

**REPORT OF THE  
INTERNATIONAL PACIFIC HALIBUT COMMISSION**

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

**NUMBER 23**

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**THE INCIDENTAL CAPTURE  
OF HALIBUT BY VARIOUS TYPES  
OF FISHING GEAR**

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## FOREWORD

This report is the twenty-third report published by the International Pacific Halibut Commission under the terms of the Conventions of 1923, 1930, 1937 and 1953 between the United States and Canada for the preservation of the halibut fishery of the Northern Pacific Ocean and Bering Sea.

It deals with conservation and regulatory problems associated with the incidental catching of halibut by vessels primarily engaged in fishing for other species.

The report reviews the terms under which vessels using setline gear have been permitted to retain halibut caught incidentally to other fishing in areas closed to regular halibut fishing. It also records and evaluates the facts that have been gradually accumulated by and available to the Commission in considering the regulation of the capture of halibut caught incidentally by vessels using setline, troll and bottom trawl net gear while fishing for other species.

## ACKNOWLEDGMENTS

It has been particularly helpful to have had the early draft of the report critically read either in its entirety or in part by William E. Ripley, Donald H. Fry, Ralph McCormick, Doyle E. Gates, James Squire, Ronald E. Rey, Eldon P. Hughes, all of the Department of Fish and Game, California; Frederick C. Cleaver, George Y. Harry, of the Fish Commission of Oregon; Donald E. Kauffman, Dayton Lee Alverson, Hiromu Heyamoto, of the Department of Fisheries, Washington, and Alonzo T. Pruter, formerly of the latter Department and now employed by the Commission; John L. Hart, Keith S. Ketchen, Donald J. Milne, W. E. Barraclough, Fisheries Research Board of Canada; Walter Kirkness, Kenneth N. Thorson, Department of Fisheries, Alaska. John T. Gharrett presently with the United States Fish and Wildlife Service compiled most of the data on the troll fishery while employed by the Commission and has since provided many useful suggestions which have been incorporated in this report. The writer feels a debt of gratitude for much useful information and the many constructive suggestions provided by these workers and by the organizations they represent.

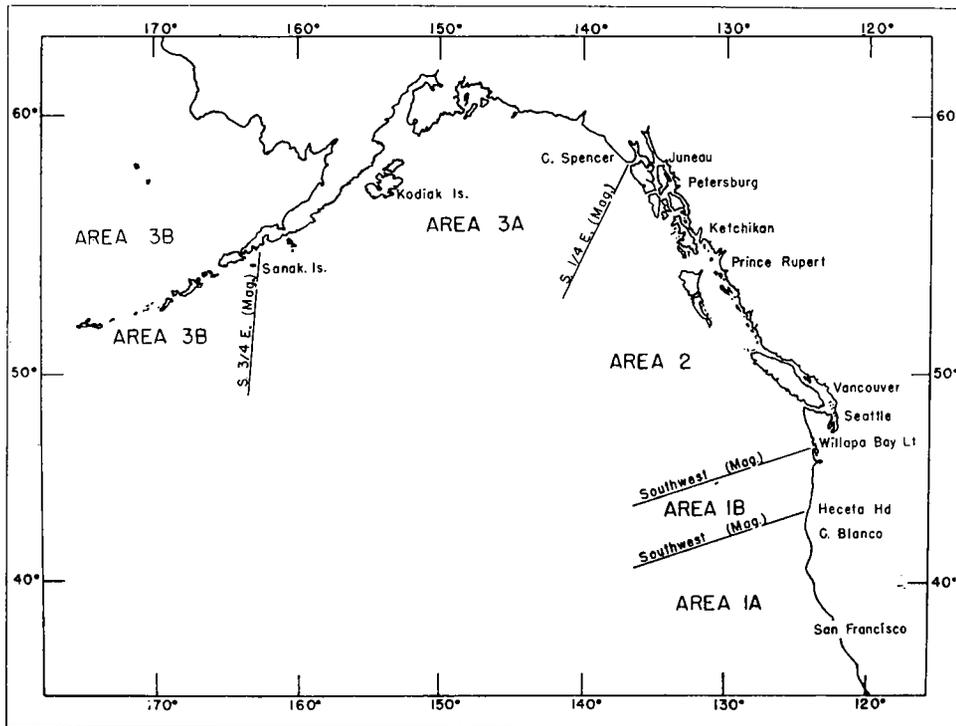
Several present and former members of the Commission staff have assisted in the collection and compilation of the data presented in this report. The Director of Investigations, Henry A. Dunlop, has contributed many suggestions and extensive editorial advice.

The author expresses his appreciation to the past and present Commissioners who have, from time to time, reviewed much of the material presented in this report.

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## THE INCIDENTAL CAPTURE OF HALIBUT



Pacific Coast of North America, showing regulatory areas defined by the International Pacific Halibut Commission in 1954.

## INTRODUCTION

The Pacific halibut fishery since its commencement in 1888 has been essentially a setline fishery. Up to about 1920 most of the catches were taken by vessels carrying from four to 12 dories from which the setline gear was set and hauled by hand. Such dory fishing declined rapidly after 1921, being replaced by what is known as the "longline" method in which the setline gear is set over the stern of the vessel automatically and hauled at high speed by power from the fishing vessel itself. By 1926 not over 15 per cent of the Pacific coast halibut catch was taken by the dory fishing method and by 1934 the proportion of the total catch so caught was less than one per cent.

The International Fisheries Commission, renamed the International Pacific Halibut Commission under the 1953 convention, and referred to in this report as the Commission, had no regulatory authority over gear under the convention of 1923 which established it. The power to fix the size and character of halibut fishing appliances to be used in any area was provided by the 1930 and subsequent conventions.

It had been recognized that dory fishing was adaptable to the capture of a higher proportion of small-sized halibut. The regulations for 1933 and 1934 enacted under authority of the 1930 convention included a provision against the further use of that method of fishing that was to become operative at a time to be determined by the Commission. After two years of such warning, the use of dory gear on grounds south of Cape Spencer was prohibited by the Commission in 1935. Though very little dory fishing was subsequently conducted on the grounds west of Cape Spencer and none after 1937, the prohibition was extended in 1944 to include all convention waters.

Halibut are also susceptible to capture by types of gear other than the traditional setline gear. They can be captured with net gear, both fixed or of the bottom trawl type, as well as by other types of hook and line gear such as trolling, handline or jig gear. The latter two types of gear, handlines and jigs, are not widely used within the Pacific coast range of the halibut and do not take a consequential amount of halibut. They are not discussed in this report.

The taking of halibut by bottom set nets had not developed on this coast up to 1938 although a few such nets had been purchased in Norway by Pacific coast fishermen. In that year the Commission, anticipating the introduction of such gear to the fishery, prohibited its use and has continued the prohibition to date. Basis for the action was the indicated high selectivity of the gear for large spawning-sized fish. (Devold, 1938).

The use of bottom trawl nets in the capture of halibut has been a much larger problem. This report deals chiefly with the use of that gear for the taking of halibut either as a primary objective or on an incidental or secondary basis. In 1944 the Commission prohibited the retention of halibut taken by bottom trawl net gear both on an incidental and primary basis.

Halibut has been a variable, and at times a very significant, item in the hook-and-line troll fishery for salmon. During the halibut fishing season in each regulatory area, the retention of troll-caught halibut has been permitted but, after the close of the halibut fishing season, the retention of such halibut has been prohibited. The

practical problems involved in permitting the retention of incidentally-caught halibut by trollers after the closure of the grounds to halibut fishing are examined in this report.

### REGULATION OF THE INCIDENTAL TAKING OF HALIBUT

Article I of the 1923 convention provided that:

“Any halibut that may be taken incidentally when fishing for other fish during the season when fishing for halibut is prohibited under the provisions of this Article may be retained and used for food for the crew of the vessel by which they are taken. Any portion thereof not so used shall be landed and immediately turned over to the duly authorized officers of the Department of Commerce of the United States or of the Department of Marine and Fisheries of the Dominion of Canada. Any fish turned over to such officers in pursuance of the provisions of this Article shall be sold by them to the highest bidder and the proceeds of such sale, exclusive of the necessary expenses in connection therewith, shall be paid by them into the treasuries of their respective countries.”

Since there was practically no activity in other demersal fisheries at that time during the three-month statutory closed season from November 15 to February 15 inclusive established by the treaty, the question of the incidental capture of halibut and its disposition arose only infrequently. Only minor changes in wording of the above provision were made in the 1930 convention which was phrased as follows:

“Any halibut that may be taken incidentally when fishing for other fish during the season when fishing for halibut is prohibited under the provisions of this Convention or by any regulations adopted in pursuance of its provisions may be retained and used for food for the crew of the vessel by which they are taken. Any portion thereof not so used shall be landed and immediately turned over to the duly authorized officers of the Department of Marine and Fisheries of the Dominion of Canada or of the Department of Commerce of the United States of America. Any fish turned over to such officers in pursuance of the provisions of this article shall be sold by them to the highest bidder and the proceeds of such sale, exclusive of the necessary expenses in connection therewith, shall be paid by them into the treasuries of their respective countries.”

While the same November 15 to February 15 statutory three-month closed season was continued under the 1930 convention, the fishing season each subsequent year became shorter than the preceding one by reason of the earlier attainment of the catch limits. By 1933 under regulations enacted under the new treaty, the closed season on the grounds south of Cape Spencer commenced on August 25 compared to November 15 in 1930. The open halibut fishing season thus no longer encompassed the main period of activity in other fisheries such as the setline fishery for blackcod (*Anoplopoma fimbria*) in which significant amounts of halibut were being caught incidentally.

Under these new conditions the provision of the 1930 treaty governing incidentally-caught halibut became increasingly less satisfactory to the enforcement

agencies and to the halibut fleet while fishing blackcod. From the enforcement standpoint, the detection of sales of illegal fish was made almost impossible by the fact that the boats, even when found unloading halibut at the dock, could claim that they were going to turn it over "immediately" to the authorities. Also when contacted at sea, it could be claimed that all halibut would be surrendered in excess of what was consumed as "food for the crew." This was conducive to some vessels selling catches illegally instead of surrendering them.

Since a certain amount of halibut was caught by setline boats fishing for other species during the closed season and in view of the difficulty of controlling the landing of such halibut under the convention of 1930, the regulatory provision relating to the incidental capture of halibut was revised in the 1937 convention which stated that the Commission could

"permit, limit, regulate and prohibit in any area or at any time when fishing for halibut is prohibited, the taking, retention and landing of halibut caught incidentally to fishing for other species of fish, and the possession during such fishing of halibut of any origin."

The provision was designed to avoid unnecessary wastage in the setline fishery for blackcod, lingcod (*Ophiodon elongatus*) and mixed rockfish (*Sebastes ssp.*). In the late thirties there was no significant bottom trawl net fishery and the incidental capture of halibut by the troll fishery was not a problem as the open halibut season still covered most of the active salmon trolling season.

The 1953 convention continued the substance of the above provision but broadened the authority so that the limited capture of incidentally-caught halibut could be permitted in areas or in portions of areas both open or closed to halibut fishing instead of only in closed areas.

It was evident that granting permission to retain and sell incidentally-caught halibut under the 1937 convention involved determination of the amount of halibut to be allowed and that control of the determined amount required supervision of the unloading. Without adequate enforcement, violations would be even more extensive than under the provisions of the 1930 convention.

In 1937 under its broader authority the Commission allowed the retention and sale of a proportion of halibut caught by setline vessels incidentally to fishing for other species in an area for a specified period after closure to halibut fishing. This was done by providing for the endorsement of halibut licenses as "permits" to retain incidentally-caught halibut under conditions which would make enforcement of the regulations practicable.

The ratio of halibut allowed to be retained and sold by setline vessels was set at one pound to each seven pounds of other marketable species during the permit season. This ratio was adopted after a comprehensive study of the conditions that existed on all Pacific coast grounds where incidental catches occurred.

Since 1937 various sections of the fleet have petitioned for a larger ratio. Each time investigations showed that the ratio of 1:7 continued to be an adequate proportion for incidentally-caught setline halibut on the coast as a whole.

#### REQUIREMENTS FOR ENFORCEMENT

Observation of the blackcod fishery has shown that the following are minimum requirements for the control and supervision of the retention and landing of

incidentally-caught halibut from areas closed to halibut fishing. They have been incorporated in the regulations each year.

(a) All vessels retaining the incidentally-caught halibut should be licensed to facilitate control of their activities.

(b) Licenses of such vessels should be validated by enforcement officers prior to departure for each trip to assure compliance with all related provisions of the regulations on the previous trip.

(c) Landings should be made at ports where enforcement officers are actually available to supervise unloading.

(d) The presence of halibut on board should be reported in advance of unloading so that enforcement officers may be assigned to provide such supervision as may be deemed advisable.

#### APPLICABILITY OF PERMITS TO SETLINE VESSELS

The degree to which a fishery could fulfill the above minimum enforcement requirements should be taken into account in considering the granting of permits to it, as regulations should be administratively practical and enforceable. The following features of the setline fishery indicate a capacity to meet the above requirements.

(a) Setline boats that engage in permit fishing are relatively few in number and are already licensed for the regular halibut fishery. (The number varied from 98 to 197 between 1951 and 1953.) Thus, the setline boats place no additional burden of licensing upon the staffs of the administrative agencies.

(b) All setline boats that have taken out permits have been five net tons or over. In most instances they are required to clear at customs, hence the endorsement of their halibut licenses as permits is a routine matter.

(c) The length of a setline permit trip is as long as a regular halibut voyage, hence the frequency with which a boat requires revalidation of its license involves no above-normal burden for the validating officers.

(d) The average number of fares landed by each vessel in the permit fishery is about two to four per season.

(e) The natural concentration of landings in relatively few ports is demonstrated in Table 1, showing the United States and Canadian permit landings in 1951, a very active year for the setline blackcod fishery.

(f) The permit setline boats have customarily fished out of ports where there are established authorized enforcement officers. Those ports in the following list marked with an asterisk, which received 78 per cent of the total number of fares in 1951, have field inspectors who could from time to time be exclusively assigned to dockside supervisory duties.

(g) In all the major ports the permit fares are sold by auction and considerable time elapses before the unloading of the fare, which permits enforcement officers to arrange for supervision.

(h) The fares are relatively large and warrant the assignment of an officer to the particular boat to supervise unloading.

(i) Supervision is facilitated by the fact that relatively few setline vessels are in port at one time. The greatest number of fares on any one day in any port in recent years was five and the highest average number in any landing port during the permit season was about one per day.

TABLE 1. Number of United States and Canadian vessels fishing halibut under permit and number of landings of permit-caught halibut by port in 1951.

United States vessels		
Port	No. of landings	No. of vessels
California.....Eureka*	6	2
Oregon.....Newport	32	8
.....Astoria	3	2
Washington.....Bellingham	11	3
.....Seattle*	160	47
.....Neah Bay	40	19
.....Everett	5	2
.....Other Ports	17	8
British Columbia.....Prince Rupert*	3	3
Alaska.....Ketchikan*	25	14
.....Wrangell	5	5
.....Petersburg*	100	36
.....Sitka	9	7
.....Juneau*	33	17
.....Pelican	17	11
.....Cordova	12	6
.....Sand Point	3	1
Totals	481	147**
Canadian vessels		
Port	No. of landings	No. of vessels
British Columbia.....Vancouver*	32	15
.....Victoria*	2	1
.....Butedale	18	8
.....Klemtu	18	10
.....Prince Rupert*	52	27
Totals	122	52**
Total U.S. and Canada	604	199**

\* Ports with dock enforcement officers.

\*\* Exclusive of duplications.

## MAGNITUDE OF SETLINE PERMIT FISHERY

Regulations governing the incidentally-caught halibut by setline boats have been enacted each year since the ratification of the 1937 convention. The recorded landings of incidentally-caught halibut and the length of the permit season on grounds south of Cape Spencer, where the permit season has always been the longest, are shown in Table 2.

TABLE 2. Landings in pounds of halibut caught under permit in Area 2\* and the length of the permit season, 1937 to 1954.

Year	Permit halibut landings in pounds	Length of permit season in Area 2	No. of days
1937	274,000	July 28 — Oct. 19	83
1938	272,000	July 29 — Oct. 29	92
1939	416,000	July 29 — Oct. 31	94
1940	304,000	July 13 — Sept. 30	79
1941	510,000	June 30 — Oct. 4	96
1942	556,000	June 29 — Oct. 15	108
1943	856,000	June 20 — Nov. 30	163
1944	845,000	July 9 — Nov. 30	144
1945	805,000	June 15 — Nov. 15	153
1946	1,180,000	June 11 — Nov. 15	157
1947	346,000	June 8 — Nov. 15	160
1948	825,000	June 1 — Nov. 15	167
1949	850,000	June 3 — Nov. 15	165
1950	319,000	June 1 — Nov. 15	167
1951	794,000	May 28 — Nov. 15	170
1952	461,000	June 9 — Nov. 15	161
1953	620,000	June 9 — Nov. 15	161
1954	759,000	June 6 — Nov. 15	164

\* Small quantities of permit halibut are also landed from Areas 1A, 1B and 3A.

The limited extent of the blackcod fishery has resulted in a relatively small production of incidentally-caught halibut. Available information and the history of the blackcod fishery to date indicate that the stocks are not extensive. It is not likely that the potential sustained production of blackcod by setline gear would exceed 15 to 20 million pounds annually. The greater probability is that the total would be near the lesser amount.

In the years 1937 to 1940 the length of the permit season extended from the closing date of Area 2, which lies south of Cape Spencer, to the closing date of Area 3, lying to the west of Cape Spencer. As the closure of Area 3 became earlier, the last date of validity of permits was extended for a short time beyond the closing date of Area 3 in order to cover the major portion of the blackcod fishing season. In 1943 and 1944, the period of validity of permits was extended to November 30, to encourage the wartime production of line-caught mixed cod. In 1945, the date of November 15 was set, due in part to the United States Fish and Wildlife Service's announced intention of closing the southeastern Alaska blackcod fishery at that time. Mid-November has been continued as the last date of validity and is independent of the time of closure of Area 3 where the halibut fishing season has also become very short.

#### REQUESTS FOR EXTENSION OF THE PERMIT PROVISION TO OTHER THAN SETLINE GEAR

Since 1937, the Commission has received numerous petitions from both Canadian and United States salmon trolling groups for the extension of the permit provision to the salmon troll fishery. The otter trawl fishery likewise has desired and repeatedly petitioned that it be permitted to retain and land incidentally-caught halibut.

Each request was examined in the light of current conditions in the fisheries and each time the Commission found it undesirable to broaden the scope of the permit system. The question of the practicability of enforcement, aside from biological considerations, was deemed sufficient to preclude extension of the permit provision to other than setline boats.

This report records and evaluates the facts that may be pertinent to the consideration of extending permission to salmon trollers to retain halibut caught incidentally to fishing for salmon in areas closed to halibut fishing or of allowing otter trawlers to retain halibut either on an incidental or unlimited basis.

### TROLL CAPTURE OF HALIBUT

#### THE TROLL SALMON FISHERY

A number of features of the troll salmon fishery are pertinent in considering the problem of the capture of halibut by that gear.

The troll salmon fishery operates from California to Cape St. Elias, Alaska.

Trolling vessels are of two classes, the "day" boats and the "ice" boats. The day boats are usually smaller. They dominated the fishery prior to 1925 and on some sections of the coast are still the dominant type. They fish close to the landing point and usually make daily deliveries. The ice boats are generally larger and have increased in number since 1925. The ice boats make trips of up to two weeks' duration and can operate on grounds relatively distant from their landing port. Fishing by

both types of boats is carried on by trailing various types of hooked lures at speeds of from one to three knots. Herring, metal spoons and plugs are the chief lures now used.

The catches of the salmon trollers, consisting chiefly of king (*Oncorhynchus tshawytscha*) and coho, silver or medium red salmon (*Oncorhynchus kisutch*), are not only landed in nearly every Canadian and United States coastal customs port from Monterey, California, to Juneau, Alaska, but they are also landed at many isolated buying stations whence they are taken in consolidated loads to regular ports by packers or collecting boats or by motor trucks. The regular landing ports and the other buying points where trollers land are shown in Table 3.

TABLE 3. Landing places of troll and otter trawl-caught fish in the United States, Alaska, and British Columbia in 1952 or 1953.

(Major halibut ports capitalized)

	Troll	Trawl	Officer*		Troll	Trawl	Officer*
California**							
San Francisco	X	X	X	Meyer's Chuck	X	—	—
Point Reyes	X	X	—	Kelly Cove	X	—	—
Tomales Bay	—	X	—	San Antonio (Port)	X	—	—
Bodega Bay	X	X	—	Santa Cruz	X	—	—
Point Arena	X	X	—	Cape Muzon	X	—	—
Albion	X	—	—	(Central District)			
Shelter Cove	X	—	—	PETERSBURG	X	—	X
Fields Landing	X	X	—	WRANGELL	X	—	X
Eureka	X	X	X	Point Baker	X	—	—
Trinidad	X	—	—	Hole-in-Wall	X	—	—
Crescent City	X	X	—	Tyee	X	—	—
Oregon				Saginaw Bay	X	—	—
Coos Bay	X	X	X	Killisnoo	X	—	—
North Bend	X	—	—	(Cape Ommaney District)			
Charleston	X	X	—	Tebenkof Bay	X	—	—
Reedsport	X	—	—	Gedney Harbor	X	—	—
Port Orford	X	—	—	Port Alexander	X	—	—
Florence	X	—	—	Cape Pole	X	—	—
Tillamook	X	X	—	Coronation Island	X	—	—
Hammond	X	—	—	Whale Bay	X	—	—
Newport	X	X	X	Snipe Bay	X	—	—
Depoe Bay	X	—	—	(Chichagof District)			
Warrenton	X	X	—	SITKA	X	—	X
ASTORIA	X	X	X	Shelikof Bay	X	—	—
Washington				Kalinin Bay	X	—	—
Westport	X	—	—	Khaz Bay	X	—	—
Aberdeen	X	X	X	(Icy Strait District)			
Hoquiam	X	—	—	JUNEAU	X	—	X
La Push	X	—	—	Funter Bay	X	—	—
Neah Bay	X	X	X	Swanson Harbor	X	—	—
SEATTLE	X	X	X	Auk Bay	X	—	—
Everett	X	X	X	Elfin Cove	X	—	—
Anacortes	X	X	X	Point Adolphus	X	—	—
Bellingham	X	X	X	Graves Harbor	X	—	—
Blaine	—	X	X	Dixon Harbor	X	—	—
Port Angeles	X	—	X	PELICAN CITY	X	—	X
Ilwaco	X	—	—	Bingham Cove	X	—	—
Tacoma	X	—	X	Green Top	X	—	—
Southeastern Alaska				Deer Harbor	X	—	—
(Southern District)				Cape Cross	X	—	—
KETCHICAN	X	—	X	Porcupine Harbor	X	—	—
Tokeen	X	—	—	Lituya Bay	X	—	—
Craig	X	—	X	Yakutat Bay	X	—	—

\* Some dock enforcement supervision possible.

\*\* San Francisco Bay and north.

TABLE 3. Continued.

	Troll	Trawl	Officer*		Troll	Trawl	Officer*
British Columbia				Mink Trap	X	—	—
(Southern District)				Klemtu	X	—	—
Victoria	X	—	X	Finn Bay	X	—	—
VANCOUVER	X	X	X	Barnard Cove	X	—	—
Steveston	X	X	—	Gillen Harbor	X	—	—
Nanaimo	X	—	X	Borrowman Bay	X	—	—
Port Alberni	X	—	X	Surf Inlet	X	—	—
Bamfield	X	X	X	Spider Island	X	—	—
Dodger Cove	X	—	—	Safety Cove	X	—	—
Kildonan	X	X	X	Moore Island	X	—	—
Ahousat	X	—	—	BUTEDALE	X	X	X
Ucluelet	X	—	X	Codfish Pass	X	—	—
Queen Cove	X	—	—	(Northern District)			
Tofino	X	—	X	PRINCE RUPERT	X	X	X
Port Albion	X	—	—	Qlawdzeet (Squaderee)	X	—	—
Nootka	X	—	X	Zavas Island	X	—	—
Christie Pass	X	—	—	Goose Bay	X	—	—
Kyuquot	X	—	X	Port Simpson	X	—	—
Winter Harbor	X	—	—	Victory Cove	X	—	—
Klaskish	X	—	—	Somerville	X	—	—
Hot Springs Cove	X	—	—	Boat Harbor	X	—	—
Quatsino	X	—	X	Work Channel	X	—	—
Nuchalitz	X	—	—	North Island	X	—	—
Alert Bay	X	—	X	Wiah Point (7-mile)	X	—	—
Quathiaski	X	—	—	Naden Harbor	X	—	—
Hardy Bay	X	—	—	Pacofi	X	—	—
Cascade Harbor	X	—	—	Skidegate (S. Bay)	X	—	X
Bull Harbor	X	—	—	Jedway	X	—	—
Duncanby Landing	X	—	—	Ramsay Island	X	—	—
(Central District)				Tartu (Rennel Sound)	X	—	—
NAMU	X	X	X	Freeman's Pass	X	—	—
Rennison Island	X	—	—	Canoe Pass	X	—	—
Bella Bella	X	—	—	Butler's Cove	X	—	—
White Rock	X	—	—	Kitkatla	X	—	—
Milbank Sound	X	—	—	Welcome Harbor	X	—	—

\* Some dock enforcement supervision possible.

Statistics of the troll fishery are scattered and lacking in some places, making it necessary to compile the data used herein from a variety of official and private sources. Where estimates have been necessary, they have been made on a conservative basis.

The numbers of salmon trollers on the Pacific coast, without duplications and not including quasi-sports fishermen with commercial licenses, are shown in Table 4. They have been estimated for several years from various private and governmental sources as no comprehensive non-duplicated official figures are available.

The totals are shown to the nearest 100 vessels as it is evident that the enumeration of this fleet cannot be precise. Fry and Hughes (1951) provide one of the few adequately evaluated estimates of the size of a commercial trolling fleet. Referring to California they state: "In 1947, over 1100 boats landed ocean-caught salmon and 846 landed more than 1000 pounds each."

In spite of deficiencies in the totals in Table 4, about 6000 boats may be considered to be currently engaged in the Pacific coast troll fishery for salmon, of which 5000 may be regarded as effective producers.

The Pacific coast landings of troll-caught king and coho salmon for some recent years are shown in Table 5, according to various state and federal governmental sources as amended by other information.

TABLE 4. Estimated non-duplicated numbers of offshore commercial trollers on each section of the Pacific coast in various recent years.

	1942	1944	1947	1951
Northern California	500	500	900	900
Oregon	600	400	500	500
Washington	600	600	900	1100
British Columbia	1800	2000	2300	2500
Alaska	900	1100	1200	1300
Totals	4400	4600	5800	6300

TABLE 5. Landings\* of troll-caught coho and king salmon on each section of the Pacific coast in 1000's of pounds for various recent years.

Landing Area	1941		1947		1951		1952		1953	
	King	Coho								
California**	2651	295	7273	808	5386	464	5786	751	6550	593
Oregon	1570	2439	2602	1889	2600	2275	3084	2864	1927	2349
Washington	4728	4231	5784	4513	5430	5386	6549	6993	6352	5497
British Columbia	6580	9601	7000	12000	8400	19510	10310	17200	10560	13710
Alaska	11911	9653	9499	7567	9026	18025	8936	8853	9253	4390
Totals	27440	26219	32158	26777	30842	45660	34665	36661	34642	26539
King-Coho Totals	53659		58935		76502		71326		61181	

\* Figures chiefly from U.S. Fish and Wildlife Annual Statistical Digests and from reports of Department of Fisheries of Canada.

\*\* Split on basis 10 per cent coho in 1941 and 1947.

The 1953 seasonal distribution of the king salmon catch by the troll fishery in three important producing areas is given in Table 6, showing the percentage of each annual total landed each month.

The onset and peak of the coho fishery is about one month later. In most areas trolling for coho and king salmon is now subject to statutory opening dates. The relative attractiveness from year to year of the fishery for albacore affects the salmon activity of the trolling fleets in some areas.

It is apparent that the troll salmon fishery is prosecuted by a very large and increasing number of small boats operating over about a 4.5-month season between late April and early September and producing a total salmon catch of 60 to 70 million pounds annually.

TABLE 6. Per cent\* total troll king salmon landed each month on three representative sections of the Pacific coast in 1953.

Month	Southeastern Alaska	West coast Vancouver Island	Washington ports Neah Bay and Seattle
January	—	0.1	—
February	—	1.2	0.1
March	—	4.5	1.1
April	1.3	4.7	2.1
May	7.0	5.8	10.3
June	24.7	22.7	17.0
July	27.3	19.6	27.2
August	21.9	40.6	24.0
September	17.4	0.7	14.7
October	0.6	—	3.1
November	—	—	0.2
December	—	—	—

\* Determined from monthly landings provided by the Fish and Wildlife Service for Alaska, reports of the Department of Fisheries, Canada, for west coast of Vancouver Island and by the State Department of Fisheries, Washington, for that state.

## THE CAPTURE OF HALIBUT IN THE TROLL SALMON FISHERY

The actual number of trollers that catch some halibut cannot be determined as the occasional halibut caught is often not sold. However, the records of the Commission show in Table 7 the minimum numbers of trollers that landed and actually sold halibut caught during their salmon trolling operations in the month of June, 1942 and 1944 when the open halibut season extended through that month.

TABLE 7. Number of salmon trollers landing incidentally-caught halibut in June 1942 and 1944.

Landing area	1942	1944
Oregon	12	30
Washington	88	135
Southern British Columbia	271	315
Northern British Columbia	274	305
Alaska	400	550
Totals	1045	1335

The improved condition of the stocks of halibut since 1930 (I.P.H.C., 1953) has been largely responsible for an increasing number of trollers outfitting for set-line halibut fishing in the spring months prior to the most productive part of the salmon trolling season. This interest in halibut has extended into the salmon trolling season and has been increased by poor salmon runs in some years. Trollers now tend to seek out and to catch more halibut than heretofore. The use of wire lines and power gurdies, permitting deeper fishing, and improvements in lures have all tended to increase this trend.

The landings of halibut by salmon trollers from Area 2 between Willapa Bay and Cape Spencer, as recorded by the Commission for the 1943 halibut season (not including the halibut landed by trollers fishing with setlines during or prior to their salmon fishing), are shown in Table 8 for the different landing regions in the area.

TABLE 8. Landings of troller-caught halibut from Area 2 in pounds in April, May and June, 1943.

Landing area	April	May	June	Total
Oregon*	618	2,227	5,036	7,881
Washington	18,676	79,595	162,059	260,330
Southern British Columbia	28,721	173,870	190,870	393,461
Northern British Columbia	17,909	143,920	240,062	401,891
Alaska	23,747	89,576	230,952	344,275
Totals	89,671	489,188	828,979	1,407,838

\*1942 landings—1943 data incomplete.

The shortening of the regular Area 2 season since 1943 has reduced the amount of halibut legally landed by trollers. The total in the May-June season is conservatively determined to have been not over 1.2 million pounds in any recent year. In 1954 during the corresponding season in Area 2 about 1,100,000 pounds were landed by troll gear. However, during a newly established, supplementary, 8-day halibut season in August 1954 in Area 2, some 1530 salmon boats using troll gear accounted for nearly 1.5 million pounds of the 9.5 million pound total catch.

It has been the practice of some hand trollers and a few power boats to carry and use jig gear which is a type of handline. This gear has been fished when salmon

are scarce and is, in some sections, responsible for some of the halibut recorded in Table 8.

Table 9 shows the average amount of halibut landed in a sample of landings from the 1942 Area 2 season and the number of trolling trips in which halibut was a part of the sold catch.

TABLE 9. Number and average size of landings of troller-caught halibut in pounds by sections of the Pacific coast for April, May and June, 1942.

Landing area	April		May		June	
	No. landings	Av. lbs.	No. landings	Av. lbs.	No. landings	Av. lbs.
Oregon	10	62	31	72	61	67
Washington	21	127	379	81	1067	62
Southern British Columbia	1470	21	3775	33	2940	38
Northern British Columbia	39	128	427	147	668	78
Alaska	113	88	664	95	3667	79
Totals	1653	30	5276	54	8403	63

No comprehensive study has been made for other than 1942 but "spot" samples for more recent years corroborate the general magnitudes of the above figures as well as their seasonal and geographical variation.

In Table 10 figures for Sitka alone in 1944 are presented as an example of the extent to which a local trolling fleet concentrated on the capture of halibut when deprived of the normally more profitable salmon catches during an unfavorable salmon season. The average landing from May to July was 479 pounds in 1944 compared to under 100 pounds in 1943.

TABLE 10. Number and average size of landings and total halibut landed in pounds by trollers in Sitka, Alaska in May, June and July, 1944.

	May	June	July	Total
No. of landings	31	388	270	689
Total halibut in pounds	4,499	189,853	135,421	329,773
Av. size of landings in pounds	145	489	502	479

The average proportions of halibut to salmon for the major sections of the Pacific coast for June are shown in Table 11 for 1942 and 1944. Many thousands of troller landings that included no incidental halibut were omitted. The higher proportion in some areas may be due to deeper trolling with heavier gear or to the stock of halibut being greater in some trolling areas than in others, or to other factors.

The magnitude and variation of the percentage of halibut in the troll landings shown for 1942 and 1944 have been borne out by verbal testimony of representative

TABLE 11. Average proportions of halibut to salmon by weight in troll catches containing halibut by sections of the Pacific coast, June, 1942 and 1944.

Landing area	1942	1944
Oregon	5%	5%
Washington	10%	15%
Southern British Columbia	15%	18%
Northern British Columbia	10%	13%
Alaska	9%	20%
Weighted averages	11%	15%

trollers and by the observations and memoranda notes made by the writer in 1925 while engaged in a troll salmon investigation off the British Columbia coast.

From data collected by K. N. Thorson of the Alaska Fisheries Department, Table 12 was compiled to show the relative amounts of halibut caught by a chartered commercial trolling vessel engaged in tagging salmon in 1952.

TABLE 12. Catches in pounds of salmon and halibut by a salmon troller fishing off Lituya Bay and in Icy Straits, Alaska from May to November, 1952.

Period	Location	Salmon			Halibut		Per cent total salmon
		King	Coho	Total	No.	Pounds	
5/15—27	Off Lituya Bay	2260	0	2260	6	132	6
6/12—7/1	do.	1420	486	1906	0	0	0
7/29—8/13	Icy Straits	2500	1467	3967	86	1927	49
8/16—9/3	do.	1600	738	2338	83	1517	65
9/16—16	do.	800	483	1283	36	725	57
9/19—26	do.	3620	234	3854	31	404	10
10/6—11/6	do.	900	0	900	1	25	3
5/15—11/6	Totals	13100	3408	16508	243	4730	29

The percentage of halibut may have been higher than normal as it was noted that the availability of king salmon in Alaska in 1952 was relatively low. The average size of the halibut in the above catches was 19.5 pounds which is about typical for the setline fishery on the same grounds. No halibut under seven pounds was captured.

#### MORTALITY AND WASTAGE OF TROLL-CAUGHT HALIBUT

No systematic observations have been made of the viability of troll-caught halibut. While some trollers have stated that a large proportion of the halibut hooked are dead when brought to the surface, the opinion of many experienced trollers is that a very large proportion of the small and medium-sized halibut are brought up alive and can be released readily but that it is often necessary to kill some of the large fish in order to retrieve the gear. Limited observations by independent observers support the latter statements.

It is possible that some of the very small halibut may not indicate their presence on the trolling gear and may be drowned before they can be released from the hook. However, as the retention or sale of such undersized fish is prohibited by the halibut regulations irrespective of the gear used, the possible waste caused by the catching of such small fish is not relevant to the problem at hand.

It is believed that the wastage that might be involved in not permitting the retention of incidentally-caught legal-sized halibut by trollers would be largely compensated for by the growth of the halibut that are returned to the water alive and by the growth of the additional halibut that are not caught by the trollers who keep their catch of halibut at a minimum by selecting their grounds and by modifying their method of fishing so as to avoid having the hooks occupied by a non-salable species.

#### POTENTIAL PERMIT HALIBUT CATCH BY THE TROLL FISHERY

It is conservatively estimated, based on present conditions, that should the salmon troll fishery be permitted to retain some logical proportion of halibut between the time of closure of Area 2 and the end of the trolling season (about mid-November), a minimum of 3.0 million to a maximum of 5.0 million pounds of halibut would

be landed during the period. Closer estimates are not possible as the amount would depend upon many unpredictable factors such as:

- (1) Yearly or seasonal changes in the size of the salmon troll fleet.
- (2) The number of trollers that might elect to subject themselves to the control measures involved in retaining incidentally-caught halibut.
- (3) The ratio of halibut that might be allowed by the regulations.
- (4) The effectiveness of enforcement of the permitted ratio.
- (5) The extent to which trollers might modify their gear or fishing methods.
- (6) The relative market value and availability of halibut and salmon.

The high potential capacity of the troll fishery to catch halibut in the late summer months was fully confirmed in 1954 when only 1530 vessels using salmon troll gear caught and landed about 1,500,000 pounds of halibut from Area 2 during the previously mentioned eight-day open period in August. During the 21-day first halibut season in Area 2 extending from May 16 to June 5 in the same year, troll gear accounted for about 1,100,000 pounds of the total halibut catch.

#### PROBLEMS OF APPLYING PERMITS TO TROLLERS

The following information provides some basis for evaluating the administrative and regulatory problems involved in applying permits to vessels trolling for salmon.

##### (a) LICENSING OF TROLLERS

It is conservatively estimated that about 2500 of the probable 5000 effective trollers might catch some halibut during the present permit period from June to the end of the trolling season. Some of these might forego the opportunity of landing occasionally-caught halibut to avoid the inconvenience of being licensed. It is believed that at least 1600 trollers would elect to be licensed for permit fishing which would involve considerable administrative cost. In contrast, the setline boats are few in number and already have halibut licenses required during the halibut fishing season.

##### (b) VALIDATION OF LICENSES

The large number of trollers and the high frequency of their landings would involve at least 12,000 to 15,000 license validations and the same number of statistical returns during a permit season lasting about four months. This is about 25 times the number required in the setline fishery during the permit period in 1951, a year of very active blackcod fishing, and six times the number made during the average permit and halibut seasons combined.

Most of the salmon trolling boats are less than five net tons and are not required to make customs clearance. Recording the activities of trolling boats through the customs offices including the taking of 12,000 to 15,000 additional statistical returns would be an administrative burden, assuming that officers were available for such purposes in the numerous landing places, which is not now the case. In contrast, setline boats over five net tons that obtain permits are already required to clear at customs in most places and are no problem to present customs' facilities.

##### (c) SUPERVISION OF UNLOADING

Providing even spot supervision of the unloading of trollers with and without permits would be another major task for enforcement officers. In some places 25 or more trollers may land in one day and occasionally several hundred may land in the face of threatening weather.

The fares of trollers are relatively small and their sale and unloading are carried out in a short space of time, insufficient for the advance assignment of supervising officers. Permit trips of setline boats are landed chiefly at ports where the fares are auctioned and in most instances one to three hours elapse between the sale of the fare and the commencement of unloading, allowing an advance assignment of officers.

**(d) CONTROL OF CONSOLIDATED LANDINGS**

To obviate the problem of the lack of supervisory officers at most of the places where troll-caught halibut is now landed, it has been suggested that the consolidated loads of salmon and halibut which are brought by packers from outside stations to the regular landing ports could be allowed a ratio of halibut and the supervision applied at these landing ports. This would provide no control over what individual trollers would land at unsupervised places and consequently would be discriminatory against trollers landing at ports with officers. Restricting the landing of halibut inadvertently caught by troll gear to the few ports already provided with adequate enforcement personnel also could be discriminatory as well as sharply alter the entire economy of the troll fishery.

Applying permits to packers would also result in the filling out of the loads with halibut caught purposely to make up the permitted consolidated ratio. Furthermore, salmon caught by other than troll-gear and carried by the same collecting boats would open up additional avenues for the landing of unjustified quantities of halibut.

The supervision of the unloading of these packer fares and any direct landings by trollers would materially add to the numerous duties of the enforcement officers in the major ports, and would in most instances be beyond their present capacity and require a sharp increase in personnel.

**MINIMUM COST OF ADDITIONAL ENFORCEMENT**

The magnitude of the task of providing some supervision of individual troll landings of halibut can be appreciated by the fact that troll salmon and variable quantities of halibut are landed at over 160 places on the Pacific coast from Fort Bragg, California, to Yakutat, Alaska (Table 3). Most of these places are small isolated buying stations only.

It would be impractical to provide enforcement personnel at each of 160 places for four to five months each year. Some supervision might be maintained by the assignment of an officer with suitable independent transportation facilities to compact groups of landing stations each of which would be visited at unexpected times during the permit season on a "spot" check basis. The numerous landing stations on the coast, not including ports already supplied with some personnel, could be combined into about 12 logical groupings.

The minimum cost of even such spot supervision using seasonal personnel and providing for some independent transportation by boat, would be at least \$75,000 annually. Such minimum enforcement conditions would not prevent the landing and sale of significant quantities of halibut in contravention of the regulations.

**TRAWL CAPTURE OF HALIBUT**

Several features of the otter trawl fishery are of significance to any consideration of the problems raised by the capture of halibut by trawl gear. Data presented regarding the otter trawl fishery has been secured from various governmental and trade

sources and from the files of the Commission. The investigations of the otter trawl fishery by the International Pacific Halibut Commission have been limited to problems involving the incidental capture of halibut by that gear. The Commission has had neither funds nor authority to proceed beyond this.

#### GROWTH OF TRAWLING ON THE PACIFIC COAST

Prior to 1939 the Pacific coast bottom trawl-net fishery, including the two-boat paranzella net fishery, its predecessor in California, was not a large operation. It offered no significant problems as far as its catch of halibut was concerned as fishing was conducted chiefly on grounds possessing very limited halibut stocks. The production of bottom trawl-caught fish of all species prior to 1939 was about 15 million pounds annually, of which over two-thirds was produced in northern California waters.

Four years later, in 1943, under the impetus of wartime demand the Pacific coast total increased to 80 million pounds and the fishery extended over a much broader section of the coast. The fleet increased from about 65 boats in 1941 to 250 in 1943 and reached 500 boats in 1945, most of them recruited from other fisheries.

Since 1945 a relatively stabilized fleet of trawling vessels, some built primarily for that fishery, has been developed. The 1952 fleet consisted of about 320 vessels but contained more large vessels, each with a greater total fishing potential. Due to a depressed market in 1953 there was a temporary decline in number of active vessels in some areas and in the number of months some of them fished.

The totals of all otter trawl-caught species from 1950 to 1954, inclusive, for each political subdivision of the coast from San Francisco Bay to Dixon Entrance and only from outside grounds, are shown in Table 13. The inside waters, Puget Sound and Strait of Georgia, are excluded as they are outside the normal range of the halibut. The annual production was maintained at a fairly high level, but there was considerable variation from year to year due to market conditions.

TABLE 13. Pacific coast otter trawl catches, food fish only, landed in each section of the coast from 1950 to 1954 in 1000's of pounds.

	California	Oregon	Washington	British Columbia	Alaska	Total Pacific coast
1950	30,555	19,106	33,380	15,721	—	98,762
1951	27,461	21,000	34,472	17,830	—	100,763
1952	28,505	21,404	37,354	22,724	—	109,987
1953	25,451	15,251	25,430	12,960	—	79,092
1954	28,000	14,000	40,000	14,000	—	96,000

1950-1953 data for California, Oregon and Washington from U.S. Fish and Wildlife Service Annual Statistical Digests, amended by records of individual state fisheries agencies. British Columbia figures from Department of Fisheries, Canada Pacific Area Statistical Reports. Data for 1954 are estimates chiefly derived from a statistical memorandum issued by Pacific Marine Fisheries Commission, December 7, 1955. California data includes only San Francisco and north—the commercial range of the halibut.

The 1953 catch by species or groups of species is given in Table 14. The variation in the proportionate representation of each group of species in the catch from each section of the coast can be attributed to both market demand and the natural distribution of the stocks.

#### RELATIVE VALUE OF THE YIELD OF THE PACIFIC OTTER TRAWL FISHERY

The trawl fishery is important on the Pacific coast, currently producing about five per cent of the United States and Canadian Pacific coast fish catch by volume and about four per cent of its landed value. The landed value of the 110-million

TABLE 14. Pacific coast otter trawl landings in 1000's of pounds from outside grounds by major groups of species and regions of landings in 1953.

Species	California*	Oregon	Washington	British Columbia	Total Pacific coast
Blackcod	636	221	322	16	1,195
Flatfish	16,666	8,691	8,269	6,276	39,902
Ling cod	655	322	1,229	753	2,959
Rockfish**	6,853	5,832	7,130	164	19,979
Grey cod	—	176	8,442	3,187	11,805
Other fish***	1,065	62	4,640	2,566	8,333

\* Includes only San Francisco and north.

\*\* Includes Pacific Ocean Perch.

\*\*\* Includes limited amounts of non-food fish which accounts for differences from state totals shown in Table 13.

pound trawl catch in 1952 was approximately \$6,500,000 to the fishermen, or about 5.9 cents per pound. The 62-million pound halibut catch of 1952 was worth about \$11,600,000 or about 18.7 cents per pound.

Much of the difference in the dockside price-per-pound for fish in the two fisheries stems from the fact that with the trawl-caught species the recovery of edible flesh averages about 30 per cent of the landed weight while halibut marketed on the same butchered basis would yield about 60 per cent in edible flesh. Halibut also commands a further premium in price per pound as it can be marketed in a much greater variety of forms including whole fish, steaks, chunks, and fillets. Like salmon it is also a distinctive species and its limited world production commands a premium market.

#### VARIABILITY IN PRODUCTION IN THE OTTER TRAWL FISHERY

The year-to-year percentage changes in catch of trawl-caught rockfish and flatfish by states and British Columbia are shown in Table 15 for 1944 to 1953, inclusive. The same is shown for Pacific coast halibut landings. These figures indicate sharp and extensive increases and declines in activity of the trawl fleets or in their interest in the two most important types of fish from year to year and from one section of the coast to another, in contrast to the relatively stable production of halibut under regulation. The variations in annual production appear to be much greater than could be expected from natural fluctuations in the stocks or in vulnerability to capture.

TABLE 15: Percentage change from year to year in landings of trawl-caught flatfish and rockfish and of setline-caught halibut, 1944 to 1953.

	1944 to 1945	1945 to 1946	1946 to 1947	1947 to 1948	1948 to 1949	1949 to 1950	1950 to 1951	1951 to 1952	1952 to 1953
Flatfish									
California	55	34	16	68	-9	23	-22	11	-25
Oregon	5	74	-42	70	-33	50	14	-13	-28
Washington	5	0	-13	48	-25	0	7	16	-36
British Columbia	25	54	-37	110	-45	53	-3	40	-58
Rockfish									
California	94	-16	-31	-30	-8	25	35	-3	-36
Oregon	54	-38	-37	-32	2	20	-2	54	-32
Washington	167	-51	-48	65	21	-3	-17	12	-39
British Columbia	9	-24	-70	49	31	-57	38	-2	-82
Halibut, Pacific coast	1	13	-7	-1	-1	3	-2	10	-4

TABLE 16. Seasonal distribution of trawl-caught food fish in 1000's of pounds by landing district San Francisco and north and by area of origin not including inside waters of Puget Sound and of the Strait of Georgia in 1952.

Area of origin and landing district	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	TOTALS
Cape Blanco and south California	1126	1660	1190	2437	3102	3118	2390	2325	2672	2709	2370	1238	26337
Cape Blanco to Willapa Bay													
California	—	202	122	354	99	174	174	202	89	47	93	44	1600
Oregon	242	622	1558	1905	379	2561	3511	2920	2430	2110	634	121	18993
All districts	242	824	1680	2259	478	2735	3685	3122	2519	2157	727	165	20593
Willapa Bay to Cape Scott													
Oregon	6	48	120	150	28	418	576	479	396	164	20	6	2411
Washington	1275	2013	2289	2544	2394	1900	1245	1291	1951	2206	684	891	20683
British Columbia	41	73	160	408	759	744	1489	869	1172	325	95	23	6149
All districts	1322	2134	2569	3102	3172	3062	3310	2639	3519	2695	799	920	29243
Cape Scott to Dixon Entrance													
Washington	410	1061	1836	1304	1127	1104	896	994	1104	944	494	793	12067
British Columbia	604	3297	691	1062	259	158	2101	1130	1484	1784	604	132	13306
All districts	1014	4358	2527	2366	1386	1262	2997	2124	2588	2728	1098	925	25373
All areas and districts	3704	8976	7966	10164	8138	10177	12382	10210	11298	10289	4994	3248	101546

BY VARIOUS TYPES OF FISHING GEAR

Seasonal distribution and area of origin based on published figures and information from respective state and federal agencies. Totals shown deviate from those shown in Table 12 due to non-inclusion of poundage caught in Puget Sound and Strait of Georgia and impossibility of precise separation of otter trawl catches from those by other gear in some areas and variable usage of round and dressed weights.

In addition to sharp changes in yearly production there has been considerable variation from year to year in the monthly pattern of landings of groups of species. Market demand affecting the activity of the fleet seems to be a major factor in causing the sharp seasonal and yearly changes in production, as, in general, processors both contract for production and at times limit the size of fares according to market orders.

#### AREA OF ORIGIN OF THE PACIFIC COAST TRAWL CATCHES

In Table 16 the approximate origin of the Pacific coast landings by trawlers from outside waters is shown by months according to area of origin and landing district for 1952, a recent representative year of high production.

The landings in California originate chiefly from waters off the northern coast of the state from San Francisco to Crescent City and to a limited extent from north to Cape Blanco, Oregon.

The Oregon landings arise mainly from grounds between Coos Bay and Destruction Island off Washington, and to a limited extent off the west coast of Vancouver Island.

The landings in Washington originate from offshore grounds mainly between the Columbia River and northern Hecate Strait, off British Columbia, and from the inside waters of Puget Sound.

The British Columbia production is taken from grounds from Barkley Sound to Dixon Entrance and from the inside grounds of the Strait of Georgia.

At present there are no trawl landings of human food fish in Alaska but one or two small vessels have trawled intermittently for fur-farm feed. There have been occasional catches made off Alaska by vessels from Washington.

#### VARIETY OF SPECIES OF FISH IN OTTER TRAWL LANDINGS

A distinctive feature of the trawl fishery is the wide variety of marketable and at times unmarketable species in the catch. (Hart, 1949) This variety is illustrated by the 1952 Washington landings which are arranged according to their importance by weight in Table 17. Individual vessel landings will not necessarily show such a variety, as the availability of species varies by grounds and seasons and allows considerable selection by the vessel according to the current demand, or lack of demand. Many hauls and many fares consist almost exclusively of a single species.

An example of the selectivity of fishing and variable demand is found in the case of the turbot (*Atheresthes stomias*) which is at present in very low market esteem. This species can be caught in large quantities on some grounds as witnessed in 1943 when it accounted for nearly one-third of the flat fish species landed in Seattle, and over one-sixth of all trawl fish landed in Oregon. Immediately before and after, in 1942 and 1944, the production of turbot was negligible. It is still caught in quantity at times but is usually rejected at sea. There has been a growing demand for its use in the fur-farm, pet-food and fish hatchery feed business and a considerable tonnage has recently been landed for this purpose.

There is evidence in the poundage rejected at sea that there are stocks of less desirable species that possess considerable production potentialities. There is a growing market for fish protein for other than human consumption. For this purpose "trash" fish, which include species unwanted as human food and undersized food fish, are

TABLE 17. Landings of the Washington State otter trawl fleet by species in 1952.

Common Name	Scientific Name	Pounds
True cod	<i>Gadus macrocephalus</i>	8,729,000
English sole	<i>Parophrys vetulus</i>	5,130,000
Black rockfish	<i>Sebastes melanops</i>	5,038,000
Petrale sole	<i>Eopsetta jordani</i>	3,295,000
Red rockfish	<i>Sebastes ssp.</i>	3,046,000
Rockfish	Various species	1,797,000
Pacific perch	<i>Sebastes ssp.</i>	1,612,000
Lingcod	<i>Ophiodon elongatus</i>	1,510,000
Dover sole	<i>Microstomus pacificus</i>	1,599,000
Rock sole	<i>Lepidopsetta bilineata</i>	1,576,000
Scrapfish	Various species	1,319,000
Flounder	<i>Platichthys stellatus</i>	1,262,000
Ratfish	<i>Hydrolagus colliei</i>	981,000
Blackcod	<i>Anoplopoma fimbria</i>	643,000
Skate	<i>Raja ssp.</i>	535,000
Dogfish	<i>Squalus acanthias</i>	515,000
Perch	Various species	149,000
Sand sole	<i>Psettichthys melanostictus</i>	82,000
Octopus	<i>Octopus vulgaris</i>	43,000
Red snapper	<i>Sebastes ruberrimus</i>	22,000
Rex sole	<i>Glyptocephalus zachirus</i>	22,000
Butter sole	<i>Isopsetta isolepis</i>	16,000
C-O sole	<i>Pleuronichthys coenosus</i>	11,000
Hake	<i>Merluccius productus</i>	10,000
Tomcod	<i>Microgadus proximus</i>	2,000
Dusky sea perch	<i>Damalichthys vacca</i>	1,000
Shark	<i>Hexanchus griseus</i>	1,000
Turbot	<i>Atheresthes stomias</i>	1,000

purchased in considerable quantities in some ports. In 1955 the Pacific coast production of such fish for fur-farm feed will probably exceed 15,000,000 pounds. In addition to fur-farm demand, an increase in demand for fish for pet-food and for liquid fish fertilizer also appears to be imminent.

The availability of some undersized marketable species and of "trash" species appears to be very great on the fishing grounds. The percentages of unmarketable fish discarded from 983 unselected drags recorded in log books by Washington trawlers fishing in 1950 between Cape Flattery and Goose Island, on the British Columbia coast, are shown in Table 18. The weighted average proportion of trash fish per drag was 49.5 per cent.

TABLE 18. Frequency of hauls between Cape Flattery and Goose Island by Washington otter trawl vessels in 1950, according to the proportion of trash by weight in each haul.

Percentage of trash in haul	Number of hauls
0— 20	119
21— 40	287
41— 60	273
61— 80	210
81—100	94
Total	983

In 100 drags by Canadian trawlers on five sections of the British Columbia coast between Barkley Sound and Dixon Entrance, summarized in Table 22, the percentage of trash fish per drag varied from 31 per cent to 73 per cent with a weighted average of 40 per cent.

In 78 drags in Hecate Strait made by an otter trawler chartered by the Commission (I.F.C. 1942, p. 24) using standard commercial gear, about 202,000 pounds of fish were caught, of which about 90,000 pounds, or 45 per cent, were unmarketable.

In the setline halibut fishery, the catch is very largely halibut and only occasionally are any significant quantities of other species caught. The capture of other species in quantity by setline vessels is usually the result of being temporarily off the fishing grounds or the result of deliberate effort to capture them for market. The wastage of other species by setline vessels on most grounds is very small and reports to the contrary have no sound basis in fact. They have been based largely on repeated hearsay or on isolated individual experiences. Difficulty is experienced on most halibut grounds in catching sufficient "scrap" fish for supplemental bait purposes.

#### CONDITIONS OF THE STOCKS OF OTTER TRAWL-CAUGHT SPECIES

The following recently published statement as to the general condition of the stocks of trawl-caught fish off western United States (Pac. Mar. Fish. Comm., 1952, p. 10) is presumably a summation of the opinions of the investigational groups of the several Pacific coast states:

"Analyses of the otter trawl fishery statistics indicate, in general, a decline in the abundance of the various flounders with some species being at very low levels."

Conditions in the Canadian fishery (Canada, Fisheries Research Board, 1952) seem to be in general accord with the above conclusions. The situation varies from species to species and more emphasis is placed upon the element of fluctuating availability than upon decline in stocks.

#### REGULATION OF THE OTTER TRAWL FISHERY

Prior to the end of World War II various segments of the Pacific coast fishing industry frequently recommended that the blackcod and the trawl fisheries be subjected to an intensive investigation with the view to halting declines that were believed to exist in the two fisheries.

After the war both federal and state agencies in the United States and the Fisheries Research Board in Canada intensified their studies of the trawl fisheries which up to that time had been conducted in most instances on a very modest scale. The Pacific Marine Fisheries Commission supported by Oregon, California and Washington was established in 1947 and has acted since as a coordinating agency for expanded investigations of the otter trawl and other fisheries of joint state interest.

To the present time there has been only limited regulation directed to the Pacific trawl fishery. Some control is exercised over the sizes of some species that may be sold but the limits coincide for the most part with what is acceptable to the market.

The Pacific Marine Fisheries Commission (1954, p. 9) noted in the following statement some of the difficulties encountered in developing a management program for the trawl fishery.

"The variety of species involved, fluctuations in market demand for the various species, and constant changes in fishing methods and gear make it

difficult to assess the condition of the stocks of the different species and to develop management measures for the fishery."

California instituted a 4½-inch mesh limit in 1948 and it is believed that the regulation has resulted in improvement in the catches of the San Francisco fleet which had been using very small mesh gear prior to that time.

Recent developments pointing to general regulation of the trawl fishery are the following recommendations of the Pacific Marine Fisheries Commission in its Fifth Annual Report (1952, p. 6).

#### OTTER TRAWL MESH SIZE

"That there be a coastwide minimum mesh size for cod ends of trawl nets such as to permit an escapement opening of 4½ inches and further that it be left to the fisheries agencies of the various political subdivisions to develop provisions for the local use of double cod ends and chafing gear, and for smaller mesh for special fisheries such as ocean perch and shrimp."

#### CLOSED OTTER TRAWL SEASON

"That a closed fishing season be applied to the outside trawl fishery during the months of December, January and February, effective with the 1953-54 winter. This recommendation is made to bring about better economic utilization of the fishery resource and not primarily as a conservation measure."

Oregon and Washington have implemented the first recommendation with a proposed mesh limit of 4½ inches, subject to some conditions. However, this or any larger mesh that might be biologically desirable or economically feasible in the trawl fishery would not significantly affect the selectivity of the gear in respect to the size of halibut caught. Thus, mesh control offers no direct solution to the problem of the trawl-capture of undersized halibut that is discussed in a later section of this report.

However, mesh control, by improving the utilization of the stocks of trawl fish, could have an indirect bearing upon the incidental capture of halibut. Any improvement in the trawl-fished stocks might tend to reduce the economic demands of trawlers to supplement their catches with the more valuable halibut, particularly during any period of depressed market demand for other species.

It must also be recognized that should mesh control be economically or biologically advantageous to the trawl fishery, more vessels probably would be attracted to the improved fishery and increase the drain on the sizes permitted to be caught. Thus size limits or mesh limits, unless supplemented by other measures such as catch quotas, might not in the long run improve the productivity or economic status of the trawl fishery.

#### OTTER TRAWL CATCH OF HALIBUT

The catch of halibut by trawlers increased sharply by 1943 as a result of the growth in the trawling fleets and a sharp rise in the general wartime demand for fish. The Oregon and Washington otter trawl landings of halibut increased from 80,000 pounds in 1941 to 528,000 pounds in 1943. Recorded landings in California and British Columbia combined did not exceed 35,000 pounds annually prior to 1943. Pacific coast landings of trawl-caught halibut in 1943, the last year in which legal landing of trawl-caught halibut was permitted, are shown in Table 19.

TABLE 19. Landings in pounds of trawl-caught halibut from grounds south and north of Willapa Bay, Washington in 1943.

Landing area	South of Willapa Bay	Willapa Bay to Cape Spencer	Total
California	67,000	—	67,000
Oregon	64,984	4,765	69,749
Washington	—	458,558	458,558
British Columbia	—	37,505	37,505
Totals	131,984	500,828	632,812

The rise in the landings of trawl-caught halibut from 1941 to 1943 was relatively much greater than the increase in total landings, indicating a growing interest in halibut and reflecting some shift of the trawl fishery to areas possessing larger stocks of halibut.

The delivery in Seattle of a single fare of 40,000 pounds of halibut from Hecate Strait by an otter trawler in 1943 and the expressed intention of a number of vessels then engaged or about to engage in trawling to concentrate upon the capture of halibut in 1944, indicated need for a decision regarding the trawl capture of halibut. It was evident that a broad expansion of trawl fishing to grounds between Cape Scott and Dixon Entrance was imminent. In these areas trawlers would be operating on or in close proximity to very important halibut grounds and be in a position to take very large catches of halibut. As a result of these developments, in 1944 the Commission extended the earlier (1938) prohibition against the use of set nets for the capture of halibut to include all types of bottom nets.

#### BASIS FOR PROHIBITING THE RETENTION OF HALIBUT BY OTTER TRAWLERS

The history of the European halibut fishery had clearly demonstrated the ability of a trawl fishery to dominate the catching of halibut. The increased proportion of trawl-caught halibut in the total halibut landed in England and Wales from the two most important halibut grounds prior to 1937 is shown in Table 20.

TABLE 20. Proportion of the total halibut catch\* landed in England and Wales from Iceland and the Faeroes by trawlers, shown as three-year averages for representative periods between 1906 and 1936.

Grounds	1906-08	1924-26	1934-36
Faeroes Fishery	22%	65%	98%
Icelandic Fishery	20%	25%	83%

\* Sea Fisheries Statistical Tables, Great Britain 1906 to 1936.

The Commission decided in 1943 to prohibit the retention of all net-caught halibut in the regulations for 1944. This action was based upon the biological evidence then at hand regarding the nonselectivity of trawl net gear with respect to halibut which made it capable of catching halibut far below the sizes that could be caught with the setline gear currently in use. The decision was a continuation of the Commission's long established policy in regard to securing the maximum yield from recruits.

Earlier comparisons of growth and natural mortality had shown that a net gain in yield from the Pacific halibut stocks would accrue from permitting small halibut to grow to a reasonable size before capture. This had led to the following control

measures being incorporated and subsequently continued in the Pacific halibut fishery regulations.

- (1) Since 1932, the setting aside and closing of certain well defined "nursery" grounds.
- (2) Since 1932, the control of the catch in order to reduce the rate at which the fish are removed from the stock and thereby increase the average size of the fish caught.
- (3) Since 1935, the prohibition of the use of dory gear by reason of its extensive use on grounds characterized by small fish.
- (4) Since 1940, the application of a size limit below which halibut could not be retained.

The fully developed trawl fisheries, such as that in the North Sea, and the growing Pacific coast otter trawl fishery also appear to recognize the biological and economic desirability of controlling the capture of the small undersized fish of most demersal species.

Comparison of the limited 1943 Pacific coast commercial landings of trawl-caught halibut with line-caught halibut from the same grounds had indicated a somewhat larger proportion of smaller sizes in the landings by the trawl gear.

In the European trawl fishery off Iceland, 31 per cent by weight and probably about 60 per cent by number of the 1936 German trawl catch of halibut was recorded in the German Sea Fisheries Yearbooks as being under two pounds, the proportion having increased from about 15 per cent by weight in 1930. In the Pacific setline fishery a halibut less than four pounds has always been a rarity in the catch even when fishing "nursery" areas.

Thus, while the evidence then at hand was limited or largely circumstantial, it indicated a strong lack of selectivity on the part of trawl gear with respect to the small and unmarketable sizes of halibut. On the basis of a similar type of evidence, the Commission in 1938 had prevented the development of a bottom set-net fishery for halibut by prohibiting its use.

On several occasions after 1943 the Commission re-examined its decision to prohibit the capture of halibut by trawl gear. A comprehensive investigation of the halibut catch by trawl gear was undertaken by the Commission at the end of the war. A large proportion of the time of its staff from 1945 to 1947 and all funds available for vessel operation in 1946 and 1947 were devoted to this project.

Information collected by the Commission on the trawl capture of halibut has been supplemented by data secured from other governmental and private agencies, where the data was based on commercial rather than research catches. The results of hauls made on other than a commercial basis are not generally applicable to the problems at hand.

#### PROPORTION OF HALIBUT TAKEN WITH OTTER TRAWL-CAUGHT FISH

There is considerable variation in the proportion of halibut taken by otter trawlers during commercial fishing for other species. Some information on this point has been secured by an examination of Commission records of the Seattle otter trawl landings in 1942 and 1943, the last years that halibut could be retained and sold legally by trawlers.

In 1942 and 1943, 66 and 67 per cent respectively of the otter trawl fares landed at Seattle during the Area 2 halibut season included some halibut. The fares were from grounds inside Puget Sound, and from outside grounds off Cape Flattery and the west coast of Vancouver Island. Very little halibut was caught in "inside" waters. Halibut represented 3.4 and 5.1 per cent of the total trawl landings of all species, in 1942 and 1943 respectively, not including liver landings.

The proportion of halibut in the above otter trawl landings increased toward the end of the Area 2 halibut season. During the last two weeks of that season in 1942 from June 16 to June 30, halibut represented 4.2 per cent of the total catch and 88 per cent of the fares included some halibut. During the last two weeks of the Area 2 season in 1943, from June 6 to 20, halibut represented 7.6 per cent of the landings and 71 per cent of the trips included some halibut. The variation in the proportion of halibut in individual trips is shown in Table 21 for the entire season.

TABLE 21. Frequency of trawl landings in Seattle according to proportion of halibut therein, in 1942.

Per cent of halibut by weight	No. of landings and per cent of total			
	1942		1943	
None	110	34.4%	137	33.1%
0.1 to 0.9	42		37	
1.0 to 1.9	48		37	
2.0 to 2.9	22	44.7%	26	33.6%
3.0 to 3.9	31		39	
4.0 to 4.9	12		19	
5.0 to 5.9	8		21	
6.0 to 6.9	5		18	
7.0 to 7.9	1	16.6%	13	30.0%
8.0 to 8.9	3		9	
9.0 to 9.9	3		6	
10.0 to 14.9	17		30	
15.0 to 19.9	4		8	
20.0 and over	14	4.4%	14	3.4%
Totals	320		414	

If the fares of those otter trawlers that landed no halibut during the season are removed from the above figures for 1943, 7.7 per cent of the individual landings had 0.0 per cent halibut, 46.3 per cent had from 0.1 per cent to 3.9 per cent halibut and 41.3 per cent had from 4.0 per cent to 19.9 per cent halibut and 4.7 per cent had over 20 per cent halibut.

Compared to 1942, there were relatively fewer trips in 1943 with halibut in excess of 20 per cent of the total fare, but a much higher proportion of the fares had between 4.0 and 19.9 per cent halibut. Since halibut could be retained without restriction, the above percentages would tend to be maximum values from the standpoint of a truly incidental catch in the areas then fished.

In examining the halibut landings of the individual otter trawl vessels, it was observed that the experienced otter trawl fisherman usually caught less halibut than the inexperienced, and that many of the larger landings of halibut were made by vessels captained by former halibut boat operators who were more familiar with

the halibut grounds than with the trawling grounds. It is noteworthy that 13 per cent of the otter trawlers landing in Seattle in 1943 from other than Puget Sound grounds accounted for 75 per cent of the total halibut landed.

Analysis of the 1941 California trawl catch by area of origin, according to log book records compiled by J. H. Clark (Memo. 194) of the California Fish and Game Commission covering about 85 per cent of the state total trawl catch during the open halibut season, April to June, indicated that the percentages of halibut by weight in catches from all areas were 0.5 for April, 2.7 for May and 3.8 for June. Including only those statistical areas where some halibut were caught, the average proportion of halibut to other species was 3.3 per cent for May and June combined.

The proportions of halibut taken during the Commission's operation of an otter trawler in May and June, 1947 on various grounds off British Columbia with the capture of halibut for viability studies and for tagging as major objectives are shown in Table 22. (I.F.C., 1948, p. 24)

TABLE 22. Number of hauls and catch in pounds of halibut and other species, during trawling operations between Vancouver Island and Dixon Entrance in May and June, 1947.

Fishing grounds	No. of hauls	Halibut		Other species
		Av. catch per haul	Total	
Goose Island				
N. W. Edge	8	3,628	29,025	21,575
N. W. Corner	10	530	5,300	20,900
S. E. Edge	5	130	650	11,650
S. E. Corner	24	910	21,850	35,950
Cape Scott	7	686	4,800	7,800
Butterworth Rocks	6	525	3,150	11,450
Two Peaks	5	80	400	13,100
Rose Spit	4	37	150	1,150
Masset	9	933	8,400	5,100
Totals	78	945	73,725	128,675

The average haul of halibut ranged from 37 pounds on Rose Spit to 3,628 pounds on the N. W. edge of Goose Island. The total halibut catch from all grounds was 57 per cent of all other species caught. About 70 per cent of the latter were unmarketable sizes or species.

Observations by the Commission on 95 hauls by commercial otter trawlers in 1944 off Cape Flattery showed a catch of 102,700 pounds of marketable food fish and 4,144 pounds or 4.0 per cent of halibut.

More recent information upon the proportion of halibut taken by commercial trawlers presumably not seeking out halibut is available from records of various investigational groups on the Pacific coast. They are summarized in Table 23 for those areas represented by a reasonable number of hauls.

The proportion of halibut to all marketable otter trawl fish in the hauls with some halibut varied from 0.6 to 3.5 per cent in five of the areas shown in the table. The Kyuquot data are omitted from consideration as it was obvious that fishing was being conducted directly on halibut spots.

The combined 141 hauls in the five useable areas caught 349,350 pounds of food fish not including halibut, and 3,665 pounds or 1.1 per cent of halibut. About 51 per cent of the 141 hauls contained some halibut.

TABLE 23. Observed\* catches by commercial trawlers off California and British Columbia.

Location of catch	California	British Columbia				
	Crescent City—Eureka	Middle Hec. Str.	Northern Hec. Str.	Barkley Sound	Sidney Inlet	Kyuquot
Period, month/year	11/52—5/53	7/45—9/45	4/45—7/47	6/45—9/45	6/45—9/45	8/45
Total number of hauls	57	18	33	23	10	16
Total catch incl. "trash" fish and halibut (lbs.)	(not given)	47,658	68,935	52,790	14,752	27,300
Total marketable catch (lbs.)†	236,500	28,600	39,745	36,610**	7,895	7,240
No. of hauls with halibut	19	10	24	10	6	16
Total halibut (lbs.)	1,480	258	1,410	440	77	7,700
Per cent halibut of total marketable catch	.6	.9	3.5	1.2	1.0	107.0***
Av. haul of halibut (lbs.)	78	26	59	44	13	481
Range of halibut catches (lbs.)	25—200	9—63	8—216	9—117	5—18	75—1455

\* California catches observed by Dept. of Fish and Game personnel; British Columbia, by Fisheries Research Board personnel.

\*\* Mostly dogfish.

\*\*\* The hauls on this ground were obviously being made directly on halibut spots.

† Exclusive of halibut which was not "commercial" as it could not be sold.

The recoveries of setline-caught tagged halibut brought in by the otter trawl fleet indicate conclusively that halibut caught by that gear are generally of the same stocks that are available to the setline fishery. It is also evident from the geographical distribution of the setline fishery that the grounds over which such line gear is actually fished largely encompasses those fished by the otter trawl fleet.

Only on the west coast of Vancouver Island is there any portion of the shelf area on which the trawl fleet fishes exclusively, and on those grounds the stocks of halibut are relatively inconsequential.

The recoveries of tagged halibut by the United States and Canadian setline fleets per 100,000 pounds of halibut caught and the number of recoveries by the Canadian otter trawl fleet per 100,000 pounds of halibut estimated to have been caught by that fleet are shown in Table 24 for the section of the coast between Cape Scott and Dixon Entrance for the years 1951 to 1955, inclusive.

TABLE 24. Numbers of tagged halibut taken by otter trawl and setline gear per 100,000 pounds of halibut caught or estimated\* to have been caught between Cape Scott to Dixon Entrance, 1951 to 1955

	Trawl caught		Setline caught
	5%	10%	
1951	1.31	.65	.84
1952	3.88	1.94	2.88
1953	11.16	5.56	3.01
1954	6.36	3.18	3.86
1955	1.24	.62	1.93
Av. 1951-1955	4.00	2.00	2.58

\* Two estimates, 5% and 10% of the total landed catch of all otter trawl-caught species are used.

The most probable proportion of halibut actually taken by otter trawl gear on this section of the coast may average between 5 per cent to 10 per cent, as discussed elsewhere in this report. The recorded number of tags shown as taken by trawl net gear is undoubtedly a minimal figure as it is known that some otter trawl vessels do not save the tagged fish even though provision is made for this in the Pacific halibut fishery regulations. Also the manner in which unmarketable halibut is usually discarded on the grounds is conducive to the overlooking of tagged individuals and the shore canvass of otter trawlers for tagged halibut is probably also less intensive than that for those caught by setline vessels.

The foregoing data on tag recoveries indicates that the trawl fishery of recent years on this section of the coast provides no evidence of unfished stocks of halibut and that the setline fishery is capable of utilizing those commercially available. Similarly, on other sections of the coast, otter trawlers recover tagged halibut in the same general proportion as does setline gear.

#### SIZE OF HALIBUT CAUGHT BY OTTER TRAWLS

Since 1944 when the retention of halibut was prohibited, further information has been secured regarding the size of halibut caught by otter trawl gear.

The Commission's investigations in 1946 and 1947 on the size of halibut caught while otter trawling between Cape Scott and Dixon Entrance showed that "baby" halibut, weighing less than five pounds dressed heads-off and thus below the

legal size limit, ranged in the catches from a low of 16 per cent by number on the N.W. edge of Goose Island grounds to a high of 49 per cent off Butterworth Rocks in northern Hecate Strait, and averaged 31 per cent on all grounds sampled. Large, 60 pounds and over, did not appear in significant numbers in the otter trawl catches on any ground. The number of halibut caught and the percentage in each trade category, during the Commission's trawling operations on various grounds in May and June, 1947 are shown in Table 25. (I.F.C., 1948, p. 25)

TABLE 25. Number of halibut caught and percentage between Vancouver Island and Dixon Entrance in each trade category, during trawling operations in May and June, 1947.

Fishing grounds	Total No. halibut	Catch of halibut Per cent of total number		
		Babies	Chickens	Mediums
Goose Island				
N. W. Edge	3,317	16	63	21
N. W. Corner	59	34	52	14
S. E. Edge	68	29	55	16
S. E. Corner	2,339	36	47	17
Cape Scott	518	26	64	10
Butterworth Rocks	372	49	41	10
Two Peaks	43	44	44	12
Rose Spit	7	—	—	—
Masset	1,463	45	51	4
All grounds	8,186	31	54	15

During the 1947 otter trawling operations by the Commission observers were placed upon commercial setline vessels fishing halibut in the immediate vicinity to obtain comparable samples of the catches of setline gear. In Table 26 the halibut catches of the two types of gear are compared as to the size composition. (I.F.C., 1948, p. 26.)

TABLE 26. Number and average length of halibut and percentage falling in each trade category, for comparable samples of halibut caught by otter trawl gear and by halibut setline gear on two fishing grounds in May and June, 1947.

Fishing grounds and type of gear	Catch of halibut				
	Number	Average length (cm.)	Per cent of total number		
			Babies	Chickens	Mediums
S.E. Corner of Goose Id.					
Trawl	2,339	70.6	36	47	17
Setline	1,830	77.6	13	49	38
Cape Scott					
Trawl	1,176	71.3	25	64	11
Setline	1,571	78.9	10	47	43

The Commission observed in the catches of a commercial otter trawler using the standard commercial 4½-inch mesh in the Bering Sea and on grounds south of the Alaska peninsula in 1947 a high percentage of undersized halibut or babies in the catches as shown in Table 27. (I.F.C., 1948, p. 27.)

It was observed in Faxa Bay, Iceland, by Jespersen (1938) that 93.2 per cent by number of the commercial trawl catch of halibut on that important ground consisted of fish three years old or less. On the offshore Icelandic grounds as well,

TABLE 27. Number of halibut caught and percentage in each trade category during trawling operations south and north of the Alaska Peninsula or Bering Sea in July, August and September, 1947.

Fishing grounds	No. halibut caught	Per cent of number caught			
		Babies	Chickens	Mediums	Large
South of Alaska Peninsula	319	72	14	13	1
Bering Sea	434	44	34	22	0

94.9 per cent of the trawl-caught halibut were of such young age groups.

A sharp distinction in the size of halibut caught by trawl and line gear may be seen in the European fishery off Iceland (McIntyre, 1952). It was noted that the commercial trawl catch of halibut consisted exclusively of fish two to five years of age, whereas the line catches were of six-year-olds and over as is the case in the Pacific setline fishery.

#### SURVIVAL OF OTTER TRAWL-CAUGHT HALIBUT

Information regarding the viability of trawl-caught halibut is limited because the observations on the research vessels are generally not comparable to what would occur in the commercial fishery due to the relatively shorter duration of the hauls and the smaller size of the catches and probably to more expeditious and careful sorting on deck. They are not used in this report. Even on commercial vessels observations may not be representative due to the possibility of greater than normal care being exercised in the presence of the observer.

Estimates by Commission observers on commercial trawlers in 1943 and 1944 off Cape Flattery indicated that from 69 to 79 per cent of the halibut caught in the various hauls were alive, 4 to 11 per cent were of doubtful vitality and 17 to 20 per cent were dead when sorted on deck. These relatively low average survivals were attributed in part to the large amounts of dogfish in some of the hauls. This species was being intensively sought out at that time.

It was concluded at that time that the primary factors causing mortality were the size of the haul and the kind and size of fish in the haul. Large hauls not only tended to "smother" the halibut in the net but the greater length of time required to sort the larger catches increased mortality.

The Commission (I.F.C., 1948, p. 27) observed in the Bering Sea in 1947 during 148 trawl hauls by commercial vessels that it was possible to tag about 97 per cent of the halibut caught with the other demersal species. The hauls averaged from 1.5 to 2.5 hours in duration and 80 per cent of them had over 1000 pounds of fish (50 per cent had over 2000 pounds).

During the trawling operations by the Commission in 1946 and 1947 off British Columbia, observations were made of the viability of halibut. While the gear used and the method of fishing and the duration of haul were similar to commercial practice, the operations served a number of purposes which open to question the applicability of the viability data as indications of what may occur in the commercial fishery.

During the operations, a deliberate effort was made to catch halibut in quantity for tagging and other biological purposes. This resulted in the catching and retention of large catches of halibut which in a purely commercial operation would usually

have been released without bringing the fish on board. Selection for tagging was very rigorous, any halibut of even slightly questionable viability being placed in the "dead" category and used to provide other valuable biological data. When very large catches of halibut were made, the proportion of "dead" was further increased by inability to tag more than a fraction of the catch before the majority died, even with the use of a live box.

In Table 28 the proportion of "dead" fish is shown by size of haul. The table summarizes all hauls made during the Commission's operations in 1946 and 1947. (I.F.C., 1948, p. 25) It includes some extremely large catches. In one haul 1593 halibut weighing approximately 18,000 pounds were caught. Another haul had 50,000 pounds of fish of all species. Such hauls are not typical of the commercial fishery and the number of "dead" was extremely high.

TABLE 28. Number of hauls, number of halibut caught and proportion "dead" according to size of haul in trawling operations off the British Columbia coast in 1946 and 1947.

Total catch all species per haul	No. of hauls	No. of halibut	Per cent dead
1—1500 pounds	72	2225	4
1501—3500 pounds	51	2552	11
3501 or more pounds	47	6440	61

Inasmuch as there was a deliberate effort to obtain halibut for tagging and other purposes, non-typical hauls with large quantities of halibut should be omitted before comparing it with results obtained from commercial fishing. This is done in Table 29 where hauls with more than 500 pounds of halibut have been removed from the series, but those with large catches of other species have been retained.

TABLE 29. Number of hauls, number of halibut caught and proportion "dead" according to size of haul in hauls under 501 pounds of halibut off the British Columbia coast in 1946 and 1947.

Total catch all species per haul	No. of hauls	No. of halibut	Per cent dead
1—1500 pounds	55	973	13.2
1501—3500 pounds	34	636	20.6
3501 or more pounds	29	663	31.4

The proportions of "dead" halibut are still much higher than found by most observers of the commercial trawl fishery. This is understandable in view of the conditions under which the estimate of "dead" was made.

The information on the viability of trawl-caught halibut collected by the Fisheries Research Board of Canada during 58 commercial hauls on various grounds off the British Columbia coast from 1944 to 1952, inclusive, is summarized in Table 30. Of the 964 halibut caught, 943 fish or 98 per cent were designated in the Research Board records as being in "excellent" or "good" shape and only 21 fish or 2 per cent were considered "doubtful" or "dead."

On account of the large number of hauls that were under 501 pounds, a survival figure that may be more in keeping with the typical commercial fishery is secured by omitting the hauls containing less than 501 pounds of marketable

TABLE 30. Number of live and dead halibut according to size of haul of marketable fish and of all fish in 58 commercial hauls off the British Columbia coast, 1944 to 1952.

Haul size of marketable fish only	No. of halibut		Haul size incl. trash fish	No. of halibut	
	Alive	Dead		Alive	Dead
1—500	608	2	1—500	101	1
501—1000	176	4	501—1000	67	0
1001—1500	121	9	1001—1500	501	2
1501—2000	10	1	1501—2000	234	9
2001—2500	4	3	2001—2500	3	1
2501—3000	18	2	2501—3000	8	5
3001—3500	—	—	3001—3500	—	—
3501 and up	6	0	3501 and up	29	3
Totals	943	21		943	21

fish. Of the 354 halibut caught in hauls of over 500 pounds, 335 fish or 95 per cent were alive when released and five per cent were doubtful or dead.

Investigators of the Oregon Fish Commission have stated that in 172 hauls of typical commercial vessels 95 per cent of the approximately 300 halibut caught could be returned to the sea in good shape. Observers of the Washington State Department of Fisheries on commercial trawlers have stated that at least 90 to 95 per cent of the halibut caught can be returned to the sea alive. Field observations recorded by the California Department of Fish and Game did not cover the condition of the halibut in the hauls observed by its investigators.

Presently available data thus indicate that it is possible to return to the sea alive from 75 to 95 per cent of the halibut caught in normal commercial trawling operations with nets of about 4½-inch mesh. According to most recorded observations the average survival is at the upper limit of this range, probably 90 to 95 per cent.

The survival of the incidentally-caught halibut should improve with wider adoption of larger-meshed gear as it would reduce the amount of trash in the hauls which tends to smother the halibut.

The foregoing data on the proportion and mortality of halibut caught by trawlers throws some light on the amounts of so-called wastage that may be involved in the rejection of the halibut at sea. The factual evidence on hand indicates that the coastwise average proportion of halibut caught incidentally by trawl gear does not exceed from two to five per cent of the total marketable fish caught by weight, and that on the average about 90 to 95 per cent of these halibut can be returned alive to the sea. Thus, the wastage of halibut might range from one-tenth of one per cent to one-half of one per cent of the total trawl landings.

### PROPOSALS FOR CONTROLLING THE INCIDENTAL CAPTURE OF HALIBUT BY OTTER TRAWLERS

A number of proposals have been made for controlling the capture of halibut by trawlers on either an incidental or an unlimited basis.

#### RECOMMENDATION BY UNITED STATES OTTER TRAWLERS IN 1943 FOR PROHIBITING THE RETENTION AND LANDING OF HALIBUT BY OTTER TRAWL GEAR

In 1943 the Washington and Oregon trawl fleets recommended that the retention of halibut by trawlers be prohibited. The reasons according to the *Pacific Fisherman* (Jan. 1944, p. 19) were: to encourage vessels to maintain a steady supply of fish for the fillet lines; recognition of the prior right of the setline fleet to halibut; to encourage maximum wartime production of species not capable of being caught by other than trawl gear; to encourage year-round trawl fishing in areas not then fished.

The fleets appeared to be aware that the Commission was considering some limitation on the catching of halibut by trawl gear and to believe that the Commission had authority to ban trawling on specific halibut grounds. They may also have believed that their action would forestall any regulation of the latter type. In addition there were potential union jurisdictional problems with the halibut fishermen. Thus the above proposal did not conflict with the action that the Commission already had under consideration.

The Canadian otter trawler operators had expressed no views on the Washington and Oregon group's recommendations to the Commission and some individual United States operators were opposed to the recommendations.

#### SUBSEQUENT RECOMMENDATIONS BY OTTER TRAWLERS FOR ALLOWING THE RETENTION OF HALIBUT ON THE SAME BASIS AS ALLOWED SETLINE VESSELS IN THE BLACKCOD FISHERY

Since 1944 when the retention of otter trawl-caught halibut was prohibited, the Commission has been repeatedly petitioned by the trawlers and by individuals in the fishing industry to allow such trawlers to retain at least some of their incidental catch of halibut. An estimate of the effects of applying permits to trawlers by comparing the trawl and setline fishery is given below.

The setline fishery for blackcod is relatively stabilized and mature insofar as production is concerned. In light of the past history and present conditions of the stocks, the sustained yield is unlikely to exceed 15 to 20 million pounds annually. At the present permitted ratio of 1:7 the potential total halibut involved would not exceed 2.5 million pounds annually with 1.5 million pounds being a more probable maximum figure. The percentage variation in total permit catch of halibut from year to year might be considerable but the poundage variation would be small in relation to the total halibut catch.

In contrast, the otter trawl fishery is unstable marketwise and is still in the process of development. Stocks of the more valuable species are productive though some may be below their optimum levels. The less valuable species have a fluctuating market demand and many varieties are not presently utilized or sought. The coast trawl food fish catch reached about 110,000,000 pounds in 1952 but was less than 80,000,000 pounds in 1953 due to a decline in market demand for the less

desirable species. There is also a large amount of so-called trash fish caught and discarded. Under other conditions this rejected fish might be marketed, either as food fish, pet-food or as fertilizer and could ultimately expand the future salable production to as much as 250,000,000 pounds annually.

Permitting incidentally-caught halibut to be retained by trawl gear would result in highly variable, and potentially very heavy, landings of that species from Area 2, possibly ranging from 3.0 to 5.0 million pounds on a 1:50 basis and from 8.5 to 12.5 million pounds on a 1:20 basis. On the 1:7 basis now allowed the setline fishery and assuming annual fluctuations in trawl landings proportionate to what currently occurs, the potential production of halibut could, with a fully developed trawl fishery, reach a minimum range of 16.0 to 20.0 million pounds annually. This would represent between 40 to 50 per cent of the probable maximum sustainable yield of halibut from the grounds between Willapa Bay and Cape Spencer.

The above estimates are very conservative as they have been heavily discounted for vessels that would be fishing on grounds with very limited stocks of halibut and for those on other grounds that would fail to catch the full proportion of halibut indicated.

It is apparent that permitting the retention of incidentally-caught halibut in the trawl fishery might ultimately result in a very significant and highly variable portion of the annual halibut catch being made by that gear. Under such conditions it would not be possible to control the total annual catch of halibut from the various stocks, the basic method of management.

In the setline blackcod fishery there is no problem of the capture of an undue proportion of small-sized halibut as occurs in the otter trawl fishery. While not immediately pertinent a parallel situation exists between the two gears in respect to the catch of blackcod. The trawl gear catches a far greater proportion of smaller-sized blackcod than does setline gear. (Bell and Pruter, 1954.)

The blackcod fishery in the important producing areas on grounds south of Cape Spencer is restricted to a limited portion of the year, as shown in Table 31, by reason of the apparent seasonal availability of fishable stocks.

TABLE 31. Percentage of the annual catch of blackcod taken each month by setline and by otter trawl gear for a representative number of years off Oregon, Washington and British Columbia.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Washington												
Setline												
1916-1918	2	1	2	2	9	14	12	15	22	17	3	1
1943-1952	0	0	0	0	1	2	7	15	29	30	15	1
Otter trawl												
1943-1952*	1	0	0	1	2	6	19	20	21	24	5	1
Oregon												
Setline												
1942-1950	0	0	0	0	2	11	10	10	24	28	14	1
Otter trawl												
1942-1950	0	0	1	0	4	20	38	25	7	4	1	0
British Columbia												
Setline												
1948-1950	1	1	4	3	1	4	18	36	18	8	5	1
Otter trawl												
1946-1950	0	0	0	0	0	3	9	35	28	25	0	0

\*Not including 1946.

That the present seasonal pattern is not merely a function of the activity of the setline fleet during the closed halibut season is supported by the fact that the same general pattern existed in 1916 to 1918, as shown for the Washington landings. In those years there was an active halibut fishery out of Washington State throughout the year. There was also a strong wartime and postwar year-around demand for both halibut and blackcod in Seattle in those early years.

This restricted seasonal trend in availability is further supported by the catches in the trawl fishery. The seasonal distribution of the blackcod component in the catch of otter trawlers which are active to some degree at practically all seasons of the year is also shown in Table 31.

Thus the period of apparent maximum availability of blackcod on the important producing sections of the coast occurs between the opening of the halibut season of recent years and before the beginning of the statutory winter closed season at the end of November. This limits generally the period during which the incidental capture of halibut occurs and for the most part would make unnecessary any arbitrary decision as to when or when not to permit the retention of halibut in that fishery.

In contrast, the trawl fishery is operative practically all year. Consequently, to permit retention of halibut during only a limited portion of the year would involve an arbitrary decision not related to conservation.

#### PROPOSALS BY FISHERIES RESEARCH BOARD OF CANADA, 1945

In 1945 a memorandum report (Hart, 1945) was distributed by the Fisheries Research Board of Canada concerning "the nature and extent of the competition of otter trawls with other types of fishing gear and the possibilities of a continued successful otter trawl fishery." The observations made and opinions expressed in that report dealt chiefly with halibut.

It was emphasized that due to immediate demands the report had to be based on very preliminary investigations and upon opinions of the investigators and of those associated with the commercial fisheries, and also that the recommendations presented were not based primarily upon biological considerations.

Comments were made in the memorandum upon the amount of halibut caught and its condition as affected by the size of the hauls, or species included, the greater efficiency of trawl gear, and the impracticability of regulations requiring fish once caught to be returned to the sea. It was suggested that trawling be prohibited on particular areas of most importance to the setline halibut fishery during the season of availability of that species; also that in compensation for such closures, otter trawlers be allowed to retain halibut at other times or on other grounds, not to exceed five per cent of the total catch of edible fish including salable livers. It was stated that the conclusions took into consideration traditional fishing practice, prior rights of a fishery to particular species, and patrol problems.

The extent to which the observations and conclusions in this report may diverge from those of the above report is discussed below.

On the question of the condition of halibut caught by trawl gear, the Commission's observations and a study of all applicable subsequent data made available by other government agencies, indicate that most halibut caught are in good condition not only in relatively unsuccessful trawling but also in normally successful trawling.

With respect to the condition of halibut caught with dogfish, the Commission found that the halibut were in generally poorer condition than in hauls with food fish. This was attributed to the spines and rough skins of the dogfish injuring the halibut and to the smothering effect of the usually larger catches of dogfish. Fortunately, fewer halibut were found, as a rule, with dogfish and that species is today no longer intensively sought owing to the decline in the market for natural vitamin A.

In regard to the condition of the halibut in the larger hauls, examination of the Research Board records of the commercial hauls observed by them, as given in Table 30 of this report, indicates that in all the hauls of over 2500 pounds of marketable fish, a total of 24 halibut were taken, of which two, or about eight per cent, were dead. In all the hauls having over 3500 pounds of fish of all species, including trash, there was a total of 32 halibut, of which three fish or 10 per cent were dead.

In the occasional very large hauls, the Commission has observed on its own chartered vessels a considerable mortality of all species including halibut. However, such hauls are relatively few in number in the commercial fishery, as indicated by Table 32.

TABLE 32. Frequency of various sized hauls for marketable fish and for all fish, by representative United States otter trawl vessels fishing on the west coast of Vancouver Island, Cape Scott and Goose Island grounds in 1952.

Size of haul (pounds)	Number of hauls of each size	
	Marketable fish	All fish
0—1500	649	293
1501—3500	279	392
3501—6500	96	242
6501—up	24	121
Totals	1048	1048

Of the 1048 hauls in the above sample 928 or 89 per cent had less than 3500 pounds of marketable fish and 685 or 65 per cent had less than 3500 pounds of all fish, including those unmarketable. Furthermore, mesh control probably would reduce the number and size of the very large hauls which frequently contain large amounts of unmarketable small fish.

The question of the efficiency of otter trawl gear in respect to capture of demersal fish requires no elaboration as it is the only gear capable of catching many demersal species in commercial amounts. It is also probable that trawling for halibut on some grounds might be temporarily more productive in pounds caught per man per unit time than is setline gear. However, should the trawl gear be unduly destructive of sizes which should be protected, it could not be recognized as efficient from the standpoint of conservation and maximum food production. Any temporary gains could be more than offset by losses in total yield and decline in average size of fish that would ultimately ensue.

While traditional fisheries practice cannot always be disregarded in the control of domestic fisheries because of social and other considerations, it does not provide a sound primary basis for conservation of a fishery by international agreement. The question of what is traditional practice is subject to widely conflicting opinion due to the constantly changing character of the fisheries and of their economy.

Recognition of prior claim of any class of vessel or any type of gear to a particular fishery has become increasingly difficult due to the extensive interchange

of vessels from one fishery to another and the development of multiple-purpose boats. Even in international understandings, prior claim to offshore fisheries appears to be a very difficult concept to maintain unless associated with the element of maximum use.

In this report only conservation considerations and the feasibility of enforcement are used to assess the effects of the various types of gear upon the halibut fishery. It is believed that they provide the only tenable basis for resolving such questions in a fishery engaged in by more than one nation. Also, the terms of past and present halibut treaties have been limited to conservation considerations.

It has been contended that it is not practical to require fishermen to return fish to the sea once caught. With complete and coordinated control of all fisheries and fishing gear, it might be possible to permit the retention and sale of any species or sizes that may be inadvertently caught by any type of fishing gear. However, since such circumstances do not prevail in any fishery or in any group of associated fisheries, most fishery regulations either directly or indirectly require that some particular variety of fish or sizes thereof be not retained at certain times regardless of whether they may be alive or dead when inadvertently caught. This practice recognizes certain cardinal facts about most commercial fisheries and their regulation.

Practically all species and often certain sizes thereof show a relatively high degree of vertical or horizontal segregation on the fishing grounds. Experienced fishermen by either slightly modifying the gear or their methods of fishing or the depth or the locality of their operations can thus largely avoid or favor the capture of certain species and sizes of fish. The degree of segregation naturally varies with species and, like all rules, breaks down on occasion.

Fishermen, if permitted to sell all incidentally-caught species will retain both the live and dead specimens and will tend to maximize their catch of such fish, particularly of any valuable species. In the event such incidentally-caught fish are allowed to be retained in some fixed proportion to the primary catch, the fishermen will endeavor to assure the taking of the full permitted ratio, particularly when the incidental species is of high market value.

It has been contended that fishermen will not deviate from their accustomed pattern of fishing in order to secure the maximum of any permitted ratio of incidentally-caught fish. This will only be true when wide deviation from their customary fishing practices is required to secure the full proportion allowed. As the relative value of the catch of the incidental species increases in respect to that of the primary one, the more the vessel can afford to alter its normal routine. Productive halibut grounds are relatively close to good trolling, trawling and blackcod areas or are in line-of-route to port.

Incidentally-caught halibut could appear very attractive to an otter trawler whose primary catch normally averages much less in value per pound. Based on a representative sample of United States trawl catches in the autumn of 1953, a permitted ratio of halibut of two per cent would have added seven per cent to the gross value of the average fare. A ratio of five per cent would have added 17 per cent and a one in seven ratio, 28 per cent.

Based on conditions prevailing in the Canadian otter trawl fishery out of Prince Rupert from June to November, 1953, about nine per cent would have been added

to the gross earnings of the vessels with a two per cent permitted ratio of halibut, 22 per cent with a five per cent ratio and 36 per cent with a one to seven ratio. The net earnings of the crews in the above instances would have shown an even greater percentage increase.

Prohibiting the retention of halibut by trawl gear in 1944 does not appear to have resulted in unfavourable consequences to either the trawl or the halibut fisheries. Both have grown and prospered insofar as economic conditions have permitted. Though there has been trawl-caught halibut sold in contravention to the regulations, it has not been of sufficient magnitude to threaten the halibut management program or disturb the general halibut market. Nor would the wastage of dead halibut rejected at sea have been of any significant magnitude due to the relatively high survival rate of the low proportion of halibut caught in the trawl fishery. The average trawler probably makes some attempt to return the viable halibut to the sea.

Violations and wastage would neither cease nor decrease should otter trawlers be permitted to retain some halibut. The landing of illegal halibut would undoubtedly continue to some degree in the form of excesses over any permitted ratio. Wastage would also probably continue as a result of deliberate halibut fishing to make up the permitted ratio, with rejection at sea of the undersized halibut and of any surplus of legal-sized fish.

With some proportion of halibut permitted to be retained, it is more than probable that the large hauls of halibut that occur from time to time would be brought on deck to select legal-sized fish. Any excess of legal fish and the illegal undersized fish would be discarded with the high mortality characteristic of very large hauls. With the retention of halibut prohibited, the large hauls of halibut are usually released by "pulling the string" to conserve gear, time and effort.

It has been suggested that trawlers be allowed to retain halibut caught on other than the important halibut producing grounds and that they be excluded from fishing on the latter grounds during periods of high halibut availability. Whether or not there is treaty authority to apply any such exclusion, regulations that involve any type of differential treatment of distinctly offshore fishing grounds require close examination. Long experience with the division of the coast into even large regulatory areas with readily recognizable boundaries has demonstrated the difficulties of offshore patrol.

Closure of bays, estuaries or inlets can be effectively patrolled but closure of offshore areas not contiguous to the land is exceedingly difficult to enforce. Exceptions to this would be offshore areas that are completely circumscribed by a readily recognizable natural barrier or barren ground. Unfortunately, neither of the above conditions prevail to any extent in the Pacific coast halibut fishery.

The closure of such areas to all trawling while halibut are in great availability would necessitate closure throughout most of the year regardless of the length of the present halibut fishing season. Such closure would eliminate from the trawl fishery many productive trawling grounds that are too close to concentrations of halibut to allow effective separation. At present levels of trawling intensity, no serious problem of interference between the two gears occurs even on closely adjacent grounds.

Permitting trawlers to retain incidentally-caught halibut might actually encourage interference on the fishing grounds between trawl and setline gear. Trawlers endeavoring to fill any permitted ratio of halibut would move to halibut grounds for one or more hauls as this would not involve any significant shift of operations.

The closure to trawling of all important halibut grounds between Cape Flattery and Dixon Entrance would create a sea patrol problem of great magnitude. To provide patrol over halibut grounds on this section of the coast would require at least three coordinated units of sea and air patrol off British Columbia, one for the west coast of Vancouver Island, one for Queen Charlotte Sound and lower Hecate Strait and a third for middle and upper Hecate Strait. Since halibut are available throughout most of the year on the typical halibut grounds, and the otter trawl fishery is active most of the year, patrol would be required on an annual basis. The cost of patrol would be almost as great as the value of the halibut that might be allowed.

Decision regarding the closing of important halibut grounds and the opening of less important grounds to trawling should be on the basis of biological desirability and administrative feasibility and not on any compensatory basis.

**PROPOSAL TO ALLOW RETENTION OF HALIBUT BY ANY TYPE OF GEAR  
OFF SOME SECTIONS OF THE COAST**

It has been suggested that any type of gear be permitted to retain halibut caught off those broad sections of the coast where halibut stocks are of lesser consequence. Under such conditions, trollers, trawlers, setliners or any other type of gear should be permitted to land unlimited or limited amounts of halibut at certain times or at any time of the year.

**(a) SOUTH OF WILLAPA BAY**

The section of the coast for which the above proposal might appear to be most appropriate is that south of Willapa Bay which is designated in the halibut regulations as Areas 1A and 1B.

Area 1A in 1954 included the convention waters south of Heceta Head which is located about the middle of the Oregon coast. Area 1B lies between Heceta Head and Willapa Bay on the Washington coast, including about 160 miles of the coast line. Prior to 1946, Area 1A and Area 1B were a single unit, Area 1, which was closed with Area 2. With reduced utilization arising from the continued shortening of the Area 2 season, Area 1 was divided into approximately the present areas in 1946 and the closure of the southern section was deferred until the closure of the last quota area, rather than to the closing date of Area 2. This allowed greater utilization of the halibut stocks in Area 1A. Area 1B continued to be closed with Area 2 for enforcement reasons.

The stocks of halibut in Areas 1A and 1B are relatively limited, and no catch limits have been applied to either. In the past ten years prior to 1954, the recorded annual production from the two areas combined has seldom exceeded one-half million pounds, largely owing to the shortening of the halibut fishing season and decline in the number of setline boats fishing. Some additional poundage has been sold in contravention to the regulations.

With the longer halibut season in the 1930's the annual catch was usually between three-quarters and one million pounds. Over 90 per cent of this was caught

by about 20 small setline boats. The remainder was landed by nearly 200 smaller boats, such as salmon trollers and boats using other types of line gear whose primary catch was of species other than halibut.

Most of the halibut catch from Area 1A is now landed by numerous small boats fishing for a variety of species out of Eureka and, to a very limited extent, from Fort Bragg, California and Newport, Oregon. In Eureka, the important landing port, from four to six small setline boats carrying two men and using light setline basket gear fish each year. As a result of provisions in the halibut regulations instituted in 1954 that permitted uninterrupted halibut fishing from May to September in Area 1A, the catch reported from the original Area 1 is approaching the levels of the 1930's and may increase further.

To attempt to limit the retention of halibut by trawlers to a stated proportion of their other catch would be largely ineffective in this area due to the difficulty of providing supervision of unloading at the several points at which trawlers may land. While some of these places have customs offices, the offices do not possess outside inspection personnel to carry out time-consuming supervision of unloading of trawler fares.

On the other hand, the unrestricted retention of halibut by trawlers in this area at all times of the year would not require shore supervision. However, no justification can be seen for such unlimited retention except the inability to enforce any control.

By permitting the exclusively United States trawlers, fishing south of Willapa Bay, to retain any halibut, the opportunity for illegal retention of halibut by trawlers fishing on productive halibut grounds off Washington and British Columbia would be increased many-fold as sea patrol in those areas is both difficult and expensive. Such patrol difficulties were particularly well evidenced in 1934 and 1935 when all the grounds south of Willapa Bay, the original Area 1, remained open to halibut fishing after closure of Area 2 to the north. Illegal halibut fishing on grounds north of Willapa Bay, with false declarations of area of origin, were so extensive that the grounds between Cape Blanco and Willapa Bay were thereafter closed simultaneously with Area 2.

Aside from enforcement obstacles the setting aside of the foregoing sections of the Pacific coast for differential treatment of their halibut stocks could be setting an undesirable precedent. On all sections of the coast there are trawling grounds that do not yield heavily of halibut and which could qualify for similar treatment. It would involve arbitrary decisions regarding the importance of a particular halibut stock in relation to the total stock.

**(b) WILLAPA BAY TO CAPE SCOTT**

It has been suggested that the grounds off the Washington coast and off the west coast of Vancouver Island between Willapa Bay and Cape Scott, which constitute part of Area 2, could be treated in the same manner as proposed for the grounds south of Willapa Bay.

During the period of unrestricted fishing prior to regulation, the annual production of halibut from this section of the coast declined steadily, from a 6-million pound level in 1921 to about 1.4 million in 1930 and 1931. Under regulation the annual yield has been gradually increased and reached about 3.0 million pounds

by 1943. With the subsequent further shortening of the halibut season the annual yield had fallen to a 2.0 million pound level in recent years. With the multiple seasons instituted in 1954 the catch has again increased to about 3.0 million pound level and further increases are in prospect.

A number of the regular United States halibut vessels, and many small Canadian halibut boats operating out of ports on the west coast of Vancouver Island, depend on this area for their halibut fishing operations. Nearly all the Seattle vessels that fish blackcod after the closure of the halibut season operate off this section of the coast and, by their incidental catches of halibut, account for about 25 per cent of the total United States catch there. The landings in Seattle from this portion of the coast represent about 15 per cent of the total Seattle halibut receipts from grounds south of Cape Spencer.

Trawling is also important in this area throughout the year as shown in Table 16. The 1952 production of food fish there by the United States trawl fleet was about 19.0 million pounds and by the Canadian fleet about 5.0 million pounds.

Previous comments on the problems of supervising the unloading of incidental halibut caught by trawlers south of Willapa Bay are largely applicable to the Willapa Bay to Cape Scott section of the coast. Adequate shore supervision would be beyond the capacity of present facilities in this area also. The sea enforcement problem would be much greater due to the closer proximity of this area to very productive halibut grounds. False reports of the origin of trawl catches made on grounds north of Cape Scott would be a major problem.

The stocks of halibut on the grounds between Willapa Bay and Cape Scott have increased considerably since 1930. The catch in pounds per set of a standard unit of gear has been as follows:

1930	1935	1940	1945	1950	1954
23.9	48.2	50.0	68.7	89.5	145.2

The improvement shows that this section of the coast again contains useful stocks of halibut that are susceptible to management and have the capacity to provide a good and probably improved yield. Abandonment of these stocks to a gear that is deemed to be biologically undesirable for the taking of halibut would be difficult to justify.

#### TREATY CHANGE RESPECTING INCIDENTALY-CAUGHT HALIBUT

The 1953 treaty provided authority for permitting, limiting or prohibiting the retention of halibut caught incidentally while fishing for other species in areas or portions of areas both open or closed to halibut fishing rather than only in closed areas as provided in the 1937 treaty. This broader authority had been recommended by the Commission in a report to the two governments in 1946. The report stated that "flexible authority" was required to deal with incidental capture of halibut by any type of gear "because of the time required to secure treaty changes and the unpredictability of future developments and needs." It was stated that the Commission should have power to control the incidental capture "on a rational basis" and to deal with any question on a basis of merit rather than because of lack of authority.

While the absence of flexible treaty authority and difficulties of enforcement have been stated (I.F.C., 1948, p. 15 and 1949, p. 17) as reasons for deferring consideration of the extension of the permit provision to trawl gear, it has not been indicated that securing more flexible authority as provided by the 1953 treaty would necessarily result in an extension of the permit provision to that or any other type of gear. Similar statements were made with respect to the troll capture of halibut in areas closed to halibut fishing.

### GENERAL CONSIDERATIONS

It is clear that consideration of proposals to broaden the present permit system for the retention of incidentally-caught halibut requires that judgment or estimation be made of the probable extent to which such action may interfere with attaining treaty objectives; namely, developing the stocks of halibut to levels which will permit the maximum sustained yield from the fishery and permit the stocks to be maintained at those levels.

In judging the effects of any regulation, the future as well as present potentialities should be evaluated as the fisheries are in a constant state of change and development. A regulatory measure of inconsequential effect today could have a profound impact under changed conditions tomorrow.

The halibut fishery has been under investigation for 30 years and subjected to control measures of various types during that time. Since the institution of catch limits, 24 years ago, the combined annual yields from the several stocks have been steadily increased from a 44 million pound level to a 70 million pound level in 1954. It is the only major fishery in the world where the annual catch and size of stock have been increased by controlling the amount of fishing.

The fact that the catches in the setline halibut fishery are almost exclusively halibut has been a primary factor in the successful rehabilitation of the fishery. This feature has greatly facilitated the investigations as it has provided usable and quantitative measures of stock size and of yield.

In the next decade it is probable that the management of the halibut fishery may be able to approximate its ultimate objective, the optimum yield. This will require a proper distribution of stock exploitation both in space and in time. It will be a difficult administrative process and may require as much control over the amount and distribution of fishing as is possible without disruption of the fishery. The task could become impossible to accomplish if the halibut fishery were involved with the destinies of other fisheries over which the Commission has no control.

The multiplicity of species in the otter trawl fisheries and their complex inter-relationships is in sharp contrast to the situation in the halibut fishery. The magnitude of the research programs that are required to provide a comprehensive basis for management of trawl fisheries has in the past discouraged such projects in most parts of the world. Scientific trawl fishery investigations over the past 50 years have been sporadic and of necessity chiefly directed to but a few of the more important species in the catch.

As to regulation of the trawl fisheries, there has been lately some concerted effort both in Europe and North America to apply mesh control measures. Catch

quotas, controlled intensities, closed seasons, and other measures are generally not feasible at the present time due to the large number of species involved and the limited biological knowledge of the many components in the catch.

These above factors seem to provide the strongest reasons for maintaining the individuality and independence of the halibut fishery and the almost exclusive nature of its catch.

### CONCLUSIONS

The retention of incidentally-caught halibut in the setline blackcod fishery does not appear to present any serious obstacle to effective management of the halibut fishery on account of the selective nature of the gear, the relatively small blackcod production and the short seasonal availability of that species. The nature of the fishery makes enforcement a limited problem capable of being handled by available facilities.

The retention of incidentally-caught halibut by trolling gear in closed areas does not appear to be biologically undesirable but to implement such a program would require a new and very costly enforcement organization.

Conditions are quite different in the very productive otter trawl fishery. The gear is less selective in that it catches a much higher proportion of small under-sized halibut than does setline or troll gear. It is also less selective in that the fish are not individually handled. However, present wastage is probably considerably under one per cent of the total trawl landings, as only about five per cent of the average trawl catch by weight consists of halibut and, on the average, at least 90 per cent of the fish can be returned to the sea alive.

To allow otter trawlers to retain incidentally-caught halibut on all or on some sections of the coast would involve control problems beyond the present capacity of the enforcement agencies.

Permitting the present trawl and troll fleets to retain a reasonable proportion of incidentally-caught halibut during part of the year could result in the taking of from 11.0 to 17.0 million pounds of halibut on the grounds between Willapa Bay, Washington and Cape Spencer, Alaska. Such an amount would represent a very considerable proportion of the probable maximum sustained yield from the area and could be expected to increase with the foreseeable development of the trawl fishery.

Prohibiting the retention of incidentally-caught halibut by trawl gear appears well founded on both biological and enforcement grounds, and restricting the retention of incidentally-caught halibut by troll gear to the open halibut season appears justified for enforcement reasons.

Any broadening of the base with respect to the retention of halibut by associated fisheries would alter those characteristics of the halibut fishery that have made possible the successful rebuilding of the resource.

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