut fishing and for prohibiting the departure of vessels to any area when those which had already departed would suffice to take that area's catch limit.

Under regulation which began in 1932, the stocks on some grounds had doubled in size by 1940. Larger individual catches were made with one-half the fishing effort. As the density of the stocks increased, the Commission from time to time increased the annual catches allowed. The policy followed was to hold the annual catches from the stocks slightly below the additions being made by growth and new recruits. The total coast catch reached 54 million pounds in 1940 and almost 58 million pounds in 1950.

During this period the much larger catches per trip and a greatly increased fleet sharply reduced the length of the fishing season. It became evident that, because the stocks of halibut on the different grounds were not equally available at all times

of the year, some were no longer contributing to the fishery in the proportion of which they were capable. After the end of World War II, in 1946, the Commission recommended to the governments treaty changes that would enable it to broaden the period of the year over which halibut might be caught. Most important of these recommendations was one which would permit more than one fishing season in an area during a single year.

Between 1951 and 1953, pending action upon the Commission's recommendations, three underfished sections of the coast were closed to fishing during the regular season and opened at a more appropriate time when other sections were closed. A significant increase in the utilization of their underfished stocks resulted and the total annual catch reached 60 million pounds.

A fourth halibut convention, signed and ratified late in 1953, has given the Commission broader powers including authority to establish one or more open or closed seasons each year in any area. It has increased the responsibilities of the Commission by requiring development of the stocks of halibut to levels which will permit maximum sustained yield and maintenance of the stocks at those levels. The convention also changed the name of the Commission to International Pacific Halibut Commission and increased its membership from four to six Commissioners, three from each country.

The responsibilities of the Commission were further augmented by the International North Pacific Fisheries Convention, signed and ratified in 1953 by the United States, Canada and Japan. This requires Canada and the United States not only to develop the stocks of halibut and maintain them at levels of maximum productivity but also to demonstrate that they are being fully utilized.

To fulfill its duties under the new convention the Commission in 1954 undertook a broad 10-year program of research to secure the factual information which would permit it to adopt regulations required for attainment of maximum sustainable yield. It requested additional funds to provide for the greater expense of administering multiple open seasons and of conducting the new research program. A beginning was made on this program in the latter half of 1955 when the requisite funds were made available.

Under authority of the new convention, the period of fishing was extended in 1954 by the use of multiple open seasons with intervening closed periods. The use of multiple open seasons was continued without significant change in 1955 and 1956.

In 1954, under very favorable operating conditions, the total catch from all areas reached an all-time high of 71,200,000 pounds. During 1955, very unfavorable weather conditions prevailed throughout the entire period of fishing and reduced the total catch to 59,100,000 pounds. In 1956, under more normal operating conditions, the total Pacific coast catch was 67,500,000 pounds. The average of the 1954 to 1956 catches was 22 million pounds greater than the annual total in 1931, the year preceding regulation. At current dockside prices to the fishermen, this average gain in production was worth about \$3,800,000 annually, nearly twice the usable funds appropriated by both countries for the Commission during the 33 years of its existence.

The multiple-season system of regulation during these three years has spread fishing over a longer season. It has increased fishing on underfished grounds and the annual yield from these.

ACTIVITIES OF THE COMMISSION

In 1956 the Commission completed its twenty-fifth year of regulation of the halibut fishery and carried forward the statistical and biological investigations that form the basis for current and future regulation.

The members of the Commission from the United States in 1956 were: Mr. Seton H. Thompson, Washington, D.C., elected Chairman; Mr. J. W. Mendenhall, Boulder Creek, California; and Mr. Mattias Madsen, Seattle, Washington. The Canadian members were: Mr. S. V. Ozere, Ottawa, Ontario, elected Vice-Chairman; Mr. Richard Nelson, Vancouver, British Columbia; and Mr. Harold S. Helland, Prince Rupert, British Columbia.

The Commission held its regular annual meeting at its office in Seattle from January 20 to January 26 inclusive. On January 20, it met with a newly-formed Industry Advisory Group consisting of representatives of the fishermen, the vessel owners, and the dealers in Alaska, in British Columbia, and in Washington. On January 23, the research program for 1956, budget needs, and other administrative matters were considered. On January 24, a joint meeting was held with representatives of the Pacific coast halibut industry for a review of the 1955 fishery and a presentation of the results of investigations. There was also a general discussion of several suggestions regarding regulation in 1956. On January 25, the Commission conferred separately with wholesale halibut buyers, and with representatives of the vessel owners and fishermen to receive their respective recommendations regarding regulation of the fishery in 1956.

On the last day of the meeting, January 26, the Commission considered the proposals of the industry in the light of conditions in the stocks and in the fishery and adopted regulations for 1956. A press release, summarizing the regulatory changes that were being recommended to the two Governments, was subsequently issued for the information of the industry and the public.

During the fishing season the Commission determined the dates upon which the area catch limits should be attained, announced these dates in advance, and closed the areas accordingly.

THE 1956 REGULATIONS

The Pacific Halibut Fishery Regulations for 1956 were approved by the Governor General of Canada on April 12 and by the President of the United States on April 18 and became effective on the latter date.

The regulations were not changed materially from those of 1955. Due to the abnormal fishing conditions that prevailed during the 1955 season, the scientific investigations had not been able to provide the necessary confirmation of the effects of the multiple seasons inaugurated in 1954. Consequently, the Commission decided against any change in the regulations which would alter either the amount or the disposition of fishing during 1956.

The five regulatory areas in 1956, shown in Figure 1, were: Area 1A, the waters off the northern California and southern Oregon coasts, south of Heceta Head, Oregon; Area 1B, the waters off the Oregon and Washington coasts between Heceta Head and Willapa Bay, Washington; Area 2, the waters between Willapa Bay and Cape Spencer, Alaska; Area 3A, from Cape Spencer to Kupreanof Point, near the Shumagin Islands, Alaska; Area 3B, all convention waters west of Area 3A including those of the Bering Sea.

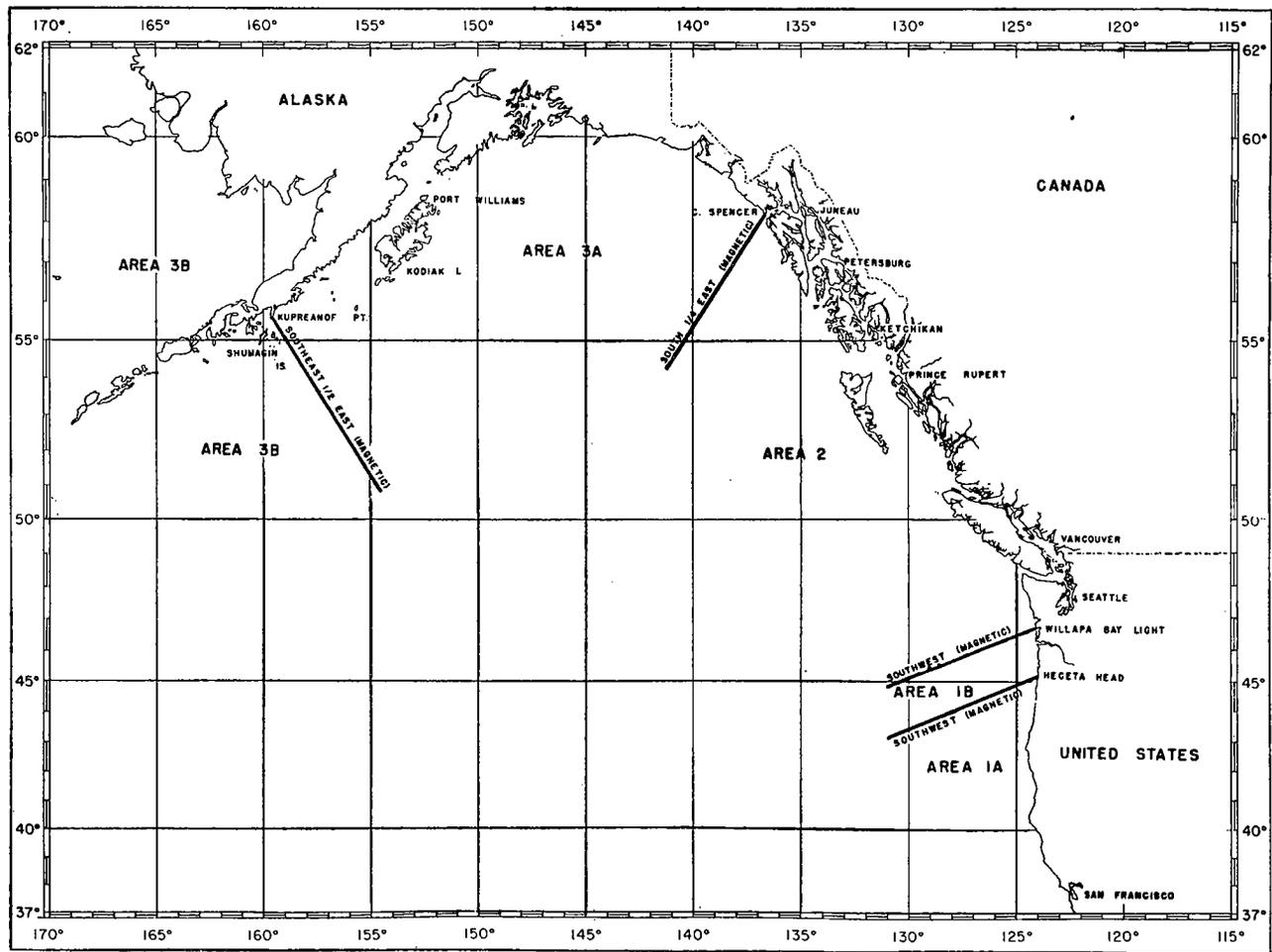


Figure 1. Pacific Coast of North America showing regulatory areas defined by the International Pacific Halibut Commission in 1956.

Catch limits of 26,500,000 pounds during the first season in Area 2 and of 28,000,000 pounds in Area 3A were provided as in 1955. Fishing in other areas and other seasons, in which the total catch of halibut is comparatively small, was controlled by length of season.

Vessels fishing for crab in the Bering Sea with bottom nets of 12-inch or larger mesh were again permitted to retain a limited proportion of halibut caught incidentally to such fishing between May 12 and November 15 inclusive.

Other regulatory provisions were also continued as follows: a minimum size limit of 26 inches heads-on, or five pounds heads-off for halibut; the closure of two nursery areas, one off Masset in northern British Columbia and one off Timbered Islet in southeastern Alaska; the prohibition of the use of dory gear and nets of any kind in fishing for halibut; the termination after November 15 of permits for the retention and possession of halibut caught incidentally by setline gear during fishing for other species in Areas 1A, 1B, 2, 3A and 3B; and, the beginning of the statutory closed season after November 30 in any area that might still be open by reason of the non-attainment of the catch limit which otherwise determined its closure.

The fishing season in all areas was opened on May 12. Area 1A was closed to halibut fishing on October 23. The first seasons in Areas 1B and 2 were terminated on June 27 and the first seasons in Areas 3A and 3B on August 24, at which dates it was deemed that the catch limits set for Areas 2 and 3A respectively would be attained. A number of factors contributed to the lengthening of the first seasons in 1956, chief of which were the fleet's 8-day voluntary delay in starting fishing and a voluntary 7-day lay-in between trips. Second seasons of seven days in Areas 1B and 2 and of nine days in Areas 3A and 3B commenced on September 9. A third season of 23 days in Area 3B commenced on September 30 and terminated on October 23. The lateness of the second and third seasons resulted from the prolongation of the first season in Areas 3A and 3B.

STATISTICS OF THE FISHERY

LANDINGS FROM REGULATORY AREAS

Landings during 1956 from groups of regulatory areas that correspond to the original Areas 1, 2 and 3 are shown in the following table and compared with landings for 1953, 1954 and 1955, and with those at intervals back to 1931, the year immediately prior to the commencement of regulation by the Commission.

UNITED STATES AND CANADIAN CATCHES BY REGULATORY AREAS

Year	Areas 1A, 1B*	Area 2**			Area 3***			All Areas		
	U.S.	U.S.	Can.	Total	U.S.	Can.	Total	U.S.	Can.	Total
1931	923	14,609	7,018	21,627	20,907	765	21,672	36,439	7,783	44,222
1940	779	15,362	12,254	27,616	25,266	646	25,912	41,407	12,900	54,307
1950	392	12,862	14,184	27,046	25,396	4,815	30,211	38,650	18,999	57,649
1953	383	14,832	18,175	33,007	19,447	7,678	27,125	34,662	25,853	60,515
1954	674	19,165	17,574	36,739	23,841	9,952	33,793	43,680	27,526	71,206
1955	650	15,717	13,027	28,744	20,595	9,121	29,716	36,962	22,148	59,110
1956	604	20,291	15,149	35,440	21,014	10,475	31,489	41,909	25,624	67,533

*South of Willapa Bay, Washington

**Willapa Bay to Cape Spencer, Alaska

***West of Cape Spencer

All poundages given in the tables are in thousands of pounds. They are corrected for amounts declared from the wrong area and include amounts of halibut caught in contravention of the regulations. All 1956 figures in this report are preliminary and subject to minor change.

The landings from Areas 1A and 1B are combined and correspond to those from original Area 1. The halibut stocks in these areas, at the southern extremity of the commercial range of the species, are relatively small and no catch limits have been placed upon them. The combined annual catch from them has been about one-half million pounds in recent years. The increase since 1954 has resulted from a change in the regulations providing for Area 1A to remain open to halibut fishing as long as any other area is open. This extended the Area 1A season well into September in 1955 and into October in 1956 instead of into July or August as in other recent years.

The total catch from Area 2 was 35.4 million pounds from all sources in 1956. This was considerably above the 1955 total of 28.7 million pounds but lower than in 1954 when the catch reached a 40-year high of nearly 37 million pounds.

The catch in Area 2 during the first season of 38* days amounted to about 26.8 million pounds and approximated the catch limit of 26.5 million pounds. The difference represents but a small fraction of a day's fishing by the Area 2 fleet. The catch during the 7-day second season, commencing September 9, amounted to 7.6 million pounds compared to 5.4 million pounds and 9.4 million pounds during the second seasons in 1955 and 1954 respectively.

Included in the combined total landings from Area 2 in the preceding table are 756,000 pounds of halibut caught incidentally to fishing for other species under permit after the area was closed to halibut fishing. Such catches were below those of 1954 and 1955 as permit fishing in September, normally a very active period of blackcod fishing, was reduced by the occurrence of the second halibut fishing season in that month in 1956. Also, the unexpected appearance of albacore in northwest waters attracted a number of vessels from the blackcod fishery.

All 1956 catches from Areas 3A and 3B are combined in the preceding table to make them comparable to the catch from Area 3 of earlier years. They amounted to 31.5 million pounds compared to 29.7 million pounds in 1955 and 33.8 million in 1954.

The catch in Area 3A during the first season of 96* days amounted to 29.3 million pounds, about 1.3 million pounds over the 28.0 million pound catch limit provided in the regulations for that season. In 1955 the catch taken in a 84-day season was about three-quarters of a million pounds below the catch limit. The 1955 season was greatly prolonged primarily by the unduly bad weather, and that of 1956 chiefly by the voluntary between-trip lay-ins of the fleet.

During the second season of 9 days in Area 3A a catch of 1.5 million pounds was taken. This was about the same as in 1955 but considerably below the 3.4 million pound total of 1954.

In Area 3B during the first and second seasons only about 292,000 pounds were caught, including 284,000 pounds of dead fish retained by the Commission's tagging vessel. The fishing boats largely remained to the eastward of the area as in 1954 and 1955.

*The legal season opened in all areas May 12 but due to a voluntary delay in fishing by all fleets the effective opening date was May 20.

During the third season of 23 days in Area 3B, commencing on September 30, the catch totaled 397,000 pounds compared to 934,000 pounds in 1955 and 611,000 pounds in 1954 when the third season occurred in September. The increase in 1955 is largely attributable to a change in the eastern boundary of the area which facilitated operations and made the fishery attractive to more vessels. The decline in 1956 is a result of the great prolongation of the first season in Area 3A which delayed the third season in Area 3B until October, an unattractive time of year to fish this area on account of weather. A limited portion of the catch was taken by the setline fleet on the Bering Sea side of the Aleutian Peninsula.

United States and Canadian landings from all areas in 1956 amounted to 67.5 million pounds compared to 59.1 million pounds in 1955 and to 71.2 million in 1954. The lower amount in 1955 resulted chiefly from a 6.0 million-pound reduction in yield from the second fishing seasons in Areas 2 and 3A and deficits in the catch-limit landings taken in the two areas. The higher catch in 1954 was due mainly to the fact that 1954 was the first year of multiple seasons, with a large production during the second seasons when fishing was being conducted to a considerable extent upon accumulated stocks that had been relatively unfished for a number of years.

LANDINGS BY PORTS

The distribution of halibut landings from all areas according to regions and ports or groups of ports is shown for various years in the following table.

LANDINGS BY REGIONS AND PORTS FROM ALL AREAS BY
UNITED STATES AND CANADIAN VESSELS COMBINED

Year	Calif. and Oregon	Washington		Alaska		British Columbia			Total	
		Seattle	Other Ports	SE Alaska	Western Alaska	Vanc- ouver	Prince Rupert	Other Ports	Can. Ports	U.S. Ports
1931	892	15,032	202	8,240	1,482	1,066	16,792	516	18,374	25,848
1940	1,014	19,203	258	9,544	182	1,907	18,765	3,434	24,106	30,201
1950	723	7,473	1,465	21,008	4,367	1,096	17,020	4,497	22,613	35,036
1953	622	13,192	1,706	14,589	3,625	4,572	18,086	4,123	26,781	33,734
1954	1,061	16,270	1,510	19,493	3,408	5,892	18,187	5,385	29,464	41,742
1955	737	14,521	1,992	14,233	5,025	5,230	14,626	2,746	22,602	36,508
1956	773	14,248	2,669	20,696	3,200	7,631	15,855	2,461	25,947	41,586

While the distribution of landings in 1956 was generally similar to 1955, there was some tendency for landings to increase in the home ports of the fishing vessels as a result of their voluntary between-trip lay-in program. This reduced the proportion of the catch landed in western Alaska to the level that prevailed prior to 1955.

CATCH PER UNIT FISHING EFFORT

All halibut vessels of five net tons or over are required to keep records showing the date, fishing location, amount of gear fished and estimated catch of halibut in pounds for each fishing operation. By dividing the catches by the amount of gear fished the average return per standardized unit of fishing effort is obtained. Such returns per unit effort are then compared to ascertain whether changes in relative abundance have occurred and to measure the magnitude of such changes.

In Area 2 the catch per unit effort during the first or May-June season recovered

to nearly the 1954 level from the lower level of 1955 in which weather and other factors had sharply reduced the availability of fish.

During the second season in Area 2 the catch per unit effort relative to that of the first season declined slightly each year to 142 percent of the first season value in 1954, to 136 percent in 1955 and to 121 percent in 1956. Such a declining ratio might be expected in view of the removals in each of these years from what appeared to be accumulated and to some extent unfished segments of the stocks.

Some grounds in Area 2, such as Cape Scott and Goose Island, failed to show any recovery during the first season in 1956 from the 1955 low. The second season on these grounds has also witnessed a sharp reduction in catch per unit effort in each of the past three years. Any continuation of this situation will require a critical evaluation of the effects of the recent larger removals from these grounds.

On the other hand, lower and middle Hecate Strait, which have been subjected to an increased amount of fishing for the past six years, first from the special fishery in the area from 1951 to 1953 and from the multiple seasons since 1954, have indicated a capacity to sustain such increased removals. The catch per unit effort during the first and second seasons and the ratio between the two have shown no decline during the past three years.

The very productive grounds in upper Hecate Strait have also apparently sustained the increased removals brought about by the multiple seasons of the past three years. The catch per unit effort during the first season has shown a steady increase during the period, and only a normal decline has occurred during the second seasons.

In southeastern Alaska, where only modest increases in catch have resulted from the multiple seasons, the catch per unit effort has been well maintained during both seasons on both the "inside" and the "outside" grounds.

In Area 3A during the first season in 1956 the catch per unit effort recovered from the low level of 1955, in which year weather seriously interfered with effective fishing, but was still slightly below the 1952-1954 level. During the second season in 1956 the catch per unit effort was lower than during the first season and much lower than during the second seasons in 1954 and 1955. The production potentialities of the Area 3A stocks must be judged accordingly.

In the Cape Spencer-Cape St. Elias section of Area 3A the catch per unit effort during the first season in 1956 was only slightly higher than in 1955 and well below the 1954 level. Insufficient fishing has been conducted on these grounds during the second seasons to indicate the stock conditions there.

The important Cape St. Elias-Trinity Islands section provided a catch per unit effort during the first season in 1956 well above the 1955 low and nearly reached the 1952-1954 levels. During the second season there has been a sharp decline during the past three years.

The remaining section of Area 3A extending from Trinity Islands to Shumagin Islands, has shown a capacity to sustain the significant increases in catch of the past three years although in 1956 the catch per skate during the second season dropped sharply from the level of 1954 and 1955 and was much lower than the level of the first season in 1956. The latter condition may have been caused by the much heavier removal of stock from these grounds during the first season in 1956.

MULTIPLE OPEN SEASONS

From 1954 to 1956 all areas except Area 1A, south of Heceta Head, Oregon, were opened in May for a first season and in August or early September for a second season. Area 3B was reopened for a third season in each of the three years.

The lengths of the fishing seasons in each of the three areas are shown below for the several areas. The length of the single season in Area 1A was determined by the final closing date of Area 3B. In other areas, the lengths of the first seasons were determined by the dates upon which the Commission deemed that the catch limits set in the regulations for Areas 2 and 3A would be taken. The closing date of Area 2 applied to Area 1B and that for Area 3A to Area 3B.

LENGTH OF SEASONS, IN DAYS

Area	First Season			Second Season			Third Season		
	1954	1955	1956*	1954	1955	1956	1954	1955	1956
1A	117	132	156	—	—	—	—	—	—
1B	21	24	38	8	7	7	—	—	—
2	21	24	38	8	7	7	—	—	—
3A	58	84	96	10	9	9	—	—	—
3B	58	84	96	10	9	9	25	23	23

*Though the legal opening date was May 12, the lengths of the seasons were calculated from May 20 due to an 8-day voluntary delay by the fleets in starting fishing.

The second season in Areas 2, 3A and 3B commenced on August 1 in 1954, and in 1955 on August 14, eighteen days later than the originally planned date of July 27. The delayed opening in 1955 was occasioned by the prolongation of the first seasons in Areas 3A and 3B chiefly arising from bad weather, and by provision in the regulations for an interval of not less than 10 days between the first and second seasons. In 1956 the second seasons commenced on September 9. The lateness of the second season in this year was caused by the delayed termination of the first season in Areas 3A and 3B due to the voluntary lay-in program, and to provision in the regulations for an interval of 16 days between the first and second seasons.

The combined catch resulting from the reopenings of the areas in 1956 amounted to 9.5 million pounds. The total catch for the three years amounted to 30.7 million pounds or a yearly average of about 10.2 million pounds.

The catches and number of regular halibut vessels participating in the second and third seasons in 1954, 1955 and 1956 are shown by areas in the following table.

CATCH AND NUMBER OF REGULAR HALIBUT VESSELS FISHING IN 1954, 1955 AND 1956 DURING THE SECOND SEASONS IN AREAS 2 AND 3A AND THE THIRD SEASONS IN AREA 3B

	AREA 2		AREA 3A		AREA 3B*		ALL AREAS	
	Catch	No. of Vessels	Catch	No. of Vessels	Catch	No. of Vessels	Catch	No. of Vessels**
Canada 1956	2,684	73	305	9	243	6	3,232	82
U.S. 1956	4,917	231	1,180	42	154	4	6,251	273
Total 1956	7,601	304	1,485	51	397	10	9,483	355
Total 1955	5,376	188	1,439	37	934	21	7,749	225
Total 1954	9,382	230	3,447	79	611	14	13,440	309

*In 1956 an additional catch of 292,000 pounds was made during the first season in Area 3B, making the total for the year 689,000 pounds.

**Exclusive of duplication caused by vessels fishing in more than one area.

Comparison of the distribution of fishing and catches from 1954 to 1956 with corresponding data for previous recent years has shown that the application of multiple seasons has, as intended, had the effect of increasing the amount of fishing and the catch on some grounds which had come to be underfished under the previous single-season method of regulation. Also, the catch per unit effort has indicated that the halibut on these grounds have sustained this increased drain upon them satisfactorily. However, catch per unit effort data also suggests that some other grounds, which were heavily fished prior to 1954 and are still being heavily fished during the first season, are being fished beyond their present productive capacity under the current seasonal pattern of fishing and that some modification of the fishing seasons on those particular grounds may be necessary to reduce the catches from them to justifiable levels.

COMPOSITION OF CATCHES

Study of the composition of the halibut stocks on different fishing grounds was carried forward using samples of length measurements and age materials obtained from the commercial landings and collected at sea during the Commission's tagging operations.

Sixty commercial trips from various grounds between Cape Flattery and Bering Sea were sampled at Seattle and 57 at Prince Rupert. Over 52,000 length measurements and 16,000 otoliths were secured from the above trips, and tagging operations provided another 7,000 otoliths and measurements. The distribution of the commercial samples was approximately proportionate to the geographical distribution of production along the coast.

The size composition of the 1956 catches from the intensively fished section of Area 2 between Goose Island and upper Hecate Strait and from the heavily fished Portlock Bank-Albatross Bank section of Area 3A continued the previously-observed declining trend in numbers of chicken halibut (5 to 10 pounds) and the increasing trend in the number of large fish (over 60 pounds).

The age composition of the landings from Goose Island in Area 2 showed that the catch continued to be largely maintained by the older age classes, particularly those over 12 years of age. The 6 and 7-year olds that entered the catch strongly in 1955 became the dominant groups in numbers as 7 and 8-year olds in 1956.

The age composition of the 1956 catches from upper Hecate Strait shows that the stocks on these grounds appear to be maintaining themselves under the increased removals of recent years. The fish over 12 years old in 1956, as in the previous three years, contributed more heavily to the catch than they did in the early 1950's when comprehensive sampling of the catches was started on this region of the coast. The fish 7 years and younger that made a strong entry into the Goose Island catches in 1955, showed up strongly in upper Hecate Strait in 1956, one year later. These young age classes were more abundant in 1956 than in any other year of sampling which commenced in this region in 1950.

In Area 3A, though the fishery continued to depend mainly on the 11 to 16-year olds for the weight of the catches, there was a strong entry of younger fish. The 8-year olds from the 1948 brood class made the strongest entry observed for any 8-year group since 1943. The 1946 brood class, as 10-year olds, made a relatively large contribution to the catch despite a weak appearance in 1954 and 1955.

The 1944 brood class, 12-year olds in 1956, was still the dominant contributor

in numbers and weight to the catches. This group, spawned at the high stock level of 1944, has been the dominant age class on all the grounds west of Cape Spencer, including the Bering Sea, since 1954.

The important weight producing classes over 11 years of age in Area 3A showed the same trend of decline in numbers throughout the first season as was observed in 1955, but were at a generally lower level of abundance. Fish over 15 years of age have tended to display a slight recovery in availability in the late seasons, in August of 1954 and 1955, and in September of 1956, but to be at a progressively lower level each year. Fish under 11 years of age, which were less abundant in 1955 than in 1954, showed a promising recovery in 1956 due primarily to the strong entry of the 1946 and 1948 year classes.

Studies of the change in age composition with time in Area 3A indicated that there had been a downward trend since 1939 in the number of fish of all age classes with an increase in the average weight at each age.

The age composition of 1956 samples from the Shumagin Islands in Area 3B showed little change from 1955 and displayed no significant seasonal differences. The 1944 and 1946 year classes were again strongly represented. There was a slight increase in average weight at each age as the season progressed which may have been due to changes in sex composition.

Samples taken from the Makushin Bay and Unalaska region of the Bering Sea by the Commission's tagging vessel POLARIS continued to show the greater abundance of young fish in this area observed in market samples taken from the commercial fishery from 1952 to 1954. Individuals of the 1944 and 1946 brood years were especially abundant in this area.

A concentration of halibut was found by the POLARIS on a "spot" upon the 100-fathom edge northwest of Unimak Pass in Bering Sea. It contained large numbers of small fish and showed the same strong 1944 and 1946 year classes as were found south of the Alaska Peninsula. It also contained many older fish, some up to 31 years of age, whose average weight at each age was well below that found elsewhere in Area 3B.

The composition of the catch suggested that the spot might contain a semi-isolated segment of stock. The catch included an above-normal number of large, grey halibut such as have been found on spots elsewhere on the coast. This condition was observed frequently in the early years of the fishery in the various areas but infrequently after the fishery had expanded throughout the entire range of the species. Such spots, particularly at the margins of the species' distribution, have failed to maintain any significant production after their initial exploitation.

GROWTH RATE STUDIES

Observations of the lengths and weights of halibut of comparable ages from various fishing grounds over a number of years have revealed that the growth rate of the fish has varied from bank to bank and has changed from one period to another. The changes were particularly apparent in samples of halibut from grounds west of Cape Spencer where commercial exploitation started more recently.

The halibut on the grounds west of Cape Spencer in the late 1920's were smaller at the same age than those in the 1950's. The former had lived part of their lives under the crowded stock conditions that existed prior to the development of a fishery.

The latter had lived part of their lives under the relatively low stock densities of the 1930's and early 1940's. The changes in growth rate appeared to be in keeping, to some extent, with the changes that had occurred in the density of the stock.

Detailed studies of growth were undertaken in 1956 and specific personnel assigned to that task. Objectives are to determine when and where changes have occurred and are occurring and, ultimately, to ascertain their causes. The method selected for trial was one which uses measurements of the widths of the annual growth zones in the otoliths to calculate the lengths of fish at each earlier age. This method would make possible the reconstruction of the pattern of growth of individual year classes of fish covered by past and current age materials.

At the outset it was necessary to determine whether there was a consistent relationship between otolith radius and body length of halibut irrespective of age. Such a relationship was demonstrated and described, using otoliths of halibut from sub-commercial to the largest commercial sizes and ranging in time from 1927 to 1956 and in space from Portlock Bank to the Bering Sea.

The validity of calculations of length based upon the otolith-radius and body-length relationship was then tested by measuring otoliths of recovered tagged fish which are measured at the time of tagging and again when recovered. Otoliths from several year classes of halibut which had been out 3 and 4 years were used. The actual average lengths at tagging were satisfactorily between the calculated average lengths for the winter before tagging and the winter after tagging.

Upon completion of the above preliminary work, samples from Portlock Bank in 1927 and 1951, from Shumagin Island ground in 1929 and 1950, and from the Bering Sea grounds in 1930 and 1956 were measured and the growth of individual year classes from the time they entered the fishery until capture were calculated. A great increase in growth from early to recent years was found.

TAGGING EXPERIMENTS

The tagging program was continued to increase knowledge of the relationship between the halibut on different banks and between stocks on the same grounds at different seasons of the year, and the contribution of each to the current fishery. Two halibut vessels were chartered for the purpose in 1956.

The vessel POLARIS was operated for five months from mid-April to mid-September in Area 3B. Seven trips were made, three in the vicinity of the Shumagin Islands, two on the Bering Sea side of Unalaska Island and two in southern Bering Sea. A total of 4,674 halibut, weighing approximately 194,000 pounds, were tagged from a catch of 496,000 pounds.

The Shumagin Island experiments provided early, middle and late season tagging and those at Unalaska Island provided early and late season tagging to study movements and seasonal changes in availability. The Bering Sea operations were of an exploratory nature but proved to be a very successful phase of the program. While they demonstrated a virtual absence of halibut in the shoal waters of the eastern Bering Sea, they also located the previously-mentioned spot with its accumulation of halibut on the 100-fathom edge between Unimak Pass and the Pribilof Islands. Two experiments were begun in this location, one in late spring and one in late summer. This spot, though limited in extent, may provide a few boats with profitable fishing from time to time in future years.

The PACIFIC was chartered for one and one-half months in November and December and operated on the Yakutat and "W" spawning grounds in the eastern part of Area 3A. Two trips were made and 588 fish weighing 23,000 pounds were tagged from a total catch of 59,000 pounds.

Operations of the PACIFIC were hampered by continuous bad weather. The catches were small and left doubt as to whether the fish had been late in reaching the spawning grounds or whether the density of the spawning stock was below that of the mid-1930's when winter fishing last occurred there. To explore these questions, arrangements were made to resume the charter for one trip in January 1957.

The time and location, the amount of fishing and catch and the numbers and weights tagged are given for each trip in the following table.

Trip	Locality	Month	No. Skates Fished	Number Tagged	Pounds Tagged	Total Catch
POLARIS						
1	Shumagin Gully	May	355	527	22,745	106,328
2	Makushin Bay - Akun Area	May-June	186	182	5,259	12,065
3	Bering Sea	June	474	1,715	62,588	135,220
4	Shumagin Islands	July	485	704	43,301	89,891
5	Makushin Bay Area	July-August	393	496	19,383	52,355
6	Bering Sea	August	383	790	28,752	69,771
7	Shumagin - Trinity	September	266	260	11,777	30,140
PACIFIC						
1	Yakutat and "W"	November	119	120	3,389	8,611
2	Yakutat and "W"	December	292	468	19,877	49,987
TOTAL			2,953	5,262	217,071	554,368

Tags recovered and returned by the fishery in 1956 from all experiments totalled 1,576 compared with 783 and 1,584 in 1955 and 1954 respectively. The 1955 experiments on the Goose Island grounds accounted for 563 or more than one-third of the 1956 recoveries. The large number of recoveries from these experiments was normal in view of the large numbers marked and the high intensity of the fishery operating on the Goose Island grounds.

A summary of recoveries in 1956 from the 1953 to 1955 tagging experiments is compared with 1955 recoveries in the table on page 18.

Longline and troll gear recovered 1,449 tags during the two fishing seasons in 1956. Of these, 1,199 or 83 percent were taken in the first season and 250 or 17 percent in the second season. These proportions appeared to hold for experiments in all sections of Area 2. In 1954 and 1955 the proportion of second-season recoveries was higher in lower Hecate Strait and in southeastern Alaska than it was elsewhere. From this it seems that the second season in 1956 did not provide better utilization of late-appearing stocks as it did in 1954 and 1955, possibly because the first season was prolonged in 1956 to approximately the time of the second seasons in 1954 and 1955.

The first returns from 1955 Masset and Timbered Islet nursery-ground tagging were made in 1956. The Masset experiment produced 109 recoveries from the 2,535 tags released, a recovery of 4.3 percent which agreed well with first-year returns of 2.9 percent from a 1947 Masset experiment. Ninety percent of these recoveries were made during the first fishing season compared with 78 percent first-season returns from 1955 experiments on the adjacent Two Peaks and Rose Spit grounds.

The Timbered Islet experiment produced only 36 returns from the 1,400 tags released, for a 2.6 percent recovery. Seventy-seven percent were recovered during the first fishing season.

SUMMARY OF 1955 AND 1956 TAG RECOVERIES FROM
1953 TO 1955 TAGGING EXPERIMENTS

Year and Location	Month	No. Tagged	Number of Recoveries*							
			1955				1956			
			1st	2nd	Other	Total	1st	2nd	Other	Total
SOUTH OF CAPE SPENCER										
1953 Experiments										
W. Coast Graham I.	April	171	2	—	—	2	—	2	—	2
Whaleback	April	359	15	—	1	16	9	2	1	12
Dixon Entrance	April	120	8	—	—	8	8	1	1	10
Two Peaks	May	692	36	3	2	41	16	3	—	19
Two Peaks	July	173	14	4	2	20	4	1	—	5
Bonilla I.	May	944	35	12	2	49	30	4	—	34
Horseshoe Gnd.	June-July	1,701	46	22	6	74	61	11	2	74
Ramsay I.	June-July	641	10	6	—	16	16	1	—	17
Pr. of Wales I.	June	98	—	—	—	—	—	1	—	1
Cape Ulitka	June	726	4	—	11	15	2	—	—	2
Goose I.	June	191	17	2	—	19	3	2	—	5
Coronation I.	June	235	5	—	—	5	1	1	—	2
Cape Scott	July	139	11	—	—	11	4	—	—	4
1955 Experiments										
Goose I.	July	1,963	—	—	—	—	321	67	43	431
Goose I.	Oct.	900	—	—	—	—	76	26	30	132
Lower Hecate Strait	Sept.	392	—	—	—	—	28	4	4	36
Upper Hecate Strait	Aug.	1,337	—	—	—	—	191	53	19	263
Masset Nursery	Aug.-Sept.	2,535	—	—	—	—	94	10	5	109
Timbered I. Nursery	Aug.	1,400	—	—	—	—	27	8	1	36
WEST OF CAPE SPENCER										
1954 Experiments										
Seward Gully	May	735	36	—	—	36	13	1	1	15
Albatross Bank	May-June	485	5	—	—	5	6	—	—	6
Yakutat	June	741	48	—	—	48	36	—	1	37
Cape Fairweather	June	11	2	—	—	2	—	—	—	—
Portlock	June-July	509	17	1	1	19	1	1	—	2
Albatross Bank	July	307	4	—	—	4	1	—	—	1
Yakutat	Aug.	959	50	1	1	52	43	—	2	45
Trinity Is.	July	255	—	—	—	—	3	—	—	3
Bering Sea	Mar.-May, Nov.	41	—	—	—	—	—	—	—	—
1955 Experiments										
Yakutat	Nov.-Dec.	527	—	—	—	—	25	2	1	28
"W" Ground	Nov.-Dec.	715	—	—	—	—	25	1	1	27

*No zero-year recoveries used because they are not comparable.

Assuming that tagged fish react in the same manner as untagged fish, the percentage recovery of tagged fish may be used as an estimate of the utilization rate. In practice, the estimate obtained will usually be minimal due to inherent shortcomings in the tagging method. Assuming further that these shortcomings apply equally to all fish tagged in a series of experiments, the percentages recovered from the experiments may be used as measures of the relative rates of utilization.

On the strength of the above assumptions, the percentages of tags recovered from a number of major experiments on important halibut grounds during the 1949-1953 period are presented in Figure 2 as measures of the relative rates of utilization of the halibut on these banks. Only recoveries made during the first three full years after tagging are used. The average number of units of gear fished in each tagging area during the 1950-1956 period is also given to show the dissimilarities between the relative amounts of fishing and the relative rates of utilization on the different banks.

It is apparent from the figure that utilization as indicated by the recovery of tagged fish varies widely from bank to bank and is not related directly to the amount of fishing. The rate of utilization at the time of the experiments was relatively high for most of Area 2 and as far north as Yakutat in Area 3A but became progressively lower on the grounds farther to the westward.

On the basis of tag returns alone, it would appear that the halibut in the western part of Area 3A and in Area 3B are not being utilized as heavily as elsewhere. Such a conclusion is not consistent with the results of catch statistics and age-composition studies nor with the experience of fishermen operating in those regions. The results of statistical and age composition studies agree with the results of tagging experiments as far north as Yakutat but indicate higher rates of utilization to the westward than does tagging. Present evidence suggests that the assumptions upon which the tagging estimates of utilization were based may not hold on the western grounds and that further evaluation of them is necessary.

It should be noted that the recoveries from available far-western experiments, shown in Figure 2, were made prior to 1954 and that changes have been made in the regulations since that time to increase fishing in the region. New tagging experiments have been initiated throughout the region of apparent low utilization to ascertain the effect of recent regulatory changes and the causes of the above-mentioned contradictory results. Experiments to ascertain the viability of tagged halibut on different sections of the coast also appear to be necessary.

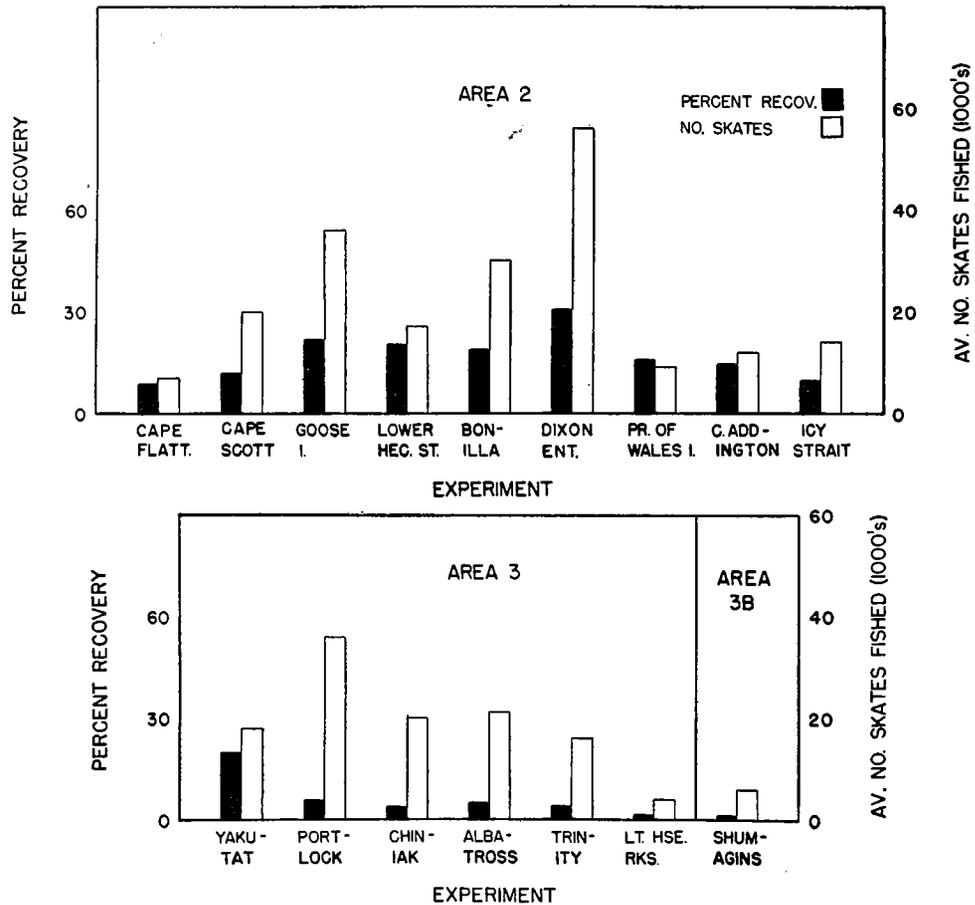


Figure 2. Percentage of tags recovered from selected 1949-1953 tagging experiments and average number of skates fished per year in the area of tagging during the first three complete years after tagging.

STUDIES OF SUB-COMMERCIAL SIZED HALIBUT

In 1955 the Commission initiated investigations of the life and habits of halibut during their early years on the bottom prior to their entry into the fishery. A vessel was chartered for one trip to test the effectiveness of small-meshed trawls, to solve operational problems and to learn as much as possible regarding the halibut's habitat and depth distribution. The results of this preliminary work are summarized in an appendix to this report.

The studies were continued and expanded in 1956. The U.S. trawler *COMMANDO* was chartered for 67 days in two periods extending from mid-June to mid-July and from mid-August to mid-September. Operations were confined to the inshore waters of Hecate Strait, Dixon Entrance and southeastern Alaska as far north as Sitka Sound.

A variety of gear was tried, including three small otter trawls of 1¼, 2½ and 4½-inch mesh; a small beam trawl and beach seine each of 1-inch mesh; a bottom gill net consisting of four 25-foot sections of 1½-inch, 2-inch, 2½-inch and 3½-inch mesh panels; six traps of 1¼-inch mesh; and four 50-fathom lightweight setlines with fine gangings and small hooks capable of being taken by small fish.

Fishing was attempted over a wide range of bottom conditions from the surfline to 30 fathoms with occasional hauls in deeper water. Most of the fishing was done in less than 25 fathoms on what appeared to be sandy and gravelly bottom.

Precipitous shorelines and rocky bottom made fishing ineffective or impossible in most inshore waters of the region covered. Only in McIntyre Bay, off Masset, and in northeastern Hecate Strait, where small halibut were taken in numbers during September 1955, was fishing over a relatively large area possible.

The number of sets, depth ranges fished and the average duration of set for each type of gear were as follows:

Type of Gear	Number of Sets	Depth Range	Average Duration
Otter trawl	70	3 - 30 fathoms	30 min.
Otter trawl	10	30 - 70 fathoms	20 min.
Beam trawl	68	surf - 12 fathoms	10 min.
Beach seine	21	surf - 5 fathoms	—
Traps	22	1 - 10 fathoms	5 - 72 hrs.
Gill net	5	2 - 7 fathoms	2 - 15 hrs.
Setline	33	1 - 25 fathoms	1 hr.

In fishing the trawls, the direction and length of the tows was varied to fit the trawlable bottom. The placement of stationary gear was varied as much as possible to obtain coverage of the different environmental conditions in each locality.

A total of 90 sub-commercial sized halibut were taken in 1956. Of these, 78 were captured by otter trawl and 12 with hook and line. No halibut were taken by the other types of gear, though the beam trawl, beach seine and traps caught other species of flatfish.

As was the case in 1955, the catch was about equally divided as to males and females, and there was no measurable difference in the average size of the males and females at a given age.

The sizes of sub-commercial halibut caught ranged from 3¼ to 23 inches. Two main size groups were apparent—ranging from 5 to 11½ inches and from 11½ to 19 inches. The annual growth zones in the otoliths indicated these two groups to be one-year olds and two-year olds respectively.

Only three halibut less than 5 inches long were taken, one 3¼ inches and two 3½ inches. These were captured in early September in Sitka Sound in 11 to 12 fathoms on rocky bottom with the 1¼-inch mesh otter trawl. Their otoliths showed that they were less than one year old, having been hatched the preceding winter.

The catch also included two 3-year olds, one 4, two 5 and one 6-year old, all between 20 and 23 inches long. Occasional halibut of commercial size were also caught throughout the entire depth range fished.

Captures of halibut of sub-commercial size in 1956 according to date, locality, depth and age were as follows:

Location	Date	Fathoms	Numbers of Halibut by Age							Total
			0*	1	2	3	4	5	6	
British Columbia										
Rose Spit	June 30	10-14	—	6	3	—	—	—	—	9
McIntyre Bay	July 1	8-14	—	5	2	—	—	—	—	7
Rose Spit	July 2	12-20	—	4	8	1	—	—	—	13
McIntyre Bay	July 11	3-9	—	4	—	—	—	—	—	4
Rose Spit	July 12	10-14	—	—	14	—	—	—	—	14
Warrior Rks	July 15	14-25	—	—	7	—	1	1	1	10
McIntyre Bay	Aug. 21	10-20	—	1	8	—	—	1	—	10
Naden Harbour	Sept. 11	9	—	1	2	1	—	—	—	4
Naden Harbour	Sept. 12	8-15	—	1	4	—	—	—	—	5
Southeastern Alaska										
Cape Addington	Aug. 24	20-24	—	—	1	—	—	—	—	1
Sitka Sound	Sept. 7	7-12	3	—	1	—	—	—	—	4
Sitka Sound	Sept. 8	7-14	—	3	6	—	—	—	—	9
Total			3	25	56	2	1	2	1	90

*Less than one year old.

Although it is too early to draw any firm conclusions, several apparent tendencies were noted. The 0-year, 1-year and 2-year halibut were found in the same localities between 3 and 25 fathoms on bottom ranging from flat to irregular in character and from mud to rock in composition. The 0-year halibut were not taken until September, at which time they were also found in 1955.

The diet of the 0-year halibut consisted of small invertebrates, whereas that of the 1-year and 2-year olds consisted mainly of fish. The stomachs of the other species of flatfish caught with the halibut contained worms and other small invertebrates. Only the very largest of the other species contained food similar to that found in the stomachs of the 1-year and 2-year halibut.

APPENDIX

INVESTIGATIONS OF SMALL HALIBUT IN SEPTEMBER 1955

By William H. Hardman and G. Morris Southward

INTRODUCTION

Preliminary to the investigations of the sub-commercial sized halibut planned for the next several years under the research program of the International Pacific Halibut Commission, an exploratory voyage was undertaken in September 1955. The objectives of the expedition were to test the effectiveness of fine-meshed trawls, to develop methods of handling trawl catches and of recording the data, and to acquire as much information as possible regarding the geographical and depth distribution of the small halibut.

The *PHYLLIS CARLYLE*, a 55-foot Canadian trawler with a 6.4 foot draft was chartered. The vessel was rigged to otter trawl with a single towing warp believed to facilitate maneuvering the trawl during fishing operations.

The general area of operations selected was the relatively sheltered waters of northern British Columbia where the Fisheries Research Board of Canada had caught halibut of the 0-year, 1-year and 2-year classes during investigation of other species. Fifty-four tows were made in fifteen general locations with trawlable bottom in Dixon Entrance, Chatham Sound, upper and lower Hecate Strait and Queen Charlotte Sound as shown in Figure 1.

DESCRIPTION OF GEAR

Small fine-mesh otter trawls, patterned after trawls used by the Fisheries Research Board Biological Station at Nanaimo, British Columbia, were used throughout. They were constructed of 1¼-inch stretched mesh of 18-thread cotton. The trawls had a 32-foot head rope of ¾-inch manila line and a 40-foot ground line of ½-inch wire rounded with ¾-inch rope. The cod end was enclosed in a bag of "brailer web" of 48-thread hard cotton twine and was protected by a sheet of black neoprene chafing gear. Glass floats on the head rope provided lifting power and a length of chain was seized to the ground line to weight it to the bottom.

The otter boards measured 2½ x 6 feet and weighed approximately 400 pounds each. The two ends and the top were faced with approximately ½ inch flat iron; the running edge was faced with a heavy metal shoe.

OPERATIONAL PROCEDURE

Areas indicated on charts as sand, sand and shell, sand and gravel or mud were usually trawlable. Several of these which appeared trawlable from the charts were not sampled after trial sounding runs with a fathometer indicated bottom too hard or rough for the relatively light trawl.

As an arbitrary procedure, tows of approximately 15-minutes duration approximately parallel to the shore and following a depth contour were adopted as a standard. When the size of a trawlable area permitted, a series of parallel tows were taken beginning in shallow water, three to five fathoms, and continuing outward at intervals of two to four-fathoms increase in depth until approximately 30-fathoms depth was reached. Occasionally when fathometer soundings indicated limited trawlable grounds, a single tow of longer duration was made. The tows were made with the

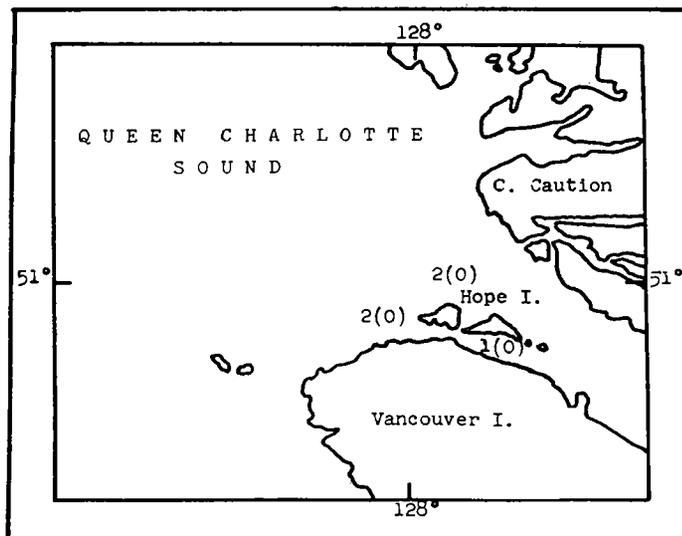
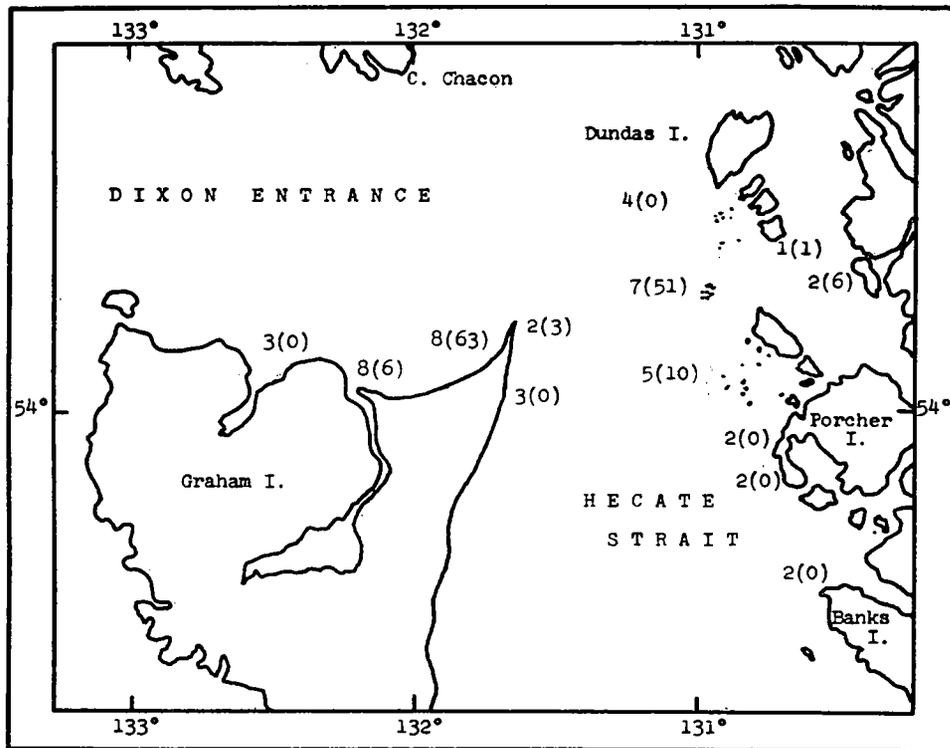


Figure 1. Fishing locations in Northern Hecate Strait and Dixon Entrance (upper), and in Queen Charlotte Sound (lower). Numbers outside brackets indicate the number of tows, those inside the brackets the number of halibut caught.

tide since the light trawl fished more effectively when it was not in opposition to the tidal currents.

The trawl was lifted aboard in the conventional manner and the catch was immediately examined, sorted by species and counted. When a large number of an individual species was taken, the total number was estimated by counting a fraction of the catch. Samples of each species encountered were preserved. No attempt was made to classify or enumerate the various crustacea with the exception of the commercial crab, *Cancer magister*.

Several lengths were recorded for all halibut caught: the "preopercular" length, from the anterior extremity of the head to the posterior edge of the preopercular bone; "head" length, from the anterior extremity of the head to the posterior tip of the opercular membrane; and "fork" length, from the anterior extremity of the head to the end of the median caudal rays. The preopercular and opercular measurements are recorded in the halibut investigations as checks upon the accuracy of the fork length.

Otoliths were removed through a dorsal incision into the auditory capsules. Pairs of otoliths were placed in coin envelopes on which the tow number, the date, the individual measurements, the sex when determinable by the unaided eye, and the general contents of the stomach were recorded.

The small halibut, whose sex could not be determined without careful dissection in the laboratory, were preserved for later study. Except when sex had to be determined microscopically in the laboratory no attempt was made to identify a specific fish with its recorded data. After examination the halibut from each tow were rolled together in cheesecloth with an identifying label and preserved in wooden kegs containing approximately a five percent formaldehyde solution. Small specimens of incidentally-caught species were preserved in formaldehyde solution in jars for later examination. The body cavities of larger, thicker fish were first injected with a ten percent formaldehyde solution to stop digestion and prevent spoilage. Fish from different areas were kept separate; however, with few exceptions, no attempt was made to keep separate the fish taken in successive tows from the same area. A detailed log of information regarding the date, location, bottom type, depth and catch of each haul was kept.

COMPOSITION AND DISTRIBUTION OF THE HALIBUT CATCHES

One hundred and forty halibut, smaller than commercial size (less than 66 centimeters), were taken during this exploratory trip. Several commercial-sized halibut were also taken and were released after being measured. No attempt was made to collect halibut larger than 66 centimeters as these sizes are available from tagging operations and the landings of commercial vessels.

The length frequencies of the small halibut fell into two main groups—from 7 to 12 centimeters and from 18 to 35 centimeters (Figure 2). The 5-centimeter interval (from 13 to 17 centimeters) between the two groups of smaller and larger halibut suggested a separation between two age classes. The overlap of the length-frequency curves of the males and females is nearly complete indicating no difference between the lengths of the sexes in the samples.

Examination of the otoliths showed that the catches did in fact consist of two year classes of halibut. Otoliths from fish of the smaller size group did not show any indication of an annulus and consequently belonged in the zero-year class, spawned

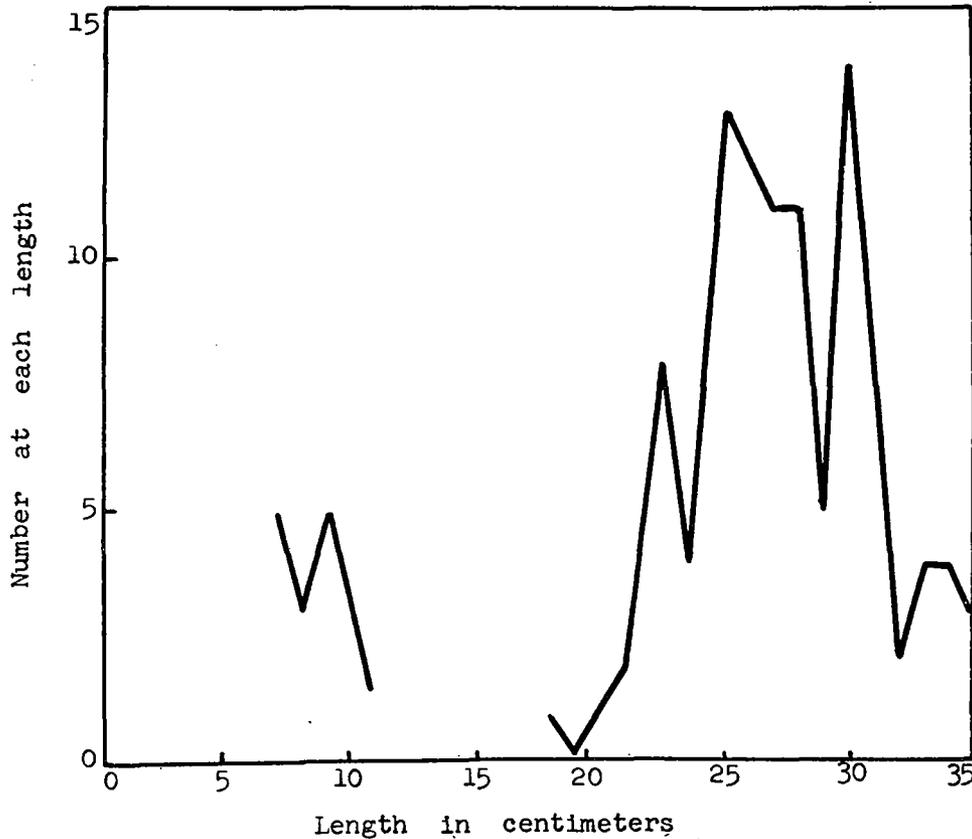


Figure 2. Number at each centimeter of length for sub-commercial sized halibut taken by the PHYLLIS CARLYLE in northern Hecate Strait and Dixon Entrance during September, 1955.

in the winter season of 1954-55. A single complete annulus in the otoliths of the larger group showed that they belonged in the one-year class, despite the considerable range of sizes.

The sex composition of the halibut caught was 62 males, 66 females, and 12 for which sex information was not recorded. Of the 128 sexed halibut the zero-year group was composed of 3 males and 13 females, the one-year group of 59 males and 53 females.

Identification of the sex of the one-year group was easily done at sea by opening the body cavity. The sex organs were readily seen and had approximately the form found in commercial-sized adults.

It was found necessary to dissect the zero-year specimens carefully and to examine the thin and transparent gonads under low-power magnification in the laboratory before identification could be positive. The ovaries already have adult form and are readily recognized, whereas the testes are very threadlike and difficult to find even with magnification.

Although tows were made in depths ranging from 3 to 36 fathoms, few halibut were taken in depths greater than 14 fathoms. Halibut less than 35 centimeters in length were taken on all bottom types sampled. All the zero-year halibut were caught on sand, sand and shell, and sand and gravel bottom in less than 8 fathoms.

Table 1. Number and depth of hauls and catches at each location.

Location	Hauls	Fathoms Depth	Halibut		Rock	Butter	Sand	Lemon	Dabs	Other Flat Fish*	Cod and Whiting	Rat and Dog	Crab	Other*	
			0-yr	1-yr											
Archibald Edge	1	11-14	—	39	141	10	1	—	—	—	3	—	—	—	x
" "	1	12-16	—	5	65	9	4	1	—	1	60	—	—	—	x
" "	3	13-14	—	6	144	16	9	7	—	10	64	18	—	—	x
" "	2	14-24	—	1	44	34	—	21	—	11	317	4	3	—	x
Archibald Spit	2	11-13	—	8	384	44	3	8	—	1	22	1	—	—	x
" "	1	14	—	2	44	14	—	3	—	—	—	—	—	3	x
" "	1	16	—	—	85	14	—	1	—	—	7	—	—	—	x
" "	1	20-25	—	—	14	—	—	55	—	35	†	281	—	—	x
Swan Hill	3	8-14	—	—	3	134	13	4	5	2	—	120	50	—	x
Tow Hill	1	4	—	—	2	62	78	—	6	—	—	—	2	4	x
" "	1	6	2	5	5	5	1	—	—	1	—	4	1	—	x
" "	3	7-8	14	40	84	67	9	59	32	9	2	—	—	59	x
" "	3	8	—	2	3	—	2	24	—	2	31	9	280	—	x
Entry Pt.	1	8	—	—	2	—	2	—	9	—	3	—	—	—	x
" "	4	12-18	—	6	39	33	—	117	369	10	†	—	—	—	x
" "	1	23	—	—	1	—	—	—	—	—	—	†	—	—	x
Chown Pt.	2	6	—	—	—	—	—	—	—	—	—	—	—	—	x
C. Edensaw	1	23	—	—	1	—	—	—	—	—	—	—	—	—	x
Virago S'nd.	1	16	—	—	700	60	—	214	400	262	3	1	1	—	x
" "	1	20-22	—	—	84	—	—	1	32	14	27	—	—	—	x
Rose Spit	1	3	—	3	119	9	28	175	—	—	—	3	1000	—	x
" "	1	8	—	—	130	—	2	270	—	—	1	9	2000	—	x
Triple I.	3	14-16	—	—	37	8	3	4	—	7	8	—	—	12	x
" "	1	36	—	—	1	6	—	44	—	10	21	1	—	—	x
Melville I.	1	14-16	—	1	35	—	—	—	—	—	—	17	—	—	x
Tugwell I.	1	6-8	—	5	33	—	—	—	—	12	40	13	—	—	x
" "	1	10	—	1	12	—	—	—	—	—	100	9	—	—	x
Oval Bay	2	8-14	—	—	159	—	15	23	25	48	—	9	1	—	x
Seal Rocks	2	13-14	—	—	1	—	—	—	—	—	1	1	—	—	x
Banks I. Shoal	2	16-18	—	—	66	—	—	4	10	9	—	3	—	—	x
Secretary Pt.	2	11-17	—	—	1	—	—	—	—	—	100	312	—	—	x
Mexicana Pt.	2	12-28	—	—	100	—	—	30	150	110	—	112	—	—	x
Suquash	1	12	—	—	1	—	—	—	—	—	—	†	—	—	x
Total	54	4-36	16	140	2540	525	170	1065	1038	554	†	†	3414	—	x

*See text page 25.

†Indicates "numerous".

The number of halibut and the associated species taken from each of the areas sampled are shown in Table 1. Flatfish other than those named in the table include starry flounder, brill, bastard halibut, slime sole, witch or rex sole, C-O sole, and curl-fin sole. The species included in the last column under "other" include poachers,

Table 2. Common and scientific names of species of fish encountered and recorded in Table 1 are as follows:

COMMON NAME	SCIENTIFIC NAME	COMMON NAME	SCIENTIFIC NAME
Halibut	<i>Hippoglossus stenolepis</i> Schmidt	C-O sole	<i>Pleuronichthys coenosus</i>
Rock sole	<i>Lepidopsetta bilineata</i>	Curl-fin sole	<i>Pleuronichthys decurrens</i>
Butter sole	<i>Isopsetta isolepis</i>	Poachers	<i>Agonidae</i> (various)
Sand sole	<i>Psettichthys melanostictus</i>	Tube-snout	<i>Aulorbynchus flavidus</i>
Lemon sole	<i>Parophrys vetulus</i>	Sculpins	<i>Cottidae</i> (various)
Dabs	<i>Citharichthys sordidus</i> and <i>C. stigmaeus</i>	Sand-lance	<i>Anmodytes tobianus personatus</i>
Cod	<i>Microgadus proximus</i>	Sand-fish	<i>Trichodon trichodon</i>
Cod	<i>Gadus macrocephalus</i>	Skates	<i>Rajidae</i> (various)
Whiting	<i>Theragra chalcogramma</i>	Rock fishes	<i>Sebastes</i> (various)
Ratfish	<i>Hydrolagus collieri</i>	Grunt-fish	<i>Rhamphocottus richardsoni</i>
Dogfish	<i>Squalus suckleyi</i>	Lump-sucker	<i>Eumicrotremus orbis</i>
Starry flounder	<i>Platichthys stellatus</i>	Perch	<i>Cymatogaster aggregatus</i>
Brill or Petrale	<i>Eopsetta jordani</i>	Lingcod	<i>Ophiodon elongatus</i>
Bastard halibut	<i>Atheresthes stomias</i>	Greenlings	<i>Hexagrammidae</i> (various)
Slime or Dover sole	<i>Microstomus pacificus</i>	Wolf-eel	<i>Anarrhichthys ocellatus</i>
Rex or Witch sole	<i>Glyptocephalus zachirus</i>		

sand-lance, sand-fish, skates, tube-snout, sculpins, grunt-fish, lump-sucker, perch, greenlings, rock fishes, wolf-eel, lingcod, shrimps, crabs other than *Cancer magister*, starfishes, sea urchins, squid and octopuses. When such large numbers of a species were taken as to make numerical estimates impractical, its abundance was recorded as "numerous". The common and scientific names of the fish encountered are listed in Table 2 on page 26.

STOMACH CONTENTS

Stomachs of most of the halibut caught were filled with relatively large and widely varied forms of fish and crustacea. All zero-year class individuals were gorged, primarily with amphipods. Several contained miscellaneous small decapod parts such as shrimp tails and small crab appendages. One zero-year individual also had unidentifiable partially-digested fish flesh in its stomach.

In the one-year group the frequency of occurrence of various types of identifiable food was as follows: shrimp, 29; crab, 11; sand-lance, 11; partially digested unidentifiable fish flesh, 10; sea poacher, 1; sculpin, 1; amphipod, 1. A number of stomachs contained unidentifiable food and fourteen were empty.

DISCUSSION

This preliminary investigation fulfilled its general objectives. Efficient methods of handling the trawl and the catches and of recording the data were developed. Small halibut of the zero and one-year groups were found on trawlable bottom and useful information regarding their geographical and depth distribution in early autumn was obtained. Experience indicated the desirability of modifying the equipment and developing additional sampling devices.

A vessel the size of the *PHYLLIS CARLYLE* with a 6.4 foot draft is too big and unwieldy to fish safely in areas charted as shallower than three fathoms where it appeared small halibut might live. A small auxiliary boat, such as a powered seine skiff, or a 25 to 30-foot troller, equipped with a small beam or otter trawl seems essential for fishing in such shallow waters. It would also have the maneuverability necessary to fish in small enclosed bays or bights.

While small halibut were taken with the trawl used, the absence of two and three-year olds from the catches suggests that halibut larger than 35 centimeters may be able to elude the 1¼-inch mesh trawl. In view of the well-known selectivity of trawls it would be advisable to equip further sampling expeditions with trawls of a variety of meshes to secure halibut of all sizes. A chain "tickler" in advance of the footrope, which was not tried in this experiment, might increase the effectiveness of the net.

Most of the region surveyed was found to be untrawlable in the conventional manner due to the rough and rocky bottom. A few small halibut were caught on bottom where trawling had to be abandoned after fouling of the net. Several other types of gear might be tried in these areas. Setline gear, with small hooks and fine gangings, and baited traps such as modified crab pots or ring nets probably could be used almost regardless of the bottom conditions. The Danish seine or some modification thereof might be effectively fished on small areas of sand or gravel bottom between rock piles and reefs where there is not enough room to maneuver a conventional trawl. A beach seine might also be used in some places from depths slightly beyond the low tide line toward the beach. If effective, the use of any of these gears would greatly increase the extent of the sampling area.