

**REPORT OF THE INTERNATIONAL FISHERIES
COMMISSION**

**APPOINTED UNDER THE TREATY BETWEEN THE UNITED STATES
AND CANADA FOR THE PRESERVATION OF THE
NORTHERN PACIFIC HALIBUT FISHERY**

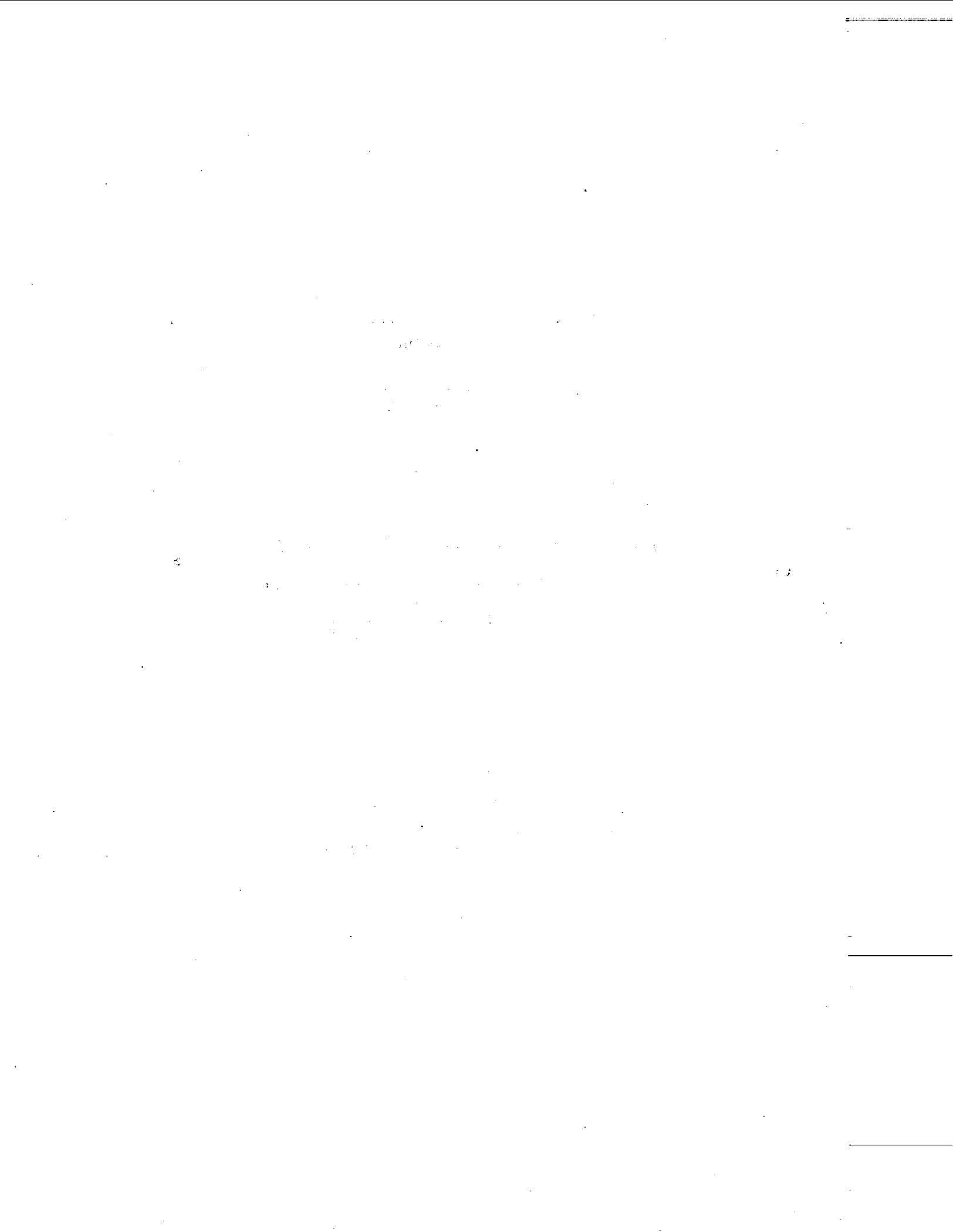
NUMBER 15

**REGULATION AND INVESTIGATION
OF THE PACIFIC HALIBUT
FISHERY IN 1949**

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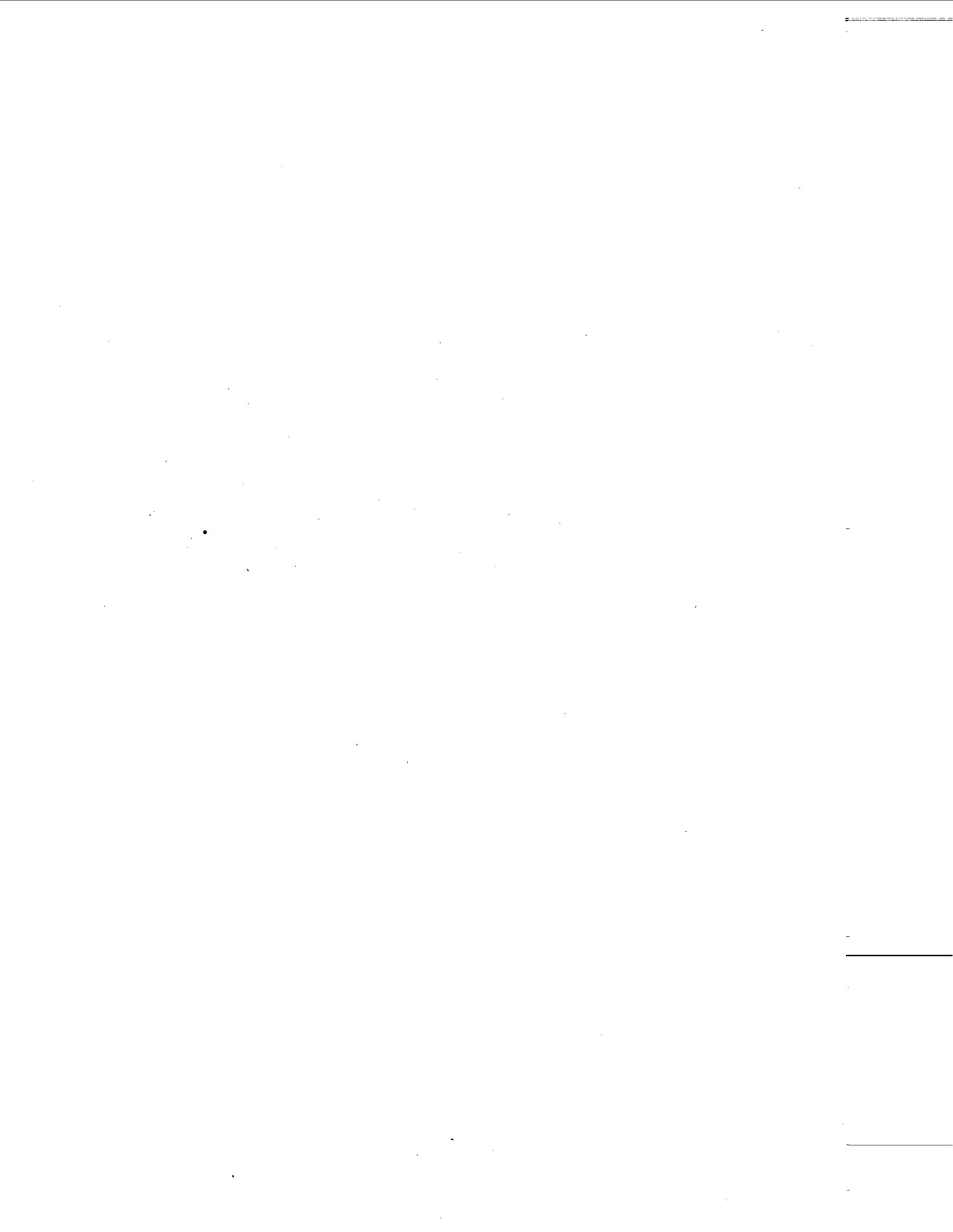


FOREWORD

The present is the fifteenth report published by the International Fisheries Commission under the terms of the Conventions of 1923, 1930 and 1937 between the United States and Canada for the preservation of the halibut fishery of the Northern Pacific Ocean and Bering Sea.

It is the third of a series of annual reports commenced in 1947 to provide a brief summary of the Commission's administrative and investigational activities during the year. Information of interest to the fishing industry and the general public regarding the halibut fishery is also included.

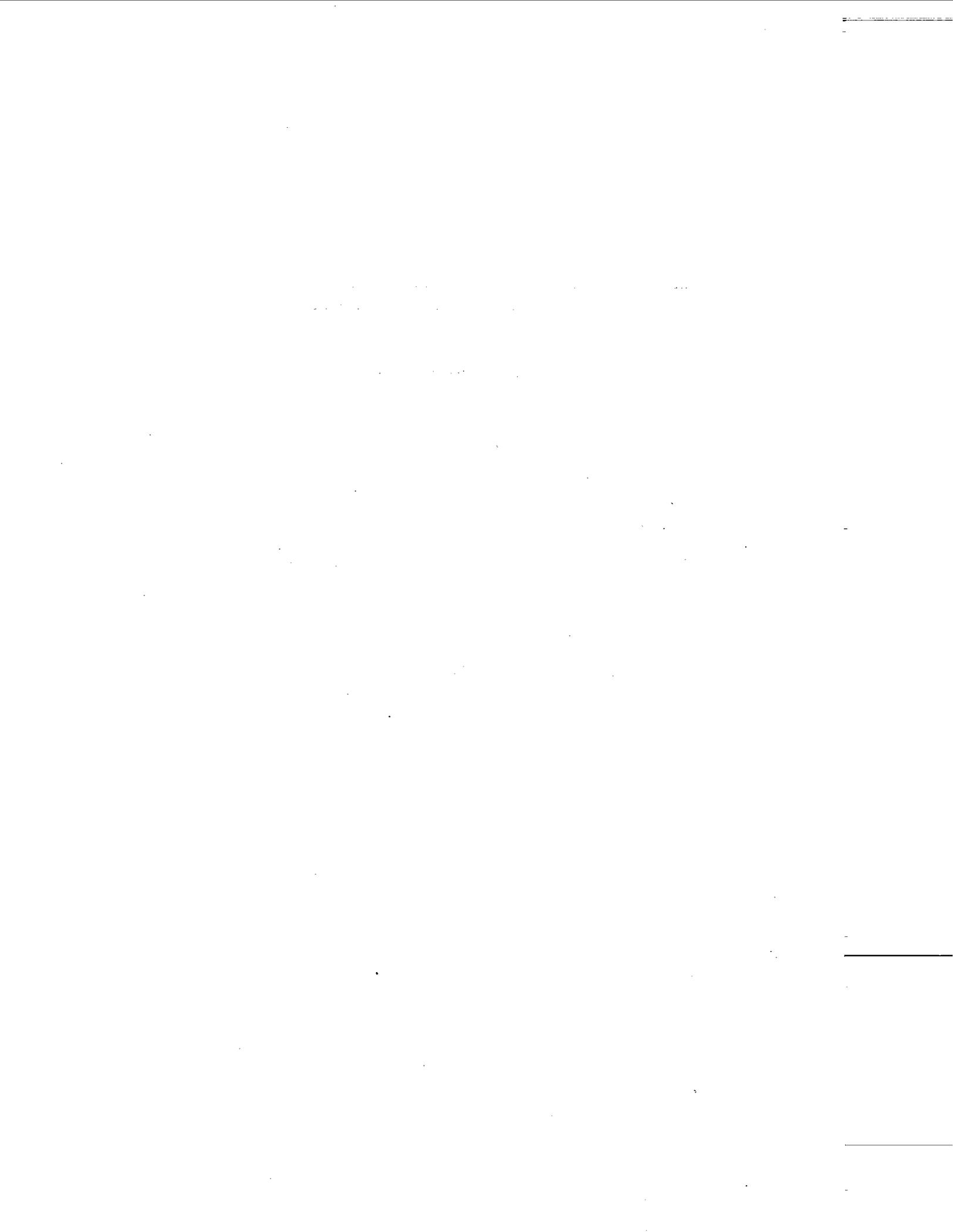
For further background material, the reader not familiar with the halibut fishery and past work of the Commission, is referred to the Annual Reports for 1947 and 1948.



**REGULATION AND INVESTIGATION OF THE PACIFIC
HALIBUT FISHERY IN 1949**

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INTRODUCTION*

The Pacific halibut fishery is engaged in jointly by nationals of Canada and of the United States. About 90 per cent of the catch originates outside of territorial waters of either nation.

International control of the fishery was contemplated as early as 1915 when the industry in both countries became concerned about the annual production, which was declining in spite of the progressive enlargement of the fleets and a continuous expansion of the fishery to new grounds.

After some delay, occasioned chiefly by World War I, a treaty between the United States and Canada for the preservation and development of the fishery was signed in 1923 and ratified in 1924. It established a three-month winter closed season from November 15 to February 15, corresponding to the spawning season of the halibut, and provided for the appointment of the International Fisheries Commission composed of two non-salaried members from each country. It charged the Commission to investigate the fishery and to recommend to the two governments measures for its preservation and development. The treaty also authorized the Commission to modify or suspend the closed season after the third such season subsequent to ratification of the treaty.

After an intensive scientific investigation of the fishery, the Commission in 1928 recommended application of specific regulatory measures to reduce fishing and halt the continued decline in the fishery. The necessary authority was provided in a new convention, signed in 1930 and ratified in 1931. This treaty empowered the Commission to change or suspend the closed season; to divide the convention waters into areas and limit the catch of halibut to be taken from each; to regulate the licensing and departure of vessels; to collect the statistics necessary for administering the catch limits and for determining the condition and trend of the fishery; to fix the type of gear to be used; and, to close grounds found to be populated by small immature halibut.

A third treaty was signed and ratified in 1937, and is still in effect. This expanded the Commission's regulatory authority by providing for the control of the capture of halibut caught incidentally to fishing for other species in areas closed to halibut fishing by reason of attainment of their catch limits. It also authorized the Commission to prohibit the departure of vessels for any area when those which had already departed would suffice to take the area's catch limit.

In 1932 and each subsequent year the fishery has been governed by regulations adopted by the Commission and approved by the President of the United States and the Governor-General in Council of Canada.

*For the benefit of new readers this introduction repeats some of the historical background reviewed in previous annual reports.

Enforcement of the regulations in the United States has been the statutory duty of the Coast Guard, the Customs Service and the Fish and Wildlife Service, and in Canada the responsibility of the Federal Department of Fisheries, with particular assistance from the Customs Division of the Department of National Revenue.

Under regulation, the abundance of halibut on the coast as a whole has increased almost 150 per cent and the total catch during the past five years has averaged over 56 million pounds annually, about 12 million pounds greater annually than in 1931. This additional poundage with the associated vitamin-bearing livers and viscera has added more than \$3,000,000 to the fleets' earnings in each recent year. In spite of the larger catches now permitted each year, the increased abundance has resulted in a one-third reduction in the amount of fishing effort required to secure the catch.

Noteworthy improvements in the supply and annual yield have been made under the system of management authorized by the conventions of 1930 and 1937. However, this system may have to be modified in some respects if the full potential yield is to be secured from each stock.

The improvement in the abundance of halibut and a resultant doubling in the size of the halibut fleets have greatly increased the rate of capture and sharply reduced the length of the authorized fishing season, in spite of the greater total catch allowed. The fishing season which was eight and one-half months long in 1932 was in 1949 one month long in one of the two important fishing areas and only two and one-third months long in the other.

Statistical and biological information indicates that a short fishing season does not permit the full exploitation of all sections of known available stocks. To realize the full potentialities of the known available stocks over all sections of the grounds at different times of the year, the fishing season should be extended over a longer period of the year.

ACTIVITIES OF THE COMMISSION IN 1949

During 1949 the Commission continued the regulation of the fishery and the statistical and biological observations upon which regulation depends. It maintained close contact with all branches of the halibut industry, by means of conferences with the fleets and wholesale dealers and through public hearings.

Mr. Stewart Bates, Deputy Minister of Fisheries, Ottawa, who became a Canadian member of the Commission in April, 1948, resigned in September, 1949. Mr. G. R. Clark, Director, Pacific and Inland Fisheries, Department of Fisheries, Ottawa, was appointed to fill the vacancy.

The investigations were carried forward by the Commission's staff from office and laboratory quarters provided at the University of Washington in Seattle, Washington. They involved the operation of a chartered halibut vessel, the maintenance of field offices at Prince Rupert and Vancouver, B.C., during the fishing season, and visits to Southeastern Alaska ports from time

to time to collect fishing records and statistics of landings and to redeem tagged halibut recovered by the fishermen.

Meetings of the Commission in 1949 were held at Seattle, Washington, on January 11, 12 and 13, and at Juneau, Alaska, on October 1.

The January meetings were the regular annual meetings. A meeting was held with the Halibut Conference Board composed of representatives from the fishermen's and vessel owners' organizations in the major halibut ports—Seattle, Vancouver, Prince Rupert, Ketchikan, Petersburg and Juneau. Results of the previous season's fishery, current findings of the Commission and proposals of the delegates regarding the regulation of the fishery in 1949 were discussed. Regulations and a program of investigations for the 1949 season were adopted.

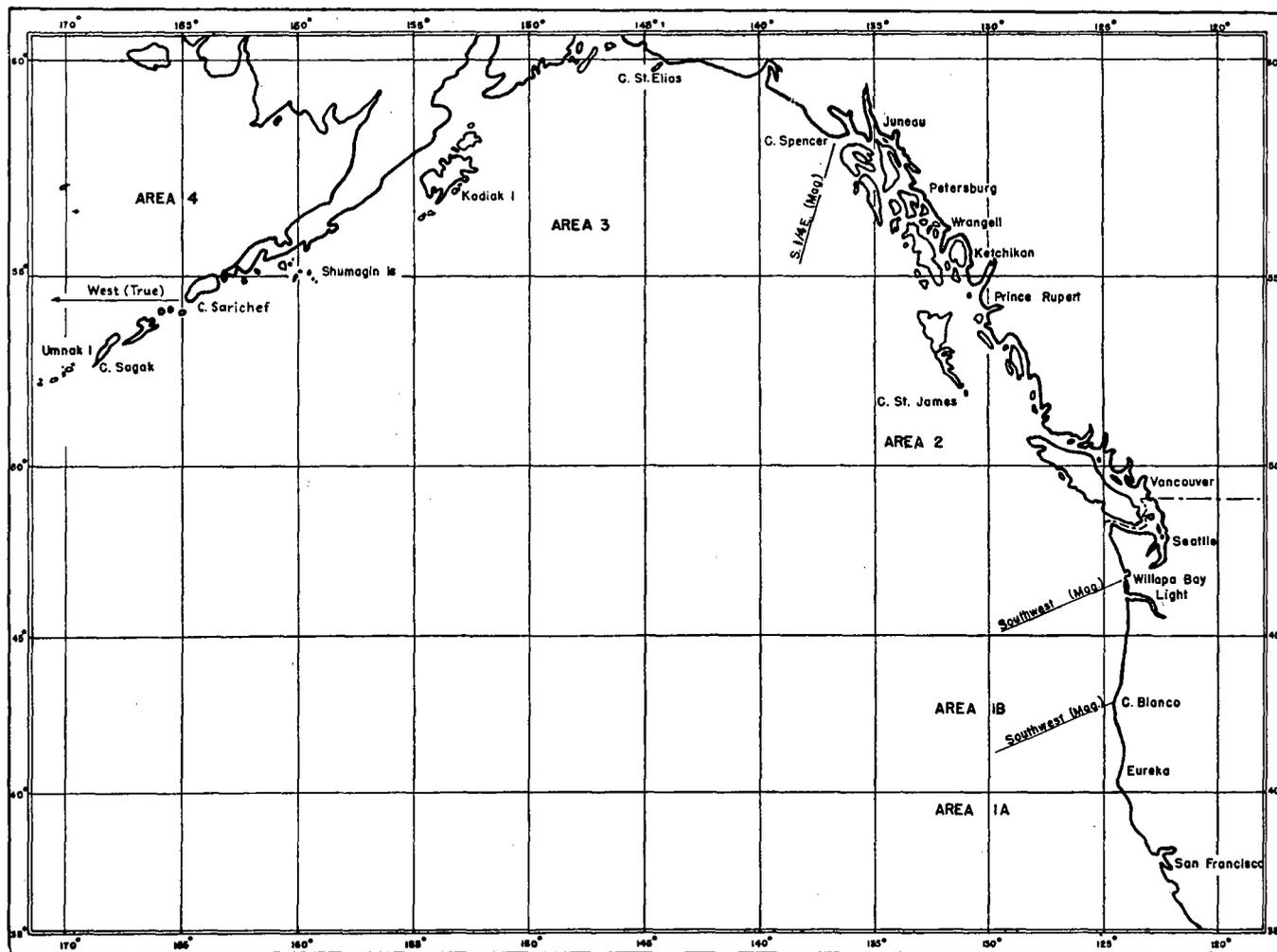
Among the proposals made by the Commission was a splitting of the fishing season in each regulatory area into a number of successive open and closed periods, as a means of overcoming the biological disadvantages of the current short season. Since the proposal had considerable support amongst the delegates, and was the only method of distributing fishing that appeared to be within the Commission's present treaty authority, it was referred to the various fleets and to other interested parties for further consideration.

Finding that some sections of the industry believed that the application of such a split season would be economically disastrous to them, the Commission subsequently deferred any action in the matter until public hearings could be held at the end of the fishing season.

Hearings relative to the above proposal were held September 23 at Seattle, September 26 at Vancouver, September 28 at Prince Rupert, September 29 at Ketchikan, September 30 at Petersburg, and October 1 at Juneau. Fishermen, vessel owners, halibut dealers and local business interests were well represented. Vessel owners and fishermen supported the biological information indicating need for a spreading of the permitted catch over a longer season and expressed themselves in favor of such action. Most halibut dealers concurred. However, the particular split season proposal developed at the January meeting of the Conference Board, involving a succession of open and closed periods applied simultaneously to all boats, received little support from fishermen, vessel owners or dealers in all ports.

A group of British Columbia dealers proposed a modified split season, suggesting that the current open season be supplemented by a short open period of fishing in late summer to permit the utilization of portions of the stocks that became available later in the year.

The fleets in all ports stated that the best means of extending the fishing season was a program of between-trip lay-ins, applied to each vessel individually at the expiration of each trip rather than to all boats simultaneously as in any split-season method. However, they recognized that the Commission could not carry out such a program without broader treaty powers such as were recommended to the Governments in 1946.



Pacific Coast of North America, showing the regulatory areas defined by the International Fisheries Commission in 1949.

THE 1949 REGULATIONS

The Pacific Halibut Fishery Regulations for 1949 were approved by the Governor-General in Council of Canada on April 26 and by the President of the United States on April 28, and became effective as of the latter date.

There were no significant changes in the regulations for 1949 from those of the previous year.

The convention waters were divided into the same five regulatory areas: Area 1A, the waters off the southern Oregon and northern California coasts south of Cape Blanco, Oregon; Area 1B, lying off the Washington and Oregon coasts between Cape Blanco and Willapa Bay; Area 2, between Willapa Bay and Cape Spencer, Alaska; Area 3, between Cape Spencer and a line running true west from Cape Sarichef on Unimak Island; Area 4, the Bering Sea north of the above Cape Sarichef line.

Catch limits of 25,500,000 pounds, 28,000,000 pounds and 500,000 pounds were provided for Areas 2, 3 and 4, respectively, involving no changes from last year. Area 1A and 1B, where the catch of halibut is relatively inconsequential, were allowed to continue without catch limits.

Provision was again made for the opening of the fishing season in all areas on May 1, and for the subsequent closure of each. The closure dates of Areas 2, 3 and 4 were again contingent upon the attainment of their catch limits, or in the case of Area 4, upon the earlier closure of Area 3 to eliminate opportunities for illegal post-season fishing in Area 3. The closure date of Area 2 was applied to Area 1B and that of Area 2 or 3, whichever was later, was applied to Area 1A.

Other regulatory provisions were continued, including: 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 of nets of any kind for the capture of halibut; the termination of permits for the retention of halibut caught incidentally during fishing for other species in closed areas after November 15, and the beginning of the winter closed season after November 30, if it had not previously begun through the earlier attainment of the catch limits.

Areas 2 and 1B were closed to halibut fishing at midnight of June 3, and Areas 3, 4 and 1A were closed at midnight July 12. The closure dates of Areas 2 and 3 were announced in advance on May 23 and June 17, respectively, on the basis of the estimated dates of attainment of their catch limits.

STATISTICS OF THE FISHERY

Landings from Areas 1A and 1B combined, 2 and 3 during 1948 and 1949 are compared in the following table with those at five-year intervals back to 1931, the year immediately preceding the commencement of the Commis-

sion's regulation of the fishery. No landings were made from Area 4. All figures are in thousands of pounds.

The figures are as reported and have not been amended for the variable amounts of illegally caught halibut or for amounts declared from the wrong area or for amounts estimated to have been landed but not reported. They do include halibut caught incidentally while fishing under permit for other species in areas closed to halibut fishing.

Year	Area 1		Area 2		Area 3			Areas 1, 2, 3		
	U. S.	U. S.	Can.	Total	U. S.	Can.	Total	U. S.	Can.	Total
1931	923	14629	7018	21647	20887	765	21652	36439	7783	44222
1935	1489	13113	8955	22068	22533	1251	23784	37135	10206	47341
1940	779	14396	11102	25498	25396	1582	26978	40571	12684	53255
1945	529	13230	11750	24980	25605	3551	29156	39364	15301	54665
1948	282	13273	14203	27476	23276	4453	27729	36831	18656	55487
1949	426	12461	13588	26049	23433	5158	28591	36320	18746	55066

Landings shown for Area 1 in 1948 and 1949 include those for the present Areas 1A and 1B into which the Area 1 of previous years was subdivided. Landings in 1949 from this section are of the same general magnitude as in 1948. The shortened season of recent years has sharply reduced landings of legally caught halibut off the southern Washington, Oregon and northern California coasts.

Area 2 landings have increased markedly over those in earlier years, the production from that area in 1948 and 1949 averaging about 5.1 million pounds more than in 1931, the year immediately preceding commencement of regulation. The much larger Canadian fleet has doubled its production from this area while the catch of the United States fleet has shown some decline since 1931.

Area 3 landings in 1949 were about 7.0 million pounds above the 1931 total. The U.S. fleet accounted for about 2.5 million pounds of the increase and the Canadian fleet for the remaining 4.5 million pounds. The 1949 Canadian Area 3 catch was seven times greater than in 1931.

Combined United States and Canadian landings from Areas 1, 2 and 3 in 1949 were about 10.8 million pounds above the 1931 level.

The distribution of landings from the two major regulatory areas, Areas 2 and 3, is shown in the following table:

Year	Canadian Ports				United States Ports				
	Vancouver, New West- minster	Prince Rupert	Minor Ports	Total	Puget Sound	S. E. Alaska	Central Alaska	Minor Ports	Total
1931	1066	16792	516	18374	15201	8240	1484	24925
1935	2242	12964	1921	17127	22067	6532	12	114	28725
1940	1996	18580	3314	23890	18773	9305	182	326	28586
1945	1910	15272	2498	19680	11951	19060	2181	1264	34456
1948	1829	14984	4144	20957	9013	19226	4742	1267	34248
1949	1473	16809	3986	22268	9161	17425	4689	1096	32371

Combined landings by Canadian and U.S. vessels in Canadian ports in 1949 were about 3.9 million pounds greater than in 1931. The increase was largely accounted for by higher receipts in the minor ports, which include Butedale, Namu, Klemtu and places on Vancouver Island or the adjacent islands.

Receipts from U.S. and Canadian vessels in United States ports in 1949 were about 7.4 million pounds above the 1931 level. Southeastern Alaska ports in 1949 received 17.4 million pounds, or more than double the 1931 total. This growth was in large part due to the sharp increase in number of Area 2 vessels fishing out of Southeastern Alaska ports. Landings of 9.2 million pounds in Puget Sound ports in 1949 represented a decline of 6.0 million from the 1931 level. The decrease occurred in the landings from both Area 2 and Area 3. The recent expansion of freezing facilities in Central Alaska was responsible for the sharp increase in the landings on that section of the coast.

THE PROBLEM OF THE SHORT SEASON

The length of the fishing season in 1949 was only 34 days in Area 2 and 73 days in Area 3. It has progressively declined since 1931 from eight and one-half months in both areas. This concentration of the season is contrary to what has traditionally prevailed in the fishery since its inception 60 years ago.

The Commission considers that the short season is interfering with the full utilization of the available supply of halibut and that its continuation may prevent the further expansion of the fishery. The fishermen and some sections of the industry claim that it is also preventing them from achieving their commercial objective, the orderly marketing of high-quality fish in maximum amounts.

The adverse biological consequences of the shortened season lie chiefly in the failure of some sections of the stocks to yield the poundage of which they are capable. There is also the possibility that other sections of the stocks are being subjected to an over-intensive fishery. With the current short season the fishery tends to concentrate on those grounds where the fish are congregated with greatest density at that particular time of the year. The stocks on other grounds which have different periods of greatest density are under-exploited, as are the sections of the stocks available later (or earlier) on grounds now heavily fished. The result is that certain grounds do not contribute to the total catch in the proportion they did in years when there was a longer season.

Halibut fishermen had learned by long experience that the stocks are not equally available on all banks at any one time nor equally available on any one bank at all times. Thus, they tended to develop a pattern of fishing which took them to different grounds at different times of the year. This is illustrated by the following table which shows the average percentage of

the catch taken from the different subsections of the coast between Cape Scott and Cape Spencer in Area 2, during each month in the 1931-1935 period. At that time the fishing seasons were long and the fleets were able to fish each subsection at the best time from the standpoint of weather conditions and of availability and value of the catch.

Examination of the table shows that the present May fishing period corresponds with the traditionally most productive season of middle Hecate Strait. It misses the best fishing season in lower Hecate Strait and barely touches the beginning or end of the best seasons on the Cape Scott, Goose Island and upper Hecate Strait grounds. Examination of the data also shows that no other single fishing period of one month will coincide with the most productive season on all grounds.

Per Cent of 1931-1935 Catch Taken in Each Month for Each Section of the Coast between the North End of Vancouver Island and Cape Spencer in Area 2

	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.- Nov.
British Columbia									
Cape Scott.....	1.8	14.7	28.1	17.9	9.8	3.8	10.0	7.0	6.4
Goose Island.....	3.3	5.5	11.6	16.5	16.6	13.9	19.5	8.2	6.5
Lower Hecate Strait.....	3.5	7.0	7.3	9.9	20.1	25.2	21.9	3.6	2.5
Middle Hecate Strait.....	—	6.7	20.0	28.0	16.5	13.2	12.3	2.5	1.0
Upper Hecate Strait and Dixon Entrance...	2.0	7.2	10.5	15.0	17.1	19.7	19.6	5.5	2.7
Southeastern Alaska									
Inside Grounds.....	5.4	12.9	16.7	16.2	15.2	14.1	13.5	3.7	2.3
Outside Grounds.....	2.9	8.7	11.5	14.7	16.4	17.8	17.6	6.5	3.9

Fishing on the grounds of Southeastern Alaska did not have such marked seasonal trends. However, it will be observed that fishing tended to be heavier on the sheltered inside grounds in spring and on the exposed outside grounds in summer.

In the following table, the average annual production from the same sections of Area 2 during the years 1931-1935 when the season was long, is compared with the average production during the 1946 and 1948 seasons which were approximately one month long.

The increase or decrease in the average annual catch in each subsection tends to vary with the proximity of the present May season to each section's best fishing. In middle Hecate Strait and inside Southeastern Alaska where May has always been a month of high production, catches are up 96 and 71 per cent, respectively. On the Cape Scott, Goose Island and upper Hecate Strait grounds where May was at the beginning or end of the season of high production, the catch has increased only from 38 to 48 per cent. On the grounds of lower Hecate Strait and off Southeastern Alaska, where production normally increased in later months, annual production has declined 48 and 25 per cent, respectively.

Other factors have also contributed to the redistribution of fishing. With the present extremely short season in Area 2, vessels of the regular fleet are reluctant to make the longer run to the more distant and exposed grounds of lower Hecate Strait and outside Southeastern Alaska. Possible loss of time from bad weather and tides coupled with the longer run could seriously reduce their season's operations. Furthermore, the greatly increased fleets of small boats operating from camps tend to avoid these exposed offshore fishing grounds.

Fishing records indicate that there has been a general increase in the abundance of halibut and consequently in the productive capacity of the stocks in the various subsections of Area 2. However, the trend of abundance has not been uniform in all sections of the area in recent years.

In middle Hecate Strait, where the increase in production has been greatest, the catch per unit of effort has shown some decline since 1944. In upper Hecate Strait and inside Southeastern Alaska, the increase in abundance has ceased. It appears that these regions are being fished up to or beyond their capacity.

In the Cape Scott and Goose Island regions, the improvement in abundance has continued, suggesting that fishing is not exceeding their present productive capacity.

Comparison of Average Annual Catches of Halibut during the 1931-1935 Period and in 1946 and 1948 for Each Section of the Coast between the North End of Vancouver Island and Cape Spencer in Area 2

	1931-35	1946 and 1948	Percentage increase or decrease
BRITISH COLUMBIA			
Cape Scott	1,614,000	2,237,000	+38
Goose Island	3,372,000	4,804,000	+43
Lower Hecate Strait	2,074,000	1,075,000	-48
Middle Hecate Strait	1,418,000	2,784,000	+96
Upper Hecate Strait and Dixon Entrance	4,103,000	6,064,000	+48
SOUTHEASTERN ALASKA			
Inside Grounds	3,113,000	5,362,000	+71
Outside Grounds	4,352,000	3,242,000	-25

In lower Hecate Strait and outside Southeastern Alaska, where production has been reduced despite continued increases in abundance, it can be concluded that a potential catch of significant size is now being lost. This amount of potential production being lost is estimated to be about 4,500,000 pounds annually.

It is suspected that the shortening of the season in Area 3 has had similar unfavorable effects upon the yield. However, this cannot be demonstrated clearly on account of the relative lack of stability in the distribution of fishing resulting from economic factors. The fishing has not been stable in any region for a sufficient length of time to indicate the productive capacity of its stock.

The above findings regarding the under-utilization of the stocks of halibut on some grounds in Area 2 and the over-utilization of them on others imply that the halibut on these grounds form a number of relatively distinct units. This concept of conditions is not new, as is indicated by the following quotation from a discussion of the division of Areas 2 and 3 in Commission Circular No. 5 (1937).

"The stock in Area 2 is however composed of several units that are not only independent of the Area 3 stock but also of one another. These separate Area 2 units could be regulated as separate stocks but because they are all in about the same condition they can also be regulated together. It is desirable to have as few regulatory areas as possible, so the more or less distinct small units in the Area 2 stock have been treated as a single large unit."

Much biological evidence was and is at hand to demonstrate the relative lack of interchange of stocks between Areas 2 and 3 and between subsections of Area 2. Some of this evidence is as follows:

1. Various grounds within the areas are characterized by distinctive size-classes of halibut which have persisted down through the years.
2. Racial studies conducted on scattered grounds in Area 2 indicated that their populations did not mingle to any significant extent at least until the approach of maturity.
3. Tagging experiments on immature stocks in Area 2 showed practically no movement from bank to bank.
4. Tagging experiments on spawning grounds in Area 2 showed that the mature fish migrated within relatively restricted sections of the area adjacent to the place of marking and were not dispersed evenly throughout the area.
5. Other tagging experiments in Area 2 have shown that the stocks on the grounds at different times of year are not all equally available to the fishery during the present fishing season.
6. Present differences in the trends of abundance in different sections of Area 2 correspond inversely to the amounts of fishing being conducted on them.

The above statistical and biological evidence indicates that the full potential catch cannot be secured from Area 2 by concentrating fishing in

some sections of the area during a very short period of the year and neglecting other areas and other periods of the year. They suggest that proper utilization would require fishing to some degree at least from late April through August.

EXTENDING THE LENGTH OF THE FISHING SEASON

The fleets have long been concerned about the shortening of the season, at first because of its effect upon the orderly marketing of their product and more recently due to its possible added effect upon total annual catch. Between 1933 and 1942 they engaged in a voluntary control program designed to spread landings over a longer period of a year. The program consisted primarily of between-trip tie-ups and of limitation of the size of fares. It was called a "curtailment" program by the fleets though it did not restrict the annual production which was set by the Commission. It merely spread the taking of the catch limits over a longer period.

In spite of repeated requests by the fleet, the Commission, whose sole function under both the 1930 and 1937 treaties was furthering the conservation and development of the fishery, did not participate in the program. It did, however, assist the fleets by providing general statistical data.

Early in 1938, as a result of insistent and unanimous requests of the fleets, the Commission presented to the two Governments a report recommending to their consideration some of the fleets' demands for an extension of the Commission's treaty authority to provide legal support for their voluntary program. The report pointed out that the purpose of the fleets' proposals was primarily economic. It mentioned the possible unfavorable biological effects of a shortened season but did not emphasize them as the seasons were still four and seven months long in Areas 2 and 3, respectively.

In 1940, the Commission was instructed by the Governments to ascertain the industry's current attitude with respect to the treaty changes requested earlier. It found through public hearings that the previous unanimity no longer existed and recommended that consideration of such treaty changes be deferred.

During the war the seasons contracted further and by 1945 were but one and one-half months in Area 2 and five months in Area 3. This made the question of lengthening the season one of prime biological importance. Accordingly, in 1946 the Commission on its own initiative and on grounds of sound conservation recommended treaty changes that would enable it to lengthen the season. The entire halibut fleet supported this action and most of the wholesale halibut dealers appeared to favor it.

Conditions continued to deteriorate in respect to the length of the season, and the Commission in 1948 again drew the attention of the Governments to the 1946 recommendations and to the urgent conservation need for extended treaty authority.

The possibility that a broader interpretation of present treaty powers would permit the application of some control measures to spread fishing over a longer season and secure better utilization of the stocks, was discussed with representatives of several departments of the two Governments in 1948. They indicated the belief that the terms of the present treaty might permit the Commission to split the fishing season into two or more open periods or to apply tie-up periods to all vessels simultaneously between trips. It was agreed, however, that the present treaty did not provide any authority to limit the poundage that might be caught by a vessel. Furthermore, the Commission did not desire such authority nor consider it necessary for conservation purposes.

In 1949 the Commission examined the feasibility of dividing the fishing season into two or more periods, on the premise that the present treaty provided such authority. The industry was consulted and public hearings held.

Subsequently the Commission was formally advised by the United States Government, that, in its opinion, the 1937 treaty would not permit the Commission to divide the fishing season into two or more periods or to apply between-trip tie-ups to the vessels individually or on any other basis. This decision was based partly upon the wording of the treaty and partly upon the fact that at the time of negotiation such control of the fishery was neither stated nor contemplated.

The Canadian Government, however, advised the Commission of its opinion, that the terms of the 1937 treaty would permit the division of the fishing season into two or more periods.

Without reconciliation of these conflicting interpretations or negotiating of a new treaty with broader powers there are but two types of measures permissible under the present treaty that might alleviate some of the adverse biological effects of the short season; namely, the rotation of opening dates from year to year, and opening of sections of the grounds at different times of the year.

A properly designed rotation of opening dates for the present areas could, under the present catch limit system, over a period of years provide appropriate amounts of late April to September fishing in Area 2 and late April to late August fishing in Area 3. A first logical step in this long-range program would be to provide for a May, June and July fishery which would require a rotation of opening dates between about May 1 and June 10 within a period of a few years.

Closing certain sections of each regulatory area during the regular fishing season and opening them at other times of the year could be used as a separate or supplementary method to secure additional fishing on late or early appearing sections of the stocks that are not now contributing to the total catch to the extent they did in earlier years. However, directing fish-

ing to certain limited grounds at specific times of year would create very difficult operational problems for the fleet and could probably be applied effectively only to a few grounds. Enforcement of closure of some sections of the present areas while other sections remained open might be difficult.

THE CHANGES IN THE YIELD AND ABUNDANCE OF THE STOCKS

The primary interest of all concerned with the halibut fishery is the total annual poundage produced for market. The Commission's responsibility is to secure the maximum that each stock can produce from year to year in perpetuity. What this maximum may be, how close the present annual production is to that amount and to what extent the short season may interfere with its attainment are of immediate interest.

Tentative conclusions may be drawn regarding present and future yields from each stock by examining the changes in abundance and yield that each stock has undergone. Although the acts of the Commission are always the result of thorough investigations and analysis, it is inevitable in dealing with an ocean fishery of this character that final conclusions must await the process of trial and error. Only experience can provide final proof.

The trend of landings since the beginning of a significant fishery are shown for present Areas 2 and 3 in the following abbreviated table.

<i>Year</i>	<i>Area 2</i>	<i>Area 3</i>
1899	8,935,000	—
1905	22,000,000	—
1912	59,600,000	900,000
1915	44,200,000	24,500,000
1920	32,400,000	14,300,000
1925	23,100,000	26,800,000
1929	24,700,000	31,000,000
1931	21,600,000	21,652,000
1935	22,811,000	23,041,000
1940	27,563,000	25,913,000
1945	26,004,000	28,709,000
1949	27,234,000	28,459,000

The above figures differ from the reported catches, published elsewhere, as they include corrections for poundage reported from the wrong area and for commercial poundage estimated to have been landed but not reported. They are reasonably accurate measures of the actual yield from each area during the years shown.

Area 2

While the commercial fishery in this area commenced in 1888, it was not until after 1905 that it attained a magnitude commensurate with the full extent of its stocks. All sections of Area 2 were being exploited by 1912 when production reached nearly 60 million pounds.

Under the impact of an intensive fishery, the annual yields declined with some fluctuation to the low level of 21.5 million pounds by 1930. With control of fishing under regulation, the yield increased to 27.5 million pounds by 1940. Little increase in yield has been justified since 1940, due in part to the progressive shortening of the season resulting in under-utilization of some sections of the stock and in probable over-fishing of others.

The relative abundance of the stocks in Area 2, as measured by the average catch in pounds per set of a standardized unit of gear, has undergone great changes since 1900. Early fishing off British Columbia between Cape Scott, Vancouver Island, and Dixon Entrance recorded many catches of over 600 pounds per unit, and not infrequently in excess of 1000 pounds. These grounds appear to have been the center of maximum primitive abundance for the Pacific halibut.

By 1910 the catch per unit of gear in Area 2 had declined to between 250 and 300 pounds. The combined effects of intensive fishing and heavy production reduced the catch per unit to below 120 pounds by 1915, to below 90 pounds by 1920, and to below 40 pounds by 1930.

Under controlled fishing after 1932, the catch per skate in Area 2 increased sharply to over 60 pounds by 1935, and at a lower rate of increase to over 90 pounds by 1949.

Area 3

In more remote Area 3, fishing commenced in 1912 and was largely confined to the more accessible eastern portion of the area until 1920. Annual production climbed rapidly to 24.5 million pounds by 1915 but declined to a 1918-1922 level of about 12.5 million, as a result of conditions arising from World War I. After 1922, with rapid increases in size and effectiveness of the fleet, production rose until 1925 in which 27 million pounds were taken. Subsequent great increases in the amount of fishing and extension of the fishery to the most westerly portions of the area produced but inconsequential increases in yield. In 1930 the annual catch was only slightly greater than in 1924, yet the amount of fishing was almost twice as great. In 1931, when the economic conditions reduced fishing to slightly above the 1925 level, the catch fell off sharply to 21 million pounds, nearly 20 per cent below that of 1925.

Commencing in 1932, regulation reduced the amount of fishing in Area 3 and the resultant improvement in the stocks permitted a gradual increasing of the annual yield to 28 million pounds by 1945. Cessation of improvement

during the past four years has necessitated holding the annual yield at about this level.

The productive capacity of the stocks in Area 3 at the same stage of exploitation has never been as great as of those in Area 2. The largest annual yield from Area 3 was 31,000,000 pounds, taken in 1929 by an intense fishery operating throughout the entire area during a long season. In contrast, nearly 60,000,000 pounds were taken from Area 2 in 1912 despite the fact that catches taken from this area in the preceding five years had been twice as great as in the comparable period in Area 3.

Neither has the abundance of halibut in Area 3 ever been as great as Area 2, at the comparable stages of their fisheries. Shortly after the outset of the fishery in Area 3 the average catch per unit of effort was only about 150 pounds, while in Area 2 average catches of 300 pounds per unit of effort prevailed in early years. Under the impact of an increasingly intensive fishery, the catch per unit of effort in Area 3 dropped to 100 pounds by 1925 and to less than 70 pounds by 1930.

Reduced fishing in 1931 and control of the intensity of fishing thereafter contributed to a steady rise in the catch per unit of gear which exceeded 140 pounds in 1944. Subsequently a gradual recession occurred due apparently to these larger catches and changes in the stocks resulting from conditions some years earlier. By 1949 it had declined to about 110 pounds, which still represented an increase of 70 per cent* over the low point of 1930.

This gross examination of the history of yield and of abundance of the two stocks indicates that the maximum annual yield to be expected from Area 2 will exceed that from Area 3.

It appears that the catch from Area 2, averaging about 28 million pounds in recent years, could ultimately be increased by about 9 million pounds. Of this 4.5 million could be expected from increased fishing on sections of the area now not adequately exploited, 3 million from fishing stocks appearing on the grounds later or earlier than the present May season, and about 1.5 million from spreading catches over a longer season, thus permitting a larger proportion of the fish taken each year to acquire their summer growth before capture.

Present annual yields of about 28 million pounds from Area 3 are not far removed from the 30 million pound maximum that these stocks may be expected to produce. In the late 1920's in spite of very intensive fishing over a long season and over the entire area, it was not possible to increase the yield beyond 31 million pounds.

*Measurement of the changes in relative abundance of the Area 3 stocks is difficult, on account of the marked changes in the fishery and the complex character of the stocks. Studies are under way to determine what corrections must be made for changes in the fleet, the gear, the operating personnel and the seasonal and geographical distribution of the fishery within the area. Preliminary results indicate that the abundance of halibut in Area 3 in 1949 was actually more than 100 per cent above the 1930 level.

These estimates are believed to be conservative. They are the best that can be made until more intensive studies of the statistics and of the past and present changes in recruitment and in composition of the stocks are completed.

With the present unbalanced exploitation of the stocks, it seems unlikely that the present Area 3 production of about 28 million pounds can be more than maintained or that the yield from Area 2 can be increased to more than about 30 million pounds.

CHANGES IN COMPOSITION OF STOCKS

Studies of the changes in the size and age composition of the stocks, resulting from fluctuations in the numbers of young entering the fishery in different years and from changes in the intensity of fishing, were expanded during 1949. Information was derived from samples of length measurements and otoliths taken from commercial catches at the time of landing, from measurements and otoliths collected during tagging operations at sea, and to a limited degree from dealers' records of landings according to trade categories.

Prior to 1949, the collection of measurement and otolith samples from commercial landings was conducted normally only at Seattle. Changes in the distribution of landings and other circumstances during and immediately after the war, prevented the sampling of Area 3 catches and reduced Area 2 sampling to one representative region. Improved conditions in 1949 permitted sampling the landings at both Seattle and Prince Rupert.

More than 43,600 halibut were measured in 1949, 21,700 from 35 trips originating in Area 2 and 21,900 from 34 trips taken in Area 3. Otoliths for the determination of ages and age composition were secured at the same time from 8,550 of the fish measured from the two areas. These data and materials were supplemented by the collection of more than 2,720 measurements and 1,440 otoliths in Area 3, and 1920 measurements and 880 otoliths in Area 2, during tagging operations on a chartered fishing vessel.

Analysis of the 1949 measurements from Area 2 grounds which had been sampled for fifteen consecutive years showed that the number of small halibut entering the fishery were even lower than in 1948. As a result of these two consecutive years in which the numbers of entering young were considerably below average, the contribution of the "chicken" class (5-10 pounds) dropped sharply. The "medium" (10-60 pounds) and "large" (over 60 pounds) trade categories supported the fishery to an abnormal extent.

The age composition of the catches from these grounds revealed that the six, seven and eight year olds, which should be the mainstay of the fishery three years later, were less abundant than in any year since 1942. The nine and eleven year olds appeared in greater than average abundance and the ten and twelve year olds were more abundant than in any of the preceding fourteen years.

Studies of the composition of the Area 3 stocks showed that they consisted of complex groupings of individuals of different sizes, sexes and degrees of maturity. Conclusions regarding the composition of these stocks and changes occurring in them must be deferred until data from several consecutive current years are available for comparison.

Age determination, based on otoliths collected during tagging operations in Area 3, indicated that the commercial catch from the very important Portlock-Albatross bank region was composed mainly of halibut from 10 to 16 years old, with 13 and 14 year olds most dominant. Conditions were similar in this respect to those found in 1927 when the stocks were first sampled in this region.

The above suggests very strongly that the portion of the recent decline in the size of the commercial stocks in Area 3, not attributable to changes in the fishery, may have been a normal result of the reduced number of spawners in those stocks during the late 1920's and early 1930's when the abundance of halibut in Area 3 was at an all-time low.

MARKING EXPERIMENTS

The tagging of halibut was resumed in 1946 and 1947 in conjunction with investigation of the catches of halibut taken by otter trawling in Area 2. It resulted in the release of 5430 tagged halibut on a number of fishing grounds between the north end of Vancouver Island and Dixon Entrance. The primary object of this tagging was to ascertain whether the stocks on banks in that region were being utilized unequally, as suggested by changes in the amount of fishing on them.

Recoveries of tags during 1947 and 1948, as reported previously, showed that the stocks on different grounds were in fact contributing very unequally to the catch from that region. Since almost every recovery was made on the bank where the fish was originally marked and released, they indicated that some inequalities resulted from an uneven geographical distribution of fishing during the present May season. Differences in the rate of recovery of tags released on the same bank in different months also suggested very strongly that other inequalities resulted from different sections of the stocks being available to the fishery in different months.

Halibut recovered in 1949 from the above experiments showed similar differences in rate of recovery, according to time and place of marking. Some of these differences are shown in the following table of recoveries during the first two complete fishing seasons after marking. The experiments are arranged according to rates of recovery and month of marking.

It will be observed that fish on Goose Island in May and June and at Cape Scott in June were relatively available to the intense fishery which is now restricted to May and a few days in June.

<i>Year</i>	<i>Month</i>	<i>Tagging Location</i>	<i>Number tagged</i>	<i>Percent Recovered in first two years</i>
1947	May, June	Goose Island	2333	19
1947	June	Cape Scott	308	20
1947	June	Rose Spit	282	12
1946	July, Aug., Sept.....	Middle Hecate Strait	1563	13
1947	June	Masset	619	6
1946	July	Rose Spit	83	4
1946	Aug., Sept.	Goose Island	242	2

The halibut at Rose Spit in June and in middle Hecate Strait from July to September were less available to the May fishery despite its high intensity in both regions.

The fish at Rose Spit in July and at Goose Island in August and September were scarcely reached by the May fishery, though it was intense in both regions.

No significance can be attached to the low rate of recovery of halibut tagged at Masset because these nursery grounds are closed to all halibut fishing. These fish are not available except through migration to fished grounds.

The above results show a wide difference in the availability of halibut, marked on different grounds in the same month and on the same ground in different months, to the present May fishery. They indicate that equal utilization of all sections of the stocks on the different banks requires a different distribution of fishing both in space and time.

These results are in accord with the observations of experienced fishermen who state that, on the grounds between Dixon Entrance and north end of Vancouver Island, they used to catch a "different class" of "larger" fish in July and August than in May and June when the fishing season included all these months.

In view of the evidence of great inequalities in the utilization of the stocks and sections of the stocks available on the fishing grounds in Area 2, a broad marking program has been adopted. This provides for marking on different important banks in Areas 2 and 3 at different times of year, to determine the degree to which their stocks are contributing to the fishery during the present short season and to ascertain what geographic and seasonal changes in the distribution of fishing will be necessary to secure full utilization of them.

A beginning on this marking program was made in 1949, with the tagging of 1272 halibut on Portlock and Albatross banks in Area 3 and the tagging of 1239 halibut in northern Hecate Strait in Area 2, between mid-July and mid-September.