

**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

NUMBER 26

**REGULATION AND INVESTIGATION
OF THE PACIFIC HALIBUT
FISHERY IN 1957**

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SEATTLE, WASHINGTON
1958

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-five reports have been issued prior to the present one which is the eleventh of a series of annual reports that were commenced in 1947 to provide a brief summary of the Commission's activities and the most significant results of its investigations during the year.

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HALIBUT FISHERY IN 1957**
by
INTERNATIONAL PACIFIC HALIBUT COMMISSION

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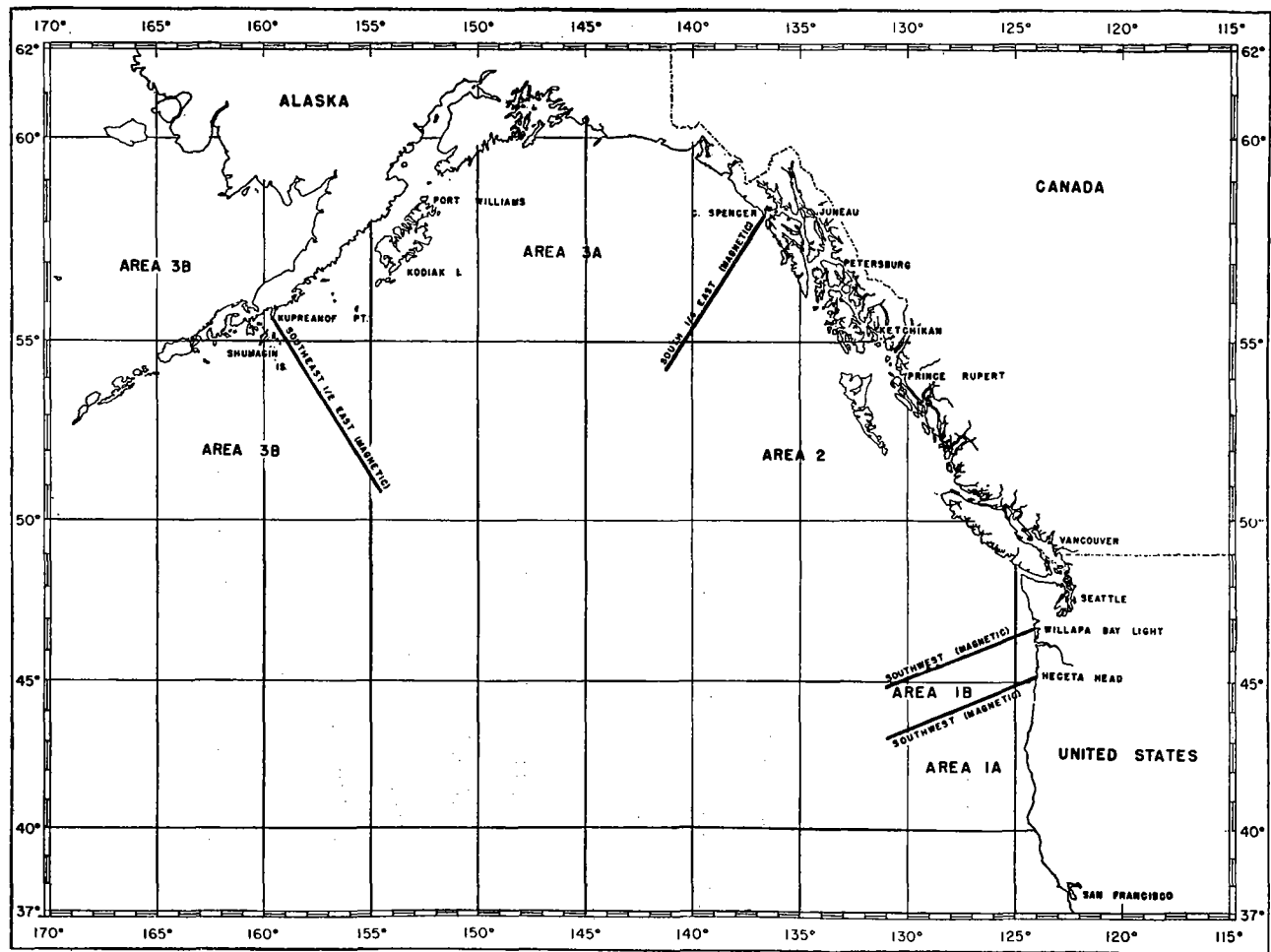


Figure 1. Pacific Coast of North America showing regulatory areas defined by the International Pacific Halibut Commission in 1957.

HISTORICAL BACKGROUND

The Pacific halibut fishery as an important commercial operation had its beginning in 1888 in which year a significant fishery commenced off Cape Flattery, Washington, and shipments were made by railway to the Atlantic coast. Growth of both the United States and Canadian fleets and the exploitation of new fishing grounds increased the annual catches until 1915 when landings reached 69 million pounds. Ten years later, in spite of continued increases in fishing pressure and the exploitation of more and more new grounds, annual catches declined to a level of about 50 million pounds.

Joint control of the fishery by the United States and Canada was advocated by sections of the industry in both countries as early as 1915 on account of declining yields from the longer-fished grounds. Continuation of the unfavorable trend led after World War I to negotiations between United States and Canada and a convention for the preservation and development of the fishery, signed by the two countries in 1923 and ratified in 1924.

The Convention of 1923 established a three-month winter closed season which became 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 condition 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 conservation measures to the two Governments.

A new convention was signed in 1930 and ratified in 1931 continuing 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, signed and ratified in 1937, extended the Commission's authority, providing for control of the capture of halibut caught incidentally to fishing for other species in areas closed to halibut fishing.

Regulation which began in 1932 reduced the intensity of fishing, resulted in the stocks on some grounds doubling in size by 1940 and made possible larger individual catches with much less fishing effort. As investigations demonstrated that the size of the stocks had increased, the Commission from time to time raised the total catches permitted annually. The management policy followed was to hold the annual catches from the stocks slightly below the additions to the stocks being made by growth and new recruits. The total coast catch reached 54 million pounds in 1940 and about 58 million pounds in 1950.

During this period, increases in the number of vessels fishing and much larger catches per trip 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 propor-

tion of which they were capable. 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.

From 1951 to 1953 inclusive, 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 underfished stocks resulted and the total annual catch reached 60 million pounds.

A fourth halibut convention, signed and ratified late in 1953, authorized the Commission to establish one or more open or closed seasons each year in any area. It 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 have been still further augmented indirectly 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 at each stage of this development.

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 in some areas has been continued to date.

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. In 1957, due in part to a reduction in the catch taken in the second season in Area 2, the total coast catch declined to 62,300,000 pounds. The average of the 1954 to 1957 catches was 21 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 funds made available by both countries for the Commission during the 34 years of its existence.

The multiple season system of regulation has spread fishing over a longer season. It has increased fishing on underfished grounds and the annual yields therefrom.

ACTIVITIES OF THE COMMISSION

In 1957 the Commission completed its twenty-sixth year of regulation of the fishery. It continued the comprehensive program of statistical and biological investigations adopted in 1954 to provide the factual basis for regulations designed to attain maximum maintainable yield from current stocks and to build the stocks to levels of maximum sustainable yield in the future.

The members of the Commission from Canada in 1957 were: Mr. Richard Nelson, Vancouver, British Columbia, elected Chairman; Mr. Harold S. Helland, Prince Rupert, British Columbia; and Mr. Samuel V. Ozere, Ottawa, Ontario, replaced in November by Dr. William M. Sprules of Ottawa, Ontario. The United States members were Mr. Seton H. Thompson, Washington, D.C., elected Vice-

Chairman; Mr. J. W. Mendenhall, Boulder Creek, California; and Mr. Mattias Madsen, Seattle, Washington.

The Commission held its regular annual meeting at its office in Seattle from January 28 to January 31 inclusive to examine the results of regulation and investigations in 1956, to consider the research program for 1957, to deal with budgetary and other administrative matters, to confer with industry representatives regarding regulation of the fishery and to adopt regulations for 1957.

On January 28 a joint open meeting was held with members of all branches of the Pacific coast halibut industry for a review of the 1956 fishery and a presentation of the results of investigations. There was a general discussion of suggestions regarding regulation in 1957. On January 29 the Commission met with the 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 30 the Commission conferred with representatives of the vessel owners and fishermen to receive their recommendations regarding regulation of the fishery in 1957, and on January 31 heard a delegation from the British Columbia Trollers Association.

At a later session on January 31 the Commission considered the proposals of the industry in the light of conditions in the stocks and in the fishery as shown by the investigations and adopted regulations for 1957.

A press release, summarizing the regulatory changes that were being recommended to the two Governments, was issued on February 1 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 1957 REGULATIONS

The Pacific Halibut Fishery Regulations for 1957 were approved by the Governor General of Canada on March 21 and by the President of the United States on April 10 and became effective on the latter date.

Only three material changes from the regulations of 1956 were made. The fishing seasons in all areas were opened 11 days earlier than in 1956. The second fishing season in Area 3A was discontinued and the catch limit in Area 3A was increased 2,000,000 pounds in lieu thereof. The two latter changes were made on account of a prolongation of the fishing season in Area 3A which had resulted from the voluntary between-trip lay-in program instituted by the halibut fleets in 1956.

The five regulatory areas in 1957, shown in Figure 1, were: Area 1A, the waters off northern California and southern Oregon, south of Hecate Head, Oregon; Area 1B, the waters off Oregon and Washington between Area 1A and Willapa Bay, Washington; Area 2, the waters off Washington, British Columbia and southeastern Alaska between Area 1B and Cape Spencer, Alaska; Area 3A, the waters off Alaska between Cape Spencer and Kupreanof Point, near the Shumagin Islands, Alaska; Area 3B, all convention waters west of Area 3A including those of the Bering Sea.

The catch limit of 26,500,000 pounds during the first season in Area 2 was continued and that of the single season in Area 3A was set at 30,000,000 pounds. Fishing in other areas and other seasons, in which the total catch of halibut is comparatively small, was controlled by length of season.

Other regulatory provisions were also continued as follows: the 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 1. The first seasons in Areas 1B and 2 were terminated on June 17 and the single season in Area 3A on September 22 at which dates it was deemed that the catch limits set for Areas 2 and 3A respectively would be attained. The second season of seven days in Areas 1B and 2 commenced on July 29. Areas 1A and 3B were closed to halibut fishing on October 16.

STATISTICS OF THE FISHERY

LANDINGS FROM REGULATORY AREAS

Landings in thousands of pounds during 1957 from groups of regulatory areas that correspond to the original Area I, Area 2 and Area 3 are shown in the following table. Also given are comparable landings for 1953, 1954, 1955 and 1956 and for 1931, the year immediately preceding regulation by the Commission.

United States and Canadian Catches by Regulatory Areas, in Thousands of Pounds

Year	Areas 1A and 1B	Area 2			Areas 3A and 3B			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
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	15,121	35,412	21,014	10,475	31,489	41,909	25,596	67,505
1957	407	16,841	14,428	31,269	20,027	10,624	30,651	37,275	25,052	62,327

All poundages are corrected for amounts declared from the wrong areas and include amounts of halibut caught in contravention of the regulations. The 1957 figures are preliminary and subject to some change.

The landings from Areas 1A and 1B are combined and correspond to those from original Area 1. The halibut stocks in those 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 averaged about one-half million pounds in recent years.

The total catch from Area 2 was 31.3 million pounds from all sources in 1957. It was below the average for the four preceding years though well above the total of 1955.

The catch in Area 2 during the first season amounted to about 26.1 million pounds, slightly below the catch limit of 26.5 million pounds. The deficit represented but a small fraction of one day's fishing by the Area 2 fleet.

The catch during the 7-day second season in Area 2 amounted to 4.4 million pounds compared to 7.6 million pounds in 1956, 5.4 million in 1955 and 9.4 million in 1954. The smaller catch in 1957 during the second season resulted chiefly from a 48 percent reduction in the number of vessels that participated.

Included in the combined total landings from Area 2 in the preceding table are 786,000 pounds of halibut caught incidentally to fishing for other species under permit after the area was closed to halibut fishing.

The catches in 1957 from Areas 3A and 3B, which are combined in the preceding table to make them closely comparable to the catch from the Area 3 of earlier years, amounted to 30.7 million pounds, slightly above the average of the four preceding years.

The catch in Area 3A during the single season amounted to 29.3 million pounds, about 700,000 pounds under the 30.0 million-pound catch limit provided in the regulations for that season. In 1956 the catch taken in the first season was about 1.3 million pounds above the 28 million-pound catch limit.

In Area 3B a total of 1.4 million pounds was taken in 1957 compared to 879,000 and 934,000 pounds in 1956 and 1955 respectively. Of the 1957 Area 3B catch only 39,000 pounds were taken in Bering Sea, which was designated as Area 4 prior to 1954, compared to 267,000 pounds and 45,000 pounds in 1956 and 1955 respectively.

United States and Canadian landings from all areas in 1957 amounted to 62.3 million pounds compared to 67.5 million pounds in 1956 and 59.1 million in 1955. The lower amount in 1957 compared to 1956 resulted chiefly from a reduction in yield from the second fishing season in Area 2 and from small deficits in the catch-limit landings taken in Areas 2 and 3A. The high catch of 71.2 million pounds 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 built up by relatively light fishing for a number of years. By 1957 these accumulations appeared to have been reduced.

LANDINGS BY PORTS

The distribution of halibut landings in thousands of pounds from all areas according to regions and ports or groups of ports is shown for 1957 in the following table, with comparable data for the 1953 to 1956 period and for 1931, the year before regulation.

Landings by Regions and Ports from All Areas by United States and Canadian Vessels Combined, in Thousands of Pounds

Year	Calif. and Oregon	Washington		Alaska		British Columbia			Total Can. Ports	Total U.S. Ports
		Seattle	Other Ports	SE Alaska	Western Alaska	Van-couver	Prince Rupert	Other Ports		
1931	892	15,032	202	8,240	1,482	1,066	16,792	516	18,374	25,848
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	772	14,238	2,669	20,707	3,200	7,631	15,827	2,461	25,919	41,586
1957	546	16,073	1,055	16,360	3,820	5,737	15,875	2,861	24,473	37,854

The proportion of the 1957 catch landed in Seattle and central Alaska increased. In Vancouver and southeastern Alaska the proportion declined.

CATCH PER UNIT FISHING EFFORT

All halibut vessels of five net tons or over are required to keep records showing the date, the fishing location, the amount of gear fished and the estimated catch of halibut in pounds for each fishing operation. These records are collected and analyzed to determine the average catch per standardized unit of fishing effort in the various areas and subsections thereof and in the different seasons. The resultant returns per unit of effort are then compared with those of earlier years to ascertain whether changes in relative abundance or availability 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 and during the second season in late July and early August was much lower than in the corresponding seasons of 1956. This was also apparent in each major section of the area, the decline in each section appearing to be generally proportional to recent increases in the catches from it.

In the Goose Island, Cape Scott and Icy Strait sections of Area 2 where total removals had been high in recent years, the sharply declining trend in catch per unit effort of the preceding three years was continued in 1957. There was also a sharp decline in lower Hecate Strait where the abundance had been well maintained through 1956. In middle and upper Hecate Strait and in the outside waters of southeastern Alaska, which had shown some increase in abundance during 1954, 1955 and 1956, the catch per unit effort declined in 1957. Frederick Sound and Chatham Strait, where heavier removals were made in 1955 and 1956, yielded a considerably lower catch per unit of effort for the second consecutive year.

The catch per unit effort for the entire fishing season in Area 3A maintained the level trend of recent years. It was at a high level at the outset of the season, due in part to fishing on an accumulation of fish in Shelikof Strait where little fishing had been done for several years. Thereafter, the catch per unit declined sharply to the average of recent years throughout the entire area.

The catch per unit effort on the Trinity Islands grounds and on those farther west in Area 3A was lower in 1957 than in 1956, apparently reflecting the heavy removals from that section of the area in 1956.

In Area 3B the catch per unit effort was lower in 1957 than during both 1956 and 1955.

LENGTH OF FISHING SEASONS

The adoption of multiple seasons by the Commission in 1954 under authority of the Convention of 1953 and the institution of a voluntary between-trip lay-in program by the fleets in 1956 have resulted in a substantial lengthening of the fishing seasons. The lengths of the season or combined seasons in each area have been as shown below for the years 1951 to 1957 inclusive.

Number of Legal Fishing Days by Area and Year from 1951 to 1957

Year	Area 1A	Areas 1B and 2	Area 3A	Area 3B
1951	56	28	56	56
1952	60	26	60	17
1953	52	24	52	25
1954	117	29	68	94
1955	132	31	93	116
1956	156	44	104	127
1957	168	54	144	168

The 1953 seasons in the two main producing areas, Area 2 and Area 3, were the shortest in the history of the halibut fishery. In 1957 the periods of fishing in the same areas were 30 and 90 days longer respectively.

The voluntary between-trip lay-in program instituted by the United States and Canadian halibut fleets in 1956 provided lay-ins of seven days with deferment of lay-ins in Area 2 after the Commission announced the closure date of that area. In 1957 the lay-in period was increased to eight days and the deferment of lay-ins in Area 2 was eliminated. These two changes in the program contributed to the further increase in the length of the season in Area 2.

COMPOSITION OF THE CATCHES

To continue studies of the size and age composition of the halibut stocks, samples of length measurements and otoliths were obtained from the commercial catches and from the catches made during the course of tagging operations. Seventy-eight commercial trips from various grounds between Cape Flattery and Bering Sea were sampled at Seattle and 61 at Prince Rupert. Almost 53,000 measurements plus over 19,000 measurements and otoliths were secured from the combined 139 trips that represented about 20 percent of the total landings at the two ports. In addition, 5,000 measurements plus 9,000 measurements and otoliths were taken at sea during tagging operations.

The size composition of the stocks on the Goose Island grounds in Area 2 and on the Portlock and Albatross banks in Area 3A showed for the fourth consecutive year a decline in the numbers of chicken halibut (under 10 pounds) and of small mediums (10 to 40 pounds) in both early and late seasons. The numbers of large mediums (40 to 60 pounds) and of large (over 60 pounds) available to the fishery appeared to have increased in Area 2 and to have been stable in Area 3A through 1956 but to have declined in 1957.

The age composition of the catches from Area 2 showed a decline in the numbers of older fish beginning in 1954 when fishing pressure was increased by the inauguration of a second fishing season. The decline was most pronounced in the Goose Island-Cape Scott section of the area, but was also apparent in samples from grounds in upper and lower Hecate Strait. During the second season in 1957 young fish of the year classes just entering the fishery appeared to be available in greater numbers than during any of the previous three years. Apparent contradictions between the above observations upon size and age compositions probably result from variations in the sex composition of the samples and differences in the growth rate of males and females.

Comparison of the age composition of the catches made while tagging on the Masset and Timbered Islet nursery grounds in 1926 and in 1955 revealed a marked increase in the proportion of larger and older fish. These grounds have been closed to fishing since 1932 to protect the numerous small young halibut known to inhabit them. The numerical proportion of fish over 10 pounds increased from less than 10 percent in 1926 to more than 50 percent in the 1955 catches. A reduction of this accumulation of older fish appears desirable.

In Area 3A there was a cessation of the decline which had been observed during each of the three preceding years in the availability of most of the commercially important age classes. There was an increase in the availability of the younger age classes, particularly of individuals belonging to the 1948 and 1946 year classes which made a strong appearance as 8 and 10-year olds respectively in the 1956 catches.

Due to the concentration of the commercial fishery on an accumulation of fish in Shelikof Strait during 1957, a number of samples were secured throughout the season. This series, in conjunction with samples taken by the Commission's tagging vessel, showed a decline in availability or abundance of all age groups as the season progressed, paralleling the continuous decline in the catch per unit effort.

Samples from fares caught in Cook Inlet revealed that more than 40 percent of the fish were less than seven years of age. Observations made in the area while tagging showed the stocks to consist of predominantly immature fish. This was in sharp contrast with the conditions on Portlock and Albatross banks where less than one percent of the catch was under seven years of age. The age composition of the samples from the Shelikof Strait grounds was intermediate between that in Cook Inlet and that on Portlock and Albatross banks.

Samples from catches made in the Shumagin Islands section of Area 3B showed an increase in abundance or availability of older halibut until midseason and a decline thereafter. This suggests a seasonal movement of matures into and out of the region which is in agreement with some observations of stock movements based on tagging.

There was little fishing in Bering Sea in 1957 and only one sample was obtained from the grounds discovered by the Commission's tagging vessel in 1956. The age composition of the sample showed a high concentration of old slow-growing fish similar to that observed in 1956.

GROWTH STUDIES

With the rebuilding of some of the stocks to levels apparently approaching those capable of producing maximum sustainable yield, a knowledge of the growth rates in the various stocks, of the changes that occur, and of the factors responsible for differences and changes became necessary for the future management of those stocks. Intensive investigations of growth were instituted in 1956 and continued in 1957.

The method selected for trial was one which uses measurements of the widths of the annual growth zones in the otoliths to estimate the lengths of fish at each earlier age. Use of this method would make it possible to reconstruct the patterns of growth of the several year classes of fish in each age sample and to fill gaps that unavoidably occur in sampling the stocks on many halibut grounds.

In 1956 the existence of a consistent relationship between otolith radius and body length regardless of year or the fishing ground where the otoliths were obtained was demonstrated. The validity of estimates of length based upon growth-zone measurements was tested and confirmed. A photographic projection method of measuring the growth zones was developed to facilitate and expedite the work. Some preliminary information regarding growth on a few widely scattered grounds at widely separated times was obtained incidentally.

In 1957 the determination of growth rates by growth-zone measurements of otoliths collected from the commercial landings from Portlock Bank and during the Commission's tagging operations in the same region were completed. The materials used were from catches made in 1914, in 1927 and from 1935 to 1956. The 1914 sample, collected by W. F. Thompson for the British Columbia Department of Fisheries during the first investigation of Pacific halibut, was obtained at the outset of fishing in the region and provided valuable data regarding the growth rate prior to fishing. The 1927 sample came from early tagging operations by the Commission. The 1935 to 1956 materials, with the exception of a few samples secured during recent tagging operations, were obtained from the Commission's market sampling program which was begun in 1935.

Measurements of the radius of approximately 4000 otoliths were made and the growth patterns of each year class from 1902 to 1945 were reconstructed for the first 12 years of life. The changes in growth which had been observed in other phases of the halibut investigations were clearly evident in the changing structure of the otoliths, particularly for the fish from 7 to 12 years of age.

The growth within each year class was examined and appeared to be associated with the numerical strength of that year class. Body lengths of recent year classes in the 7-year and older groups were clearly above those of earlier year classes at the same age. For example, fish 12 years old were 34 inches long and weighed 15 pounds on the average in 1914 whereas fish of the same age in 1956 were 44 inches long and weighed 34 pounds on the average.

Halibut below commercial size, taken by the chartered vessel *COMMANDO*, provided additional information regarding the basic relationship of otolith-radius to body length. Further data were obtained from a small sample of otoliths from young fish taken in the Bering Sea by the United States Fish and Wildlife Service while engaged in king crab investigations. The latter sample also gave direct information regarding the growth of young halibut near the northern limit of the range of the species.

Results to date have proven the value of the investigations and of the methods employed. They give promise that extension of the studies to other regions and analysis of results will provide essential information regarding some of the factors that determine the productivity of the stocks.

TAGGING EXPERIMENTS

An extensive tagging program was conducted in 1957 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 stock to the current fishery. Two halibut vessels were chartered for the purpose.

The halibut vessel *PACIFIC* was operated in January for a period of 29 days. One trip was made to the Yakutat and "W" spawning grounds in the Gulf of Alaska. Fishing was good on "W" ground but poor on the eastern and western spits off Yakutat.

The operation of the second vessel *WESTERN* was begun in April and continued for 164 days into September during which nine trips were made between Cape Cleare and the Semidi Islands. Trips were made to Cape Cleare, Cook Inlet and Shelikof Strait grounds where tagging had not been conducted previously. Fishing was distributed throughout each of the grounds to make the tagged fish as representative as possible of the halibut present.

A general summary of the above tagging operations is given in the following table.

Trip	Locality	Month	Skates* Fished	No. Tagged	Pounds Tagged	Total Catch
PACIFIC						
1	"W" ground-Yakutat	January	422	504	25,010	67,450
WESTERN						
1	Seward Gully	April-May	361	588	18,060	54,080
2	Cape Cleare	May	335	275	10,640	46,670
3	Shelikof Strait	May	404	1,089	22,880	73,440
4	Foggy Cape	June	303	506	21,010	43,740
5	Cook Inlet	June	420	748	16,950	50,170
6	Foggy Cape	July-August	432	539	22,400	61,200
7	Albatross Bank	August	508	328	10,920	31,930
8	Cape Cleare	August-September	128	43	1,650	8,170
9	Cape Cleare	September	232	51	1,610	11,140
Sub-total			3,123	4,167	126,120	380,540
TOTAL			3,545	4,671	151,130	447,990

* 250 fathom skates each bearing 76 hooks.

The number of tags recovered in 1957 was lower than in 1956, primarily because most of the recent tagging had been conducted in the western part of Area 3A where the rate of recovery tends to be lower than from experiments in Area 2. Total recoveries in 1957 were 1172 compared with 1577 in 1956.

A summary of the tags recovered in 1957 from the 1954, 1955 and 1956 experiments is given in the following table, according to seasons of recapture. The "other" recoveries are those made outside the fishing seasons and by trawlers during the year.

Summary of 1956 and 1957 Tag Recoveries from 1954 to 1956 Tagging Experiments

Year and Location	Month	No. Tagged	Number of Recoveries*							
			1956				1957			
			1st**	2nd**	Other	Total	1st**	2nd**	Other	Total
SOUTH OF CAPE SPENCER										
1955 Experiments										
Goose I.	July	1,963	321	67	43	431	130	23	31	184
Goose I.	Oct.	900	76	26	30	132	63	7	23	93
Lower Hecate Strait	Sept.	392	28	4	5	37	32	—	2	34
Upper Hecate Strait	Aug.	1,337	191	53	19	263	84	27	9	120
Masset Nursery	Aug.-Sept.	2,535	94	10	5	109	206	14	9	229
Timbered I. Nursery	Aug.	1,400	27	8	1	36	30	10	4	44
WEST OF CAPE SPENCER										
1954 Experiments										
Seward Gully	May	735	13	1	1	15	17	—	2	19
Albatross Bank	May-June	485	6	—	—	6	5	—	1	6
Yakutat	June	741	36	—	1	37	12	—	—	12
Portlock	June-July	509	1	1	—	2	4	—	—	4
Albatross Bank	July	307	1	—	—	1	2	—	—	2
Yakutat	Aug.	959	43	—	2	45	27	—	—	27
Trinity Is.	July	255	3	—	—	3	4	—	—	4
1955 Experiments										
Yakutat and "W" Ground	Nov.-Dec.	1,242	50	3	2	55	24	1	—	25
1956 Experiments										
Shumagin Gully	May	527	—	—	—	—	4	—	1	5
Shumagin Is.	July	704	—	—	—	—	7	2	1	10
Shumagin Is.	Sept.	163	—	—	—	—	1	—	—	1
Bering Sea	June	1,715	—	—	—	—	4	—	—	4
Bering Sea	Aug.	790	—	—	—	—	5	—	—	5
Makushin-Akun	May-June	182	—	—	—	—	—	—	—	—
Makushin-Akun	July-Aug.	496	—	—	—	—	1	—	—	1
Yakutat and "W" Ground	Nov.-Dec.	588	—	—	—	—	35	—	1	36
Trinity Is.	Sept.	97	—	—	—	—	—	—	—	—

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

** Fishing seasons.

The pattern of tags recovered in 1957 was generally similar to those of other recent years in the same regions. Of particular interest were recoveries from the 1955 experiments on the Masset and Timbered Islet nursery grounds, and first year recoveries of halibut released in 1956 in Bering Sea and at the Shumagin Islands.

The 1955 tagging experiments on the closed Masset and Timbered Islet nursery grounds produced 229 and 44 recoveries respectively in 1957 compared with 109 and 36 respectively in 1956. These constitute a 13 percent recovery rate for the Masset experiment and a 6 percent recovery rate for the Timbered Islet experiment during the first two full years after tagging, considerably lower than the rates obtained from experiments in adjacent areas where fishing is permitted. The recoveries from the Masset experiment showed a marked increase over those of 1956 due to a shift of the Canadian small boat fleet to adjacent grounds. Most of these tags were taken immediately outside the boundary of the closed nursery grounds.

First year recoveries from the 1956 Bering Sea experiments were few in number but showed a widespread movement into Areas 3A and 2 similar to that observed during the first year of 1930 and 1947 experiments in Bering Sea. In the latter experiments the rate of recovery increased to a maximum about four years after tagging, reflecting an emigration out of Bering Sea and an eastward dispersion to the heavily fished grounds in Areas 3A and 2. A comparable increase in the recovery of 1956 tags is expected outside Bering Sea during the next few years.

Although the numbers of first year recoveries from the 1956 Shumagin Island experiments were small, they suggest that tagging in early May and in early June was done upon different segments of the stock. The relative numbers returned from the two experiments suggest that the fish tagged in May moved westward into a lightly-fished region whereas those tagged in July moved eastward into well-fished regions.

The tags from the May experiment were recovered from grounds west of Kodiak Island while those released in July were largely from grounds east of Kodiak Island. The need for careful integration of the fishing seasons with the seasonal availability of the stocks is clearly apparent.

Recoveries to date from the 1955 and 1956-57 winter tagging on Yakutat and the "W" grounds have shown a marked westerly migration similar to that demonstrated by the 1926 Yakutat winter experiment. Only 6 percent of 1955 winter releases have been recovered in two years compared with a 14 percent return in two years from the 1951 summer experiment on Yakutat.

STUDIES OF HALIBUT OF SUB-COMMERCIAL SIZE

Investigations of the distribution and availability of the early bottom stages of halibut initiated in 1955 were continued in 1956 and 1957. During 1955, fishing with experimental gear was conducted on the grounds between the north end of Vancouver Island and Dixon Entrance. In 1956 the area of operations was extended to include both the inside and outside waters of southeastern Alaska. Although no heavy concentrations of small halibut were found during these years much was learned regarding fishable locations and methods of handling experimental fishing gear. A detailed account of results in 1955 and a summary of results in 1956 were given in Commission Report No. 25.

The investigations were resumed and the area of operations was further extended in 1957. The University of Washington's research vessel *COMMANDO* was chartered for a two-month period from mid-July to mid-September. Sampling was repeated at the locations in northern Hecate Strait and Dixon Entrance off northern British Columbia and in southeastern Alaska where some small halibut had been found in 1955 and 1956. In addition extensive exploration was done in the coastal waters of the Gulf of Alaska and off central Alaska as far west as the Kodiak Island region. The main places sampled were McIntyre Bay in Dixon Entrance, Shelikof Bay near Sitka, Yakutat Bay, the vicinity of Prince William Sound, Cook Inlet, Shelikof Strait and Kodiak Island.

Fishing was conducted chiefly with otter trawls of 2½-inch mesh in the wings and 1¾-inch mesh in the body and cod-end. Other types of gear were used on untrawlable bottom and in areas too shallow for otter trawling, including a small beam trawl of 1¾-inch mesh, a beach seine of 1-inch mesh, ring nets of ¾-inch mesh and lightweight setlines with fine gangions and small hooks capable of being taken by small fish.

The number of sets, the depth of 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	58	6 - 29 fathoms	30 min.
Beam trawl	16	1 - 15 fathoms	15 min.
Beach seine	4	Surf - 7 fathoms	—
Ring nets	12	2 - 20 fathoms	1 hr.
Setline	28	1 - 30 fathoms	1 hr.

A total of 1123 halibut was taken during 1957 in depths ranging from 10 to 20 fathoms. As in other years, very few small halibut were caught in the shallow waters adjacent to the beaches which suggests that relatively few are present there. The halibut caught ranged from 2 inches to 25 inches in length and from less than one to seven years of age. Of the total catch, 1088 were taken with fine-meshed otter trawls, 32 with hook and line, 2 with light beam trawl and 1 with beach seine. Occasional halibut of commercial size were also caught throughout the depth range fished.

Captures of halibut of sub-commercial size in 1957 according to locality, date, depth and age were as shown in the following table.

Catches of Halibut of Sub-Commercial Size During Investigations in 1957

Location	Date	Fathoms	Numbers of Halibut by Age								Total	
			0*	1	2	3	4	5	6	7		?
British Columbia												
McIntyre Bay and	July 20-23	8-16	—	1	2	—	—	—	—	—	—	3
Naden Harbor	Sept. 3-6	6-22	8	4	5	5	—	1	1	—	1**	25
Southeastern Alaska												
Sumner Strait	July 24	17	—	—	—	—	1	—	—	—	—	1
Shelikof Bay	July 27-28	10-16	10	26	9	41	27	11	3	—	—	127
	Aug. 28	11-19	20	14	15	60	37	20	9	—	—	175
Gulf of Alaska												
Fairweather	Aug. 26	18-19	—	—	—	—	15	5	2	—	—	22
Yakutat	July 30-31	8-18	1	2	5	16	25	12	11	—	—	72
	Aug. 1	Surf-15	3	—	—	—	—	—	—	—	—	3
	Aug. 26	10-21	—	—	—	10	25	7	4	1	—	47
Central Alaska												
Prince William Sound	Aug. 3-4	6-19	6	5	8	14	9	11	1	—	—	54
	Aug. 7	9-21	—	—	—	1	—	—	—	—	—	1
	Aug. 23-24	13-23	—	5	23	41	44	10	8	1	—	132
Cook Inlet	Aug. 9-11	14-24	—	33	60	95	6	2	—	—	—	196
Kodiak Island	Aug. 13-15	10-21	2	49	54	48	37	6	2	—	—	198
	Aug. 18	10-29	—	—	1	1	2	1	—	—	—	5
Shelikof Strait	Aug. 15	11-13	8	35	19	—	—	—	—	—	—	62
TOTAL			58	174	201	332	228	86	41	2	1	1123

*Less than one year old.

**Otolith illegible (probably 2 or 3 years old).

As in 1955 and 1956 the catch in a given area was about equally divided as to males and females, and there was no measurable difference in the average size of the males and females within the first three age groups.

The diet of halibut from 4 to approximately 8 inches in length consisted mainly of shrimp and small crabs. In most areas, fish was the dominant type of food found in the stomachs of halibut over 12 inches long — an exception being Cook Inlet where halibut up to 16 inches long were still feeding mainly upon shrimp.

Progress was made in 1957 toward achieving the primary objective — the locating of concentrations of halibut of sub-commercial size that might permit quantitative yearly studies. Areas which showed promise of supplying sufficient numbers of small halibut for such a program were Shelikof Bay near Sitka, sections of Prince William Sound and Cook Inlet, several bays on Kodiak Island and Puale Bay on the mainland shore of Shelikof Strait.

During the three years of study relatively low catches per unit effort of small halibut have been taken in the trawlable areas off northern British Columbia where adult halibut are abundant. Nowhere did the numbers approach those taken near Sitka off southeastern Alaska or off central Alaska. Whether the small catches off British Columbia are due to the presence of fewer small halibut generally or to a difference in type of habitat is not yet known and indicates a need for more intensive investigations there.